



EUROPEAN COMMISSION
Research Executive Agency
Director



GRANT AGREEMENT

NUMBER — 774234 — LANDSUPPORT

This **Agreement** ('the Agreement') is **between** the following parties:

on the one part,

the **Research Executive Agency (REA)** ('the Agency'), under the powers delegated by the European Commission ('the Commission'), represented for the purposes of signature of this Agreement by Deputy Head of Unit, Research Executive Agency, Industrial Leadership and Societal Challenges Department, Sustainable Resources for Food Security and Growth, Tereza BUDNAKOVA,

and

on the other part,

1. 'the coordinator'³ :

UNIVERSITA DEGLI STUDI DI NAPOLI FEDERICO II. (UNA), established in Corso Umberto I 40, NAPOLI 80138, Italy, VAT number: IT00876220633, represented for the purposes of signing the Agreement by Director of CRISP, FABIO TERRIBILE

and the following other beneficiaries, if they sign their 'Accession Form' (see Annex 3 and Article 56):

2. **ARIESPACE SRL (ARIES)**, established in Centro Direzionale IS.A3, NAPOLI 80143, Italy, VAT number: IT05291901212,

3. **BARCELONA SUPERCOMPUTING CENTER - CENTRO NACIONAL DE SUPERCOMPUTACION (BSC)**, established in Calle Jordi Girona 31, BARCELONA 08034, Spain, VAT number: ESS0800099D,

4. **UNIVERSITAET FUER BODENKULTUR WIEN (BOKU)**, established in GREGOR MENDEL STRASSE 33, WIEN 1180, Austria, VAT number: ATU16285008,

5. **CONSIGLIO NAZIONALE DELLE RICERCHE (CNR)**, established in PIAZZALE ALDO MORO 7, ROMA 00185, Italy, VAT number: IT02118311006,

6. **CROPS FOR THE FUTURE RESEARCH CENTRE (CFF)**, established in JALAN BROGA, SELANGOR 43500, Malaysia, VAT number: not applicable,

³ The coordinator shall be the ITD/IADP/TA technical coordinator.

7. **INTERNATIONAL CENTRE FOR AGRICULTURAL RESEARCH IN THE DRY AREAS (ICARDA)**, established in BECHIR AL KASSAR DALIA BUILDING 2ND FLOOR AREA VERDUN, BEIRUT, Lebanon,

8. **FELSOBBFOKU TANULMANYOK INTEZETE (iASK)**, established in CHERNEL U. 14, KOSZEG 9730, Hungary, VAT number: HU15833239,

9. **Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA)**, established in Via Vitaliano Brancati 48, Rome 00144, Italy, VAT number: IT10125211002,

10. **RASDAMAN GMBH (RASDAMAN)**, established in HANS HERMANN SIELING STRASSE 17, BREMEN 28759, Germany, VAT number: DE274855819,

12. **REGIONE CAMPANIA (REGCAM)**, established in VIA S. LUCIA 81, NAPOLI 80132, Italy, VAT number: IT80011990639,

13. **PANNON EGYETEM (UPA)**, established in EGYETEM U 10, VESZPREM 8200, Hungary, VAT number: HU15308816,

14. **UNIVERSITA DEGLI STUDI DI MILANO (UMI)**, established in Via Festa Del Perdono 7, MILANO 20122, Italy, VAT number: IT03064870151,

15. **ZALA MEGYEI ONKORMANYZATA (ZALA)**, established in KOSZTOLANYI DEZSO UTCA 10, ZALAEGERSZEG 8900, Hungary, VAT number: HU15734305,

16. **CMAST (CMAST)**, established in GEORGES VAN DAMMEPLEIN 57, TEMSE 9140, Belgium, VAT number: BE0807942001,

17. **ACTEON SARL (ACTEON)**, established in BP FERME DU PRE DU BOIS LE CHALIMONT, ORBEY 68370, France, VAT number: FR57481460194,

18. **UMWELTBUNDESAMT GESELLSCHAFT MIT BESCHRANKTER HAFTUNG (UBA GMBH) (EAA)**, established in SPITTELAUER LANDE 5, WIEN 1090, Austria, VAT number: ATU45908200,

19. **GOZDARSKI INSTITUT SLOVENIJE (SFI)**, established in VECNA POT 2, LJUBLJANA 1000, Slovenia, VAT number: SI37808052,

and 11. the **Joint Research Centre (JRC)** established in Rue de la Loi 200, BRUSSELS 1049, Belgium,, if it signs the ‘Administrative Arrangement’ (see Annex 3b).

Unless otherwise specified, references to ‘beneficiary’ or ‘beneficiaries’ include the coordinator and the Joint Research Centre (JRC).

The parties referred to above have agreed to enter into the Agreement under the terms and conditions below.

By signing the Agreement or the Accession Form or the Administrative Arrangement, the beneficiaries accept the grant and agree to implement it under their own responsibility and in accordance with the Agreement, with all the obligations and conditions it sets out.

The Agreement is composed of:

Terms and Conditions

- Annex 1 Description of the action
- Annex 2 Estimated budget for the action
 - 2a Additional information on the estimated budget
- Annex 3 Accession Forms
 - 3b Administrative Arrangement
- Annex 4 Model for the financial statements
- Annex 5 Model for the certificate on the financial statements
- Annex 6 Model for the certificate on the methodology

TERMS AND CONDITIONS

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CHAPTER 1 GENERAL

ARTICLE 1 — SUBJECT OF THE AGREEMENT

This Agreement sets out the rights and obligations and the terms and conditions applicable to the grant awarded to the beneficiaries for implementing the action set out in Chapter 2.

CHAPTER 2 ACTION

ARTICLE 2 — ACTION TO BE IMPLEMENTED

The grant is awarded for the action entitled ‘**Development of Integrated Web-Based Land Decision Support System Aiming Towards the Implementation of Policies for Agriculture and Environment — LANDSUPPORT**’ (‘**action**’), as described in Annex 1.

ARTICLE 3 — DURATION AND STARTING DATE OF THE ACTION

The duration of the action will be **42 months** as of the first day of the month following the date the Agreement enters into force (see Article 58) (‘**starting date of the action**’).

ARTICLE 4 — ESTIMATED BUDGET AND BUDGET TRANSFERS

4.1 Estimated budget

The ‘**estimated budget**’ for the action is set out in Annex 2.

It contains the estimated eligible costs and the forms of costs, broken down by beneficiary and budget category (see Articles 5, 6).

4.2 Budget transfers

The estimated budget breakdown indicated in Annex 2 may be adjusted — without an amendment (see Article 55) — by transfers of amounts between beneficiaries, budget categories and/or forms of costs set out in Annex 2, if the action is implemented as described in Annex 1.

However, the beneficiaries may not add costs relating to subcontracts not provided for in Annex 1, unless such additional subcontracts are approved by an amendment or in accordance with Article 13.

CHAPTER 3 GRANT

ARTICLE 5 — GRANT AMOUNT, FORM OF GRANT, REIMBURSEMENT RATES AND FORMS OF COSTS

5.1 Maximum grant amount

The ‘**maximum grant amount**’ is **EUR 6,999,771.00** (six million nine hundred and ninety nine thousand seven hundred and seventy one EURO).

5.2 Form of grant, reimbursement rates and forms of costs

The grant reimburses **100% of the action's eligible costs** (see Article 6) (**‘reimbursement of eligible costs grant’**) (see Annex 2).

The estimated eligible costs of the action are EUR **6,999,771.25** (six million nine hundred and ninety nine thousand seven hundred and seventy one EURO and twenty five eurocents).

Eligible costs (see Article 6) must be declared under the following forms (**‘forms of costs’**):

(a) for **direct personnel costs**:

- as actually incurred costs (**‘actual costs’**) or
- on the basis of an amount per unit calculated by the beneficiary in accordance with its usual cost accounting practices (**‘unit costs’**).

Personnel **costs for SME owners or beneficiaries that are natural persons** not receiving a salary (see Article 6.2, Points A.4 and A.5) must be declared on the basis of the amount per unit set out in Annex 2a (**unit costs**);

(b) for **direct costs of subcontracting**: as actually incurred costs (**actual costs**);

(c) for **direct costs of providing financial support to third parties**: not applicable;

(d) for **other direct costs**: as actually incurred costs (**actual costs**);

(e) for **indirect costs**: on the basis of a flat-rate applied as set out in Article 6.2, Point E (**‘flat-rate costs’**);

(f) **specific cost category(ies)**: not applicable.

5.3 Final grant amount — Calculation

The **‘final grant amount’** depends on the actual extent to which the action is implemented in accordance with the Agreement’s terms and conditions.

This amount is calculated by the Agency — when the payment of the balance is made (see Article 21.4) — in the following steps:

Step 1 – Application of the reimbursement rates to the eligible costs

Step 2 – Limit to the maximum grant amount

Step 3 – Reduction due to the no-profit rule

Step 4 – Reduction due to substantial errors, irregularities or fraud or serious breach of obligations

5.3.1 Step 1 — Application of the reimbursement rates to the eligible costs

The reimbursement rate(s) (see Article 5.2) are applied to the eligible costs (actual costs, unit costs and flat-rate costs; see Article 6) declared by the beneficiaries (see Article 20) and approved by the Agency (see Article 21).

5.3.2 Step 2 — Limit to the maximum grant amount

If the amount obtained following Step 1 is higher than the maximum grant amount set out in Article 5.1, it will be limited to the latter.

5.3.3 Step 3 — Reduction due to the no-profit rule

The grant must not produce a profit.

‘**Profit**’ means the surplus of the amount obtained following Steps 1 and 2 plus the action’s total receipts, over the action’s total eligible costs.

The ‘**action’s total eligible costs**’ are the consolidated total eligible costs approved by the Agency.

The ‘**action’s total receipts**’ are the consolidated total receipts generated during its duration (see Article 3).

The following are considered **receipts**:

- (a) income generated by the action; if the income is generated from selling equipment or other assets purchased under the Agreement, the receipt is up to the amount declared as eligible under the Agreement;
- (b) financial contributions given by third parties to the beneficiary specifically to be used for the action, and
- (c) in-kind contributions provided by third parties free of charge and specifically to be used for the action, if they have been declared as eligible costs.

The following are however not considered receipts:

- (a) income generated by exploiting the action’s results (see Article 28);
- (b) financial contributions by third parties, if they may be used to cover costs other than the eligible costs (see Article 6);
- (c) financial contributions by third parties with no obligation to repay any amount unused at the end of the period set out in Article 3.

If there is a profit, it will be deducted from the amount obtained following Steps 1 and 2.

5.3.4 Step 4 — Reduction due to substantial errors, irregularities or fraud or serious breach of obligations — Reduced grant amount — Calculation

If the grant is reduced (see Article 43), the Agency will calculate the reduced grant amount by deducting the amount of the reduction (calculated in proportion to the seriousness of the errors, irregularities or fraud or breach of obligations, in accordance with Article 43.2) from the maximum grant amount set out in Article 5.1.

The final grant amount will be the lower of the following two:

- the amount obtained following Steps 1 to 3 or

- the reduced grant amount following Step 4.

5.4 Revised final grant amount — Calculation

If — after the payment of the balance (in particular, after checks, reviews, audits or investigations; see Article 22) — the Agency rejects costs (see Article 42) or reduces the grant (see Article 43), it will calculate the ‘**revised final grant amount**’ for the beneficiary concerned by the findings.

This amount is calculated by the Agency on the basis of the findings, as follows:

- in case of **rejection of costs**: by applying the reimbursement rate to the revised eligible costs approved by the Agency for the beneficiary concerned;
- in case of **reduction of the grant**: by calculating the concerned beneficiary’s share in the grant amount reduced in proportion to the seriousness of the errors, irregularities or fraud or breach of obligations (see Article 43.2).

In case of **rejection of costs and reduction of the grant**, the revised final grant amount for the beneficiary concerned will be the lower of the two amounts above.

ARTICLE 6 — ELIGIBLE AND INELIGIBLE COSTS

6.1 General conditions for costs to be eligible

‘**Eligible costs**’ are costs that meet the following criteria:

(a) for **actual costs**:

- (i) they must be actually incurred by the beneficiary;
- (ii) they must be incurred in the period set out in Article 3, with the exception of costs relating to the submission of the periodic report for the last reporting period and the final report (see Article 20);
- (iii) they must be indicated in the estimated budget set out in Annex 2;
- (iv) they must be incurred in connection with the action as described in Annex 1 and necessary for its implementation;
- (v) they must be identifiable and verifiable, in particular recorded in the beneficiary’s accounts in accordance with the accounting standards applicable in the country where the beneficiary is established and with the beneficiary’s usual cost accounting practices;
- (vi) they must comply with the applicable national law on taxes, labour and social security, and
- (vii) they must be reasonable, justified and must comply with the principle of sound financial management, in particular regarding economy and efficiency;

(b) for **unit costs**:

- (i) they must be calculated as follows:

{amounts per unit set out in Annex 2a or calculated by the beneficiary in accordance with its usual cost accounting practices (see Article 6.2, Point A)

multiplied by

the number of actual units};

(ii) the number of actual units must comply with the following conditions:

- the units must be actually used or produced in the period set out in Article 3;
- the units must be necessary for implementing the action or produced by it, and
- the number of units must be identifiable and verifiable, in particular supported by records and documentation (see Article 18);

(c) for **flat-rate costs**:

- (i) they must be calculated by applying the flat-rate set out in Annex 2, and
- (ii) the costs (actual costs or unit costs) to which the flat-rate is applied must comply with the conditions for eligibility set out in this Article.

6.2 Specific conditions for costs to be eligible

Costs are eligible if they comply with the general conditions (see above) and the specific conditions set out below for each of the following budget categories:

- A. direct personnel costs;
- B. direct costs of subcontracting;
- C. not applicable;
- D. other direct costs;
- E. indirect costs;
- F. not applicable.

‘Direct costs’ are costs that are directly linked to the action implementation and can therefore be attributed to it directly. They must not include any indirect costs (see Point E below).

‘Indirect costs’ are costs that are not directly linked to the action implementation and therefore cannot be attributed directly to it.

A. Direct personnel costs

Types of eligible personnel costs

A.1 Personnel costs are eligible, if they are related to personnel working for the beneficiary under an employment contract (or equivalent appointing act) and assigned to the action (**‘costs for employees (or equivalent)’**). They must be limited to salaries (including during parental leave), social security contributions, taxes and other costs included in the **remuneration**, if they arise from national law or the employment contract (or equivalent appointing act).

Beneficiaries that are non-profit legal entities¹ may also declare as personnel costs **additional**

remuneration for personnel assigned to the action (including payments on the basis of supplementary contracts regardless of their nature), if:

- (a) it is part of the beneficiary's usual remuneration practices and is paid in a consistent manner whenever the same kind of work or expertise is required;
- (b) the criteria used to calculate the supplementary payments are objective and generally applied by the beneficiary, regardless of the source of funding used.

Additional remuneration for personnel assigned to the action is eligible up to the following amount:

- (a) if the person works full time and exclusively on the action during the full year: up to EUR 8 000;
- (b) if the person works exclusively on the action but not full-time or not for the full year: up to the corresponding pro-rata amount of EUR 8 000, or
- (c) if the person does not work exclusively on the action: up to a pro-rata amount calculated as follows:
 - {EUR 8 000
 - divided by
 - the number of annual productive hours (see below)},
 - multiplied by
 - the number of hours that the person has worked on the action during the year}.

A.2 The costs for natural persons working under a direct contract with the beneficiary other than an employment contract are eligible personnel costs, if:

- (a) the person works under the beneficiary's instructions and, unless otherwise agreed with the beneficiary, on the beneficiary's premises;
- (b) the result of the work carried out belongs to the beneficiary, and
- (c) the costs are not significantly different from those for personnel performing similar tasks under an employment contract with the beneficiary.

A.3 The costs of personnel seconded by a third party against payment are eligible personnel costs, if the conditions in Article 11.1 are met.

A.4 Costs of owners of beneficiaries that are small and medium-sized enterprises ('**SME owners**') who are working on the action and who do not receive a salary are eligible personnel costs, if they correspond to the amount per unit set out in Annex 2a multiplied by the number of actual hours worked on the action.

A.5 Costs of 'beneficiaries that are natural persons' not receiving a salary are eligible personnel

¹ For the definition, see Article 2.1(14) of the Rules for Participation Regulation No 1290/2013: '**non-profit legal entity**' means a legal entity which by its legal form is non-profit-making or which has a legal or statutory obligation not to distribute profits to its shareholders or individual members.

costs, if they correspond to the amount per unit set out in Annex 2a multiplied by the number of actual hours worked on the action.

Calculation

Personnel costs must be calculated by the beneficiaries as follows:

{hourly rate
multiplied by
the number of actual hours worked on the action},
plus
for non-profit legal entities: additional remuneration to personnel assigned to the action under the conditions set out above (Point A.1)}.

The number of actual hours declared for a person must be identifiable and verifiable (see Article 18).

The total number of hours declared in EU or Euratom grants, for a person for a year, cannot be higher than the annual productive hours used for the calculations of the hourly rate. Therefore, the maximum number of hours that can be declared for the grant is:

{the number of annual productive hours for the year (see below)
minus
total number of hours declared by the beneficiary for that person in that year for other EU or Euratom grants}.

The ‘**hourly rate**’ is one of the following:

- (a) for personnel costs declared as **actual costs**: the hourly rate is calculated *per full financial year*, as follows:

{actual annual personnel costs (excluding additional remuneration) for the person
divided by
number of annual productive hours}.

using the personnel costs and the number of productive hours for each full financial year covered by the reporting period concerned. If a financial year is not closed at the end of the reporting period, the beneficiaries must use the hourly rate of the last closed financial year available.

For the ‘number of annual productive hours’, the beneficiaries may choose one of the following:

- (i) ‘fixed number of hours’: 1 720 hours for persons working full time (or corresponding pro-rata for persons not working full time);
- (ii) ‘individual annual productive hours’: the total number of hours worked by the person in the year for the beneficiary, calculated as follows:

{annual workable hours of the person (according to the employment contract, applicable collective labour agreement or national law)
plus

overtime worked
 minus
 absences (such as sick leave and special leave)}.

‘Annual workable hours’ means the period during which the personnel must be working, at the employer’s disposal and carrying out his/her activity or duties under the employment contract, applicable collective labour agreement or national working time legislation.

If the contract (or applicable collective labour agreement or national working time legislation) does not allow to determine the annual workable hours, this option cannot be used;

- (iii) ‘standard annual productive hours’: the ‘standard number of annual hours’ generally applied by the beneficiary for its personnel in accordance with its usual cost accounting practices. This number must be at least 90% of the ‘standard annual workable hours’.

If there is no applicable reference for the standard annual workable hours, this option cannot be used.

For all options, the actual time spent on **parental leave** by a person assigned to the action may be deducted from the number of annual productive hours.

As an alternative, beneficiaries may calculate the hourly rate *per month*, as follows:

{actual monthly personnel cost (excluding additional remuneration) for the person
 divided by
 {number of annual productive hours / 12}}

using the personnel costs for each month and (one twelfth of) the annual productive hours calculated according to either option (i) or (iii) above, i.e.:

- fixed number of hours or
- standard annual productive hours.

Time spent on **parental leave** may not be deducted when calculating the hourly rate per month. However, beneficiaries may declare personnel costs incurred in periods of parental leave in proportion to the time the person worked on the action in that financial year.

If parts of a basic remuneration are generated over a period longer than a month, the beneficiaries may include only the share which is generated in the month (irrespective of the amount actually paid for that month).

Each beneficiary must use only one option (per full financial year or per month) for each full financial year;

- (b) for personnel costs declared on the basis of **unit costs**: the hourly rate is one of the following:

- (i) for SME owners or beneficiaries that are natural persons: the hourly rate set out in Annex 2a (see Points A.4 and A.5 above), or
- (ii) for personnel costs declared on the basis of the beneficiary's usual cost accounting practices: the hourly rate calculated by the beneficiary in accordance with its usual cost accounting practices, if:
 - the cost accounting practices used are applied in a consistent manner, based on objective criteria, regardless of the source of funding;
 - the hourly rate is calculated using the actual personnel costs recorded in the beneficiary's accounts, excluding any ineligible cost or costs included in other budget categories.

The actual personnel costs may be adjusted by the beneficiary on the basis of budgeted or estimated elements. Those elements must be relevant for calculating the personnel costs, reasonable and correspond to objective and verifiable information;

and

- the hourly rate is calculated using the number of annual productive hours (see above).

B. Direct costs of subcontracting (including related duties, taxes and charges such as non-deductible value added tax (VAT) paid by the beneficiary) are eligible if the conditions in Article 13.1.1 are met.

C. Direct costs of providing financial support to third parties

Not applicable

D. Other direct costs

D.1 Travel costs and related subsistence allowances (including related duties, taxes and charges such as non-deductible value added tax (VAT) paid by the beneficiary) are eligible if they are in line with the beneficiary's usual practices on travel.

D.2 The depreciation costs of equipment, infrastructure or other assets (new or second-hand) as recorded in the beneficiary's accounts are eligible, if they were purchased in accordance with Article 10.1.1 and written off in accordance with international accounting standards and the beneficiary's usual accounting practices.

The **costs of renting or leasing** equipment, infrastructure or other assets (including related duties, taxes and charges such as non-deductible value added tax (VAT) paid by the beneficiary) are also eligible, if they do not exceed the depreciation costs of similar equipment, infrastructure or assets and do not include any financing fees.

The costs of equipment, infrastructure or other assets **contributed in-kind against payment** are eligible, if they do not exceed the depreciation costs of similar equipment, infrastructure or assets, do not include any financing fees and if the conditions in Article 11.1 are met.

The only portion of the costs that will be taken into account is that which corresponds to the duration of the action and rate of actual use for the purposes of the action.

D.3 Costs of other goods and services (including related duties, taxes and charges such as non-deductible value added tax (VAT) paid by the beneficiary) are eligible, if they are:

- (a) purchased specifically for the action and in accordance with Article 10.1.1 or
- (b) contributed in kind against payment and in accordance with Article 11.1.

Such goods and services include, for instance, consumables and supplies, dissemination (including open access), protection of results, certificates on the financial statements (if they are required by the Agreement), certificates on the methodology, translations and publications.

D.4 Capitalised and operating costs of ‘large research infrastructure’² directly used for the action are eligible, if:

- (a) the value of the large research infrastructure represents at least 75% of the total fixed assets (at historical value in its last closed balance sheet before the date of the signature of the Agreement or as determined on the basis of the rental and leasing costs of the research infrastructure³);
- (b) the beneficiary’s methodology for declaring the costs for large research infrastructure has been positively assessed by the Commission (‘**ex-ante assessment**’);
- (c) the beneficiary declares as direct eligible costs only the portion which corresponds to the duration of the action and the rate of actual use for the purposes of the action, and
- (d) they comply with the conditions as further detailed in the annotations to the H2020 grant agreements.

E. Indirect costs

Indirect costs are eligible if they are declared on the basis of the flat-rate of 25% of the eligible direct costs (see Article 5.2 and Points A to D above), from which are excluded:

- (a) costs of subcontracting and

² ‘**Large research infrastructure**’ means research infrastructure of a total value of at least EUR 20 million, for a beneficiary, calculated as the sum of historical asset values of each individual research infrastructure of that beneficiary, as they appear in its last closed balance sheet before the date of the signature of the Agreement or as determined on the basis of the rental and leasing costs of the research infrastructure.

³ For the definition, see Article 2(6) of the H2020 Framework Programme Regulation No 1291/2013: ‘**Research infrastructure**’ are facilities, resources and services that are used by the research communities to conduct research and foster innovation in their fields. Where relevant, they may be used beyond research, e.g. for education or public services. They include: major scientific equipment (or sets of instruments); knowledge-based resources such as collections, archives or scientific data; e-infrastructures such as data and computing systems and communication networks; and any other infrastructure of a unique nature essential to achieve excellence in research and innovation. Such infrastructures may be ‘single-sited’, ‘virtual’ or ‘distributed’.

- (b) costs of in-kind contributions provided by third parties which are not used on the beneficiary's premises;
- (c) not applicable;
- (d) not applicable.

Beneficiaries receiving an operating grant⁴ financed by the EU or Euratom budget cannot declare indirect costs for the period covered by the operating grant.

F. Specific cost category(ies)

Not applicable

6.3 Conditions for costs of linked third parties to be eligible

Not applicable

6.4 Conditions for in-kind contributions provided by third parties free of charge to be eligible

In-kind contributions provided free of charge are eligible direct costs (for the beneficiary), if the costs incurred by the third party fulfil — *mutatis mutandis* — the general and specific conditions for eligibility set out in this Article (Article 6.1 and 6.2) and Article 12.1.

6.5 Ineligible costs

'**Ineligible costs**' are:

- (a) costs that do not comply with the conditions set out above (Article 6.1 to 6.4), in particular:
 - (i) costs related to return on capital;
 - (ii) debt and debt service charges;
 - (iii) provisions for future losses or debts;
 - (iv) interest owed;
 - (v) doubtful debts;
 - (vi) currency exchange losses;
 - (vii) bank costs charged by the beneficiary's bank for transfers from the Agency;
 - (viii) excessive or reckless expenditure;
 - (ix) deductible VAT;

⁴ For the definition, see Article 121(1)(b) of Regulation (EU, Euratom) No 966/2012 of the European Parliament and of the Council of 25 October 2012 on the financial rules applicable to the general budget of the Union and repealing Council Regulation (EC, Euratom) No 1605/2002 ('**Financial Regulation No 966/2012**') (OJ L 218, 26.10.2012, p.1): '**operating grant**' means direct financial contribution, by way of donation, from the budget in order to finance the functioning of a body which pursues an aim of general EU interest or has an objective forming part of and supporting an EU policy.

- (x) costs incurred during suspension of the implementation of the action (see Article 49);
- (b) costs declared under another EU or Euratom grant (including grants awarded by a Member State and financed by the EU or Euratom budget and grants awarded by bodies other than the Agency for the purpose of implementing the EU or Euratom budget); in particular, indirect costs if the beneficiary is already receiving an operating grant financed by the EU or Euratom budget in the same period.

6.6 Consequences of declaration of ineligible costs

Declared costs that are ineligible will be rejected (see Article 42).

This may also lead to any of the other measures described in Chapter 6.

CHAPTER 4 RIGHTS AND OBLIGATIONS OF THE PARTIES

SECTION 1 RIGHTS AND OBLIGATIONS RELATED TO IMPLEMENTING THE ACTION

ARTICLE 7 — GENERAL OBLIGATION TO PROPERLY IMPLEMENT THE ACTION

7.1 General obligation to properly implement the action

The beneficiaries must implement the action as described in Annex 1 and in compliance with the provisions of the Agreement and all legal obligations under applicable EU, international and national law.

7.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 8 — RESOURCES TO IMPLEMENT THE ACTION — THIRD PARTIES INVOLVED IN THE ACTION

The beneficiaries must have the appropriate resources to implement the action.

If it is necessary to implement the action, the beneficiaries may:

- purchase goods, works and services (see Article 10);
- use in-kind contributions provided by third parties against payment (see Article 11);
- use in-kind contributions provided by third parties free of charge (see Article 12);
- call upon subcontractors to implement action tasks described in Annex 1 (see Article 13);
- call upon linked third parties to implement action tasks described in Annex 1 (see Article 14).

In these cases, the beneficiaries retain sole responsibility towards the Agency and the other beneficiaries for implementing the action.

ARTICLE 9 — IMPLEMENTATION OF ACTION TASKS BY BENEFICIARIES NOT RECEIVING EU FUNDING

Not applicable

ARTICLE 10 — PURCHASE OF GOODS, WORKS OR SERVICES

10.1 Rules for purchasing goods, works or services

10.1.1 If necessary to implement the action, the beneficiaries may purchase goods, works or services.

The beneficiaries must make such purchases ensuring the best value for money or, if appropriate, the lowest price. In doing so, they must avoid any conflict of interests (see Article 35).

The beneficiaries must ensure that the Agency, the Commission, the European Court of Auditors (ECA) and the European Anti-Fraud Office (OLAF) can exercise their rights under Articles 22 and 23 also towards their contractors.

10.1.2 Beneficiaries that are ‘contracting authorities’ within the meaning of Directive 2004/18/EC⁵ (or 2014/24/EU⁶) or ‘contracting entities’ within the meaning of Directive 2004/17/EC⁷ (or 2014/25/EU⁸) must comply with the applicable national law on public procurement.

10.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under Article 10.1.1, the costs related to the contract concerned will be ineligible (see Article 6) and will be rejected (see Article 42).

If a beneficiary breaches any of its obligations under Article 10.1.2, the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 11 — USE OF IN-KIND CONTRIBUTIONS PROVIDED BY THIRD PARTIES AGAINST PAYMENT

11.1 Rules for the use of in-kind contributions against payment

⁵ Directive 2004/18/EC of the European Parliament and of the Council of 31 March 2004 on the coordination of procedures for the award of public work contracts, public supply contracts and public service contracts (OJ L 134, 30.04.2004, p. 114).

⁶ Directive 2014/24/EU of the European Parliament and of the Council of 26 February 2014 on public procurement and repealing Directive 2004/18/EC. (OJ L 94, 28.03.2014, p. 65).

⁷ Directive 2004/17/EC of the European Parliament and of the Council of 31 March 2004 coordinating the procurement procedures of entities operating in the water, energy, transport and postal services sectors (OJ L 134, 30.04.2004, p. 1)

⁸ Directive 2014/25/EU of the European Parliament and of the Council of 26 February 2014 on procurement by entities operating in the water, energy, transport and postal services sectors and repealing Directive 2004/17/EC (OJ L 94, 28.03.2014, p. 243).

If necessary to implement the action, the beneficiaries may use in-kind contributions provided by third parties against payment.

The beneficiaries may declare costs related to the payment of in-kind contributions as eligible (see Article 6.1 and 6.2), up to the third parties' costs for the seconded persons, contributed equipment, infrastructure or other assets or other contributed goods and services.

The third parties and their contributions must be set out in Annex 1. The Agency may however approve in-kind contributions not set out in Annex 1 without amendment (see Article 55), if:

- they are specifically justified in the periodic technical report and
- their use does not entail changes to the Agreement which would call into question the decision awarding the grant or breach the principle of equal treatment of applicants.

The beneficiaries must ensure that the Agency, the Commission, the European Court of Auditors (ECA) and the European Anti-Fraud Office (OLAF) can exercise their rights under Articles 22 and 23 also towards the third parties.

11.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the costs related to the payment of the in-kind contribution will be ineligible (see Article 6) and will be rejected (see Article 42).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 12 — USE OF IN-KIND CONTRIBUTIONS PROVIDED BY THIRD PARTIES FREE OF CHARGE

12.1 Rules for the use of in-kind contributions free of charge

If necessary to implement the action, the beneficiaries may use in-kind contributions provided by third parties free of charge.

The beneficiaries may declare costs incurred by the third parties for the seconded persons, contributed equipment, infrastructure or other assets or other contributed goods and services as eligible in accordance with Article 6.4.

The third parties and their contributions must be set out in Annex 1. The Agency may however approve in-kind contributions not set out in Annex 1 without amendment (see Article 55), if:

- they are specifically justified in the periodic technical report and
- their use does not entail changes to the Agreement which would call into question the decision awarding the grant or breach the principle of equal treatment of applicants.

The beneficiaries must ensure that the Agency, the Commission, the European Court of Auditors (ECA) and the European Anti-Fraud Office (OLAF) can exercise their rights under Articles 22 and 23 also towards the third parties.

12.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the costs incurred by the third parties related to the in-kind contribution will be ineligible (see Article 6) and will be rejected (see Article 42).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 13 — IMPLEMENTATION OF ACTION TASKS BY SUBCONTRACTORS

13.1 Rules for subcontracting action tasks

13.1.1 If necessary to implement the action, the beneficiaries may award subcontracts covering the implementation of certain action tasks described in Annex 1.

Subcontracting may cover only a limited part of the action.

The beneficiaries must award the subcontracts ensuring the best value for money or, if appropriate, the lowest price. In doing so, they must avoid any conflict of interests (see Article 35).

The tasks to be implemented and the estimated cost for each subcontract must be set out in Annex 1 and the total estimated costs of subcontracting per beneficiary must be set out in Annex 2. The Agency may however approve subcontracts not set out in Annex 1 and 2 without amendment (see Article 55), if:

- they are specifically justified in the periodic technical report and
- they do not entail changes to the Agreement which would call into question the decision awarding the grant or breach the principle of equal treatment of applicants.

The beneficiaries must ensure that the Agency, the Commission, the European Court of Auditors (ECA) and the European Anti-Fraud Office (OLAF) can exercise their rights under Articles 22 and 23 also towards their subcontractors.

13.1.2 The beneficiaries must ensure that their obligations under Articles 35, 36, 38 and 46 also apply to the subcontractors.

Beneficiaries that are ‘contracting authorities’ within the meaning of Directive 2004/18/EC (or 2014/24/EU) or ‘contracting entities’ within the meaning of Directive 2004/17/EC (or 2014/25/EU) must comply with the applicable national law on public procurement.

13.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under Article 13.1.1, the costs related to the subcontract concerned will be ineligible (see Article 6) and will be rejected (see Article 42).

If a beneficiary breaches any of its obligations under Article 13.1.2, the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 14 — IMPLEMENTATION OF ACTION TASKS BY LINKED THIRD PARTIES

Not applicable

ARTICLE 15 — FINANCIAL SUPPORT TO THIRD PARTIES

15.1 Rules for providing financial support to third parties

Not applicable

15.2 Financial support in the form of prizes

Not applicable

15.3 Consequences of non-compliance

Not applicable

ARTICLE 16 — PROVISION OF TRANS-NATIONAL OR VIRTUAL ACCESS TO RESEARCH INFRASTRUCTURE

16.1 Rules for providing trans-national access to research infrastructure

Not applicable

16.2 Rules for providing virtual access to research infrastructure

Not applicable

16.3 Consequences of non-compliance

Not applicable

SECTION 2 RIGHTS AND OBLIGATIONS RELATED TO THE GRANT ADMINISTRATION

ARTICLE 17 — GENERAL OBLIGATION TO INFORM

17.1 General obligation to provide information upon request

The beneficiaries must provide — during implementation of the action or afterwards and in accordance with Article 41.2 — any information requested in order to verify eligibility of the costs, proper implementation of the action and compliance with any other obligation under the Agreement.

17.2 Obligation to keep information up to date and to inform about events and circumstances likely to affect the Agreement

Each beneficiary must keep information stored in the Participant Portal Beneficiary Register (via the electronic exchange system; see Article 52) up to date, in particular, its name, address, legal representatives, legal form and organisation type.

Each beneficiary must immediately inform the coordinator — which must immediately inform the Agency and the other beneficiaries — of any of the following:

- (a) **events** which are likely to affect significantly or delay the implementation of the action or the EU's financial interests, in particular:
- (i) changes in its legal, financial, technical, organisational or ownership situation
- (b) **circumstances** affecting:
- (i) the decision to award the grant or
 - (ii) compliance with requirements under the Agreement.

17.3 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 18 — KEEPING RECORDS — SUPPORTING DOCUMENTATION

18.1 Obligation to keep records and other supporting documentation

The beneficiaries must — for a period of five years after the payment of the balance — keep records and other supporting documentation in order to prove the proper implementation of the action and the costs they declare as eligible.

They must make them available upon request (see Article 17) or in the context of checks, reviews, audits or investigations (see Article 22).

If there are on-going checks, reviews, audits, investigations, litigation or other pursuits of claims under the Agreement (including the extension of findings; see Article 22), the beneficiaries must keep the records and other supporting documentation until the end of these procedures.

The beneficiaries must keep the original documents. Digital and digitalised documents are considered originals if they are authorised by the applicable national law. The Agency may accept non-original documents if it considers that they offer a comparable level of assurance.

18.1.1 Records and other supporting documentation on the scientific and technical implementation

The beneficiaries must keep records and other supporting documentation on scientific and technical implementation of the action in line with the accepted standards in the respective field.

18.1.2 Records and other documentation to support the costs declared

The beneficiaries must keep the records and documentation supporting the costs declared, in particular the following:

- (a) for **actual costs**: adequate records and other supporting documentation to prove the costs declared, such as contracts, subcontracts, invoices and accounting records. In addition, the beneficiaries' usual cost accounting practices and internal control procedures must enable direct

reconciliation between the amounts declared, the amounts recorded in their accounts and the amounts stated in the supporting documentation;

- (b) for **unit costs**: adequate records and other supporting documentation to prove the number of units declared. Beneficiaries do not need to identify the actual eligible costs covered or to keep or provide supporting documentation (such as accounting statements) to prove the amount per unit.

In addition, for **direct personnel costs declared as unit costs calculated in accordance with the beneficiary's usual cost accounting practices**, the beneficiaries must keep adequate records and documentation to prove that the cost accounting practices used comply with the conditions set out in Article 6.2, Point A.

The beneficiaries may submit to the Commission, for approval, a certificate (drawn up in accordance with Annex 6) stating that their usual cost accounting practices comply with these conditions (**'certificate on the methodology'**). If the certificate is approved, costs declared in line with this methodology will not be challenged subsequently, unless the beneficiaries have concealed information for the purpose of the approval.

- (c) for **flat-rate costs**: adequate records and other supporting documentation to prove the eligibility of the costs to which the flat-rate is applied. The beneficiaries do not need to identify the costs covered or provide supporting documentation (such as accounting statements) to prove the amount declared at a flat-rate.

In addition, for **personnel costs** (declared as actual costs or on the basis of unit costs), the beneficiaries must keep **time records** for the number of hours declared. The time records must be in writing and approved by the persons working on the action and their supervisors, at least monthly. In the absence of reliable time records of the hours worked on the action, the Agency may accept alternative evidence supporting the number of hours declared, if it considers that it offers an adequate level of assurance.

As an exception, for **persons working exclusively on the action**, there is no need to keep time records, if the beneficiary signs a **declaration** confirming that the persons concerned have worked exclusively on the action.

18.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, costs insufficiently substantiated will be ineligible (see Article 6) and will be rejected (see Article 42), and the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 19 — SUBMISSION OF DELIVERABLES

19.1 Obligation to submit deliverables

The coordinator must submit the **'deliverables'** identified in Annex 1, in accordance with the timing and conditions set out in it.

19.2 Consequences of non-compliance

If the coordinator breaches any of its obligations under this Article, the Agency may apply any of the measures described in Chapter 6.

ARTICLE 20 — REPORTING — PAYMENT REQUESTS

20.1 Obligation to submit reports

The coordinator must submit to the Agency (see Article 52) the technical and financial reports set out in this Article. These reports include requests for payment and must be drawn up using the forms and templates provided in the electronic exchange system (see Article 52).

20.2 Reporting periods

The action is divided into the following ‘**reporting periods**’:

- RP1: from month 1 to month 18
- RP2: from month 19 to month 30
- RP3: from month 31 to month 42

20.3 Periodic reports — Requests for interim payments

The coordinator must submit a periodic report within 60 days following the end of each reporting period.

The **periodic report** must include the following:

(a) a ‘**periodic technical report**’ containing:

- (i) an **explanation of the work carried out** by the beneficiaries;
- (ii) an **overview of the progress** towards the objectives of the action, including milestones and deliverables identified in Annex 1.

This report must include explanations justifying the differences between work expected to be carried out in accordance with Annex 1 and that actually carried out.

The report must detail the exploitation and dissemination of the results and — if required in Annex 1 — an updated ‘**plan for the exploitation and dissemination of the results**’.

The report must indicate the communication activities;

- (iii) a **summary** for publication by the Agency;
- (iv) the answers to the ‘**questionnaire**’, covering issues related to the action implementation and the economic and societal impact, notably in the context of the Horizon 2020 key performance indicators and the Horizon 2020 monitoring requirements;

(b) a ‘**periodic financial report**’ containing:

- (i) an ‘**individual financial statement**’ (see Annex 4) from each beneficiary, for the reporting period concerned.

The individual financial statement must detail the eligible costs (actual costs, unit costs and flat-rate costs; see Article 6) for each budget category (see Annex 2).

The beneficiaries must declare all eligible costs, even if — for actual costs, unit costs and flat-rate costs — they exceed the amounts indicated in the estimated budget (see Annex 2). Amounts which are not declared in the individual financial statement will not be taken into account by the Agency.

If an individual financial statement is not submitted for a reporting period, it may be included in the periodic financial report for the next reporting period.

The individual financial statements of the last reporting period must also detail the **receipts of the action** (see Article 5.3.3).

Each beneficiary must **certify** that:

- the information provided is full, reliable and true;
 - the costs declared are eligible (see Article 6);
 - the costs can be substantiated by adequate records and supporting documentation (see Article 18) that will be produced upon request (see Article 17) or in the context of checks, reviews, audits and investigations (see Article 22), and
 - for the last reporting period: that all the receipts have been declared (see Article 5.3.3);
- (ii) an **explanation of the use of resources** and the information on subcontracting (see Article 13) and in-kind contributions provided by third parties (see Articles 11 and 12) from each beneficiary, for the reporting period concerned;
- (iii) information on the amount of each interim payment and payment of the balance to be paid by the Agency to the Joint Research Centre (JRC);
- (iv) a ‘**periodic summary financial statement**’, created automatically by the electronic exchange system, consolidating the individual financial statements for the reporting period concerned and including — except for the last reporting period — the **request for interim payment**.

20.4 Final report — Request for payment of the balance

In addition to the periodic report for the last reporting period, the coordinator must submit the final report within 60 days following the end of the last reporting period.

The **final report** must include the following:

- (a) a ‘**final technical report**’ with a **summary** for publication containing:
- (i) an overview of the results and their exploitation and dissemination;
 - (ii) the conclusions on the action, and

- (iii) the socio-economic impact of the action;
- (b) a **'final financial report'** containing:
 - (i) a **'final summary financial statement'**, created automatically by the electronic exchange system, consolidating the individual financial statements for all reporting periods and including the **request for payment of the balance** and
 - (ii) a **'certificate on the financial statements'** (drawn up in accordance with Annex 5) for each beneficiary, if it requests a total contribution of EUR 325 000 or more, as reimbursement of actual costs and unit costs calculated on the basis of its usual cost accounting practices (see Article 5.2 and Article 6.2, Point A).

20.5 Information on cumulative expenditure incurred

Not applicable

20.6 Currency for financial statements and conversion into euro

Financial statements must be drafted in euro.

Beneficiaries with accounting established in a currency other than the euro must convert the costs recorded in their accounts into euro, at the average of the daily exchange rates published in the C series of the *Official Journal of the European Union*, calculated over the corresponding reporting period.

If no daily euro exchange rate is published in the *Official Journal of the European Union* for the currency in question, they must be converted at the average of the monthly accounting rates published on the Commission's website, calculated over the corresponding reporting period.

Beneficiaries with accounting established in euro must convert costs incurred in another currency into euro according to their usual accounting practices.

20.7 Language of reports

All reports (technical and financial reports, including financial statements) must be submitted in the language of the Agreement.

20.8 Consequences of non-compliance

If the reports submitted do not comply with this Article, the Agency may suspend the payment deadline (see Article 47) and apply any of the other measures described in Chapter 6.

If the coordinator breaches its obligation to submit the reports and if it fails to comply with this obligation within 30 days following a written reminder, the Agency may terminate the Agreement (see Article 50) or apply any of the other measures described in Chapter 6.

ARTICLE 21 — PAYMENTS AND PAYMENT ARRANGEMENTS

21.1 Payments to be made

The following payments will be made to the coordinator:

- one **pre-financing payment**;
- one or more **interim payments**, on the basis of the request(s) for interim payment (see Article 20), and
- one **payment of the balance**, on the basis of the request for payment of the balance (see Article 20).

21.2 Pre-financing payment — Amount — Amount retained for the Guarantee Fund

The aim of the pre-financing is to provide the beneficiaries with a float.

It remains the property of the EU until the payment of the balance.

The amount of the pre-financing payment will be EUR **3,733,211.20** (three million seven hundred and thirty three thousand two hundred and eleven EURO and twenty eurocents).

The Agency will — except if Article 48 applies — make the pre-financing payment to the coordinator within 30 days, either from the entry into force of the Agreement (see Article 58) or from 10 days before the starting date of the action (see Article 3), whichever is the latest.

An amount of EUR **349,988.55** (three hundred and forty nine thousand nine hundred and eighty eight EURO and fifty five eurocents), corresponding to 5% of the maximum grant amount (see Article 5.1), is retained by the Agency from the pre-financing payment and transferred into the ‘**Guarantee Fund**’.

Moreover, the part of the pre-financing payment related to the Joint Research Centre (JRC) **160,000.00** (one hundred and sixty thousand EURO) is not paid to the coordinator, but kept by the Agency for the JRC.

21.3 Interim payments — Amount — Calculation

Interim payments reimburse the eligible costs incurred for the implementation of the action during the corresponding reporting periods.

The Agency will pay to the coordinator the amount due as interim payment within 90 days from receiving the periodic report (see Article 20.3), except if Articles 47 or 48 apply.

Payment is subject to the approval of the periodic report. Its approval does not imply recognition of the compliance, authenticity, completeness or correctness of its content.

The **amount due as interim payment** is calculated by the Agency in the following steps:

Step 1 – Application of the reimbursement rates

Step 2 – Limit to 90% of the maximum grant amount

21.3.1 Step 1 — Application of the reimbursement rates

The reimbursement rate(s) (see Article 5.2) are applied to the eligible costs (actual costs, unit costs and flat-rate costs ; see Article 6) declared by the beneficiaries (see Article 20) and approved by the Agency (see above) for the concerned reporting period.

21.3.2 Step 2 — Limit to 90% of the maximum grant amount

The total amount of pre-financing and interim payments must not exceed 90% of the maximum grant amount set out in Article 5.1. The maximum amount for the interim payment will be calculated as follows:

{90% of the maximum grant amount (see Article 5.1)
 minus
 {pre-financing and previous interim payments}}.

21.4 Payment of the balance — Amount — Calculation — Release of the amount retained for the Guarantee Fund

The payment of the balance reimburses the remaining part of the eligible costs incurred by the beneficiaries for the implementation of the action.

If the total amount of earlier payments is greater than the final grant amount (see Article 5.3), the payment of the balance takes the form of a recovery (see Article 44).

If the total amount of earlier payments is lower than the final grant amount, the Agency will pay the balance within 90 days from receiving the final report (see Article 20.4), except if Articles 47 or 48 apply.

Payment is subject to the approval of the final report. Its approval does not imply recognition of the compliance, authenticity, completeness or correctness of its content.

The **amount due as the balance** is calculated by the Agency by deducting the total amount of pre-financing and interim payments (if any) already made, from the final grant amount determined in accordance with Article 5.3:

{final grant amount (see Article 5.3)
 minus
 {pre-financing and interim payments (if any) made}}.

At the payment of the balance, the amount retained for the Guarantee Fund (see above) will be released and:

- if the balance is positive: the amount released will be paid in full to the coordinator together with the amount due as the balance;
- if the balance is negative (payment of the balance taking the form of recovery): it will be deducted from the amount released (see Article 44.1.2). If the resulting amount:
 - is positive, it will be paid to the coordinator
 - is negative, it will be recovered.

The amount to be paid may however be offset — without the beneficiaries' consent — against any other amount owed by a beneficiary to the Agency, the Commission or another executive agency (under the EU or Euratom budget), up to the maximum EU contribution indicated, for that beneficiary, in the estimated budget (see Annex 2).

21.5 Notification of amounts due

When making payments, the Agency will formally notify to the coordinator the amount due, specifying whether it concerns an interim payment or the payment of the balance.

For the payment of the balance, the notification will also specify the final grant amount.

In the case of reduction of the grant or recovery of undue amounts, the notification will be preceded by the contradictory procedure set out in Articles 43 and 44.

21.6 Currency for payments

The Agency will make all payments in euro.

21.7 Payments to the coordinator — Distribution to the beneficiaries

Payments will be made to the coordinator.

Payments to the coordinator will discharge the Agency from its payment obligation.

The coordinator must distribute the payments between the beneficiaries without unjustified delay.

Pre-financing may however be distributed only:

- (a) if the minimum number of beneficiaries set out in the call for proposals has acceded to the Agreement (see Article 56) and
- (b) to beneficiaries that have acceded to the Agreement (see Article 56).

21.8 Bank account for payments

All payments will be made to the following bank account:

Name of bank: BANCA D'ITALIA

Full name of the account holder: DIPARTIMENTO DI STUDI UMANISTICI

Full account number (including bank codes): ()

IBAN code: IT28L0100003245425300036905

21.9 Costs of payment transfers

The cost of the payment transfers is borne as follows:

- the Agency bears the cost of transfers charged by its bank;
- the beneficiary bears the cost of transfers charged by its bank;
- the party causing a repetition of a transfer bears all costs of the repeated transfer.

21.10 Date of payment

Payments by the Agency are considered to have been carried out on the date when they are debited to its account.

21.11 Consequences of non-compliance

21.11.1 If the Agency does not pay within the payment deadlines (see above), the beneficiaries are entitled to **late-payment interest** at the rate applied by the European Central Bank (ECB) for its main refinancing operations in euros ('reference rate'), plus three and a half points. The reference rate is the rate in force on the first day of the month in which the payment deadline expires, as published in the C series of the *Official Journal of the European Union*.

If the late-payment interest is lower than or equal to EUR 200, it will be paid to the coordinator only upon request submitted within two months of receiving the late payment.

Late-payment interest is not due if all beneficiaries are EU Member States (including regional and local government authorities or other public bodies acting on behalf of a Member State for the purpose of this Agreement).

Suspension of the payment deadline or payments (see Articles 47 and 48) will not be considered as late payment.

Late-payment interest covers the period running from the day following the due date for payment (see above), up to and including the date of payment.

Late-payment interest is not considered for the purposes of calculating the final grant amount.

21.11.2 If the coordinator breaches any of its obligations under this Article, the grant may be reduced (see Article 43) and the Agreement or the participation of the coordinator may be terminated (see Article 50).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 22 — CHECKS, REVIEWS, AUDITS AND INVESTIGATIONS — EXTENSION OF FINDINGS

22.1 Checks, reviews and audits by the Agency and the Commission

22.1.1 Right to carry out checks

The Agency or the Commission will — during the implementation of the action or afterwards — check the proper implementation of the action and compliance with the obligations under the Agreement, including assessing deliverables and reports.

For this purpose the Agency or the Commission may be assisted by external persons or bodies.

The Agency or the Commission may also request additional information in accordance with Article 17. The Agency or the Commission may request beneficiaries to provide such information to it directly.

Information provided must be accurate, precise and complete and in the format requested, including electronic format.

22.1.2 Right to carry out reviews

The Agency or the Commission may — during the implementation of the action or afterwards — carry out reviews on the proper implementation of the action (including assessment of deliverables

and reports), compliance with the obligations under the Agreement and continued scientific or technological relevance of the action.

Reviews may be started up to two years after the payment of the balance. They will be formally notified to the coordinator or beneficiary concerned and will be considered to have started on the date of the formal notification.

If the review is carried out on a third party (see Articles 10 to 16), the beneficiary concerned must inform the third party.

The Agency or the Commission may carry out reviews directly (using its own staff) or indirectly (using external persons or bodies appointed to do so). It will inform the coordinator or beneficiary concerned of the identity of the external persons or bodies. They have the right to object to the appointment on grounds of commercial confidentiality.

The coordinator or beneficiary concerned must provide — within the deadline requested — any information and data in addition to deliverables and reports already submitted (including information on the use of resources). The Agency or the Commission may request beneficiaries to provide such information to it directly.

The coordinator or beneficiary concerned may be requested to participate in meetings, including with external experts.

For **on-the-spot** reviews, the beneficiaries must allow access to their sites and premises, including to external persons or bodies, and must ensure that information requested is readily available.

Information provided must be accurate, precise and complete and in the format requested, including electronic format.

On the basis of the review findings, a ‘**review report**’ will be drawn up.

The Agency or the Commission will formally notify the review report to the coordinator or beneficiary concerned, which has 30 days to formally notify observations (‘**contradictory review procedure**’).

Reviews (including review reports) are in the language of the Agreement.

22.1.3 Right to carry out audits

The Agency or the Commission may — during the implementation of the action or afterwards — carry out audits on the proper implementation of the action and compliance with the obligations under the Agreement.

Audits may be started up to two years after the payment of the balance. They will be formally notified to the coordinator or beneficiary concerned and will be considered to have started on the date of the formal notification.

If the audit is carried out on a third party (see Articles 10 to 16), the beneficiary concerned must inform the third party.

The Agency or the Commission may carry out audits directly (using its own staff) or indirectly (using external persons or bodies appointed to do so). It will inform the coordinator or beneficiary concerned

of the identity of the external persons or bodies. They have the right to object to the appointment on grounds of commercial confidentiality.

The coordinator or beneficiary concerned must provide — within the deadline requested — any information (including complete accounts, individual salary statements or other personal data) to verify compliance with the Agreement. The Agency or the Commission may request beneficiaries to provide such information to it directly.

For **on-the-spot** audits, the beneficiaries must allow access to their sites and premises, including to external persons or bodies, and must ensure that information requested is readily available.

Information provided must be accurate, precise and complete and in the format requested, including electronic format.

On the basis of the audit findings, a ‘**draft audit report**’ will be drawn up.

The Agency or the Commission will formally notify the draft audit report to the coordinator or beneficiary concerned, which has 30 days to formally notify observations (‘**contradictory audit procedure**’). This period may be extended by the Agency or the Commission in justified cases.

The ‘**final audit report**’ will take into account observations by the coordinator or beneficiary concerned. The report will be formally notified to it.

Audits (including audit reports) are in the language of the Agreement.

The Agency or the Commission may also access the beneficiaries’ statutory records for the periodical assessment of unit costs or flat-rate amounts.

22.2 Investigations by the European Anti-Fraud Office (OLAF)

Under Regulations No 883/2013¹⁴ and No 2185/96¹⁵ (and in accordance with their provisions and procedures) the European Anti-Fraud Office (OLAF) may — at any moment during implementation of the action or afterwards — carry out investigations, including on-the-spot checks and inspections, to establish whether there has been fraud, corruption or any other illegal activity affecting the financial interests of the EU.

22.3 Checks and audits by the European Court of Auditors (ECA)

Under Article 287 of the Treaty on the Functioning of the European Union (TFEU) and Article 161 of the Financial Regulation No 966/2012¹⁷, the European Court of Auditors (ECA) may — at any moment during implementation of the action or afterwards — carry out audits.

¹⁴ Regulation (EU, Euratom) No 883/2013 of the European Parliament and of the Council of 11 September 2013 concerning investigations conducted by the European Anti-Fraud Office (OLAF) and repealing Regulation (EC) No 1073/1999 of the European Parliament and of the Council and Council Regulation (Euratom) No 1074/1999 (OJ L 248, 18.09.2013, p. 1).

¹⁵ Council Regulation (Euratom, EC) No 2185/1996 of 11 November 1996 concerning on-the-spot checks and inspections carried out by the Commission in order to protect the European Communities’ financial interests against fraud and other irregularities (OJ L 292, 15.11.1996, p. 2).

¹⁷ Regulation (EU, Euratom) No 966/2012 of the European Parliament and of the Council of 25 October 2012 on the financial rules applicable to the general budget of the Union and repealing Council Regulation (EC, Euratom) No 1605/2002 (OJ L 298, 26.10.2012, p. 1).

The ECA has the right of access for the purpose of checks and audits.

22.4 Checks, reviews, audits and investigations for international organisations

In conformity with its financial regulations, the European Union, including the European Anti-Fraud Office (OLAF) and the European Court of Auditors (ECA), may undertake, including on the spot, checks, reviews audits and investigations.

This Article will be applied in accordance with any specific agreement concluded in this respect by the international organisation and the European Union.

22.5 Consequences of findings in checks, reviews, audits and investigations — Extension of findings

22.5.1 Findings in this grant

Findings in checks, reviews, audits or investigations carried out in the context of this grant may lead to the rejection of ineligible costs (see Article 42), reduction of the grant (see Article 43), recovery of undue amounts (see Article 44) or to any of the other measures described in Chapter 6.

Rejection of costs or reduction of the grant after the payment of the balance will lead to a revised final grant amount (see Article 5.4).

Findings in checks, reviews, audits or investigations may lead to a request for amendment for the modification of Annex 1 (see Article 55).

Checks, reviews, audits or investigations that find systemic or recurrent errors, irregularities, fraud or breach of obligations may also lead to consequences in other EU or Euratom grants awarded under similar conditions (**‘extension of findings from this grant to other grants’**).

Moreover, findings arising from an OLAF investigation may lead to criminal prosecution under national law.

22.5.2 Findings in other grants

The Agency or the Commission may extend findings from other grants to this grant (**‘extension of findings from other grants to this grant’**), if:

- (a) the beneficiary concerned is found, in other EU or Euratom grants awarded under similar conditions, to have committed systemic or recurrent errors, irregularities, fraud or breach of obligations that have a material impact on this grant and
- (b) those findings are formally notified to the beneficiary concerned — together with the list of grants affected by the findings — no later than two years after the payment of the balance of this grant.

The extension of findings may lead to the rejection of costs (see Article 42), reduction of the grant (see Article 43), recovery of undue amounts (see Article 44), suspension of payments (see Article 48), suspension of the action implementation (see Article 49) or termination (see Article 50).

22.5.3 Procedure

The Agency or the Commission will formally notify the beneficiary concerned the systemic or recurrent errors and its intention to extend these audit findings, together with the list of grants affected.

22.5.3.1 If the findings concern **eligibility of costs**: the formal notification will include:

- (a) an invitation to submit observations on the list of grants affected by the findings;
- (b) the request to submit **revised financial statements** for all grants affected;
- (c) the **correction rate for extrapolation** established by the Agency or the Commission on the basis of the systemic or recurrent errors, to calculate the amounts to be rejected if the beneficiary concerned:
 - (i) considers that the submission of revised financial statements is not possible or practicable or
 - (ii) does not submit revised financial statements.

The beneficiary concerned has 90 days from receiving notification to submit observations, revised financial statements or to propose a duly substantiated **alternative correction method**. This period may be extended by the Agency or the Commission in justified cases.

The Agency or the Commission may then start a rejection procedure in accordance with Article 42, on the basis of:

- the revised financial statements, if approved;
 - the proposed alternative correction method, if accepted
- or
- the initially notified correction rate for extrapolation, if it does not receive any observations or revised financial statements, does not accept the observations or the proposed alternative correction method or does not approve the revised financial statements.

22.5.3.2 If the findings concern **substantial errors, irregularities or fraud or serious breach of obligations**: the formal notification will include:

- (a) an invitation to submit observations on the list of grants affected by the findings and
- (b) the flat-rate the Agency or the Commission intends to apply according to the principle of proportionality.

The beneficiary concerned has 90 days from receiving notification to submit observations or to propose a duly substantiated alternative flat-rate.

The Agency or the Commission may then start a reduction procedure in accordance with Article 43, on the basis of:

- the proposed alternative flat-rate, if accepted

or

- the initially notified flat-rate, if it does not receive any observations or does not accept the observations or the proposed alternative flat-rate.

22.6 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, any insufficiently substantiated costs will be ineligible (see Article 6) and will be rejected (see Article 42).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 23 — EVALUATION OF THE IMPACT OF THE ACTION

23.1 Right to evaluate the impact of the action

The Agency or the Commission may carry out interim and final evaluations of the impact of the action measured against the objective of the EU programme.

Evaluations may be started during implementation of the action and up to five years after the payment of the balance. The evaluation is considered to start on the date of the formal notification to the coordinator or beneficiaries.

The Agency or the Commission may make these evaluations directly (using its own staff) or indirectly (using external bodies or persons it has authorised to do so).

The coordinator or beneficiaries must provide any information relevant to evaluate the impact of the action, including information in electronic format.

23.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the Agency may apply the measures described in Chapter 6.

SECTION 3 RIGHTS AND OBLIGATIONS RELATED TO BACKGROUND AND RESULTS

SUBSECTION 1 GENERAL

ARTICLE 23a — MANAGEMENT OF INTELLECTUAL PROPERTY

23a.1 Obligation to take measures to implement the Commission Recommendation on the management of intellectual property in knowledge transfer activities

Beneficiaries that are universities or other public research organisations must take measures to implement the principles set out in Points 1 and 2 of the Code of Practice annexed to the Commission Recommendation on the management of intellectual property in knowledge transfer activities¹⁷.

¹⁷ Commission Recommendation C(2008) 1329 of 10.4.2008 on the management of intellectual property in knowledge transfer activities and the Code of Practice for universities and other public research institutions attached to this recommendation.

This does not change the obligations set out in Subsections 2 and 3 of this Section.

The beneficiaries must ensure that researchers and third parties involved in the action are aware of them.

23a.2 Consequences of non-compliance

If a beneficiary breaches its obligations under this Article, the Agency may apply any of the measures described in Chapter 6.

SUBSECTION 2 RIGHTS AND OBLIGATIONS RELATED TO BACKGROUND

ARTICLE 24 — AGREEMENT ON BACKGROUND

24.1 Agreement on background

The beneficiaries must identify and agree (in writing) on the background for the action (**‘agreement on background’**).

‘Background’ means any data, know-how or information — whatever its form or nature (tangible or intangible), including any rights such as intellectual property rights — that:

- (a) is held by the beneficiaries before they acceded to the Agreement, and
- (b) is needed to implement the action or exploit the results.

24.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 25 — ACCESS RIGHTS TO BACKGROUND

25.1 Exercise of access rights — Waiving of access rights — No sub-licensing

To exercise access rights, this must first be requested in writing (**‘request for access’**).

‘Access rights’ means rights to use results or background under the terms and conditions laid down in this Agreement.

Waivers of access rights are not valid unless in writing.

Unless agreed otherwise, access rights do not include the right to sub-license.

25.2 Access rights for other beneficiaries, for implementing their own tasks under the action

The beneficiaries must give each other access — on a royalty-free basis — to background needed to implement their own tasks under the action, unless the beneficiary that holds the background has — before acceding to the Agreement —:

- (a) informed the other beneficiaries that access to its background is subject to legal restrictions or limits, including those imposed by the rights of third parties (including personnel), or
- (b) agreed with the other beneficiaries that access would not be on a royalty-free basis.

25.3 Access rights for other beneficiaries, for exploiting their own results

The beneficiaries must give each other access — under fair and reasonable conditions — to background needed for exploiting their own results, unless the beneficiary that holds the background has — before acceding to the Agreement — informed the other beneficiaries that access to its background is subject to legal restrictions or limits, including those imposed by the rights of third parties (including personnel).

‘**Fair and reasonable conditions**’ means appropriate conditions, including possible financial terms or royalty-free conditions, taking into account the specific circumstances of the request for access, for example the actual or potential value of the results or background to which access is requested and/or the scope, duration or other characteristics of the exploitation envisaged.

Requests for access may be made — unless agreed otherwise — up to one year after the period set out in Article 3.

25.4 Access rights for affiliated entities

Unless otherwise agreed in the consortium agreement, access to background must also be given — under fair and reasonable conditions (see above; Article 25.3) and unless it is subject to legal restrictions or limits, including those imposed by the rights of third parties (including personnel) — to affiliated entities¹⁸ established in an EU Member State or ‘**associated country**’¹⁹, if this is needed to exploit the results generated by the beneficiaries to which they are affiliated.

Unless agreed otherwise (see above; Article 25.1), the affiliated entity concerned must make the request directly to the beneficiary that holds the background.

Requests for access may be made — unless agreed otherwise — up to one year after the period set out in Article 3.

¹⁸ For the definition see Article 2.1(2) Rules for Participation Regulation No 1290/2013: ‘**affiliated entity**’ means any legal entity that is:

- under the direct or indirect control of a participant, or
- under the same direct or indirect control as the participant, or
- directly or indirectly controlling a participant.

‘Control’ may take any of the following forms:

- (a) the direct or indirect holding of more than 50% of the nominal value of the issued share capital in the legal entity concerned, or of a majority of the voting rights of the shareholders or associates of that entity;
- (b) the direct or indirect holding, in fact or in law, of decision-making powers in the legal entity concerned.

However the following relationships between legal entities shall not in themselves be deemed to constitute controlling relationships:

- (a) the same public investment corporation, institutional investor or venture-capital company has a direct or indirect holding of more than 50% of the nominal value of the issued share capital or a majority of voting rights of the shareholders or associates;
- (b) the legal entities concerned are owned or supervised by the same public body.

¹⁹ For the definition, see Article 2.1(3) of the Rules for Participation Regulation No 1290/2013: ‘**associated country**’ means a third country which is party to an international agreement with the Union, as identified in Article 7 of Horizon 2020 Framework Programme Regulation No 1291/2013. Article 7 sets out the conditions for association of non-EU countries to Horizon 2020.

25.5 Access rights for third parties

Not applicable

25.6 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

SUBSECTION 3 RIGHTS AND OBLIGATIONS RELATED TO RESULTS

ARTICLE 26 — OWNERSHIP OF RESULTS

26.1 Ownership by the beneficiary that generates the results

Results are owned by the beneficiary that generates them.

‘**Results**’ means any (tangible or intangible) output of the action such as data, knowledge or information — whatever its form or nature, whether it can be protected or not — that is generated in the action, as well as any rights attached to it, including intellectual property rights.

26.2 Joint ownership by several beneficiaries

Two or more beneficiaries own results jointly if:

- (a) they have jointly generated them and
- (b) it is not possible to:
 - (i) establish the respective contribution of each beneficiary, or
 - (ii) separate them for the purpose of applying for, obtaining or maintaining their protection (see Article 27).

The joint owners must agree (in writing) on the allocation and terms of exercise of their joint ownership (‘**joint ownership agreement**’), to ensure compliance with their obligations under this Agreement.

Unless otherwise agreed in the joint ownership agreement, each joint owner may grant non-exclusive licences to third parties to exploit jointly-owned results (without any right to sub-license), if the other joint owners are given:

- (a) at least 45 days advance notice and
- (b) fair and reasonable compensation.

Once the results have been generated, joint owners may agree (in writing) to apply another regime than joint ownership (such as, for instance, transfer to a single owner (see Article 30) with access rights for the others).

26.3 Rights of third parties (including personnel)

If third parties (including personnel) may claim rights to the results, the beneficiary concerned must ensure that it complies with its obligations under the Agreement.

If a third party generates results, the beneficiary concerned must obtain all necessary rights (transfer, licences or other) from the third party, in order to be able to respect its obligations as if those results were generated by the beneficiary itself.

If obtaining the rights is impossible, the beneficiary must refrain from using the third party to generate the results.

26.4 Agency ownership, to protect results

26.4.1 The Agency may — with the consent of the beneficiary concerned — assume ownership of results to protect them, if a beneficiary intends — up to four years after the period set out in Article 3 — to disseminate its results without protecting them, except in any of the following cases:

- (a) the lack of protection is because protecting the results is not possible, reasonable or justified (given the circumstances);
- (b) the lack of protection is because there is a lack of potential for commercial or industrial exploitation, or
- (c) the beneficiary intends to transfer the results to another beneficiary or third party established in an EU Member State or associated country, which will protect them.

Before the results are disseminated and unless any of the cases above under Points (a), (b) or (c) applies, the beneficiary must formally notify the Agency and at the same time inform it of any reasons for refusing consent. The beneficiary may refuse consent only if it can show that its legitimate interests would suffer significant harm.

If the Agency decides to assume ownership, it will formally notify the beneficiary concerned within 45 days of receiving notification.

No dissemination relating to these results may take place before the end of this period or, if the Agency takes a positive decision, until it has taken the necessary steps to protect the results.

26.4.2 The Agency may — with the consent of the beneficiary concerned — assume ownership of results to protect them, if a beneficiary intends — up to four years after the period set out in Article 3 — to stop protecting them or not to seek an extension of protection, except in any of the following cases:

- (a) the protection is stopped because of a lack of potential for commercial or industrial exploitation;
- (b) an extension would not be justified given the circumstances.

A beneficiary that intends to stop protecting results or not seek an extension must — unless any of the cases above under Points (a) or (b) applies — formally notify the Agency at least 60 days before the protection lapses or its extension is no longer possible and at the same time inform it of any reasons for refusing consent. The beneficiary may refuse consent only if it can show that its legitimate interests would suffer significant harm.

If the Agency decides to assume ownership, it will formally notify the beneficiary concerned within 45 days of receiving notification.

26.5 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such breaches may also lead to the any of the other measures described in Chapter 6.

ARTICLE 27 — PROTECTION OF RESULTS — VISIBILITY OF EU FUNDING

27.1 Obligation to protect the results

Each beneficiary must examine the possibility of protecting its results and must adequately protect them — for an appropriate period and with appropriate territorial coverage — if:

- (a) the results can reasonably be expected to be commercially or industrially exploited and
- (b) protecting them is possible, reasonable and justified (given the circumstances).

When deciding on protection, the beneficiary must consider its own legitimate interests and the legitimate interests (especially commercial) of the other beneficiaries.

27.2 Agency ownership, to protect the results

If a beneficiary intends not to protect its results, to stop protecting them or not seek an extension of protection, the Agency may — under certain conditions (see Article 26.4) — assume ownership to ensure their (continued) protection.

27.3 Information on EU funding

Applications for protection of results (including patent applications) filed by or on behalf of a beneficiary must — unless the Agency requests or agrees otherwise or unless it is impossible — include the following:

“The project leading to this application has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 774234”.

27.4 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such a breach may also lead to any of the other measures described in Chapter 6.

ARTICLE 28 — EXPLOITATION OF RESULTS

28.1 Obligation to exploit the results

Each beneficiary must — up to four years after the period set out in Article 3 — take measures aiming to ensure ‘**exploitation**’ of its results (either directly or indirectly, in particular through transfer or licensing; see Article 30) by:

- (a) using them in further research activities (outside the action);

- (b) developing, creating or marketing a product or process;
- (c) creating and providing a service, or
- (d) using them in standardisation activities.

This does not change the security obligations in Article 37, which still apply.

28.2 Results that could contribute to European or international standards — Information on EU funding

If results are incorporated in a standard, the beneficiary concerned must — unless the Agency requests or agrees otherwise or unless it is impossible — ask the standardisation body to include the following statement in (information related to) the standard:

“Results incorporated in this standard received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 774234”.

28.3 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced in accordance with Article 43.

Such a breach may also lead to any of the other measures described in Chapter 6.

ARTICLE 29 — DISSEMINATION OF RESULTS — OPEN ACCESS — VISIBILITY OF EU FUNDING

29.1 Obligation to disseminate results

Unless it goes against their legitimate interests, each beneficiary must — as soon as possible — ‘disseminate’ its results by disclosing them to the public by appropriate means (other than those resulting from protecting or exploiting the results), including in scientific publications (in any medium).

This does not change the obligation to protect results in Article 27, the confidentiality obligations in Article 36, the security obligations in Article 37 or the obligations to protect personal data in Article 39, all of which still apply.

A beneficiary that intends to disseminate its results must give advance notice to the other beneficiaries of — unless agreed otherwise — at least 45 days, together with sufficient information on the results it will disseminate.

Any other beneficiary may object within — unless agreed otherwise — 30 days of receiving notification, if it can show that its legitimate interests in relation to the results or background would be significantly harmed. In such cases, the dissemination may not take place unless appropriate steps are taken to safeguard these legitimate interests.

If a beneficiary intends not to protect its results, it may — under certain conditions (see Article 26.4.1) — need to formally notify the Agency before dissemination takes place.

29.2 Open access to scientific publications

Each beneficiary must ensure open access (free of charge online access for any user) to all peer-reviewed scientific publications relating to its results.

In particular, it must:

- (a) as soon as possible and at the latest on publication, deposit a machine-readable electronic copy of the published version or final peer-reviewed manuscript accepted for publication in a repository for scientific publications;

Moreover, the beneficiary must aim to deposit at the same time the research data needed to validate the results presented in the deposited scientific publications.

- (b) ensure open access to the deposited publication — via the repository — at the latest:
 - (i) on publication, if an electronic version is available for free via the publisher, or
 - (ii) within six months of publication (twelve months for publications in the social sciences and humanities) in any other case.
- (c) ensure open access — via the repository — to the bibliographic metadata that identify the deposited publication.

The bibliographic metadata must be in a standard format and must include all of the following:

- the terms “European Union (EU)” and “Horizon 2020”;
- the name of the action, acronym and grant number;
- the publication date, and length of embargo period if applicable, and
- a persistent identifier.

29.3 Open access to research data

Regarding the digital research data generated in the action (**‘data’**), the beneficiaries must:

- (a) deposit in a research data repository and take measures to make it possible for third parties to access, mine, exploit, reproduce and disseminate — free of charge for any user — the following:
 - (i) the data, including associated metadata, needed to validate the results presented in scientific publications as soon as possible;
 - (ii) other data, including associated metadata, as specified and within the deadlines laid down in the 'data management plan' (see Annex 1);
- (b) provide information — via the repository — about tools and instruments at the disposal of the beneficiaries and necessary for validating the results (and — where possible — provide the tools and instruments themselves).

This does not change the obligation to protect results in Article 27, the confidentiality obligations in Article 36, the security obligations in Article 37 or the obligations to protect personal data in Article 39, all of which still apply.

As an exception, the beneficiaries do not have to ensure open access to specific parts of their research data if the achievement of the action's main objective, as described in Annex 1, would be jeopardised by making those specific parts of the research data openly accessible. In this case, the data management plan must contain the reasons for not giving access.

29.4 Information on EU funding — Obligation and right to use the EU emblem

Unless the Agency requests or agrees otherwise or unless it is impossible, any dissemination of results (in any form, including electronic) must:

(a) display the EU emblem and

(b) include the following text:

“This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 774234”.

When displayed together with another logo, the EU emblem must have appropriate prominence.

For the purposes of their obligations under this Article, the beneficiaries may use the EU emblem without first obtaining approval from the Agency.

This does not however give them the right to exclusive use.

Moreover, they may not appropriate the EU emblem or any similar trademark or logo, either by registration or by any other means.

29.5 Disclaimer excluding Agency responsibility

Any dissemination of results must indicate that it reflects only the author's view and that the Agency is not responsible for any use that may be made of the information it contains.

29.6 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such a breach may also lead to any of the other measures described in Chapter 6.

ARTICLE 30 — TRANSFER AND LICENSING OF RESULTS

30.1 Transfer of ownership

Each beneficiary may transfer ownership of its results.

It must however ensure that its obligations under Articles 26.2, 26.4, 27, 28, 29, 30 and 31 also apply to the new owner and that this owner has the obligation to pass them on in any subsequent transfer.

This does not change the security obligations in Article 37, which still apply.

Unless agreed otherwise (in writing) for specifically-identified third parties or unless impossible under applicable EU and national laws on mergers and acquisitions, a beneficiary that intends to transfer ownership of results must give at least 45 days advance notice (or less if agreed in writing) to the

other beneficiaries that still have (or still may request) access rights to the results. This notification must include sufficient information on the new owner to enable any beneficiary concerned to assess the effects on its access rights.

Unless agreed otherwise (in writing) for specifically-identified third parties, any other beneficiary may object within 30 days of receiving notification (or less if agreed in writing), if it can show that the transfer would adversely affect its access rights. In this case, the transfer may not take place until agreement has been reached between the beneficiaries concerned.

30.2 Granting licenses

Each beneficiary may grant licences to its results (or otherwise give the right to exploit them), if:

- (a) this does not impede the access rights under Article 31 and
- (b) not applicable.

In addition to Points (a) and (b), exclusive licences for results may be granted only if all the other beneficiaries concerned have waived their access rights (see Article 31.1).

This does not change the dissemination obligations in Article 29 or security obligations in Article 37, which still apply.

30.3 Agency right to object to transfers or licensing

The Agency may — up to four years after the period set out in Article 3 — object to a transfer of ownership or the exclusive licensing of results, if:

- (a) it is to a third party established in a non-EU country not associated with Horizon 2020 and
- (b) the Agency considers that the transfer or licence is not in line with EU interests regarding competitiveness or is inconsistent with ethical principles or security considerations.

A beneficiary that intends to transfer ownership or grant an exclusive licence must formally notify the Agency before the intended transfer or licensing takes place and:

- identify the specific results concerned;
- describe in detail the new owner or licensee and the planned or potential exploitation of the results, and
- include a reasoned assessment of the likely impact of the transfer or licence on EU competitiveness and its consistency with ethical principles and security considerations.

The Agency may request additional information.

If the Agency decides to object to a transfer or exclusive licence, it must formally notify the beneficiary concerned within 60 days of receiving notification (or any additional information it has requested).

No transfer or licensing may take place in the following cases:

- pending the Agency decision, within the period set out above;

- if the Agency objects;
- until the conditions are complied with, if the Agency objection comes with conditions.

30.4 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such a breach may also lead to any of the other measures described in Chapter 6.

ARTICLE 31 — ACCESS RIGHTS TO RESULTS

31.1 Exercise of access rights — Waiving of access rights — No sub-licensing

The conditions set out in Article 25.1 apply.

The obligations set out in this Article do not change the security obligations in Article 37, which still apply.

31.2 Access rights for other beneficiaries, for implementing their own tasks under the action

The beneficiaries must give each other access — on a royalty-free basis — to results needed for implementing their own tasks under the action.

31.3 Access rights for other beneficiaries, for exploiting their own results

The beneficiaries must give each other — under fair and reasonable conditions (see Article 25.3) — access to results needed for exploiting their own results.

Requests for access may be made — unless agreed otherwise — up to one year after the period set out in Article 3.

31.4 Access rights of affiliated entities

Unless agreed otherwise in the consortium agreement, access to results must also be given — under fair and reasonable conditions (Article 25.3) — to affiliated entities established in an EU Member State or associated country, if this is needed for those entities to exploit the results generated by the beneficiaries to which they are affiliated.

Unless agreed otherwise (see above; Article 31.1), the affiliated entity concerned must make any such request directly to the beneficiary that owns the results.

Requests for access may be made — unless agreed otherwise — up to one year after the period set out in Article 3.

31.5 Access rights for the EU institutions, bodies, offices or agencies and EU Member States

The beneficiaries must give access to their results — on a royalty-free basis — to EU institutions, bodies, offices or agencies, for developing, implementing or monitoring EU policies or programmes.

Such access rights are limited to non-commercial and non-competitive use.

This does not change the right to use any material, document or information received from the beneficiaries for communication and publicising activities (see Article 38.2).

31.6 Access rights for third parties

Not applicable

31.7 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

SECTION 4 OTHER RIGHTS AND OBLIGATIONS

ARTICLE 32 — RECRUITMENT AND WORKING CONDITIONS FOR RESEARCHERS

32.1 Obligation to take measures to implement the European Charter for Researchers and Code of Conduct for the Recruitment of Researchers

The beneficiaries must take all measures to implement the principles set out in the Commission Recommendation on the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers²¹, in particular regarding:

- working conditions;
- transparent recruitment processes based on merit, and
- career development.

The beneficiaries must ensure that researchers and third parties involved in the action are aware of them.

32.2 Consequences of non-compliance

If a beneficiary breaches its obligations under this Article, the Agency may apply any of the measures described in Chapter 6.

ARTICLE 33 — GENDER EQUALITY

33.1 Obligation to aim for gender equality

The beneficiaries must take all measures to promote equal opportunities between men and women in the implementation of the action. They must aim, to the extent possible, for a gender balance at all levels of personnel assigned to the action, including at supervisory and managerial level.

33.2 Consequences of non-compliance

²¹ Commission Recommendation 2005/251/EC of 11 March 2005 on the European Charter for Researchers and on a Code of Conduct for the Recruitment of Researchers (OJ L 75, 22.3.2005, p. 67).

If a beneficiary breaches its obligations under this Article, the Agency may apply any of the measures described in Chapter 6.

ARTICLE 34 — ETHICS AND RESEARCH INTEGRITY

34.1 Obligation to comply with ethical and research integrity principles

The beneficiaries must carry out the action in compliance with:

- (a) ethical principles (including the highest standards of research integrity)
- and
- (b) applicable international, EU and national law.

Funding will not be granted for activities carried out outside the EU if they are prohibited in all Member States or for activities which destroy human embryos (for example, for obtaining stem cells).

The beneficiaries must ensure that the activities under the action have an exclusive focus on civil applications.

The beneficiaries must ensure that the activities under the action do not:

- (a) aim at human cloning for reproductive purposes;
- (b) intend to modify the genetic heritage of human beings which could make such changes heritable (with the exception of research relating to cancer treatment of the gonads, which may be financed), or
- (c) intend to create human embryos solely for the purpose of research or for the purpose of stem cell procurement, including by means of somatic cell nuclear transfer.

The beneficiaries must respect the highest standards of research integrity — as set out, for instance, in the European Code of Conduct for Research Integrity²².

This implies notably compliance with the following essential principles:

- honesty;
- reliability;
- objectivity;
- impartiality;
- open communication;
- duty of care;

²² The European Code of Conduct for Research Integrity of ALLEA (All European Academies) and ESF (European Science Foundation) of March 2011.

http://ec.europa.eu/research/participants/data/ref/h2020/other/hi/h2020-ethics_code-of-conduct_en.pdf

- fairness and
- responsibility for future science generations.

This means that beneficiaries must ensure that persons carrying out research tasks:

- present their research goals and intentions in an honest and transparent manner;
- design their research carefully and conduct it in a reliable fashion, taking its impact on society into account;
- use techniques and methodologies (including for data collection and management) that are appropriate for the field(s) concerned;
- exercise due care for the subjects of research — be they human beings, animals, the environment or cultural objects;
- ensure objectivity, accuracy and impartiality when disseminating the results;
- allow — in addition to the open access obligations under Article 29.3 as much as possible and taking into account the legitimate interest of the beneficiaries — access to research data, in order to enable research to be reproduced;
- make the necessary references to their work and that of other researchers;
- refrain from practicing any form of plagiarism, data falsification or fabrication;
- avoid double funding, conflicts of interest and misrepresentation of credentials or other research misconduct.

34.2 Activities raising ethical issues

Activities raising ethical issues must comply with the ‘**ethics requirements**’ set out as deliverables in Annex 1.

Before the beginning of an activity raising an ethical issue, each beneficiary must have obtained:

- (a) any ethics committee opinion required under national law and
- (b) any notification or authorisation for activities raising ethical issues required under national and/or European law

needed for implementing the action tasks in question.

The documents must be kept on file and be submitted upon request by the coordinator to the Agency (see Article 52). If they are not in English, they must be submitted together with an English summary, which shows that the action tasks in question are covered and includes the conclusions of the committee or authority concerned (if available).

34.3 Activities involving human embryos or human embryonic stem cells

Activities involving research on human embryos or human embryonic stem cells may be carried out, in addition to Article 34.1, only if:

- they are set out in Annex 1 or
- the coordinator has obtained explicit approval (in writing) from the Agency (see Article 52).

34.4 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43) and the Agreement or participation of the beneficiary may be terminated (see Article 50).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 35 — CONFLICT OF INTERESTS

35.1 Obligation to avoid a conflict of interests

The beneficiaries must take all measures to prevent any situation where the impartial and objective implementation of the action is compromised for reasons involving economic interest, political or national affinity, family or emotional ties or any other shared interest (**‘conflict of interests’**).

They must formally notify to the Agency without delay any situation constituting or likely to lead to a conflict of interests and immediately take all the necessary steps to rectify this situation.

The Agency may verify that the measures taken are appropriate and may require additional measures to be taken by a specified deadline.

35.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43) and the Agreement or participation of the beneficiary may be terminated (see Article 50).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 36 — CONFIDENTIALITY

36.1 General obligation to maintain confidentiality

During implementation of the action and for four years after the period set out in Article 3, the parties must keep confidential any data, documents or other material (in any form) that is identified as confidential at the time it is disclosed (**‘confidential information’**).

If a beneficiary requests, the Agency may agree to keep such information confidential for an additional period beyond the initial four years.

If information has been identified as confidential only orally, it will be considered to be confidential only if this is confirmed in writing within 15 days of the oral disclosure.

Unless otherwise agreed between the parties, they may use confidential information only to implement the Agreement.

The beneficiaries may disclose confidential information to their personnel or third parties involved in the action only if they:

- (a) need to know to implement the Agreement and
- (b) are bound by an obligation of confidentiality.

This does not change the security obligations in Article 37, which still apply.

The Agency may disclose confidential information to its staff, other EU institutions and bodies. It may disclose confidential information to third parties, if:

- (a) this is necessary to implement the Agreement or safeguard the EU's financial interests and
- (b) the recipients of the information are bound by an obligation of confidentiality.

Under the conditions set out in Article 4 of the Rules for Participation Regulation No 1290/2013²³, the Commission must moreover make available information on the results to other EU institutions, bodies, offices or agencies as well as Member States or associated countries.

The confidentiality obligations no longer apply if:

- (a) the disclosing party agrees to release the other party;
- (b) the information was already known by the recipient or is given to him without obligation of confidentiality by a third party that was not bound by any obligation of confidentiality;
- (c) the recipient proves that the information was developed without the use of confidential information;
- (d) the information becomes generally and publicly available, without breaching any confidentiality obligation, or
- (e) the disclosure of the information is required by EU or national law.

36.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 37 — SECURITY-RELATED OBLIGATIONS

37.1 Results with a security recommendation

Not applicable

37.2 Classified information

Not applicable

²³ Regulation (EU) No 1290/2013 of the European Parliament and of the Council of 11 December 2013 laying down the rules for participation and dissemination in "Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020)" (OJ L 347, 20.12.2013 p.81).

37.3 Activities involving dual-use goods or dangerous materials and substances

Not applicable

37.4 Consequences of non-compliance

Not applicable

ARTICLE 38 — PROMOTING THE ACTION — VISIBILITY OF EU FUNDING

38.1 Communication activities by beneficiaries

38.1.1 Obligation to promote the action and its results

The beneficiaries must promote the action and its results, by providing targeted information to multiple audiences (including the media and the public) in a strategic and effective manner.

This does not change the dissemination obligations in Article 29, the confidentiality obligations in Article 36 or the security obligations in Article 37, all of which still apply.

Before engaging in a communication activity expected to have a major media impact, the beneficiaries must inform the Agency (see Article 52).

38.1.2 Information on EU funding — Obligation and right to use the EU emblem

Unless the Agency requests or agrees otherwise or unless it is impossible, any communication activity related to the action (including in electronic form, via social media, etc.) and any infrastructure, equipment and major results funded by the grant must:

(a) display the EU emblem and

(b) include the following text:

For communication activities:

“This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 774234”.

For infrastructure, equipment and major results:

“This [infrastructure][equipment][insert type of result] is part of a project that has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 774234”.

When displayed together with another logo, the EU emblem must have appropriate prominence.

For the purposes of their obligations under this Article, the beneficiaries may use the EU emblem without first obtaining approval from the Agency.

This does not, however, give them the right to exclusive use.

Moreover, they may not appropriate the EU emblem or any similar trademark or logo, either by registration or by any other means.

38.1.3 Disclaimer excluding Agency and Commission responsibility

Any communication activity related to the action must indicate that it reflects only the author's view and that the Agency and the Commission are not responsible for any use that may be made of the information it contains.

38.2 Communication activities by the Agency and the Commission

38.2.1 Right to use beneficiaries' materials, documents or information

The Agency and the Commission may use, for its communication and publicising activities, information relating to the action, documents notably summaries for publication and public deliverables as well as any other material, such as pictures or audio-visual material received from any beneficiary (including in electronic form).

This does not change the confidentiality obligations in Article 36 and the security obligations in Article 37, all of which still apply.

If the Agency's or the Commission's use of these materials, documents or information would risk compromising legitimate interests, the beneficiary concerned may request the Agency or the Commission not to use it (see Article 52).

The right to use a beneficiary's materials, documents and information includes:

- (a) **use for its own purposes** (in particular, making them available to persons working for the Agency, the Commission or any other EU institution, body, office or agency or body or institutions in EU Member States; and copying or reproducing them in whole or in part, in unlimited numbers);
- (b) **distribution to the public** (in particular, publication as hard copies and in electronic or digital format, publication on the internet, as a downloadable or non-downloadable file, broadcasting by any channel, public display or presentation, communicating through press information services, or inclusion in widely accessible databases or indexes);
- (c) **editing or redrafting** for communication and publicising activities (including shortening, summarising, inserting other elements (such as meta-data, legends, other graphic, visual, audio or text elements), extracting parts (e.g. audio or video files), dividing into parts, use in a compilation);
- (d) **translation**;
- (e) **giving access in response to individual requests** under Regulation No 1049/2001²⁵, without the right to reproduce or exploit;
- (f) **storage** in paper, electronic or other form;
- (g) **archiving**, in line with applicable document-management rules, and
- (h) the right to authorise **third parties** to act on its behalf or sub-license the modes of use set out in Points (b), (c), (d) and (f) to third parties if needed for the communication and publicising activities of the Agency or the Commission.

²⁵ Regulation (EC) No 1049/2001 of the European Parliament and of the Council of 30 May 2001 regarding public access to European Parliament, Council and Commission documents, OJ L 145, 31.5.2001, p. 43.

If the right of use is subject to rights of a third party (including personnel of the beneficiary), the beneficiary must ensure that it complies with its obligations under this Agreement (in particular, by obtaining the necessary approval from the third parties concerned).

Where applicable (and if provided by the beneficiaries), the Agency or the Commission will insert the following information:

“© – [year] – [name of the copyright owner]. All rights reserved. Licensed to the Research Executive Agency (REA) and the European Union (EU) under conditions.”

38.3 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 39 — PROCESSING OF PERSONAL DATA

39.1 Processing of personal data by the Agency and the Commission

Any personal data under the Agreement will be processed by the Agency or the Commission under Regulation No 45/2001²⁶ and according to the ‘notifications of the processing operations’ to the Data Protection Officer (DPO) of the Agency or the Commission (publicly accessible in the DPO register).

Such data will be processed by the ‘**data controller**’ of the Agency or the Commission for the purposes of implementing, managing and monitoring the Agreement or protecting the financial interests of the EU or Euratom (including checks, reviews, audits and investigations; see Article 22).

The persons whose personal data are processed have the right to access and correct their own personal data. For this purpose, they must send any queries about the processing of their personal data to the data controller, via the contact point indicated in the privacy statement(s) that are published on the Agency and the Commission websites.

They also have the right to have recourse at any time to the European Data Protection Supervisor (EDPS).

39.2 Processing of personal data by the beneficiaries

The beneficiaries must process personal data under the Agreement in compliance with applicable EU and national law on data protection (including authorisations or notification requirements).

The beneficiaries may grant their personnel access only to data that is strictly necessary for implementing, managing and monitoring the Agreement.

The beneficiaries must inform the personnel whose personal data are collected and processed by the Agency or the Commission. For this purpose, they must provide them with the privacy statement(s) (see above), before transmitting their data to the Agency or the Commission.

²⁶ Regulation (EC) No 45/2001 of the European Parliament and of the Council of 18 December 2000 on the protection of individuals with regard to the processing of personal data by the Community institutions and bodies and on the free movement of such data (OJ L 8, 12.01.2001, p. 1).

39.3 Consequences of non-compliance

If a beneficiary breaches any of its obligations under Article 39.2, the Agency may apply any of the measures described in Chapter 6.

ARTICLE 40 — ASSIGNMENTS OF CLAIMS FOR PAYMENT AGAINST THE AGENCY

The beneficiaries may not assign any of their claims for payment against the Agency to any third party, except if approved by the Agency on the basis of a reasoned, written request by the coordinator (on behalf of the beneficiary concerned).

If the Agency has not accepted the assignment or the terms of it are not observed, the assignment will have no effect on it.

In no circumstances will an assignment release the beneficiaries from their obligations towards the Agency.

CHAPTER 5 DIVISION OF BENEFICIARIES' ROLES AND RESPONSIBILITIES **— RELATIONSHIP WITH COMPLEMENTARY BENEFICIARIES —** **RELATIONSHIP WITH PARTNERS OF A JOINT ACTION**

ARTICLE 41 — DIVISION OF BENEFICIARIES' ROLES AND RESPONSIBILITIES **— RELATIONSHIP WITH COMPLEMENTARY BENEFICIARIES —** **RELATIONSHIP WITH PARTNERS OF A JOINT ACTION**

41.1 Roles and responsibility towards the Agency

The beneficiaries have full responsibility for implementing the action and complying with the Agreement.

The beneficiaries are jointly and severally liable for the **technical implementation** of the action as described in Annex 1. If a beneficiary fails to implement its part of the action, the other beneficiaries become responsible for implementing this part (without being entitled to any additional EU funding for doing so), unless the Agency expressly relieves them of this obligation.

The **financial responsibility** of each beneficiary is governed by Articles 44, 45 and 46.

41.2 Internal division of roles and responsibilities

The internal roles and responsibilities of the beneficiaries are divided as follows:

(a) Each **beneficiary** must:

- (i) keep information stored in the Participant Portal Beneficiary Register (via the electronic exchange system) up to date (see Article 17);
- (ii) inform the coordinator immediately of any events or circumstances likely to affect significantly or delay the implementation of the action (see Article 17);
- (iii) submit to the coordinator in good time:

- individual financial statements for itself and, if required, certificates on the financial statements (see Article 20);
- the data needed to draw up the technical reports (see Article 20);
- ethics committee opinions and notifications or authorisations for activities raising ethical issues (see Article 34);
- any other documents or information required by the Agency or the Commission under the Agreement, unless the Agreement requires the beneficiary to submit this information directly to the Agency or the Commission.

(b) The **coordinator** must:

- (i) monitor that the action is implemented properly (see Article 7);
- (ii) act as the intermediary for all communications between the beneficiaries and the Agency (in particular, providing the Agency with the information described in Article 17), unless the Agreement specifies otherwise;
- (iii) request and review any documents or information required by the Agency and verify their completeness and correctness before passing them on to the Agency;
- (iv) submit the deliverables and reports to the Agency (see Articles 19 and 20);
- (v) ensure that all payments are made to the other beneficiaries without unjustified delay (see Article 21);
- (vi) inform the Agency of the amounts paid to each beneficiary, when required under the Agreement (see Articles 44 and 50) or requested by the Agency.

The coordinator may not delegate or subcontract the above-mentioned tasks to any other beneficiary or third party (including linked third parties).

41.3 Internal arrangements between beneficiaries — Consortium agreement

The beneficiaries must have internal arrangements regarding their operation and co-ordination to ensure that the action is implemented properly. These internal arrangements must be set out in a written ‘**consortium agreement**’ between the beneficiaries, which may cover:

- internal organisation of the consortium;
- management of access to the electronic exchange system;
- distribution of EU funding;
- additional rules on rights and obligations related to background and results (including whether access rights remain or not, if a beneficiary is in breach of its obligations) (see Section 3 of Chapter 4);
- settlement of internal disputes;

- liability, indemnification and confidentiality arrangements between the beneficiaries.

The consortium agreement must not contain any provision contrary to the Agreement.

41.4 Relationship with complementary beneficiaries — Collaboration agreement

Not applicable

41.5 Relationship with partners of a joint action — Coordination agreement

Not applicable

CHAPTER 6 REJECTION OF COSTS — REDUCTION OF THE GRANT — RECOVERY — SANCTIONS — DAMAGES — SUSPENSION — TERMINATION — FORCE MAJEURE

SECTION 1 REJECTION OF COSTS — REDUCTION OF THE GRANT — RECOVERY — SANCTIONS

ARTICLE 42 — REJECTION OF INELIGIBLE COSTS

42.1 Conditions

The Agency will — after **termination of the participation of a beneficiary**, at the time of an **interim payment, at the payment of the balance or afterwards** — reject any costs which are ineligible (see Article 6), in particular following checks, reviews, audits or investigations (see Article 22).

The rejection may also be based on the **extension of findings from other grants to this grant** (see Article 22.5.2).

42.2 Ineligible costs to be rejected — Calculation — Procedure

Ineligible costs will be rejected in full.

If the rejection of costs does not lead to a recovery (see Article 44), the Agency will formally notify the coordinator or beneficiary concerned of the rejection of costs, the amounts and the reasons why (if applicable, together with the notification of amounts due; see Article 21.5). The coordinator or beneficiary concerned may — within 30 days of receiving notification — formally notify the Agency of its disagreement and the reasons why.

If the rejection of costs leads to a recovery, the Agency will follow the contradictory procedure with pre-information letter set out in Article 44.

42.3 Effects

If the Agency rejects costs at the time of an **interim payment or the payment of the balance**, it will deduct them from the total eligible costs declared, for the action, in the periodic or final summary financial statement (see Articles 20.3 and 20.4). It will then calculate the interim payment or payment of the balance as set out in Articles 21.3 or 21.4.

If the Agency rejects costs **after termination of the participation of a beneficiary**, it will deduct them from the costs declared by the beneficiary in the termination report and include the rejection in the calculation after termination (see Article 50.2 and 50.3).

If the Agency — **after an interim payment but before the payment of the balance** — rejects costs declared in a periodic summary financial statement, it will deduct them from the total eligible costs declared, for the action, in the next periodic summary financial statement or in the final summary financial statement. It will then calculate the interim payment or payment of the balance as set out in Articles 21.3 or 21.4.

If the Agency rejects costs **after the payment of the balance**, it will deduct the amount rejected from the total eligible costs declared, by the beneficiary, in the final summary financial statement. It will then calculate the revised final grant amount as set out in Article 5.4.

ARTICLE 43 — REDUCTION OF THE GRANT

43.1 Conditions

The Agency may — **after termination of the participation of a beneficiary, at the payment of the balance or afterwards** — reduce the grant amount (see Article 5.1), if :

- (a) a beneficiary (or a natural person who has the power to represent or take decisions on its behalf) has committed:
 - (i) substantial errors, irregularities or fraud or
 - (ii) serious breach of obligations under the Agreement or during the award procedure (including improper implementation of the action, submission of false information, failure to provide required information, breach of ethical principles) or
- (b) a beneficiary (or a natural person who has the power to represent or take decision on its behalf) has committed — in other EU or Euratom grants awarded to it under similar conditions — systemic or recurrent errors, irregularities, fraud or serious breach of obligations that have a material impact on this grant (**extension of findings from other grants to this grant**; see Article 22.5.2).

43.2 Amount to be reduced — Calculation — Procedure

The amount of the reduction will be proportionate to the seriousness of the errors, irregularities or fraud or breach of obligations.

Before reduction of the grant, the Agency will formally notify a ‘**pre-information letter**’ to the coordinator or beneficiary concerned:

- informing it of its intention to reduce the grant, the amount it intends to reduce and the reasons why and
- inviting it to submit observations within 30 days of receiving notification

If the Agency does not receive any observations or decides to pursue reduction despite the observations it has received, it will formally notify **confirmation** of the reduction (if applicable, together with the notification of amounts due; see Article 21).

43.3 Effects

If the Agency reduces the grant **after termination of the participation of a beneficiary**, it will calculate the reduced grant amount for that beneficiary and then determine the amount due to that beneficiary (see Article 50.2 and 50.3).

If the Agency reduces the grant **at the payment of the balance**, it will calculate the reduced grant amount for the action and then determine the amount due as payment of the balance (see Articles 5.3.4 and 21.4).

If the Agency reduces the grant **after the payment of the balance**, it will calculate the revised final grant amount for the beneficiary concerned (see Article 5.4). If the revised final grant amount for the beneficiary concerned is lower than its share of the final grant amount, the Agency will recover the difference (see Article 44).

ARTICLE 44 — RECOVERY OF UNDUE AMOUNTS

44.1 Amount to be recovered — Calculation — Procedure

The Agency will — after **termination of the participation of a beneficiary, at the payment of the balance or afterwards** — claim back any amount that was paid, but is not due under the Agreement.

Each beneficiary's financial responsibility in case of recovery is limited to its own debt, except for the amount retained for the Guarantee Fund (see Article 21.4).

44.1.1 Recovery after termination of a beneficiary's participation

If recovery takes place after termination of a beneficiary's participation (including the coordinator), the Agency will claim back the undue amount from the beneficiary concerned, by formally notifying it a debit note (see Article 50.2 and 50.3). This note will specify the amount to be recovered, the terms and the date for payment.

If payment is not made by the date specified in the debit note, the Agency or the Commission will **recover** the amount:

- (a) by '**offsetting**' it — without the beneficiary's consent — against any amounts owed to the beneficiary concerned by the Agency, the Commission or another executive agency (from the EU or Euratom budget).

In exceptional circumstances, to safeguard the EU's financial interests, the Agency may offset before the payment date specified in the debit note;

- (b) not applicable;

- (c) by **taking legal action** (see Article 57) or by **adopting an enforceable decision** under Article 299 of the Treaty on the Functioning of the EU (TFEU) and Article 79(2) of the Financial regulation No 966/2012.

If payment is not made by the date specified in the debit note, the amount to be recovered (see above) will be increased by **late-payment interest** at the rate set out in Article 21.11, from the day following the payment date in the debit note, up to and including the date the Agency or the Commission receives full payment of the amount.

Partial payments will be first credited against expenses, charges and late-payment interest and then against the principal.

Bank charges incurred in the recovery process will be borne by the beneficiary, unless Directive 2007/64/EC²⁷ applies.

44.1.2 Recovery at payment of the balance

If the payment of the balance takes the form of a recovery (see Article 21.4), the Agency will formally notify a ‘**pre-information letter**’ to the coordinator:

- informing it of its intention to recover, the amount due as the balance and the reasons why;
- specifying that it intends to deduct the amount to be recovered from the amount retained for the Guarantee Fund;
- requesting the coordinator to submit a report on the distribution of payments to the beneficiaries within 30 days of receiving notification, and
- inviting the coordinator to submit observations within 30 days of receiving notification.

If no observations are submitted or the Agency decides to pursue recovery despite the observations it has received, it will **confirm recovery** (together with the notification of amounts due; see Article 21.5) and:

- pay the difference between the amount to be recovered and the amount retained for the Guarantee Fund, **if the difference is positive** or
- formally notify to the coordinator a **debit note** for the difference between the amount to be recovered and the amount retained for the Guarantee Fund, **if the difference is negative**. This note will also specify the terms and the date for payment.

If the coordinator does not repay the Agency by the date in the debit note and has not submitted the report on the distribution of payments: the Agency or the Commission will **recover** the amount set out in the debit note from the coordinator (see below).

If the coordinator does not repay the Agency by the date in the debit note, but has submitted the report on the distribution of payments: the Agency will:

- (a) identify the beneficiaries for which the amount calculated as follows is negative:

$\left\{ \left\{ \left\{ \text{beneficiary's costs declared in the final summary financial statement and approved by the Agency multiplied by the reimbursement rate set out in Article 5.2 for the beneficiary concerned} \right\} \right\}$

divided by

the EU contribution for the action calculated according to Article 5.3.1 }

multiplied by

²⁷ Directive 2007/64/EC of the European Parliament and of the Council of 13 November 2007 on payment services in the internal market amending Directives 97/7/EC, 2002/65/EC, 2005/60/EC and 2006/48/EC and repealing Directive 97/5/EC (OJ L 319, 05.12.2007, p. 1).

the final grant amount (see Article 5.3)},
 minus
 {pre-financing and interim payments received by the beneficiary}.

- (b) formally notify to each beneficiary identified according to point (a) a **debit note** specifying the terms and date for payment. The amount of the debit note is calculated as follows:

{amount calculated according to point (a) for the beneficiary concerned
 divided by
 the sum of the amounts calculated according to point (a) for all the beneficiaries identified according to point (a)}
 multiplied by
 the amount set out in the debit note formally notified to the coordinator}.

If payment is not made by the date specified in the debit note, the Agency will **recover** the amount:

- (a) by ‘**offsetting**’ it — without the beneficiary’s consent — against any amounts owed to the beneficiary concerned by the Agency, the Commission or another executive agency (from the EU or Euratom budget).

In exceptional circumstances, to safeguard the EU’s financial interests, the Agency may offset before the payment date specified in the debit note;

- (b) by **drawing on the Guarantee Fund**. The Agency or the Commission will formally notify the beneficiary concerned the debit note on behalf of the Guarantee Fund and recover the amount:
- (i) not applicable;
 - (ii) by **taking legal action** (see Article 57) or by **adopting an enforceable decision** under Article 299 of the Treaty on the Functioning of the EU (TFEU) and Article 79(2) of the Financial Regulation No 966/2012.

If payment is not made by the date in the debit note, the amount to be recovered (see above) will be increased by **late-payment interest** at the rate set out in Article 21.11, from the day following the payment date in the debit note, up to and including the date the Agency or the Commission receives full payment of the amount.

Partial payments will be first credited against expenses, charges and late-payment interest and then against the principal.

Bank charges incurred in the recovery process will be borne by the beneficiary, unless Directive 2007/64/EC applies.

44.1.3 Recovery of amounts after payment of the balance

If, for a beneficiary, the revised final grant amount (see Article 5.4) is lower than its share of the final grant amount, it must repay the difference to the Agency.

The beneficiary’s share of the final grant amount is calculated as follows:

{ {beneficiary's costs declared in the final summary financial statement and approved by the Agency multiplied by the reimbursement rate set out in Article 5.2 for the beneficiary concerned}

divided by

the EU contribution for the action calculated according to Article 5.3.1 }

multiplied by

the final grant amount (see Article 5.3)}.

If the coordinator has not distributed amounts received (see Article 21.7), the Agency will also recover these amounts.

The Agency will formally notify a **pre-information letter** to the beneficiary concerned:

- informing it of its intention to recover, the due amount and the reasons why and
- inviting it to submit observations within 30 days of receiving notification.

If no observations are submitted or the Agency decides to pursue recovery despite the observations it has received, it will **confirm** the amount to be recovered and formally notify to the beneficiary concerned a **debit note**. This note will also specify the terms and the date for payment.

If payment is not made by the date specified in the debit note, the Agency will **recover** the amount:

- (a) by '**offsetting**' it — without the beneficiary's consent — against any amounts owed to the beneficiary concerned by the Agency, the Commission or another executive agency (from the EU or Euratom budget).

In exceptional circumstances, to safeguard the EU's financial interests, the Agency may offset before the payment date specified in the debit note;

- (b) by **drawing on the Guarantee Fund**. The Agency or the Commission will formally notify the beneficiary concerned the debit note on behalf of the Guarantee Fund and recover the amount:

- (i) not applicable;
- (ii) by **taking legal action** (see Article 57) or by **adopting an enforceable decision** under Article 299 of the Treaty on the Functioning of the EU (TFEU) and Article 79(2) of the Financial Regulation No 966/2012.

If payment is not made by the date in the debit note, the amount to be recovered (see above) will be increased by **late-payment interest** at the rate set out in Article 21.11, from the day following the date for payment in the debit note, up to and including the date the Agency or the Commission receives full payment of the amount.

Partial payments will be first credited against expenses, charges and late-payment interest and then against the principal.

Bank charges incurred in the recovery process will be borne by the beneficiary, unless Directive 2007/64/EC applies.

ARTICLE 45 — ADMINISTRATIVE SANCTIONS

In addition to contractual measures, the Agency or the Commission may also adopt administrative sanctions under Articles 106 and 131(4) of the Financial Regulation No 966/2012 (i.e. exclusion from future procurement contracts, grants and expert contracts and/or financial penalties).

SECTION 2 LIABILITY FOR DAMAGES

ARTICLE 46 — LIABILITY FOR DAMAGES

46.1 Liability of the Agency

The Agency cannot be held liable for any damage caused to the beneficiaries or to third parties as a consequence of implementing the Agreement, including for gross negligence.

The Agency cannot be held liable for any damage caused by any of the beneficiaries or third parties involved in the action, as a consequence of implementing the Agreement.

46.2 Liability of the beneficiaries

Except in case of force majeure (see Article 51), the beneficiaries must compensate the Agency for any damage it sustains as a result of the implementation of the action or because the action was not implemented in full compliance with the Agreement.

SECTION 3 SUSPENSION AND TERMINATION

ARTICLE 47 — SUSPENSION OF PAYMENT DEADLINE

47.1 Conditions

The Agency may — at any moment — suspend the payment deadline (see Article 21.2 to 21.4) if a request for payment (see Article 20) cannot be approved because:

- (a) it does not comply with the provisions of the Agreement (see Article 20);
- (b) the technical or financial reports have not been submitted or are not complete or additional information is needed, or
- (c) there is doubt about the eligibility of the costs declared in the financial statements and additional checks, reviews, audits or investigations are necessary.

47.2 Procedure

The Agency will formally notify the coordinator of the suspension and the reasons why.

The suspension will **take effect** the day notification is sent by the Agency (see Article 52).

If the conditions for suspending the payment deadline are no longer met, the suspension will be **lifted** — and the remaining period will resume.

If the suspension exceeds two months, the coordinator may request the Agency if the suspension will continue.

If the payment deadline has been suspended due to the non-compliance of the technical or financial reports (see Article 20) and the revised report or statement is not submitted or was submitted but is also rejected, the Agency may also terminate the Agreement or the participation of the beneficiary (see Article 50.3.1(l)).

ARTICLE 48 — SUSPENSION OF PAYMENTS

48.1 Conditions

The Agency may — at any moment — suspend payments, in whole or in part and for one or more beneficiaries, if:

- (a) a beneficiary (or a natural person who has the power to represent or take decision on its behalf) has committed or is suspected of having committed:
 - (i) substantial errors, irregularities or fraud or
 - (ii) serious breach of obligations under the Agreement or during the award procedure (including improper implementation of the action, submission of false information, failure to provide required information, breach of ethical principles) or
- (b) a beneficiary (or a natural person who has the power to represent or take decision on its behalf) has committed — in other EU or Euratom grants awarded to it under similar conditions — systemic or recurrent errors, irregularities, fraud or serious breach of obligations that have a material impact on this grant (**extension of findings from other grants to this grant**; see Article 22.5.2).

If payments are suspended for one or more beneficiaries, the Agency will make partial payment(s) for the part(s) not suspended. If suspension concerns the payment of the balance, — once suspension is lifted — the payment or the recovery of the amount(s) concerned will be considered the payment of the balance that closes the action.

48.2 Procedure

Before suspending payments, the Agency will formally notify the coordinator or beneficiary concerned:

- informing it of its intention to suspend payments and the reasons why and
- inviting it to submit observations within 30 days of receiving notification.

If the Agency does not receive observations or decides to pursue the procedure despite the observations it has received, it will formally notify **confirmation** of the suspension. Otherwise, it will formally notify that the suspension procedure is not continued.

The suspension will **take effect** the day the confirmation notification is sent by the Agency.

If the conditions for resuming payments are met, the suspension will be **lifted**. The Agency will formally notify the coordinator or beneficiary concerned.

During the suspension, the periodic report(s) for all reporting periods except the last one (see Article 20.3), must not contain any individual financial statements from the beneficiary concerned.

The coordinator must include them in the next periodic report after the suspension is lifted or — if suspension is not lifted before the end of the action — in the last periodic report.

The beneficiaries may suspend implementation of the action (see Article 49.1) or terminate the Agreement or the participation of the beneficiary concerned (see Article 50.1 and 50.2).

ARTICLE 49 — SUSPENSION OF THE ACTION IMPLEMENTATION

49.1 Suspension of the action implementation, by the beneficiaries

49.1.1 Conditions

The beneficiaries may suspend implementation of the action or any part of it, if exceptional circumstances — in particular *force majeure* (see Article 51) — make implementation impossible or excessively difficult.

49.1.2 Procedure

The coordinator must immediately formally notify to the Agency the suspension (see Article 52), stating:

- the reasons why and
- the expected date of resumption.

The suspension will **take effect** the day this notification is received by the Agency.

Once circumstances allow for implementation to resume, the coordinator must immediately formally notify the Agency and request an **amendment** of the Agreement to set the date on which the action will be resumed, extend the duration of the action and make other changes necessary to adapt the action to the new situation (see Article 55) — unless the Agreement or the participation of a beneficiary has been terminated (see Article 50).

The suspension will be **lifted** with effect from the resumption date set out in the amendment. This date may be before the date on which the amendment enters into force.

Costs incurred during suspension of the action implementation are not eligible (see Article 6).

49.2 Suspension of the action implementation, by the Agency

49.2.1 Conditions

The Agency may suspend implementation of the action or any part of it, if:

- (a) a beneficiary (or a natural person who has the power to represent or take decisions on its behalf) has committed or is suspected of having committed:
 - (i) substantial errors, irregularities or fraud or
 - (ii) serious breach of obligations under the Agreement or during the award procedure (including improper implementation of the action, submission of false declaration, failure to provide required information, breach of ethical principles);

- (b) a beneficiary (or a natural person who has the power to represent or take decisions on its behalf) has committed — in other EU or Euratom grants awarded to it under similar conditions — systemic or recurrent errors, irregularities, fraud or serious breach of obligations that have a material impact on this grant (**extension of findings from other grants to this grant**; see Article 22.5.2), or
- (c) the action is suspected of having lost its scientific or technological relevance.

49.2.2 Procedure

Before suspending implementation of the action, the Agency will formally notify the coordinator or beneficiary concerned:

- informing it of its intention to suspend the implementation and the reasons why and
- inviting it to submit observations within 30 days of receiving notification.

If the Agency does not receive observations or decides to pursue the procedure despite the observations it has received, it will formally notify **confirmation** of the suspension. Otherwise, it will formally notify that the procedure is not continued.

The suspension will **take effect** five days after confirmation notification is received (or on a later date specified in the notification).

It will be **lifted** if the conditions for resuming implementation of the action are met.

The coordinator or beneficiary concerned will be formally notified of the lifting and the Agreement will be **amended** to set the date on which the action will be resumed, extend the duration of the action and make other changes necessary to adapt the action to the new situation (see Article 55) — unless the Agreement has already been terminated (see Article 50).

The suspension will be lifted with effect from the resumption date set out in the amendment. This date may be before the date on which the amendment enters into force.

Costs incurred during suspension are not eligible (see Article 6).

The beneficiaries may not claim damages due to suspension by the Agency (see Article 46).

Suspension of the action implementation does not affect the Agency's right to terminate the Agreement or participation of a beneficiary (see Article 50), reduce the grant or recover amounts unduly paid (see Articles 43 and 44).

ARTICLE 50 — TERMINATION OF THE AGREEMENT OR OF THE PARTICIPATION OF ONE OR MORE BENEFICIARIES

50.1 Termination of the Agreement, by the beneficiaries

50.1.1 Conditions and procedure

The beneficiaries may terminate the Agreement.

The coordinator must formally notify termination to the Agency (see Article 52), stating:

- the reasons why and
- the date the termination will take effect. This date must be after the notification.

If no reasons are given or if the Agency considers the reasons do not justify termination, the Agreement will be considered to have been ‘**terminated improperly**’.

The termination will **take effect** on the day specified in the notification.

50.1.2 Effects

The coordinator must — within 60 days from when termination takes effect — submit:

- (i) a periodic report (for the open reporting period until termination; see Article 20.3) and
- (ii) the final report (see Article 20.4).

If the Agency does not receive the reports within the deadline (see above), only costs which are included in an approved periodic report will be taken into account.

The Agency will **calculate** the final grant amount (see Article 5.3) and the balance (see Article 21.4) on the basis of the reports submitted. Only costs incurred until termination are eligible (see Article 6). Costs relating to contracts due for execution only after termination are not eligible.

Improper termination may lead to a reduction of the grant (see Article 43).

After termination, the beneficiaries’ obligations (in particular Articles 20, 22, 23, Section 3 of Chapter 4, 36, 37, 38, 40, 42, 43 and 44) continue to apply.

50.2 Termination of the participation of one or more beneficiaries, by the beneficiaries

50.2.1 Conditions and procedure

The participation of one or more beneficiaries may be terminated by the coordinator, on request of the beneficiary concerned or on behalf of the other beneficiaries.

The coordinator must formally notify termination to the Agency (see Article 52) and inform the beneficiary concerned.

If the coordinator’s participation is terminated without its agreement, the formal notification must be done by another beneficiary (acting on behalf of the other beneficiaries).

The notification must include:

- the reasons why;
- the opinion of the beneficiary concerned (or proof that this opinion has been requested in writing);
- the date the termination takes effect. This date must be after the notification, and
- a request for amendment (see Article 55), with a proposal for reallocation of the tasks and the estimated budget of the beneficiary concerned (see Annexes 1 and 2) and, if necessary, the

addition of one or more new beneficiaries (see Article 56). If termination takes effect after the period set out in Article 3, no request for amendment must be included unless the beneficiary concerned is the coordinator. In this case, the request for amendment must propose a new coordinator.

If this information is not given or if the Agency considers that the reasons do not justify termination, the participation will be considered to have been **terminated improperly**.

The termination will **take effect** on the day specified in the notification.

50.2.2 Effects

The coordinator must — within 30 days from when termination takes effect — submit:

- (i) a report on the distribution of payments to the beneficiary concerned and
- (ii) if termination takes effect during the period set out in Article 3, a ‘**termination report**’ from the beneficiary concerned, for the open reporting period until termination, containing an overview of the progress of the work, an overview of the use of resources, the individual financial statement and, if applicable, the certificate on the financial statement (see Articles 20.3 and 20.4).

The information in the termination report must also be included in the periodic report for the next reporting period (see Article 20.3).

If the request for amendment is rejected by the Agency, (because it calls into question the decision awarding the grant or breaches the principle of equal treatment of applicants), the Agreement may be terminated according to Article 50.3.1(c).

If the request for amendment is accepted by the Agency, the Agreement is **amended** to introduce the necessary changes (see Article 55).

The Agency will calculate — on the basis of the periodic reports, the termination report and the report on the distribution of payments — **calculate** the amount which is due to the beneficiary and if the (pre-financing and interim) payments received by the beneficiary exceed this amount.

The **amount which is due** is calculated in the following steps:

Step 1 — Application of the reimbursement rate to the eligible costs

The grant amount for the beneficiary is calculated by applying the reimbursement rate(s) to the total eligible costs declared by the beneficiary in the termination report and approved by the Agency.

Only costs incurred by the beneficiary concerned until termination takes effect are eligible (see Article 6). Costs relating to contracts due for execution only after termination are not eligible.

Step 2 — Reduction due to substantial errors, irregularities or fraud or serious breach of obligations

In case of a reduction (see Article 43), the Agency will calculate the reduced grant

amount for the beneficiary by deducting the amount of the reduction (calculated in proportion to the seriousness of the errors, irregularities or fraud or breach of obligations, in accordance with Article 43.2) from the grant amount for the beneficiary.

If the payments received **exceed the amounts due**:

- if termination takes effect during the period set out in Article 3 and the request for amendment is accepted, the beneficiary concerned must repay to the coordinator the amount unduly received. The Agency will formally notify the amount unduly received and request the beneficiary concerned to repay it to the coordinator within 30 days of receiving notification. If it does not repay the coordinator, the Agency will draw upon the Guarantee Fund to pay the coordinator and then notify a **debit note** on behalf of the Guarantee Fund to the beneficiary concerned (see Article 44);
- in all other cases, in particular if termination takes effect after the period set out in Article 3, the Agency will formally notify a **debit note** to the beneficiary concerned. If payment is not made by the date in the debit note, the Guarantee Fund will pay to the Agency the amount due and the Agency will notify a debit note on behalf of the Guarantee Fund to the beneficiary concerned (see Article 44);
- if the beneficiary concerned is the former coordinator, it must repay the new coordinator according to the procedure above, unless:
 - termination takes effect after an interim payment and
 - the former coordinator has not distributed amounts received as pre-financing or interim payments (see Article 21.7).

In this case, the Agency will formally notify a **debit note** to the former coordinator. If payment is not made by the date in the debit note, the Guarantee Fund will pay to the Agency the amount due. The Agency will then pay the new coordinator and notify a debit note on behalf of the Guarantee Fund to the former coordinator (see Article 44).

If the payments received **do not exceed the amounts due**: amounts owed to the beneficiary concerned will be included in the next interim or final payment.

If the Agency does not receive the termination report within the deadline (see above), only costs included in an approved periodic report will be taken into account.

If the Agency does not receive the report on the distribution of payments within the deadline (see above), it will consider that:

- the coordinator did not distribute any payment to the beneficiary concerned and that
- the beneficiary concerned must not repay any amount to the coordinator.

Improper termination may lead to a reduction of the grant (see Article 43) or termination of the Agreement (see Article 50).

After termination, the concerned beneficiary's obligations (in particular Articles 20, 22, 23, Section 3 of Chapter 4, 36, 37, 38, 40, 42, 43 and 44) continue to apply.

50.3 Termination of the Agreement or the participation of one or more beneficiaries, by the Agency

50.3.1 Conditions

The Agency may terminate the Agreement or the participation of one or more beneficiaries, if:

- (a) one or more beneficiaries do not accede to the Agreement (see Article 56);
- (b) a change to their legal, financial, technical, organisational or ownership situation is likely to substantially affect or delay the implementation of the action or calls into question the decision to award the grant;
- (c) following termination of participation for one or more beneficiaries (see above), the necessary changes to the Agreement would call into question the decision awarding the grant or breach the principle of equal treatment of applicants (see Article 55);
- (d) implementation of the action is prevented by force majeure (see Article 51) or suspended by the coordinator (see Article 49.1) and either:
 - (i) resumption is impossible, or
 - (ii) the necessary changes to the Agreement would call into question the decision awarding the grant or breach the principle of equal treatment of applicants;
- (e) a beneficiary is declared bankrupt, being wound up, having its affairs administered by the courts, has entered into an arrangement with creditors, has suspended business activities, or is subject to any other similar proceedings or procedures under national law;
- (f) a beneficiary (or a natural person who has the power to represent or take decisions on its behalf) has been found guilty of professional misconduct, proven by any means;
- (g) a beneficiary does not comply with the applicable national law on taxes and social security;
- (h) the action has lost scientific or technological relevance;
- (i) not applicable;
- (j) not applicable;
- (k) a beneficiary (or a natural person who has the power to represent or take decisions on its behalf) has committed fraud, corruption, or is involved in a criminal organisation, money laundering or any other illegal activity;
- (l) a beneficiary (or a natural person who has the power to represent or take decisions on its behalf) has committed:
 - (i) substantial errors, irregularities or fraud or
 - (ii) serious breach of obligations under the Agreement or during the award procedure (including improper implementation of the action, submission of false information, failure to provide required information, breach of ethical principles);

- (m) a beneficiary (or a natural person who has the power to represent or take decisions on its behalf) has committed — in other EU or Euratom grants awarded to it under similar conditions — systemic or recurrent errors, irregularities, fraud or serious breach of obligations that have a material impact on this grant (**extension of findings from other grants to this grant**; see Article 22.5.2).
- (n) despite a specific request by the Agency, a beneficiary does not request — through the coordinator — an amendment to the Agreement to end the participation of one of its linked third parties that is in one of the situations under points (e), (f), (g), (k), (l) or (m) and to reallocate its tasks.

50.3.2 Procedure

Before terminating the Agreement or participation of one or more beneficiaries, the Agency will formally notify the coordinator or beneficiary concerned:

- informing it of its intention to terminate and the reasons why and
- inviting it, within 30 days of receiving notification, to submit observations and — in case of Point (l.ii) above — to inform the Agency of the measures to ensure compliance with the obligations under the Agreement.

If the Agency does not receive observations or decides to pursue the procedure despite the observations it has received, it will formally notify to the coordinator or beneficiary concerned **confirmation** of the termination and the date it will take effect. Otherwise, it will formally notify that the procedure is not continued.

The termination will **take effect**:

- for terminations under Points (b), (c), (e), (g), (h), (j), (l.ii) and (n) above: on the day specified in the notification of the confirmation (see above);
- for terminations under Points (a), (d), (f), (i), (k), (l.i) and (m) above: on the day after the notification of the confirmation is received.

50.3.3 Effects

(a) for **termination of the Agreement**:

The coordinator must — within 60 days from when termination takes effect — submit:

- (i) a periodic report (for the last open reporting period until termination; see Article 20.3) and
- (ii) a final report (see Article 20.4).

If the Agreement is terminated for breach of the obligation to submit reports (see Articles 20.8 and 50.3.1(l)), the coordinator may not submit any reports after termination.

If the Agency does not receive the reports within the deadline (see above), only costs which are included in an approved periodic report will be taken into account.

The Agency will **calculate** the final grant amount (see Article 5.3) and the balance (see Article 21.4) on the basis of the reports submitted. Only costs incurred until termination takes effect are eligible (see Article 6). Costs relating to contracts due for execution only after termination are not eligible.

This does not affect the Agency's right to reduce the grant (see Article 43) or to impose administrative sanctions (Article 45).

The beneficiaries may not claim damages due to termination by the Agency (see Article 46).

After termination, the beneficiaries' obligations (in particular Articles 20, 22, 23, Section 3 of Chapter 4, 36, 37, 38, 40, 42, 43 and 44) continue to apply.

(b) for termination of the participation of one or more beneficiaries:

The coordinator must — within 60 days from when termination takes effect — submit:

- (i) a report on the distribution of payments to the beneficiary concerned;
- (ii) a request for amendment (see Article 55), with a proposal for reallocation of the tasks and estimated budget of the beneficiary concerned (see Annexes 1 and 2) and, if necessary, the addition of one or more new beneficiaries (see Article 56). If termination is notified after the period set out in Article 3, no request for amendment must be submitted unless the beneficiary concerned is the coordinator. In this case the request for amendment must propose a new coordinator, and
- (iii) if termination takes effect during the period set out in Article 3, a **termination report** from the beneficiary concerned, for the open reporting period until termination, containing an overview of the progress of the work, an overview of the use of resources, the individual financial statement and, if applicable, the certificate on the financial statement (see Article 20).

The information in the termination report must also be included in the periodic report for the next reporting period (see Article 20.3).

If the request for amendment is rejected by the Agency, (because it calls into question the decision awarding the grant or breaches the principle of equal treatment of applicants), the Agreement may be terminated according to Article 50.3.1(c).

If the request for amendment is accepted by the Agency, the Agreement is **amended** to introduce the necessary changes (see Article 55).

The Agency will calculate — on the basis of the periodic reports, the termination report and the report on the distribution of payments — **calculate** the amount which is due to the beneficiary and if the (pre-financing and interim) payments received by the beneficiary exceed this amount.

The **amount which is due** is calculated in the following steps:

Step 1 — Application of the reimbursement rate to the eligible costs

The grant amount for the beneficiary is calculated by applying the

reimbursement rate(s) to the total eligible costs declared by the beneficiary in the termination report and approved by the Agency.

Only costs incurred by the beneficiary concerned until termination takes effect are eligible (see Article 6). Costs relating to contracts due for execution only after termination are not eligible.

Step 2 — Reduction due to substantial errors, irregularities or fraud or serious breach of obligations

In case of a reduction (see Article 43), the Agency will calculate the reduced grant amount for the beneficiary by deducting the amount of the reduction (calculated in proportion to the seriousness of the errors, irregularities or fraud or breach of obligations, in accordance with Article 43.2) from the grant amount for the beneficiary.

If the payments received **exceed the amounts due**:

- if termination takes effect during the period set out in Article 3 and the request for amendment is accepted, the beneficiary concerned must repay to the coordinator the amount unduly received. The Agency will formally notify the amount unduly received and request the beneficiary concerned to repay it to the coordinator within 30 days of receiving notification. If it does not repay the coordinator, the Agency will draw upon the Guarantee Fund to pay the coordinator and then notify a **debit note** on behalf of the Guarantee Fund to the beneficiary concerned (see Article 44);
- in all other cases, in particular if termination takes effect after the period set out in Article 3, the Agency will formally notify a **debit note** to the beneficiary concerned. If payment is not made by the date in the debit note, the Guarantee Fund will pay to the Agency the amount due and the Agency will notify a debit note on behalf of the Guarantee Fund to the beneficiary concerned (see Article 44);
- if the beneficiary concerned is the former coordinator, it must repay the new coordinator according to the procedure above, unless:
 - termination takes effect after an interim payment and
 - the former coordinator has not distributed amounts received as pre-financing or interim payments (see Article 21.7).

In this case, the Agency will formally notify a **debit note** to the former coordinator. If payment is not made by the date in the debit note, the Guarantee Fund will pay to the Agency the amount due. The Agency will then pay the new coordinator and notify a debit note on behalf of the Guarantee Fund to the former coordinator (see Article 44).

If the payments received **do not exceed the amounts due**: amounts owed to the beneficiary concerned will be included in the next interim or final payment.

If the Agency does not receive the termination report within the deadline (see above), only costs included in an approved periodic report will be taken into account.

If the Agency does not receive the report on the distribution of payments within the deadline (see above), it will consider that:

- the coordinator did not distribute any payment to the beneficiary concerned and that
- the beneficiary concerned must not repay any amount to the coordinator.

After termination, the concerned beneficiary's obligations (in particular Articles 20, 22, 23, Section 3 of Chapter 4, 36, 37, 38, 40, 42, 43 and 44) continue to apply.

SECTION 4 FORCE MAJEURE

ARTICLE 51 — FORCE MAJEURE

'Force majeure' means any situation or event that:

- prevents either party from fulfilling their obligations under the Agreement,
- was unforeseeable, exceptional situation and beyond the parties' control,
- was not due to error or negligence on their part (or on the part of third parties involved in the action), and
- proves to be inevitable in spite of exercising all due diligence.

The following cannot be invoked as force majeure:

- any default of a service, defect in equipment or material or delays in making them available, unless they stem directly from a relevant case of force majeure,
- labour disputes or strikes, or
- financial difficulties.

Any situation constituting force majeure must be formally notified to the other party without delay, stating the nature, likely duration and foreseeable effects.

The parties must immediately take all the necessary steps to limit any damage due to force majeure and do their best to resume implementation of the action as soon as possible.

The party prevented by force majeure from fulfilling its obligations under the Agreement cannot be considered in breach of them.

CHAPTER 7 FINAL PROVISIONS

ARTICLE 52 — COMMUNICATION BETWEEN THE PARTIES

52.1 Form and means of communication

Communication under the Agreement (information, requests, submissions, ‘formal notifications’, etc.) must:

- be made in writing and
- bear the number of the Agreement.

Until the payment of the balance: all communication must be made through the electronic exchange system and using the forms and templates provided there.

After the payment of the balance: formal notifications must be made by registered post with proof of delivery (‘formal notification on paper’).

Communications in the electronic exchange system must be made by persons authorised according to the Participant Portal Terms & Conditions. For naming the authorised persons, each beneficiary must have designated — before the signature of this Agreement — a ‘legal entity appointed representative (LEAR)’. The role and tasks of the LEAR are stipulated in his/her appointment letter (see Participant Portal Terms & Conditions).

If the electronic exchange system is temporarily unavailable, instructions will be given on the Agency and Commission websites.

52.2 Date of communication

Communications are considered to have been made when they are sent by the sending party (i.e. on the date and time they are sent through the electronic exchange system).

Formal notifications through the **electronic** exchange system are considered to have been made when they are received by the receiving party (i.e. on the date and time of acceptance by the receiving party, as indicated by the time stamp). A formal notification that has not been accepted within 10 days after sending is considered to have been accepted.

Formal notifications **on paper** sent by **registered post** with proof of delivery (only after the payment of the balance) are considered to have been made on either:

- the delivery date registered by the postal service or
- the deadline for collection at the post office.

If the electronic exchange system is temporarily unavailable, the sending party cannot be considered in breach of its obligation to send a communication within a specified deadline.

52.3 Addresses for communication

The **electronic** exchange system must be accessed via the following URL:

<https://ec.europa.eu/research/participants/portal/desktop/en/projects/>

The Agency will formally notify the coordinator and beneficiaries in advance any changes to this URL.

Formal notifications on paper (only after the payment of the balance) addressed **to the Agency** must be sent to the following address:

Research Executive Agency
Sustainable Resources for Food Security and Growth
COV 2 - B2 Single Entry Point
B-1049 Brussels Belgium

Formal notifications on paper (only after the payment of the balance) addressed **to the beneficiaries** must be sent to their legal address as specified in the Participant Portal Beneficiary Register.

ARTICLE 53 — INTERPRETATION OF THE AGREEMENT

53.1 Precedence of the Terms and Conditions over the Annexes

The provisions in the Terms and Conditions of the Agreement take precedence over its Annexes.

Annex 2 takes precedence over Annex 1.

53.2 Privileges and immunities

Nothing in the Agreement may be interpreted as a waiver of any privileges or immunities accorded to the INTERNATIONAL CENTRE FOR AGRICULTURAL RESEARCH IN THE DRY AREAS, by its constituent documents or international law.

ARTICLE 54 — CALCULATION OF PERIODS, DATES AND DEADLINES

In accordance with Regulation No 1182/71²⁸, periods expressed in days, months or years are calculated from the moment the triggering event occurs.

The day during which that event occurs is not considered as falling within the period.

ARTICLE 55 — AMENDMENTS TO THE AGREEMENT

55.1 Conditions

The Agreement may be amended, unless the amendment entails changes to the Agreement which would call into question the decision awarding the grant or breach the principle of equal treatment of applicants.

Amendments may be requested by any of the parties.

55.2 Procedure

The party requesting an amendment must submit a request for amendment signed in the electronic exchange system (see Article 52).

The coordinator submits and receives requests for amendment on behalf of the beneficiaries (see Annex 3).

²⁸ Regulation (EEC, Euratom) No 1182/71 of the Council of 3 June 1971 determining the rules applicable to periods, dates and time-limits (OJ L 124, 8.6.1971, p. 1).

If a change of coordinator is requested without its agreement, the submission must be done by another beneficiary (acting on behalf of the other beneficiaries).

The request for amendment must include:

- the reasons why;
- the appropriate supporting documents;
- for a change of coordinator without its agreement: the opinion of the coordinator (or proof that this opinion has been requested in writing).

The Agency may request additional information.

If the party receiving the request agrees, it must sign the amendment in the electronic exchange system within 45 days of receiving notification (or any additional information the Agency has requested). If it does not agree, it must formally notify its disagreement within the same deadline. The deadline may be extended, if necessary for the assessment of the request. If no notification is received within the deadline, the request is considered to have been rejected.

An amendment **enters into force** on the day of the signature of the receiving party.

An amendment **takes effect** on the date agreed by the parties or, in the absence of such an agreement, on the date on which the amendment enters into force.

ARTICLE 56 — ACCESSION TO THE AGREEMENT

56.1 Accession of the beneficiaries mentioned in the Preamble

The other beneficiaries must accede to the Agreement by signing the Accession Form (see Annex 3) in the electronic exchange system (see Article 52) within 30 days after its entry into force (see Article 58).

They will assume the rights and obligations under the Agreement with effect from the date of its entry into force (see Article 58).

If a beneficiary does not accede to the Agreement within the above deadline, the coordinator must — within 30 days — request an amendment to make any changes necessary to ensure proper implementation of the action. This does not affect the Agency's right to terminate the Agreement (see Article 50).

56.2 Addition of new beneficiaries

In justified cases, the beneficiaries may request the addition of a new beneficiary.

For this purpose, the coordinator must submit a request for amendment in accordance with Article 55. It must include an Accession Form (see Annex 3) signed by the new beneficiary in the electronic exchange system (see Article 52).

New beneficiaries must assume the rights and obligations under the Agreement with effect from the date of their accession specified in the Accession Form (see Annex 3).

ARTICLE 57 — APPLICABLE LAW AND SETTLEMENT OF DISPUTES

57.1 Applicable law

The Agreement is governed by the applicable EU law, supplemented if necessary by the law of Belgium.

As an exception, there is no applicable law for INTERNATIONAL CENTRE FOR AGRICULTURAL RESEARCH IN THE DRY AREAS.

57.2 Dispute settlement

If a dispute concerning the interpretation, application or validity of the Agreement cannot be settled amicably, the General Court — or, on appeal, the Court of Justice of the European Union — has sole jurisdiction. Such actions must be brought under Article 272 of the Treaty on the Functioning of the EU (TFEU).

As an exception, if such a dispute is between the Agency and CROPS FOR THE FUTURE RESEARCH CENTRE, the competent Belgian courts have sole jurisdiction.

As an exception, for the following beneficiaries:

- INTERNATIONAL CENTRE FOR AGRICULTURAL RESEARCH IN THE DRY AREAS

such disputes must — if they cannot be settled amicably — be referred to arbitration. The Permanent Court of Arbitration Optional Rules for Arbitration Involving International Organisations and States in force at the date of entry into force of the Agreement will apply. The appointing authority will be the Secretary-General of the Permanent Court of Arbitration following a written request submitted by either party. The arbitration proceedings must take place in Brussels and the language used in the arbitral proceedings will be English. The arbitral award will be binding on all parties and will not be subject to appeal.

If a dispute concerns administrative sanctions, offsetting or an enforceable decision under Article 299 TFEU (see Articles 44, 45 and 46), the beneficiaries must bring action before the General Court — or, on appeal, the Court of Justice of the European Union — under Article 263 TFEU. Actions against enforceable decisions must be brought against the Commission (not against the Agency).

ARTICLE 58 — ENTRY INTO FORCE OF THE AGREEMENT

The Agreement will enter into force on the day of signature by the Agency or the coordinator, depending on which is later.

SIGNATURES

For the coordinator

For the Agency



EUROPEAN COMMISSION
Research Executive Agency
Sustainable Resources for Food Security and Growth



ANNEX 1 (part A)

Research and Innovation action

NUMBER — 774234 — LANDSUPPORT

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1.1. The project summary

Project Number ¹	774234	Project Acronym ²	LANDSUPPORT
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One form per project

General information

Project title ³	Development of Integrated Web-Based Land Decision Support System Aiming Towards the Implementation of Policies for Agriculture and Environment
Starting date ⁴	The first day of the month after the signature by the Commission
Duration in months ⁵	42
Call (part) identifier ⁶	H2020-RUR-2017-2
Topic	RUR-03-2017 Towards 2030 - policies and decision support tools for an integrated approach to the management of land as a resource
Fixed EC Keywords	Common agricultural policy (CAP), Environment, resources and sustainability
Free keywords	Land policies implementation, Climate Change resilience, Sustainable agriculture & forestry, Multifunctional agriculture, Land planning & management, Land Degradation Neutrality, DSS, HPC, Modelling.

Abstract ⁷

The objective of LANDSUPPORT is the construction of a web-based smart geoSpatial Decision Support System (S-DSS), which shall provide a powerful set of tools devoted to (i) support sustainable agriculture/forestry, (ii) evaluate trade-off between land uses (including spatial planning) and (iii) contribute to implementation, impact and delivery of about 20 European land policies and also selected 2030 UN Sustainable Development Goals including climate change resilience goals and the key SDG 15.3 “achieving a land degradation-neutral world”. This objective is achieved by the integration of already existing databases (interoperability) at different scales with the development of high performance modelling engines simulating agriculture & forestry (e.g.crop growth), land degradation and environmental issues (e.g.fate of pollutants, ecosystem services). All the above, including their validation by remote sensed data will be ensured by a technology at the state of art for the developing environment (i.e.COMPSs), high-performing computing (e.g.GPU) and massive raster data management (e.g.RASDAMAN). LANDSUPPORT will be applied at four geographic scales: EU; 3 Nations (Italy, Hungary, Austria); 2 European Regions in IT and HU; 3 pilot sites in AU, IT, HU; and 2 pilot sites in Tunisia and Malaysia. By doing that, LANDSUPPORT will reconcile grand agriculture/environmental sustainability policy ambitions with operational reality as required by RUR-03-2017 call such as the evaluation of “land use trade-offs” and “incentivizing real actions/behaviour/investments”; all requiring activities at detailed spatial scale. LANDSUPPORT fits with the priorities of this work programme, as LANDSUPPORT S-DSS is (i) scientific and technology innovation as driver for rural development, (ii) a framework for innovation and new business models adapted to the rural context, (iii) support for skills development in rural communities, (iv) a new approach towards policies and governance (subarea 1).

1.2. List of Beneficiaries

Project Number ¹	774234	Project Acronym ²	LANDSUPPORT
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List of Beneficiaries

No	Name	Short name	Country	Project entry month ⁸	Project exit month
1	UNIVERSITA DEGLI STUDI DI NAPOLI FEDERICO II.	UNA	Italy	1	42
2	ARIESPACE SRL	ARIES	Italy	1	42
3	BARCELONA SUPERCOMPUTING CENTER - CENTRO NACIONAL DE SUPERCOMPUTACION	BSC	Spain	1	42
4	UNIVERSITAET FUER BODENKULTUR WIEN	BOKU	Austria	1	42
5	CONSIGLIO NAZIONALE DELLE RICERCHE	CNR	Italy	1	42
6	CROPS FOR THE FUTURE RESEARCH CENTRE	CFF	Malaysia	1	42
7	INTERNATIONAL CENTRE FOR AGRICULTURAL RESEARCH IN THE DRY AREAS	ICARDA	Lebanon	1	42
8	FELSOBBFOKU TANULMANYOK INTEZETE	iASK	Hungary	1	42
9	Istituto Superiore per la Protezione e la Ricerca Ambientale	ISPRA	Italy	1	42
10	RASDAMAN GMBH	RASDAMAN	Germany	1	42
11	JRC -JOINT RESEARCH CENTRE- EUROPEAN COMMISSION	JRC	Belgium	1	42
12	REGIONE CAMPANIA	REGCAM	Italy	1	42
13	PANNON EGYETEM	UPA	Hungary	1	42
14	UNIVERSITA DEGLI STUDI DI MILANO	UMI	Italy	1	42
15	ZALA MEGYEI ONKORMANYZATA	ZALA	Hungary	1	42
16	CMAST	CMAST	Belgium	1	42
17	ACTEON SARL	ACTEON	France	1	42
18	UMWELTBUNDESAMT GESELLSCHAFT MIT BESCHRANKTER HAFTUNG (UBA GMBH)	EAA	Austria	1	42
19	GOZDARSKI INSTITUT SLOVENIJE	SFI	Slovenia	1	42

1.3. Workplan Tables - Detailed implementation

1.3.1. WT1 List of work packages

WP Number ⁹	WP Title	Lead beneficiary ¹⁰	Person-months ¹¹	Start month ¹²	End month ¹³
WP1	Land policy and socio-economic investigation to tune LANDSUPPORT system	11 - JRC	59.80	1	12
WP2	Integrated Databases for the LANDSUPPORT Decision Support System	10 - RASDAMAN	190.20	1	42
WP3	Developing high performance models	5 - CNR	276.60	1	40
WP4	Monitor/ assess/ validate LANDSUPPORT technical and scientific results	4 - BOKU	189.50	1	42
WP5	Implementation of LANDSUPPORT Geospatial Cyberinfrastructure	2 - ARIES	96.20	1	42
WP6	Testing and validation of LANDSUPPORT results as support towards land policy	13 - UPA	135.90	13	42
WP7	Empowering end-users for supporting the development of the DSS and disseminating project	17 - ACTEON	191.92	1	42
WP8	Project Management	1 - UNA	85.80	1	42
WP9	Ethics requirements	1 - UNA	N/A	1	42
Total			1,225.92		

1.3.2. WT2 list of deliverables

Deliverable Number ¹⁴	Deliverable Title	WP number ⁹	Lead beneficiary	Type ¹⁵	Dissemination level ¹⁶	Due Date (in months) ¹⁷
D1.1	Synoptic table of Land Policies SWOT analysis at European, national and regional level	WP1	11 - JRC	Report	Confidential, only for members of the consortium (including the Commission Services)	10
D1.2	Release of global comparative table of SWOT/user-requirement/impact analysis including the final tuning list with DSS priorities and timing	WP1	13 - UPA	Report	Confidential, only for members of the consortium (including the Commission Services)	12
D2.1	Data Management Plan	WP2	1 - UNA	Report	Confidential, only for members of the consortium (including the Commission Services)	6
D2.2	Integrated Data Management Report	WP2	10 - RASDAMAN	Report	Confidential, only for members of the consortium (including the Commission Services)	18
D2.3	Data Ingest and Acquisition Report	WP2	10 - RASDAMAN	Report	Confidential, only for members of the consortium (including the Commission Services)	18
D2.4	Technical Support Report	WP2	10 - RASDAMAN	Report	Confidential, only for members of the consortium (including the Commission Services)	18
D2.5	Data Management Plan – updated version	WP2	1 - UNA	ORDP: Open Research Data Pilot	Confidential, only for members of the consortium (including the Commission Services)	40
D2.6	Standardization Report	WP2	10 - RASDAMAN	Report	Confidential, only for members of the consortium (including the	42

Deliverable Number¹⁴	Deliverable Title	WP number⁹	Lead beneficiary	Type¹⁵	Dissemination level¹⁶	Due Date (in months)¹⁷
					Commission Services)	
D3.1	Newly develop modules on crop productivity, agro-ecosystems, depicting agriculture relationships between applications and scale of concern	WP3	14 - UMI	Other	Confidential, only for members of the consortium (including the Commission Services)	24
D3.2	Newly develop modules on environmental issues and land degradation depicting environmental relationships between applications and scale of concern	WP3	5 - CNR	Other	Confidential, only for members of the consortium (including the Commission Services)	24
D3.3	Newly develop multiscale models for ecosystem services evaluation	WP3	17 - ACTEON	Other	Confidential, only for members of the consortium (including the Commission Services)	24
D3.4	Newly develop climate change resilience modules in biophysical models, LULUCF models and future LULC scenarios	WP3	9 - ISPRA	Other	Confidential, only for members of the consortium (including the Commission Services)	30
D3.5	Newly develop automatic spatial modelling capable of ingesting newly available information	WP3	5 - CNR	Other	Confidential, only for members of the consortium (including the Commission Services)	30
D3.6	Report on the final models implementation and optimization. The final release of the models will integrate all the optimizations in the modelling chains	WP3	3 - BSC	Other	Confidential, only for members of the consortium (including the Commission Services)	40
D4.1	Software implementation and data delivery: Deployment of the seasonal cropland mask processor and automatic delivery of seasonal	WP4	4 - BOKU	Other	Public	18

Deliverable Number¹⁴	Deliverable Title	WP number⁹	Lead beneficiary	Type¹⁵	Dissemination level¹⁶	Due Date (in months)¹⁷
	updates and yearly synthesis					
D4.2	Software implementation and data delivery: land cover processors and integration in web interface	WP4	4 - BOKU	Other	Public	24
D4.3	Technical report: review of the forest ecosystem production mapping algorithms and roadmap for Sentinel	WP4	4 - BOKU	Report	Public	36
D4.4	Technical report: best practices for consistency checks and data assimilation in the LANDSUPPORT modelling framework	WP4	14 - UMI	Report	Confidential, only for members of the consortium (including the Commission Services)	40
D5.1	Architecture and Framework Specification	WP5	2 - ARIES	Report	Public	6
D5.2	Beta version of GCI platform	WP5	2 - ARIES	Other	Public	18
D5.3	Report on integration of COMPSs with data layer	WP5	3 - BSC	Report	Confidential, only for members of the consortium (including the Commission Services)	24
D5.4	Final version of GCI platform with adaptation to all case studies	WP5	2 - ARIES	Other	Public	40
D6.1	Internal report on the DSS performance on EU, country, regional and local scales	WP6	18 - EAA	Report	Confidential, only for members of the consortium (including the Commission Services)	42
D6.2	Report on testing, validation, meta-analysis about replicability and transferability to other areas within the EU	WP6	13 - UPA	Report	Public	42
D6.3	Report on testing and meta-analysis about replicability and	WP6	13 - UPA	Report	Public	42

Deliverable Number¹⁴	Deliverable Title	WP number⁹	Lead beneficiary	Type¹⁵	Dissemination level¹⁶	Due Date (in months)¹⁷
	transferability to other areas outside Europe					
D7.1	Launch of LANDSUPPORT website	WP7	17 - ACTEON	Websites, patents filling, etc.	Public	3
D7.2	Participation and dissemination plan (including list of SHG members)	WP7	17 - ACTEON	Report	Confidential, only for members of the consortium (including the Commission Services)	6
D7.3	How can the S-DSS tools best support land management at the field level? Synthesis report of focus groups and the workshop	WP7	17 - ACTEON	Report	Public	14
D7.4	Technical dissemination: activities, outcomes and suggestions for further research. Synthesis report of technical dissemination trainings and workshops	WP7	17 - ACTEON	Report	Public	42
D7.5	Engaging other potential users at the field level. Synthesis report of trainings and workshops with stakeholders whose activities can be supported by a targeted, thematic use of the LANDSUPPORT platform (urban planners, local ecotourism companies and local	WP7	17 - ACTEON	Report	Public	42
D7.6	Report on social media use and number of followers on different channels, as well as on feedback	WP7	17 - ACTEON	Report	Public	42
D8.1	Webtool for efficient document sharing and communication	WP8	1 - UNA	Websites, patents filling, etc.	Public	3
D8.2	Innovation Management Report	WP8	1 - UNA	Report	Confidential, only for members of the consortium	36

Deliverable Number¹⁴	Deliverable Title	WP number⁹	Lead beneficiary	Type¹⁵	Dissemination level¹⁶	Due Date (in months)¹⁷
					(including the Commission Services)	
D9.1	H - Requirement No. 1	WP9	5 - CNR	Ethics	Confidential, only for members of the consortium (including the Commission Services)	3
D9.2	NEC - Requirement No. 2	WP9	5 - CNR	Ethics	Confidential, only for members of the consortium (including the Commission Services)	3
D9.3	M - Requirement No. 3	WP9	5 - CNR	Ethics	Confidential, only for members of the consortium (including the Commission Services)	6
D9.4	NEC - Requirement No. 4	WP9	5 - CNR	Ethics	Confidential, only for members of the consortium (including the Commission Services)	24

1.3.3. WT3 Work package descriptions

Work package number ⁹	WP1	Lead beneficiary ¹⁰	11 - JRC
Work package title	Land policy and socio-economic investigation to tune LANDSUPPORT system		
Start month	1	End month	12

Objectives

WP1 has the main objective to fine tune the overall LANDSUPPORT starting from DSS tool “a” to DSS tool “o” as reported in table 1.1.B, 1.1C (see chapter 1). This WP activity will be done by analysing the land policies challenges to be implemented in the platform, compared with the user requirement needs and the potential impacts of the LANDSUPPORT deliveries in multilevel land policies. WP1 is led by JRC because their large experience on land policy implementation, also in connection with DSS. A specific reasoning about the ZALA involvement is provided in “resource to be committed” in 3.4 (DoA part B)

Thus, the following set of specific objectives follows:

1. List of all specific details of implementation challenges to be addressed by all LANDSUPPORT DSS tools taking into account multilevel land policies and socioeconomic issues;
2. Final user requirements for the implementation of Land Policies at different levels and scales;
3. Quantification of the potential socio-economic impact of DSS tools over agro-environmental and Land Policies issues

Description of work and role of partners

WP1 - Land policy and socio-economic investigation to tune LANDSUPPORT system [Months: 1-12]

JRC, UNA, IASK, ISPRA, REGCAM, UPA, ZALA, ACTEON, EAA

Approach:

JRC with the active involvement of EAA, ISPRA, REGCAM and ZALA will analyse – using an analytical framework – the wide range of multilevel land policies reported in detail in table 1.1b and covering agriculture, forestry, ecosystem services, land degradation and other environmental aspects of the UN-SDGs.

The approach will consider how LANDSUPPORT can embody key features from the outcoming results from existing multiscale SWOT analysis over land multilevel policies and social and economic impact of DSS tools. This will be done by the integrated work of land policy and socio-economic experts using socioeconomic databases (e.g. FADN) and mapping of suitable indicators (e.g. N. of farms having features which can benefit from LANDSUPPORT). Finally, a synopsis of the SWOT, user-requirement and impact analysis will identify the extent by which each DSS tool must be applied and also the priority for the DSS tools to be developed and integrated in LANDSUPPORT platform.

Task 1.1: Evaluating Land Policies SWOT analysis at European, national and regional level and identifying of implementation challenges to be addressed by LANDSUPPORT. (Start: M1; End: M12; Lead: JRC; connected with D1.1)

The state of Land Policies to be implemented in LANDSUPPORT must be evaluated. In this view, the many available SWOT reports must be analysed at European (e.g. CAP; COM(2013) 659 final; 7th Environmental Action Plan; 2030 UN Agenda for SDG (N. 2, 3, 11, 15.3); Dir 2000/60/EC; Dir 2007/2/EC; COM 2006/231, COM (2011) 571 final, 2001/42/EC and 85/337/EEC, Habitat Directive 92/43/EEC), National (RDPS (Pillar I and II), D.Lgs n 152/06,) and Regional level (e.g. PSR 2014-2020, Water Management Plan, Action plan for vulnerable zones to nitrates, General Forestry Plan 2009 – 2013, CAP Regional applications, Nature and Landscape Protection Law) in Italy, Hungary and Austria. JRC with the support of EAA, ISPRA, REGCAM and ZALA will analyse the above documents – already incorporating some elements of the SWOT assessment – providing a synoptic evaluation enabling to produce a clear and concise picture of the current state (along with the dynamic trends) of land policy implementation in EU and in the 3 countries and regions. An important element that will be taken into account is the approval of the UN Agenda for sustainable development and related Sustainable Development Goals (SDGs) to be achieved by 2030, which should be included in medium – and long – term national plans, so to avoid different and incoherent programs. All this information will be used in Task 1.4.

Task 1.2: User requirement analysis to ensure that the final S-DSS tools reflect the need of policy implementation, policy-makers local communities and stakeholders. (Start: M1; End: M12; Lead: EAA; connected with D1.2)

The LANDSUPPORT platform is designed to be used by many and different types of users as institutions, policy makers, stakeholders but even local communities. In this task, JRC, EAA, ISPRA, REGCAM and ZALA, with the support of the SHG, will analyse the needs of different types of users considering the level of policy, scales and country. To

achieve this, EAA will also analyse the output of communication (e.g. workshops, interviews, questionnaires) involving stakeholders at all relevant levels organised in WP7, will feed this WP1 task. EAA with the support of ISPRA, will establish, for each scale and level of policy to be implemented, (i) open-ended semi-restrictive interview schemes (see chapter 1.3.2) and (ii) a set of simple indicators (e.g. for each scale: N of public and private actors having a concrete potential benefit) in order to produce an ex-ante evaluation about potential impact of policy implementation. Following this evaluation, requirements for implementation of established specific targets and indicators (e.g. UN SDGs, Sendai Framework) or new ones, will emerge. In fact, with the adoption of the UN Agenda, countries accepted to take part in a monitoring process managed by the UN, through a set of statistical indicators at subnational level including 2.4 sustainable food production systems and resilient agricultural practices; 11.1 urbanization patterns, 11.2 safe, resilient and sustainable human settlements, 11.3 land consumption, 15.3 land degradation.

All the above activity will be evaluated by EAA, in a synoptic scheme, producing as results the detailed accounting of LANDSUPPORT user needs.

Task 1.3: Assessment of impacts (including environmental, socio-economic impacts) of LANDSUPPORT potential deliveries in multilevel land policies. (Start: M1; End: M12; Lead: ACTeon; connected with D1.2)

During this task iASK will produce the geospatial multiscale analysis of the main socio-economic parameters tuned to different scales (EuroStat and National Statistical Offices, see chapter 1.3.2). UNA will contribute by integrating this analysis with farm FADN geospatial databases. These databases will be processed by iASK, UNA and ACTeon to obtain a set of indicators (see chapter 1.3.2) concerning social and economic sustainability (e.g. agriculture statistics, labour market statistics, demographic statistics, etc.). The resulting geospatial analysis of these indicators will enable to process homogeneous socioeconomic mapping units. On such geospatial bases ACTeon will assess – as ex-ante expert best estimate – the impact on the social and economic aspects of the platform's achievements for different levels of land policy. At local scale, mitigation strategies and success stories with respect to sustainable soil protection will also be inventoried.

Among the social aspects will be considered the following: population, housing density, average income per census, average age population. For the economic aspects will be evaluated the type of farms, their extension, crop and livestock production.

For the agro-environmental aspect, organic farming, conversion of arable land to grassland and rotation measures, intensification of livestock, water use reduction measures, set aside and other agri-environmental measures related to land management will be covered. Results from these assessments are also important to better tune WP7; thus these results will be communicated during the WP7 activities, with special focus toward specific target groups (e.g. policy makers).

Task 1.4: Producing a synthesis of SWOT/user-requirement/impact analysis to tune LANDSUPPORT system. (Start: M1; End: M12; Lead: UPA; connected with D1.1)

Outcome from tasks 1.1, 1.2, 1.3 will be further processed by UPA with the support of JRC and UNA producing a synoptic global table weighting and merging SWOT/user-requirement/impact analysis for each DSS tool to be developed (from DSS “a” to “o” in table 1.1b; chapter 1). This synoptic table will enable the final tuning of LANDSUPPORT platform by further focusing and detailing the DSS tools to support land policies as reported in table 1.1.b (Chapter 1.1). This table will also incorporate priorities and timing for the development of the different tools and will be discussed with SHG. The table will be very useful for prioritising more applied WP3 activities (starting from the 2nd year of the project) but in general terms the outcome of this WP will not affect the first 1-2 activities of WP3 since there are many basic modelling engines required anyway for achieving the specific objectives reported in table 1.1.a and 1.1.b (chapter 1)

Participation per Partner

Partner number and short name	WP1 effort
1 - UNA	0.50
8 - iASK	12.00
9 - ISPRA	1.40
11 - JRC	4.00
12 - REGCAM	0.90
13 - UPA	4.00
15 - ZALA	22.00

Partner number and short name	WP1 effort
17 - ACTEON	9.00
18 - EAA	6.00
Total	59.80

List of deliverables

Deliverable Number ¹⁴	Deliverable Title	Lead beneficiary	Type ¹⁵	Dissemination level ¹⁶	Due Date (in months) ¹⁷
D1.1	Synoptic table of Land Policies SWOT analysis at European, national and regional level	11 - JRC	Report	Confidential, only for members of the consortium (including the Commission Services)	10
D1.2	Release of global comparative table of SWOT/user-requirement/impact analysis including the final tuning list with DSS priorities and timing	13 - UPA	Report	Confidential, only for members of the consortium (including the Commission Services)	12

Description of deliverables

D1.1 : Synoptic table of Land Policies SWOT analysis at European, national and regional level [10]
 Synoptic table of Land Policies SWOT analysis at European, national and regional level

D1.2 : Release of global comparative table of SWOT/user-requirement/impact analysis including the final tuning list with DSS priorities and timing [12]
 Release of global comparative table of SWOT/user-requirement/impact analysis including the final tuning list with DSS priorities and timing

Schedule of relevant Milestones

Milestone number ¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS3	Evaluation of outcomes of Land Policy SWOT, User Requirement and Impact Assessment completed	11 - JRC	12	Evaluation of outcomes of Land Policy SWOT, User Requirement and Impact Assessment completed – ready to integrate learnings in the DSS development Means of verification: Integration of learnings in the design and development plan for the DSS
MS8	First set (10) of DSS tools	2 - ARIES	18	First set (10) of DSS tools (mainly related to land take and agriculture) are ready for testing. Means of verification: they can be freely verified and

Schedule of relevant Milestones

Milestone number ¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
				tested by anyone through the LANDSUPPORT web site
MS13	Second set (20) of DSS tools	2 - ARIES	24	Second set (20) of DSS tools (mainly related to agriculture, land degradation and environment) ready for testing. Means of verification: They can be freely verified and tested by anyone through the LANDSUPPORT web site
MS17	Third set (20) of DSS tools	2 - ARIES	30	Third set (20) of DSS tools (mainly related to ecosystem service evaluation) ready for testing. Means of verification: they can be freely verified and tested by anyone through the LANDSUPPORT web site
MS20	Final version of LANDSUPPORT platform available	1 - UNA	40	Final version of LANDSUPPORT platform available. Means of verification: Delivery through the web of the operational final LANDSUPPORT DSS system (see also D5.4)
MS21	Final set (50) of DSS tools	2 - ARIES	40	Final set (50) of DSS tools (mainly related to LULUCF models and spatial planning) ready. Means of verification: they can be freely verified and tested by anyone through the LANDSUPPORT web site

Work package number ⁹	WP2	Lead beneficiary ¹⁰	10 - RASDAMAN
Work package title	Integrated Databases for the LANDSUPPORT Decision Support System		
Start month	1	End month	42

Objectives

1. Establish the harmonized LANDSUPPORT data service platform with integrated handling of raster, vector and meta data, including query APIs allowing “any query, any time, on any size” to be used both as explorable data (e.g. users applying LANDSUPPORT query tools) and as input data for modelling applications planned in WP3, assessed in WP4 and applied in WP5 and WP6. See Task 2.1 and Task 2.2.
 2. Ensure that all data are analysis-ready for WP3 and other WPs (considering INSPIRE and FAIR principles as adequate) by performing thorough data cleansing and establishing rigorous quality control prior to inclusion in the LANDSUPPORT database. See Task 2.3.
 3. Complement EO data with in-situ acquired, lab-evaluated and quality-controlled additional data sets as required by WP3. See Task 2.4.
 4. Provide training and continuous support for WP3 and WP5 for seamless integration of data management into the overall LANDSUPPORT ecosystem. See Task 2.5.
 5. Maintain a Data Management Plan. See Task 2.6.
- Contribute findings actively into standardization in OGC, ISO, and INSPIRE. See Task 2.7.

Description of work and role of partners

WP2 - Integrated Databases for the LANDSUPPORT Decision Support System [Months: 1-42]
RASDAMAN, UNA, ARIES, BOKU, CNR, CFF, ICARDA, iASK, ISPRA, JRC, REGCAM, UPA, ZALA, EAA

Approach:
 In WP2, the comprehensive LANDSUPPORT data management layer will be established encompassing raster, vector, and meta data.
 Data offered will consist of at least: digital thematic maps (geology, hydrogeology, land use, etc.), soil data, soil hydrology data, digital elevation models, remote sensing data, LiDAR data, climate data, ortho-images, socioeconomic data, etc.
 Access interfaces will consist of a versatile query API (Application Programming Interface) realizing a paradigm of “any query, any time, any size” based on the open OGC standards WMS (map navigation), WFS (vector data access), WCS (raster data access), and WCPS (combined raster/metadata processing). This service will be used particularly by WP3, but will be also be opened to external LANDSUPPORT users once sufficiently filled and tested. In particular, WCPS will allow WP3 to “push down” data intensive raster (i.e. BigData) processing and filtering subtasks into the datacube engine for efficient evaluation in the cloud.
 Services will rely on existing, proven tools; no new tools will be developed, but the tools chosen will be enhanced and extended with integration code where necessary. For vector data, tools like open-source GeoServer will be used. For raster data and spatio-temporal datacubes, the rasdaman scalable datacube engine (official OGC & INSPIRE WCS Reference Implementation) will be used to host all raster data (including timeseries). The rasdaman technology will be used to federate LANDSUPPORT service with other services existing / under preparation, such as EarthServer, CODE-DE, and EU EOSC-Datahub (lead: ESA). The services will duly consider FAIR principles: Findable, Accessible, Interoperable and Reusable.
 Although some data will be acquired under license (prohibiting publication), this will not inhibit FAIR principles as only derivatives of those data with sufficient depth of added value will be published. Open, free data can be published as is. Data ingest will rely on strong data cleansing techniques, for which sufficient resources will be dedicated. Among the many reasons for non-compliant data can be poorly defined databases, lack of data (e.g. lack of soil hydraulic properties), qualitative information to be converted in quantitative data, information not in compliance with INSPIRE, etc. Ingestion procedures will be established in a way that is suitable for manual as well as continuous automated update. For example, in the case of raster data this will rely on the OGC WCS-T standard (T = Transaction, defining standard-conformant insert/update/delete on raster data).
 Process model: WP2 will use an incremental approach with an early deployment of all tools and databases in a state “as is”, and stepwise enhancement subsequently. This will enable WP3 and other users to start early while giving WP2 freedom to implement their enhancements. An initial requirements analysis, a documented design, as well as strict use of the OGC standards will ensure that later increments will not lead to incompatible changes, but only to extensions of data and analysis functionality. Phases are planned as follows:

- Setup phase: deployment of all databases “as is”, ready for use by WP2.
- o Incremental phase: enhancement of the tools (integration, new analysis functionality, new data formats, etc.) with a periodic roll-out following a “release early, release often” policy; discussion of new increment functionality with users in advance for prioritizing.
- Consolidation phase: sufficiently before the end of the project, evolution of data and code is frozen and all results are consolidated for continued use after the project (e.g., documentation, testing, training material).

Remark on the WP leadership:

The WP leader role of RASDAMAN was decided considering the paramount importance of their task of integrating the handling of raster, vector and meta data, including query APIs allowing “any query, any time, on any size”. In terms of person months, CNR and particularly UNA have a considerable role in this WP as well. This large workload is mainly related to (i) Task 2.4 “Additional soil and land use data acquisition” which includes a lot of field work to collect new data on soil and land use that have a critical role in making the LANDSUPPORT system work properly and to the evidence that (ii) UNA will strongly contribute to the harmonization of the multidisciplinary data and databases, as required by LANDSUPPORT.

Task 2.1: Integrated vector and meta data management. (Start: M1; End: M42; Lead: ARIES; connected with D2.2)

The LANDSUPPORT comprehensive vector and metadata management (including interoperability between databases) will be established by ARIES using GeoServer. It is an open source software server written in Java over TOMCAT Web Server that allows users to share and edit geospatial data. Designed for interoperability, it publishes data from any major spatial data source using open standards. It is the reference implementation of the Open Geospatial Consortium (OGC) Web Feature Service (WFS) as well as a high performance certified compliant Web Map Service (WMS). Management of metadata according to INSPIRE will be performed by Catalog Services for Web (CSW) built as extension of Geoserver. CSW is OGC compliant and it supports the following standard operations: i) GetCapabilities; ii) GetRecords; iii) GetRecordById; iv) GetDomain; v) DescribeRecord.

ARIES will also ensure the interoperability between database resident on LANDSUPPORT server with databases resident on other institutional servers (JRC, ISPRA, EAA, REGCAM and ZALA) will be executed using the ability of Geoserver to load data from a remote Web Feature Server (WFS). Essential prerequisite is that each external resource is INSPIRE compliant and providing data as WFS service to permit transactions on the LANDSUPPORT server.

Direct data ingesting into the system will be performed through the REST interface of Geoserver or alternatively - with integration code where necessary - by injection into the underlying PostgreSQL – PostGIS database. Following the list of main vector datasets which will be included: i) Crop parameters required by CropBASE (e.g. AQUACROP parameterisation and calibration data and spatial modules); ii) digital thematic maps (geology, hydrogeology, land use, etc.), iii) soil data, and further more.

EO data (cf. Task 2.2) will be linked with these data via a GeoServer/rasdaman coupling, thereby establishing the common LANDSUPPORT data platform.

Task 2.2: Integrated EO raster/datacube management. (Start: M1; End: M42; Lead: RASDAMAN; connected with D2.2)

In this task, the LANDSUPPORT comprehensive EO data management (including 2D raster maps, 3D x/y/t image time series and 4D x/y/z/t spatio-temporal datacubes) will be established by RASDAMAN (addressing ingest, storage, access & analysis, and clients), based on the EU-developed rasdaman datacube analytics engine which ensures interoperability through the consequent use of the OGC “Big Earth Data” standards, WCS and WCPS. In the pipeline to be established, Task 2.2 will consume the output of Task 2.3, i.e.: harmonized, clean raster data. Data can arise from different existing sources, and also from other LANDSUPPORT WPs, in particular: WP4.

The LANDSUPPORT concept is based on a paradigm shift from file sets to analysis-ready datacubes for agencies, businesses, and scientists. Queries are not tied to predefined functionality, but any query can be asked anytime. All EO access and analysis will strictly rely on OGC WMS, WCS, and WCPS standards as client/server Application Programming Interface.

All types of raster data (ortho images from satellites, airplanes, drones; elevation data; climate data; thematic maps; etc.) will be supported. Incoming data will be homogenized to be INSPIRE conformant and integrated into larger objects, such as seamless 2D maps and seamless 3D and 4D spatio-temporal datacubes. The uniform access interface will be the OGC standards WMS1.3, WCS 2.x, and WCPS 1.0; note that this supports reprojection-on-demand as well as reformatting-on-demand so that users can choose any suitable coordinate system and data format for their query results. The LANDSUPPORT consortium believes that accessing and analysing Big EO Data must be a commodity which requires only little attention and skills. Therefore, various clients will be provided to allow users convenient access (in addition to the OGC Web APIs), based on the standards mentioned above; examples include OpenLayers and Leaflet for map navigation; QGIS and ArcGIS access for Web GIS; python and R for analytics; NASA WorldWind and Cesium for virtual globe based visualization (examples at <https://readtiger.com/rasdaman.com/>).

Data contributors can decide to operate their databases locally, or alternatively to contribute them (upfront or during a later increment) to the central database (depending on sizings, etc.) – however, in any case, the aforementioned standards will be supported. Over the increments, the following data sets will be added:

- Eodataservice.org (~1 PB of Sentinel and Landsat data). As it is already running rasdaman it can be integrated easily into the LANDSUPPORT federation.
- ECMWF (~170 PB of climate data). As it is already running rasdaman it can be integrated easily into the LANDSUPPORT federation.
- More federation candidates are available today (e.g., Plymouth Marine Laboratory, NCI Australia, etc.); the definitive slate will be determined upon fine specification of the federation increment.

With rasdaman, LANDSUPPORT will leverage cloud parallelism as well as inter-data-center parallelism through automatic query splitting and distribution (cf. Fig wp2.2). This has been implemented in EarthServer and is readily available.

Task 2.3: Data cleansing and ingestion workflows. (Start: M1; End: M42; Lead: UNA; connected with D2.3)

In this task, data harmonization will be addressed by looking at the data sources required and producing homogenized data ready for ingestion through T2.2. Most importantly, data accuracy and reliability will be especially addressed for key data referring to Earth Critical Zone (e.g., soil, land use) by UNA (in Italy), UPA (in Hungary), BOKU (in Austria), ICARDA (in Tunisia) and CFF (Malaysia) through both a periodic random check, consisting in (i) an expert evaluation and (ii) applying a data checking procedure established by UNA; to this end, a set of procedures for data and metadata harmonization will be created and performed. This will also be performed by using matching tables to remap data/metadata from the source to a target scheme. Data sources will include the following (this list will be revised and eventually extended as the project proceeds):

- JRC: All databases and datasets (e.g. soil threat/function that will be made available to the project are hosted at ESDAC (<http://esdac.jrc.ec.europa.eu/resource-type/datasets>). Most are offered via OGC WMS, hence can be integrated seamlessly with the OGC compliant LANDSUPPORT service.
- ISPRA: All environmental databases and datasets (such as land cover and soil sealing) that will be made available to the project are hosted at <http://www.isprambiente.gov.it/it/banche-dati> and will be provided via WMS/WFS services.
- BOKU: As a WP4 output, an EU-wide coverage of multispectral Sentinel-2 data at 10 m pixel size every 10-15 days will be produced. Then, value added products will be derived and all these layers will be ingested into rasdaman for exploitation by other LANDSUPPORT tools / routines.
- EAA: Data (such as land cover and use at national and regional scale, DTM, agricultural soil survey, etc.) will come from own as well as external sources.
- REGCAM: All databases and datasets (agriculture and environmental issues) will be made available to the project are hosted at https://sit2.regione.campania.it/wms_layer/add
- ZALA: Soil data are available at the AIRterkep GIS Portal (http://airterkep.nebih.gov.hu/gis_portal/talajvedelem/kiadv.htm#) while climate data will use FORESEE database
- CFF: CropBASE (www.cropbase.org) is a knowledge system, hosted by CFF, for underutilised crops designed to store data on all aspects of crops from their genetic and genomics to agronomic requirements, ecological conditions, statistics, etc. The relational format contains about 4000 variables that are organised in 330 relational tables. A wide range of geographic and socio-economic data needs to be collected and organised about CFF's Field Research Centre (FRC) where the outcome of LANDSUPPORT system is tested (WP6).
- iASK: All multilevel socioeconomy databases (e.g. EUROSTAT, ISTAT, FADN) as listed in chapter 1.3.2 and ANNEX 4.

Task 2.3 will consider, to the maximum feasible extent, compliance to INSPIRE Data Specifications for themes related to land cover (annex II), land use and soil (annex III). LANDSUPPORT will provide important practice experience for implementing the INSPIRE Directive because the project will contribute to increase the number of datasets INSPIRE compliant at Regional, National and European level; moreover, it will allow a comparative analysis among all the partners to assess their state of the art on the matter and the procedures implemented to comply with the legislation.

Task 2.4: Additional soil and land use data acquisition. (Start: M2; End: M40; Lead: UNA; connected with D2.3)

This task will provide additional geospatial data, both vector and raster type, obtained from collecting original data in-situ and processing them in the labs into coherent, high-quality products ready feeding Task 2.3 for subsequent insertion through Task 2.1 (vector and metadata) and Task 2.2 (raster data). These new key geospatial data on soils (see table below) include hydro-pedological properties of major soil types at local scale where LANDSUPPORT modelling (see WP3) impacts will be most effective.

Sampling will be done by UNA and CNR (in Italy), UPA (in Hungary), BOKU (in Austria), while lab analysis will be performed at the CNR, UNA and UPA laboratories, according to the procedures reported in the Methods of soil analysis, part 3 and 4 (Sparks et al., 1996; Dane & Topp, 2002). Details are reported in the methodology section 1.32, chapter 1. Most of the data for the Italian local site (Valle Telesina) are already available at UNA and CNR at suitable data quality

and quantity (as results of the EU LIFE+ project; see table 1.3a chapter 1). Finally, data from Task 2.4 will be ingested in the LANDSUPPORT system by Task 2.3 activities.

- New key geospatial data to be collected: Field data, hydropedological and chemical properties on 25 representative soils for each regional site (Marchfeld, ZALA and Regione Campania). The same applies for 10 representative soils of the local site Keszthely-HU. For producing the uncertainty module (Task 3.1), in the above 4 sites, variability at short-range of hydro-pedological properties will be measured.

- Corresponding analysis: Lab: Main chemical data (pH, CEC, SOC, etc.), texture, bulk density, water retention and hydraulic conductivity curves, dispersivity. Field: Pedological field survey, saturated hydraulic conductivity.

- Example of DSS application for which they are essential: Nitrate leaching and groundwater pollution, water and soil ecosystem services, carbon stock accountability, assessment of soil fertility. Spatial variability data will be employed in the analysis of uncertainties.

Task 2.5: Continuous data support for LANDSUPPORT partners. (Start: M1; End: M42; Lead: RASDAMAN; connected with D2.4)

All WP2 partners will collaborate to provide documentation, training material, and continuous support for the integrated data management platform to the other WPs (in particular: WP3) using WP2 results. Early in the project trainings will be given on the use of the query APIs; during the complete project runtime support will be provided by the resp. component providers. To this end, at project start a “trac” instance will be set up by RASDAMAN for documentation, ticket management, etc.

Task 2.6: Setting up Data Management Plan (DMP) and Standard Operating Procedures (SOPs). (Start: M1; End: M42; Lead: UNA; connected with D2.1 and D2.5).

A Data Management Plan (DMP) will be developed by UNA with the support of all WP2 partners from the early stages of the project and delivered in Month 6. It will be updated continuously to reflect the LANDSUPPORT data offerings and delivered again in Month 40. The DMP will cover the entire data management life cycle (even beyond the end of the project) and will address the following main aspects: (i) datasets identification; (ii) datasets description; (iii) standards and metadata; (iv) data exploitation and sharing for verification and re-use; (v) data curation and preservation.

Task 2.7 Standardization. (Start: M1; End: M42; Lead: RASDAMAN; connected with D2.6)

RASDAMAN is already uniquely shaping Big Data standards in the geo domain and beyond, being editor of (i) the OGC spatio-temporal coverage data and service model suite, Coverage Implementation Schema (CIS) and Web Coverage Service (WCS), including the Web Coverage Processing Service (WCPS) geo datacube analytics language; (ii) ISO 19123-2 Coverage Implementation Schema (being adopted from the OGC standard); (iii) ISO SQL MDA (Multi-Dimensional Arrays). Further, RASDAMAN is a key contributor to INSPIRE coverages and WCS as used by Annex II + III.

As EarthServer-2 is ending, RASDAMAN will continue its successful shaping of standards in OGC, ISO, and INSPIRE. This includes elaboration of specifications; presentation and discussion at standardization meetings (2-4 per year per body); trial (later: reference) implementations; following up through the adoption processes, individual per body.

Participation per Partner

Partner number and short name	WP2 effort
1 - UNA	79.00
2 - ARIES	6.00
4 - BOKU	3.00
5 - CNR	38.00
6 - CFF	18.00
7 - ICARDA	2.00
8 - iASK	10.00
9 - ISPRA	4.70
10 - RASDAMAN	9.00
11 - JRC	4.00

Partner number and short name	WP2 effort
12 - REGCAM	0.50
13 - UPA	7.00
15 - ZALA	8.00
18 - EAA	1.00
Total	190.20

List of deliverables

Deliverable Number ¹⁴	Deliverable Title	Lead beneficiary	Type ¹⁵	Dissemination level ¹⁶	Due Date (in months) ¹⁷
D2.1	Data Management Plan	1 - UNA	Report	Confidential, only for members of the consortium (including the Commission Services)	6
D2.2	Integrated Data Management Report	10 - RASDAMAN	Report	Confidential, only for members of the consortium (including the Commission Services)	18
D2.3	Data Ingest and Acquisition Report	10 - RASDAMAN	Report	Confidential, only for members of the consortium (including the Commission Services)	18
D2.4	Technical Support Report	10 - RASDAMAN	Report	Confidential, only for members of the consortium (including the Commission Services)	18
D2.5	Data Management Plan – updated version	1 - UNA	ORDP: Open Research Data Pilot	Confidential, only for members of the consortium (including the Commission Services)	40
D2.6	Standardization Report	10 - RASDAMAN	Report	Confidential, only for members of the consortium (including the Commission Services)	42

Description of deliverables

D2.1 : Data Management Plan [6]

Data Management Plan

D2.2 : Integrated Data Management Report [18]

Integrated Data Management Report

D2.3 : Data Ingest and Acquisition Report [18]

Data Ingest and Acquisition Report

D2.4 : Technical Support Report [18]

Technical Support Report

D2.5 : Data Management Plan – updated version [40]

Data Management Plan – updated version

D2.6 : Standardization Report [42]

Standardization Report

Schedule of relevant Milestones

Milestone number ¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS2	Documentation and training material ready	10 - RASDAMAN	12	Documentation and training material ready Means of verification: Training material have been distributed to partners
MS4	Setup phase finished – databases are deployed “as is”, ready for use	10 - RASDAMAN	12	Setup phase finished – databases are deployed “as is”, ready for use. Means of verification: Crosscheck with the list of databases supplied in the LANDSUPPORT proposal annex
MS8	First set (10) of DSS tools	2 - ARIES	18	First set (10) of DSS tools (mainly related to land take and agriculture) are ready for testing. Means of verification: they can be freely verified and tested by anyone through the LANDSUPPORT web site
MS13	Second set (20) of DSS tools	2 - ARIES	24	Second set (20) of DSS tools (mainly related to agriculture, land degradation and environment) ready for testing. Means of verification: They can be freely verified and tested by anyone through the LANDSUPPORT web site
MS17	Third set (20) of DSS tools	2 - ARIES	30	Third set (20) of DSS tools (mainly related to ecosystem service evaluation) ready for testing. Means of verification: they can be freely verified and tested by anyone through the LANDSUPPORT web site
MS20	Final version of LANDSUPPORT platform available	1 - UNA	40	Final version of LANDSUPPORT platform available. Means of

Schedule of relevant Milestones

Milestone number¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
				verification: Delivery through the web of the operational final LANDSUPPORT DSS system (see also D5.4)
MS21	Final set (50) of DSS tools	2 - ARIES	40	Final set (50) of DSS tools (mainly related to LULUCF models and spatial planning) ready. Means of verification: they can be freely verified and tested by anyone through the LANDSUPPORT web site

Work package number ⁹	WP3	Lead beneficiary ¹⁰	5 - CNR
Work package title	Developing high performance models		
Start month	1	End month	40

Objectives

1. A multiscale and modular modelling system to deliver the multipurpose specific objectives tuned in WP1.
2. A set of add-on models for accomplishing geospatial data, time series and uncertainty analysis.

Description of work and role of partners

WP3 - Developing high performance models [Months: 1-40]
CNR, UNA, ARIES, BSC, CFF, ICARDA, ISPRA, JRC, UPA, UMI, ACTEON, EAA, SFI

Approach:
This WP refers to the development and optimization of several models, most of them organized in a modular structure, allowing to solve many different issues related to the agro-environmental policies reported in WP1 and tables 1.1b and 1.1c (from chapter 1). WP3 is strictly depending on WP2 and take into account user requirements (WP1). Where the data availability is adequate, a physically-based modelling approach will be pursued because the transferability/replicability of a model with a strong physic-chemical base is higher than the empirical one, and the limitations due their high computation requirement is overcome by the development of the high-tech procedure embedded in WP2 and WP5 and in the very-high computational capacity expected in the near future (e.g. GPU technologies changes). Another special feature of the LANDSUPPORT approach concerns the flexibility in using different modules (and thus codes to be written in this WP) for the same issues according to the scale of concern and data availability (e.g. Tasks 3.2 & 3.3). Here we must emphasize that currently available potentially useful desktop models (e.g. AQUACROP, Roth-C) cannot be employed “as they are” in any on-the-fly web-based geospatial DSS such as LANDSUPPORT. Thus all desktop models we aim to use, must be optimised for the LANDSUPPORT platform, specifically for the COMPSs/PyCOMPSs programming environment. Some processes will need to be rewritten from already existing and well functioning models (e.g. numerical solution of soil water balance described in the SWAP model according to the Richards’ equation) and for other processes, new codes will be written when necessary (e.g. new digital mapping engine). All models for LANDSUPPORT (new codes, rewriting of already existing approaches, their optimization and their integration) will be developed in this WP3. The activities are divided into 7 - strongly interconnected - Tasks. Task 1 concerns the writing of some general models (e.g. data spatialization) crossing many issues and not specifically related to a policy; Task 2 to Task 6 concern models approaching specific policies (i.e. Agriculture and Forestry, Ecosystem services evaluation); finally, Task 7 concerns the translation of all modules from the previous Tasks to target programming language for COMPSs.

Task description
Task 3.1 Developing automatic spatial modelling, uncertainty modules and basic statistic modelling. (Start: M1; End: M39; Lead: CNR; connected with D3.4).
CNR will develop a new digital mapping engine to be embedded in the LANDSUPPORT GCI. CNR will also implement automatic pre-processing tools for time series (climatic and socioeconomic) as the ones implemented in SOILCONSWEB (www.landconsultingweb.eu) enabling the quality checks of incoming raw data and the infilling of missing and anomalous data; and an automatic digital terrain modelling which will transform a vector of sparse geospatial points into a raster of grid points by automatically perform spatial interpolation. The end-product of the digital mapping engine includes 12 digital terrains, 15 soil and 8 socio-economic maps and 5 climatic (and any other time-dependent variable) data cubes of the regions of interest. Furthermore, CNR and UNIBAS – with the responsible of data collection (see WP2) for each local pilot site in AUSTRIA (BOKU), HUNGARY (UPA), ITALY (UNA), and MALAYSIA (CFF) – will develop a procedure to evaluate for some models the propagation of inherent uncertainty in model input data into uncertainty in the model output selected by the decision maker for groundwater vulnerability to nitrate and pesticides (Marchfeld), soil sealing (Keszthely), viticulture (Valle Telesina) and underutilised annual crops (Malaysia). CNR will perform a sensitivity analysis of the model developed in the following Task 2-3-4-5-6 to identify which model parameters are more sensible to the output required and, accordingly – from the estimated parameter variability and covariance matrix – the uncertainty modules

will be implemented in MatLab programming language. These modules will be used in WP4 Task 4.2 and WP5, giving the results also in terms of their uncertainty and not only absolute value.

Task 3.2: Implementing models for crop productivity and agroecosystems management. (Start: M1; End: M24; Lead: UMI; connected with D3.1)

This activity refers to the implementation of models in a modular structure, which will allow to simulate crop growth, nutrients and water balance, pesticides, carbon management, groundwater pollution and field management in the soil–plant–atmosphere (SPA) continuum at a daily time-step with the aim of testing the feasibility and the environmental suitability of the policies (e.g. EC CAP) under various pedoclimatic conditions in Europe, including climate change scenario. Annual crops (e.g. maize, wheat, etc.), pasture, some perennial crops (e.g. orchards and grapevine), underutilized crops (see Task 3.5) and forestry will be simulated. Several combinations of modules will be realised according with the spatial extent of environmental input data (see WP2). As shown in the Fig. Wp3.1 below, for each module a different approach will be applied according to the spatial scale at which the analysis is performed.

At local scale, CNR and UMI will write the water balance modules simulating infiltration, drainage, root water uptake, transpiration, soil water storage, etc., by using both the solution of the Richards' equation (as implemented in SWAP model) and a simpler cascade (bucket) approach (i.e. AQUACROP). UMI will write the crop growth module in terms of Above Ground Biomass, yield, gross primary production and nitrogen uptake. Four modules will be delivered: a) Carbon-driven; b) Solar-driven: Light use efficiency (LUE); c) Solar-driven: Radiation use efficiency (RUE); d) Water-driven.

Then, UMI will write the detailed C-N module, mainly based on the SOILN model. Output of the module are: NO₃ leaching, soil carbon sequestration, ecosystem CO₂-C respiration, NH₃ and N₂O emissions to the atmosphere.

Finally, UMI will write module for management options (i.e. simulations of alternative agri-environmental scenario) defined by the local user: (i) crop rotation, (ii) sowing and harvest time, (iii) time, amount and type of N fertilizers, (iv) time and amount of the irrigation, (v) tillage operation (soil depth, time, etc.), (vi) crop residues management (pruning and grassing down under tree crops).

At Regional/National scale, where the detail of environmental data is expected to be lower, UMI will write codes where simpler approaches (e.g. regressions and bootstrapping methods, Stochastic Gradient Treeboost) are applied. The water balance and crop growth module will be the already described cascade module and water-driven growth-engine, both based on AQUACROP codes (FAO model, see annex 1). UMI will also write a C-N module (based on Roth-C code) with a medium to long-term soil organic matter turnover. Output of the model will be the total organic C content of top soil over a few decades with monthly time step. Furthermore, UMI will write modules on the crop and soil management (e.g. mulches, weed, irrigation) following the approach of AQUACROP.

Finally, UMI will write the modules for forestry and perennial crops such as orchards and grapevine following CropSyst approach, including management options: cultivar selection, irrigation, nitrogen fertilization, tillage and residue management.

Task 3.3: Implementing models for Land Degradation and Environmental issues. (Start month: 1; End month:24; Lead: CNR; connected with D3.1).

This activity concerns the implementation of models supporting the development of environmental policies. The policies tackled in this Task spreads over different issues and applies at different scales (e.g. soil thematic strategy COM 2006/231, nitrates Dir.91/676/EEC, water framework Dir. 2000/60/EC, SWD(2012) 101 final). The task will include the following activities:

Land take/soil sealing/urban sprawl: ISPRA with the support of JRC, UNA, EAA, will elaborate land take and soil sealing modelling to be employed for maps and indicators at European, National and Regional scales. Multi-scale and multi-temporal satellite data or other available maps services (e.g. Land Cover and Land Use maps) will feed land take models. More specifically, the net annual increase of the total urban area, the percentage and the per capita of land take/soil sealing will be computed. Moreover, ISPRA will produce several landscape indicators and indices (Patch area, Edge density, Largest Patch Index, Shape index, etc.), to identify the spatial patterns of the landscape and their change in the space. Finally, UNA with ISPRA, EAA and INU (stakeholder) will develop tools – for the national and European scales – on the rate of urban dispersion (sprawl) in order to describe physically expanding low-density urban areas accommodating new urban economies (EEA, 2006).

Pollutants modelling: Here modules to face with nitrates Dir.91/676/EEC, pesticides Dir 128/2009/EC, water framework Dir. 2000/60/EC, Soil thematic Strategy COM 2006/231 and Phosphorus COM 2013/517 will be written. The developed modules are tightly connected to the modules reported in the Task 3.2 (e.g. those for the water balance and the solute transport).

Here, CNR and its contractor (UNIBAS) will write the module for the fate of pollutants from the soil surface to the vadose zone. At local scale they will implement the well-established advection–dispersion equation including adsorption for non-reactive solutes. They first will start with modelling simple not reactive solute (e.g. chloride), then solutes exchanging with the matrix (e.g. carbonates and sodium for salinization), furthermore they include codes for reactive

solutes (e.g. nitrates, pesticides, phosphorus). At Regional/national scale CNR and UNIBAS will write the simple code for “index and overlay” models (e.g. DRASTIC-like approach) resulting in qualitative/comparative maps. Then, where more data on climate, stratigraphy, soil, groundwater and cropping practices are available (e.g. Valle Telesina-IT and Marchfeld-AT) the local-scale codes will be coupled with the uncertainty module (see Task 3.1). Finally, they will write the module called Type Transfer Function (TTF). This part on pollution will result in the writing of 3 modules for the local scale and 3 for the regional/national scale.

Soil erosion: UNA in collaboration with ICARDA, JRC and SFI (for forestry) will implement the well-established RUSLE formula (USDA), as interactive modelling procedure using the data produced in WP2 (e.g. landforms, slopes, soil, vegetation cover, etc.). The erosion tool will implement also a “what-if” procedure allowing the end-users to anticipate impacts of changes in climate and land use/management (in term of different scenarios). It will be applied in ITALY, AUSTRIA, TUNISIA and HUNGARY.

Landslides: UNA will also address landslides issue through a land evaluation approach producing a local land classification in terms of pedological vulnerability to landslides.

Organic carbon: UMI will integrate organic carbon modelling through the modelling approaches reported in RothC model, to simulate the effects on soil carbon sink according to changes in land use scenario, including management and climate change.

EU-scale and outside EU models: At Regional/National and EU scale UNA and JRC (and GSP in SHG) will implement and make interactive already existing databases, maps (see WP2) and approaches such those produced by EU-JRC: Soil erosion in EU, 2015; Soil loss rates in arable lands, 2015; European Landslide Susceptibility Map (ELSUS-1000), 2013; Natural susceptibility to soil compaction in Europe, 2008; Global Atlas for Soil Biodiversity, 2016; Top Soil Organic Matter Content map, 2004.

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ask 3.4: Implementing key models from outside Europe: CropBASE (Malaysia) and GeOC (Global). (Start: M6; End: M24; Lead: CFF; connected with D3.1).

CFF will adapt the own CropBASE tool to be operable – at local and regional scale – in the LANDSUPPORT language and system. The tool will provide a quantitative basis to evaluate crop productivity and resource-use-efficiency of major and underutilised crops and cropping systems under current and future climate scenarios. ICARDA will adapt the own GeOC tool to be operable in the LANDSUPPORT language and system. GeOC (Geoinformatic Options by Context) is a global tool for overviewing sustainable land management (SLM) options fitted to a specific social-ecological context and for extrapolating areas with a similar context for suitable application of the SLM options. The tool will be applied in ITALY, AUSTRIA and HUNGARY for simulating best agricultural practices adoption to face the land degradation, including regional scale. CNR, UNA and ARIES will collaborate with both CFF and ICARDA to guarantee the matching of CropBASE and GeOC with the LANDSUPPORT platform.

Task 3.5: Implementing climate change resilience in biophysical models and LULUCF models to estimate the impact of past and current LULCs and for future scenarios. (Start: M6; End: M24; Lead: ISPRA; connected with D3.3).

ISPRA, CNR and UNA will implement HPC algorithms to provide real-time calculations for the followings:

(i) evaluation of climate change resilience – based on two different IPCC emission scenarios – in biophysical models developed in Tasks 3.2 & 3.3. CC resilience will be implemented in terms of both CC mitigation (e.g. analysis of potential vegetation/soil carbon sequestration and mapping land-use change) and CC adaptation (e.g. change of crop type).

(ii) current and past LULUCF. Here at least 20 indicators/models will be implemented on data coming from measurements of the LULC. Examples of the output from these models can be found at www.soilmonitor.it. EAA and ISPRA provide past data (Task 2.1) and current EO data after the pre-treatments (Tasks 2.1 & 2.2).

(iii) For future LULUCF scenarios, CNR and UNA will implement the cutting-edge SLEUTH urban and land use change model (USGS) simulating multiple land cover class transitions, including the IPCC classification scheme. The urban growth model is based on cellular automata and combines digital terrain modelling (see Task 3.1) with land cover modelling. CNR, UNA and BSC will parallelize the cellular automata calculation in order to speedup the procedure of calibration and testing.

Task 3.6: Ecosystem services (ES) evaluation and socio-economic models. (Start: M3; End: M39; Lead: ACTeon; connected with D3.2).

ESs are evaluated on the base of the different scales. At the local scale, where the most demanding applications are required (e.g. SEA, farm management), models will include the most reliable approaches as those reported into Tasks 3.2 & 3.3. At coarser scale (e.g. nation) more empirical approaches will be employed (e.g. INVEST).

SFI will develop relevant indicators representing the forest ecosystems' capacity to provide the tree ES and will evaluate the above indicators estimating their values also according to forest types. The task will also employ remote sensing data (see WP4) and field data to achieve best indicators estimates (e.g. biodiversity indexes, regeneration capacity).

AGES (working through BOKU contract) will link ESs of Landmark project (see table 1.3a, chapter 1) with those to be obtained in LANDSUPPORT (e.g. crops productivity, carbon storage, biodiversity, nutrients provision) thus re-using existing results.

CNR, UNA, ICARDA, UMI and ISPRA will run the models developed in WP3 and will produce the biophysical ESs quantification. Thus, ACTeon will value ESs produced. The valuation will account for the uncertainty of variables analysed, in order to include them in the economic model through risk assessment methodology as stated in EC guidelines (European Commission, 2014).

This task includes the accountability of ES change in the context of different scenarios (e.g. land uses and climate changes).

Task 3.7: Optimization of modelling chains. (Start: M6; End: M39; Lead: BSC; connected with D3.5).

BSC will define the requirements for the programming model that will be used to implement the optimized models. BSC will provide a uniform interface to different abstractions without having to worry about work and data distribution. The application will be written in sequential code using different programming languages (Python, Java, C++) and making use of the data access and processing primitives provided by the data layer. BSC will contribute the COMPSs/PyCOMPSs programming model that provides a task-based programming environment that will be used to implement implicit workflows of modelling units whose execution is orchestrated by the runtime (see Task 5.3). Furthermore, BSC will give to the WP3 partners both (i) early in the project the training and (ii) throughout the project the support on the use of COMPSs/PyCOMPSs programming model.

Participation per Partner

Partner number and short name	WP3 effort
1 - UNA	59.00
2 - ARIES	4.00
3 - BSC	34.00
5 - CNR	51.00
6 - CFF	15.00
7 - ICARDA	9.00
9 - ISPRA	33.60
11 - JRC	2.00
13 - UPA	7.00
14 - UMI	38.00
17 - ACTEON	9.00
18 - EAA	1.00
19 - SFI	14.00
Total	276.60

List of deliverables

Deliverable Number ¹⁴	Deliverable Title	Lead beneficiary	Type ¹⁵	Dissemination level ¹⁶	Due Date (in months) ¹⁷
D3.1	Newly develop modules on crop productivity, agro-ecosystems, depicting agriculture	14 - UMI	Other	Confidential, only for members of the consortium (including	24

List of deliverables

Deliverable Number ¹⁴	Deliverable Title	Lead beneficiary	Type ¹⁵	Dissemination level ¹⁶	Due Date (in months) ¹⁷
	relationships between applications and scale of concern			the Commission Services)	
D3.2	Newly develop modules on environmental issues and land degradation depicting environmental relationships between applications and scale of concern	5 - CNR	Other	Confidential, only for members of the consortium (including the Commission Services)	24
D3.3	Newly develop multiscale models for ecosystem services evaluation	17 - ACTEON	Other	Confidential, only for members of the consortium (including the Commission Services)	24
D3.4	Newly develop climate change resilience modules in biophysical models, LULUCF models and future LULC scenarios	9 - ISPRA	Other	Confidential, only for members of the consortium (including the Commission Services)	30
D3.5	Newly develop automatic spatial modelling capable of ingesting newly available information	5 - CNR	Other	Confidential, only for members of the consortium (including the Commission Services)	30
D3.6	Report on the final models implementation and optimization. The final release of the models will integrate all the optimizations in the modelling chains	3 - BSC	Other	Confidential, only for members of the consortium (including the Commission Services)	40

Description of deliverables

D3.1 : Newly develop modules on crop productivity, agro-ecosystems, depicting agriculture relationships between applications and scale of concern [24]

Newly develop modules on crop productivity, agro-ecosystems, depicting agriculture relationships between applications and scale of concern

D3.2 : Newly develop modules on environmental issues and land degradation depicting environmental relationships between applications and scale of concern [24]

Newly develop modules on environmental issues and land degradation depicting environmental relationships between applications and scale of concern

D3.3 : Newly develop multiscale models for ecosystem services evaluation [24]

Newly develop multiscale models for ecosystem services evaluation

D3.4 : Newly develop climate change resilience modules in biophysical models, LULUCF models and future LULC scenarios [30]

Newly develop climate change resilience modules in biophysical models, LULUCF models and future LULC scenarios

D3.5 : Newly develop automatic spatial modelling capable of ingesting newly available information [30]

Newly develop automatic spatial modelling capable of ingesting newly available information

D3.6 : Report on the final models implementation and optimization. The final release of the models will integrate all the optimizations in the modelling chains [40]

Report on the final models implementation and optimization. The final release of the models will integrate all the optimizations in the modelling chains

Schedule of relevant Milestones

Milestone number ¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS2	Documentation and training material ready	10 - RASDAMAN	12	Documentation and training material ready Means of verification: Training material have been distributed to partners
MS8	First set (10) of DSS tools	2 - ARIES	18	First set (10) of DSS tools (mainly related to land take and agriculture) are ready for testing. Means of verification: they can be freely verified and tested by anyone through the LANDSUPPORT web site
MS13	Second set (20) of DSS tools	2 - ARIES	24	Second set (20) of DSS tools (mainly related to agriculture, land degradation and environment) ready for testing. Means of verification: They can be freely verified and tested by anyone through the LANDSUPPORT web site
MS17	Third set (20) of DSS tools	2 - ARIES	30	Third set (20) of DSS tools (mainly related to ecosystem service evaluation) ready for testing. Means of verification: they can be freely verified and tested by anyone through the LANDSUPPORT web site
MS20	Final version of LANDSUPPORT platform available	1 - UNA	40	Final version of LANDSUPPORT platform available. Means of verification: Delivery through the web of the operational final LANDSUPPORT DSS system (see also D5.4)
MS21	Final set (50) of DSS tools	2 - ARIES	40	Final set (50) of DSS tools (mainly related to LULUCF

Schedule of relevant Milestones

Milestone number¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
				models and spatial planning) ready. Means of verification: they can be freely verified and tested by anyone through the LANDSUPPORT web site

Work package number ⁹	WP4	Lead beneficiary ¹⁰	4 - BOKU
Work package title	Monitor/ assess/ validate LANDSUPPORT technical and scientific results		
Start month	1	End month	42

Objectives

The overall objective is i) to enable a continuous monitoring of highly dynamic land surface variables using satellite data and ii) to provide vegetation biophysical variables to run, assess and validate model results.

Description of work and role of partners

WP4 - Monitor/ assess/ validate LANDSUPPORT technical and scientific results [Months: 1-42]

BOKU, UNA, ARIES, CNR, CFF, UPA, UMI, SFI

Approach:

A variety of LANDSUPPORT tools (tools “b,d,h,k” in table 1.1b chapter1) require to address and thus to monitor some highly dynamic land surface conditions related to land cover / land use and vegetation status. WP4 aims at collecting, pre-processing and delivering a portfolio of Earth observation (EO) maps and products from the Copernicus Sentinel satellites. In particular, LANDSUPPORT proposes the fully automated processing of European-wide cloud-free surface reflectance composites to deliver data and value-added products with a regular interval of 10 days at 10 m pixel size over all Europe. The pre-processed data will be ingested into a high efficient raster data management system (rasdaman) and used for mapping land cover / land use changes (Task 4.1) and for model data assimilation (Task 4.3).

Task 4.1: High spatial resolution land surface monitoring. (Start: M1; End: M36; Lead: BOKU; connected with D4.1, D4.2 and D4.3)

The task is organised in three activities:

Continuous monitoring (production of base-layers). BOKU will tackle the problem of spatially and temporally fragmented EO data to produce homogeneous (in space and time) multi-temporal and multi-sensor set of observations to be ingested in the geodatabase WP2. On the base of the needs (see WP1, WP2 and WP3), BOKU will first analyse the data requirement (e.g. frequency of update, accuracy of retrieval, spatial extent, temporal/spatial resolution) and then performs the selection of suitable satellite platforms (Sentinel-1, -2, -3) and bio-geophysical indicators (LAI, fAPAR, Albedo) tuned to addressed spatial extent/issue (from Regional to EU) of various policies (WP1). BOKU will produce a fully automated processing of European-wide monthly image composites (cloud-free for Sentinel-2A and -2B) at high spatial resolution all projected to the same spatial reference and extent. The basic processing steps (temporal composites of surface reflectance and bio-geophysical indicators) will be performed at BOKU using available resource (Vienna Scientific Cluster).

Land cover/Land Use mapping and change analysis. BOKU will process high spatial resolution multi-temporal land cover / land use maps (and changes) as those required to evaluate greening (pillar 1) measures (e.g. buffer strips) and for carbon reporting (e.g. see Task 3.2 and 3.3). LANDSUPPORT will improve (in terms of thematic accuracy, thematic content, timing of delivery, spatial detail and representativeness) currently available land cover / land use layers for Europe (mainly based on six IPCC land categories and on a sample of field data producing an aggregated report that does not consider the high spatial variability characterizing European landscapes). Our starting point will be the maps available from the Copernicus High Resolution Layer catalogue of the Land Monitoring Services, considering the following layers:

- Tree Cover Density (TCD): 1) Evergreen/non-evergreen broad-leaved, sclerophyllous and coniferous trees; 2) Orchards, olive groves, fruit and other tree plantations, agro-forestry areas, forest nurseries, regeneration and transitional woodlands; 3) Alleys, wooded parks and gardens; 4) Groups of trees within urban areas; 5) Forest management/use features inside forests (forest roads, fire-breaks, etc.) and forest damage features inside forests (partially burnt areas, insect-infested damage, etc.) are included.
- Forest Type (FTY), close to the FAO forest definition: Dominant leaf type of trees with two classes: "broadleaved" and "coniferous" (binary product).
- Natural Grasslands (NGR): Binary product: grassland/non-grassland.
- Wetlands (WET): Binary product: wetland/non-wetland.
- Imperviousness Degree; Degree of Imperviousness (in 1-100%) or soil sealing: It is based primarily on semi-automatic classification of NDVI multispectral satellite data (derived from Image2012). Step-wise enhancement using CLC 2006/2012 and mitigation (cloud-/gap-filling) with additional EO data and subsequently final integration to a European mosaic.

- Cropland: Not available.

The spatial coverage (EU) and spatial resolution (10-20 m pixel size) of these layers are satisfactory but all products are not timely updated and the most dynamic land cover type, the cropland, is missing. In this regard, BOKU aims at improving the European land monitoring capacities and at reducing the duration and cost of the current production process.

In particular, the activity of BOKU refers to:

for Cropland mapping, the development of a fully automated processing chain to obtain European-wide:

- seasonal cropland mask and yearly synthesis to identify cultivated land at 10 m (binary product: winter/summer crops).
- yearly crop type maps using a supervised classification approach at two levels:

o EU focus -> It will be explored the suitability of the LUCAS 2018 land cover data set to map crop types automatically.

This data set will be delivery only in 2019 (<http://ec.europa.eu/eurostat/web/lucas/data/primary-data/>) therefore in the development phase we will use EO data from Landsat-8 and the existing version of the LUCAS data set (2015).

o Regional focus -> It will be implemented an automatic workflow to ingest regional reference data (acquired locally) and to produce crop type maps for the main regional crops at 10 m

for Forest land, Grassland, Wetlands and Settlements, a yearly update starting from the existing layers and include a disturbance (fires, logging, disease, etc.) mapping to highlight areas under change.

Assessment of existing products for forest ecosystem production mapping and adaptation to Sentinel-2 and -3 data. The activity concerns the delivery of spatially and temporally distributes estimates of NPP is based on the use of satellite observations to drive models. In this activity BOKU, ARIES and SFI will 1) compare the results of different Gross Primary Production (GPP) and Net Primary Production (NPP) physical models (e.g. MODIS, C-Fix and Biome-BGC) and datasets via a literature review and 2) evaluate the suitability of Sentinel-2 (fAPAR and LAI, land cover, phenology) to estimate GPP and NPP estimates for three case studies in Slovenia, Italy and Austria.

Task 4.2: Performing the consistency check of implemented models. (Start: M13; End: M36; Lead: UMI).

The task aims at implementing a framework to facilitate a direct comparison of model state variables in a number of case studies using existing data.

1) UNA, CNR, CFF, BOKU, UPA and UMI will collect the available pre-existing field data on soil and plant monitoring, in their local case studies, at different spatial scale. In the specific, the available data will cover the model input needs (e.g. soil pedological information and hydraulic parameterization; weather information) and the data needed for the consistency check. This last will consist in comparing simulation with field measurement of soil water content (SWC), crop above ground biomass (AGB), crop LAI development and crop nitrogen uptake (CNU).

2) UMI will identify the proper model structure (combination of modules) to be applied in according with the detail and quality of available data supplied by the other partners

3) UNA, CNR, CFF and UMI organize the input data for the simulation runs according with the protocols defined in the WP3.

4) UMI will produce the results of consistency check in each pilot site, comparing the output of applied model structure with the field data measurements by means of statistical indexes (RMSE, r, CRM). In the following table, a list of pre-existing available field data from involved partners of this task is reported.

- Partner:UMI&CNR - Scale:Regional (Italy) - Project:ARMOSA - Available dataset:11 years 2002-12, 6 sites, maize-based cropping systems (AGB, LAI, SWC and CNU) - Consistency check on:AGB, LAI, SWC and CNU on maize

- Partner:CNR - Scale:Local (Reg. Campania) - Project:Nitrate Campania - Available dataset:3 years (2004-2006), rotation maize-fennel:crop growth (AGB and LAI), SWC, CNU - Consistency check on:AGB, LAI, SWC and CNU on maize-fennel

- Partner:UNA&CNR - Scale:Local(Reg. Campania) - Project:ZOVisA - Available dataset:3 years (2011-2013), grapevine Aglianico: Yield, SWC - Consistency check on:Yield and SWC on grapevine

- Partner:CFF - Scale:Local(Malaysia) - Project:Internal Project - Available dataset:2 years of yield data on bambara groundnut (Vigna subterranea), 1 season yield data for Moringa oleifera - Consistency check on:crop selection and yield of the FMIS tool at farm scale in the tropics

- Partner:BOKU - Scale:Local(Marchfeld) - Project:FATIMA - Available dataset:2 years (2016/17) of biomass, management and yield data for 12 plots of winter wheat (3 Nitrogen treatments with 4 replicates) - Consistency check on:Winter wheat LAI curve estimated by model and satellite.

- Partner:UPA - Scale:Local(Keszthely) - Project:iSQAPER - Available dataset:5 years (2013-17) of biomass, management and yield data (AGB, SWC) - Consistency check on:Crop productivity model on AGB and SWC

Task 4.3: Data assimilation. (Start: M12; End: M39 Lead: BOKU; connected with D4.4)

The scope is to select best approaches to incorporate observations (model variables) collected at ground or from satellite into the numerical models deployed in LANDSUPPORT (e.g. crop growth model, soil water balance), to fine tune or update the model status and to produce a reliable model prediction. BOKU, UMI and CNR will implement

two conceptual frameworks for data assimilations: (a) Top-down: where model state variables (such as LAI, crop phenology) are estimated using satellite data and assimilated in models for field or landscape level analysis; and (b) Bottom-up: where model state variables (e.g. LAI, Soil Carbon via soil colour or punctual analysis) and ancillary data (e.g. irrigation volumes, Nitrogen application, yield) are obtained directly from farmers using smartphone applications (LANDSUPPORT-app) at field level. Via the use of pre-defined forms, the information is submitted to the central LANDSUPPORT database and used to generate reports and response to a number of management issues including water and nitrogen use efficiency, yield loss due to stresses, expected time of critical phenological phases (e.g. beginning of stem elongation, flowering), carbon net ecosystems exchange. The bottom-up contributions will also feed tools “f” and “g” (table 1.1c chapter 1) at regional and local scales. The same tools will also be available by a FMIS approach (dedicated dashboard). Here farmers can use and receive support for planning irrigation, N fertilization, harvesting and predicting the onset of fungal diseases by the LANDSUPPORT platform by inserting in the system their own soil/plant/climate parameters by using the option for customized use of LANDSUPPORT database. At local scales (e.g. see high school of Telesia in SHG) the bottom-up framework also contributes to the landscape awareness tool “o” (table 1.1c chapter 1) by acquiring georeferenced qualitative data (e.g. jpg, mp3, mp4) such as recent and old photographs of rural landscape, audio or video files related to story-telling concerning a specific landscape general information). This information will then be processed and delivered in WP5.

Participation per Partner

Partner number and short name	WP4 effort
1 - UNA	9.00
2 - ARIES	4.00
4 - BOKU	58.00
5 - CNR	42.00
6 - CFF	16.50
13 - UPA	8.00
14 - UMI	20.00
19 - SFI	32.00
Total	189.50

List of deliverables

Deliverable Number ¹⁴	Deliverable Title	Lead beneficiary	Type ¹⁵	Dissemination level ¹⁶	Due Date (in months) ¹⁷
D4.1	Software implementation and data delivery: Deployment of the seasonal cropland mask processor and automatic delivery of seasonal updates and yearly synthesis	4 - BOKU	Other	Public	18
D4.2	Software implementation and data delivery: land cover processors and integration in web interface	4 - BOKU	Other	Public	24

List of deliverables

Deliverable Number¹⁴	Deliverable Title	Lead beneficiary	Type¹⁵	Dissemination level¹⁶	Due Date (in months)¹⁷
D4.3	Technical report: review of the forest ecosystem production mapping algorithms and roadmap for Sentinel	4 - BOKU	Report	Public	36
D4.4	Technical report: best practices for consistency checks and data assimilation in the LANDSUPPORT modelling framework	14 - UMI	Report	Confidential, only for members of the consortium (including the Commission Services)	40

Description of deliverables

D4.1 : Software implementation and data delivery: Deployment of the seasonal cropland mask processor and automatic delivery of seasonal updates and yearly synthesis [18]
 Software implementation and data delivery: Deployment of the seasonal cropland mask processor and automatic delivery of seasonal updates and yearly synthesis

D4.2 : Software implementation and data delivery: land cover processors and integration in web interface [24]
 Software implementation and data delivery: land cover processors and integration in web interface

D4.3 : Technical report: review of the forest ecosystem production mapping algorithms and roadmap for Sentinel [36]
 Technical report: review of the forest ecosystem production mapping algorithms and roadmap for Sentinel

D4.4 : Technical report: best practices for consistency checks and data assimilation in the LANDSUPPORT modelling framework [40]
 Technical report: best practices for consistency checks and data assimilation in the LANDSUPPORT modelling framework

Schedule of relevant Milestones

Milestone number¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS7	Suitable satellite platforms and geo-indicators identified for continuous monitoring	4 - BOKU	18	Suitable satellite platforms and geo-indicators identified for continuous monitoring of dynamic high-resolution geodata. Means of verification: Data available on server
MS8	First set (10) of DSS tools	2 - ARIES	18	First set (10) of DSS tools (mainly related to land take and agriculture) are ready for testing. Means of verification: they can be freely verified and tested by anyone through the LANDSUPPORT web site

Schedule of relevant Milestones

Milestone number ¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS12	Solutions developed for automated updates of European land cover and land use data layers	4 - BOKU	24	Solutions developed for automated updates of European land cover and land use data layers. Means of verification: Data available on server
MS13	Second set (20) of DSS tools	2 - ARIES	24	Second set (20) of DSS tools (mainly related to agriculture, land degradation and environment) ready for testing. Means of verification: They can be freely verified and tested by anyone through the LANDSUPPORT web site
MS14	Ready for consistency check of models	4 - BOKU	24	Ready for consistency check of models. Means of verification: Data sets and modules coming from different partners are organized for the following model consistency check
MS15	Best approaches for data assimilation selected	4 - BOKU	24	Best approaches for data assimilation selected for further development and optimization. Means of verification: Concise report on the chosen approaches for data assimilation according to different tools and scales of application. This report will also be part of D4.4
MS17	Third set (20) of DSS tools	2 - ARIES	30	Third set (20) of DSS tools (mainly related to ecosystem service evaluation) ready for testing. Means of verification: they can be freely verified and tested by anyone through the LANDSUPPORT web site
MS20	Final version of LANDSUPPORT platform available	1 - UNA	40	Final version of LANDSUPPORT platform available. Means of verification: Delivery through the web of the operational final LANDSUPPORT DSS system (see also D5.4)
MS21	Final set (50) of DSS tools	2 - ARIES	40	Final set (50) of DSS tools (mainly related to LULUCF models and spatial planning) ready. Means of verification:

Schedule of relevant Milestones

Milestone number¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
				they can be freely verified and tested by anyone through the LANDSUPPORT web site

Work package number ⁹	WP5	Lead beneficiary ¹⁰	2 - ARIES
Work package title	Implementation of LANDSUPPORT Geospatial Cyberinfrastructure		
Start month	1	End month	42

Objectives

1. To design and develop a highly customized LANDSUPPORT Spatial Decision Support System web application
2. To integrate the engines modelling and data layers in the Web-based Geospatial CyberInfrastructure (GCI).
3. To customize the LANDSUPPORT Spatial Decision Support System at each scale of each country based on land policies and local requirements.

Description of work and role of partners

WP5 - Implementation of LANDSUPPORT Geospatial Cyberinfrastructure [Months: 1-42]
ARIES, UNA, BSC, BOKU, CNR, CFF, ICARDA, ISPRA, RASDAMAN, JRC, REGCAM, UPA, UMI, ZALA, ACTEON, EAA, SFI

Approach:
 This WP deal with the actual integration of approaches, data and model into the coherent frame of the Web-based Geospatial CyberInfrastructure (GCI) for the LANDSUPPORT Spatial Decision Supporting System (task 5.1). This WP is strongly technical because it aims to achieve the distributed framework which make LANSUPPORT operational through the web (task 5.2, task 5.3).
 Through the LANDSUPPORT GCI system, land policy actors (JRC, EAA, ISPRA, REGCAM, ZALA) including the stakeholders (SHG), will be supported in their institutional work towards better land policy implementation (task 5.4). From operational point of view, a user-friendly dashboard will be implemented. It will be designed based on human-centred concept: the design will focus on users, their characteristics, habits, and needs to achieve a usable system. To collect and share user requirements and needs a “wiki page” will be made available (we consider using system like Atlassian Confluence). Besides, users will be able to provide feedback to developers thanks a ticketing system with different levels of satisfaction.
 The dashboard will provide the users with tools to ingest, manage and disseminate relevant geospatial data as well as to help decision makers with addressing land policies implementation as reported in table 1.1a and 1.1.b (chapter 1). Moreover, the system allows users to download documents, reports, graphics, outputs from simulation scenarios and maps.
 To this end, it will combine many different high quality and dynamic layers of information through powerful processing tools, such as dynamic geospatial and hydrologic models running in (quasi) real-time and activated by remote queries. It will exploit the capability of various up-to date modules (rasdaman, COMPs and Geoserver), which will be mutually integrated in an innovative and performant framework.
 In order to better demonstrate how the detailed construction of the platform using existing models and writing new code, will actually happen, it is important to highlight that all models for LANDSUPPORT will be developed in WP3. As already stated, the currently available desktop models (e.g. AQUACROP, Roth-C) cannot be employed “as they are” in any on-the-fly web-based geospatial DSS such as LANDSUPPORT. First of all, models must be wrapped within COMPSs which provides a fast running environment. Each model must be written in a programming language recognized by COMPSs hence we need to translate already existent codes or write new codes in C/C++, Python or Java which are compatible with COMPSs. Once COMPSs is configured for model orchestration, it runs models according to the requests that users submit over the LANDSUPPORT GUI. Users need not to be experts about models or about the domain accounted by the models, therefore only relatively few and easy to set parameters are required over the GUI to launch a model. This is possible because all the advanced configurations and options are hidden and programmed in the middleware where the modeller and researcher expertise is embedded in. The middleware is an important piece of code to guarantee the correct use of models and the correct and accurate answer to a given problem. The following Fig. WP5.1 shows “how the detailed construction of the platform” is implemented in LANDSUPPORT GCI.

Fig. WP5.1. Overview of the LANDSUPPORT GCI with detailed steps and connection.

Task description
 Task 5.1: Overall architecture and system design (Start: M1; End: M6; Lead: ARIES; connected with D5.1)
 ARIES will design the platform architecture, ensuring that user requirements will be fully achieved. ARIES will transform user requirements (from WP1) and project objectives (see table 1.1a, 1.1b in chapter 1) into technical and software requirements: a clear understanding of user and task requirements and active involvement of users is crucial to

have a human-centred approach in system design. Output of WP1 (in particular task 1.2) led by EAA, will support ARIES in that, to be sure that software requirement will be perfectly defined. Special attention shall be paid in design of interfaces between modules and technologies used for them, to ensure a fully modular, interoperable and extensible architecture: rasdaman (provided by BSC and RASDAMAN to manage raster), COMPSs (providing by BSC to speed-up computational models) and Geoserver (to manage vectors data) have to coexist and they will be integrated in the web application. RASDAMAN and BSC will support ARIES to integrate their modules in the web application, defining specific technical requirements. All needed design information, flow-chart, use-cases and technical schemes will be collected in D5.1.

Task 5.2: Development of web platform. (Start: M3; End: M42; Lead: ARIES; connected with D5.2)

Implementing Graphical user interface: The GUI will be implemented as a modular dashboard: system administrator and user will be able to configure the GUI to adapt the systems to distinct contexts and user requirement. Thanks to this approach, the transferability for each case study will be strongly supported in order to achieve the more appropriate solution according to each case study (see also task 5.4). The system will contain about 100 DSS tools addressing agriculture, environment and spatial planning. ARIES will develop a very intuitive and user-friendly GUI based on different framework and libraries (Sencha ExtJS, OpenLayers, etc.) and in close interaction with WP5 research partners and with partners implementing land policies (JRC, EEA, ISPRA, REGCAM, ZALA). It will help and guide a multitude of profiles, such as farmers, agriculture and urban planning stakeholders, public bodies/ institutions, European citizens in their decision making process.

Through the GUI, users can see data for selected time periods and for their area of interest and then they can access to modelling and services providing by the LANDSUPPORT GCI (including OGC services). The visualisations will be based on map controls and information will be presented in map layers (including time series of raster Layers). For specific function, ARIES will provide further visualisation possibilities, like charts (including temporal chart based on time series of raster), tables, detailed reports with export capabilities and comparisons between different scenarios.

GUI will be implemented with modular approach. This will allow the customization (including a version in the language of the local site) for the different actors JRC, EAA, ISPRA, REGCAM, ZALA, ICARDA and for 2-3 groups of stakeholders to be chosen by the SHG (WP7). ARIES will also develop a multilevel land actors module for participative approach - applicable to several LANDSUPPORT models- which will give the users (citizens, scientific community, rural community, students, etc.) the possibility to populate the platform with their own data, comments and evaluation (see also WP6). To this end a “wiki page” will be made available (like Atlassian Confluence) and a ticketing system to collect the feedback from end-users.

The GUI development will follow as much as possible the agile manifesto principles (<http://agilemanifesto.org/>) based on early and continuous delivery of software which will be evaluated by end-users in order to deal with their needs and expectations.

Development of workflows control layer: ARIES will implement a control and management layer (middleware) in the server side of the GUI. It abstracts the applications from the underlying computing (WP3 by BSC) and data infrastructure (WP2 by RASDAMAN) in such a way that applications only need to focus in the actual algorithm and logic of the application. This layer, build on top of COMPSs Rasdman and Geoserver, comprises services, processes, flows and functionalities to ensure the overall execution of the system.

ARIES will deliver an alpha version of the system at M12 and a Beta version at M18 (see D5.2).

Task 5.3: Integration and testing with programming models and the data layer. (Start: M3; End: M24; Lead: BSC; connected with D5.3)

BSC will gradually integrate the components to bring the different system modules under the LANDSUPPORT GCI platform. BSC will gather the engines modelling and will develop the runtime of the GCI, implementing the expected optimizations and benefitting from the underlying hardware and software system and transparently interacting with the data services (WP2)*. The runtime will transform the calls of the tasks of a workflow to calls to specific data operators and processing primitives, automatically parallelizing the execution. This task has a tight link with WP3 for the implementation of the modelling chains. Any problems during the integration, which are due to component malfunction, shall be reported along with the necessary modifications. Results of this task will be collected in the D5.3.

*Note: LANDSUPPORT has to fulfil complex queries over big data to deliver the large amount of modelling outputs. This specific requirement can be fulfilled by taking advantage of using both the rasdaman community version which ensures transferability and replicability and the rasdaman enterprise version which will also enable to accelerate (e.g. using GPUs) the calibration, validation and testing phases of many real time modelling engines (WP3, WP4). More specifically BSC will acquire a perpetually valid license of rasdaman enterprise from RASDAMAN allowing parallel, distributed data processing of rasdaman queries. Rasdaman enterprise (it has no vendor lock-in because the interface is strictly based on open OGC standards, WMS, WCS, and WCPS) is required due to its capabilities of (i) federating with other high-profile data sites, such as ECMWF, NCI Australia, and eodatacube.org; (ii) operating on data “as is”

which is indispensable for DIAS access (where APIs are unspecified as of today); (iii) utilize the performance enablers of rasdaman enterprise for the Big Data processing foreseen.

Initially, this license will be with BSC (due to its particular experience in the field of Big Data), where one of the two data host nodes is built (the other one is at UNA), but by the end of the project the BSC licence will be hosted and/or migrated at the server of the coordinator UNA. UNA will guarantee after the end of the project (see 2.1.3 project follow-up and 2.2.1; dissemination and exploitation of results) both (i) full LANDSUPPORT functioning and (ii) sustained operation for better exploitation (e.g. maintenance, new development and testing) of the platform after the project end. The agreement between BSC and UNA has been established already.

Task 5.4: Application and adaptation of LANDSUPPORT GCI to all case studies. (Start: M12; End: M42; Lead: UNA connected with D5.4)

The aim of this task is to ensure the requested functionalities to all case study (whole European Union and 3 countries/ regions/ sites and as test outside Europe Tunisia). This implies to customize dashboard (GUI) for each pilot area, adapted to the land policies to be applied to each S-DSS scale. This customization will be achieved thanks the modular architecture of the systems (GUI included, see task 5.1 and 5.2). WP7 outputs will indicate how to customize GUI (including a version in the language of the local site) for the different actors JRC, EAA, ACTeon, ISPRA, REGCAM, ZALA, ICARDA and for 2-3 groups of stakeholders to be chosen by the SHG (WP7, Task 7.3). UNA will collect the specific additional local requirements and it will describe in detail the availability of relevant data for each case study. UNA, supported by each partner in charge of pilot areas (JRC, EAA, ISPRA, REGCAM, ZALA, ICARDA) and all research partners, will select a set of representative use case scenarios by each pilot area, it will coordinate the test of the system for each specific pilot and, finally, it will coordinate the adaptations to the service platform and its components according the user feedback. System testing and validation against the initial requirements will be performed also during this task. The test results will indicate any necessary modifications and improvements in the system. ARIES will provide modification to the platform, suggested by UNA. Output of this task is the deliverable D5.4

Participation per Partner

Partner number and short name	WP5 effort
1 - UNA	4.00
2 - ARIES	41.00
3 - BSC	18.00
4 - BOKU	2.00
5 - CNR	2.00
6 - CFF	1.00
7 - ICARDA	1.00
9 - ISPRA	0.30
10 - RASDAMAN	2.00
11 - JRC	1.00
12 - REGCAM	0.90
13 - UPA	6.00
14 - UMI	2.00
15 - ZALA	8.00
17 - ACTEON	1.00
18 - EAA	1.00
19 - SFI	5.00
Total	96.20

List of deliverables

Deliverable Number¹⁴	Deliverable Title	Lead beneficiary	Type¹⁵	Dissemination level¹⁶	Due Date (in months)¹⁷
D5.1	Architecture and Framework Specification	2 - ARIES	Report	Public	6
D5.2	Beta version of GCI platform	2 - ARIES	Other	Public	18
D5.3	Report on integration of COMPSs with data layer	3 - BSC	Report	Confidential, only for members of the consortium (including the Commission Services)	24
D5.4	Final version of GCI platform with adaptation to all case studies	2 - ARIES	Other	Public	40

Description of deliverables

D5.1 : Architecture and Framework Specification [6]
 Architecture and Framework Specification

D5.2 : Beta version of GCI platform [18]
 Beta version of GCI platform

D5.3 : Report on integration of COMPSs with data layer [24]
 Report on integration of COMPSs with data layer

D5.4 : Final version of GCI platform with adaptation to all case studies [40]
 Final version of GCI platform with adaptation to all case studies

Schedule of relevant Milestones

Milestone number¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS5	Launch of the LANDSUPPORT Web platform (1st version). Promotional material is ready	17 - ACTEON	12	Launch of the LANDSUPPORT Web platform (1st version). Means of verification: Promotional material is ready to use for communication and dissemination
MS8	First set (10) of DSS tools	2 - ARIES	18	First set (10) of DSS tools (mainly related to land take and agriculture) are ready for testing. Means of verification: they can be freely verified and tested by anyone through the LANDSUPPORT web site

Schedule of relevant Milestones

Milestone number¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS9	Beta version of platform architecture designed and ready	2 - ARIES	18	Beta version of platform architecture designed and ready for integration of the LANDSUPPORT approaches, models and data. Means of verification: It can be freely verified by anyone through the LANDSUPPORT web site
MS13	Second set (20) of DSS tools	2 - ARIES	24	Second set (20) of DSS tools (mainly related to agriculture, land degradation and environment) ready for testing. Means of verification: They can be freely verified and tested by anyone through the LANDSUPPORT web site
MS17	Third set (20) of DSS tools	2 - ARIES	30	Third set (20) of DSS tools (mainly related to ecosystem service evaluation) ready for testing. Means of verification: they can be freely verified and tested by anyone through the LANDSUPPORT web site
MS19	Test of LANDSUPPORT replicability	13 - UPA	36	Test of LANDSUPPORT replicability. Means of verification: SC evaluation about replicability. If the replicability report (see also D6.2; D6.3) is considered fine by SC then the platform is ready for the next steps otherwise a feedback will be given to other WPs and specifically for WP5 for better platform tuning.
MS20	Final version of LANDSUPPORT platform available	1 - UNA	40	Final version of LANDSUPPORT platform available. Means of verification: Delivery through the web of the operational final LANDSUPPORT DSS system (see also D5.4)
MS21	Final set (50) of DSS tools	2 - ARIES	40	Final set (50) of DSS tools (mainly related to LULUCF models and spatial planning) ready. Means of verification: they can be freely verified and tested by anyone through the LANDSUPPORT web site

Work package number ⁹	WP6	Lead beneficiary ¹⁰	13 - UPA
Work package title	Testing and validation of LANDSUPPORT results as support towards land policy		
Start month	13	End month	42

Objectives

1. Testing and validation procedures of the LANDSUPPORT DSS on European, country, regional and local (municipality and farm) levels in terms of its use as support to multilevel land policy implementation.
2. Critical evaluation of the applicability of LANDSUPPORT DSS by policy lines and biophysical conditions and feedback to system design and development
3. Meta-analysis of replicability and transferability to other areas within and outside Europe

Description of work and role of partners

WP6 - Testing and validation of LANDSUPPORT results as support towards land policy [Months: 13-42]
 UPA, UNA, ARIES, CNR, CFF, ICARDA, ISPRA, JRC, REGCAM, ZALA, EAA

Approach:
 This WP collaborates closely with other WPs, by testing the model performance (WP3 implemented in WP5) and the system according to user requirements (WP1) and features a set of feedback loops between Geospatial DSS tool development and testing and validation activities.

The testing and validation stage is implemented (including multi-actor approach), involving a large range of actors from institutional partners (JRC, EAA, ISPRA, REGCAM, ZALA) having specific responsibility in land policy implementation to end users with respect to European, country, region and local land policy implementation levels (see Table 1.1b for overview multilevel land policy details and Table 1.1.c for full descriptions of multilevel tools) and summarised by UPA. SHG will be especially active in testing the tools (see SHG members in 3.2.1) directly on the web platform. UPA will established - with the support of the all WP6 partners - a set of performance indicators for public bodies will include usability, accessibility, interoperability, reliability and operational capabilities of LANDSUPPORT services and user satisfaction. These performance indicators will be compiled by public bodies users when using the web platform. In addition, we complement these indicators with qualitative data obtained by stakeholder open-ended semi-restrictive and in-depth interviews.

Replicability and transferability of LANDSUPPORT to other European areas and outside Europe will be tested (including cross-site comparison) by involving all WP6 partners and also – most importantly - in close interaction with CFF and ICARDA. The pilot site in Tunisia will also support this replicability and transferability issue.

Indicators of stakeholder interest will be selected for cross-site comparison to ensure practical use and coherence.

This testing phase will account for meta-data measurements, ease of application, cost-effectiveness and interpretability of the LANDSUPPORT outputs.

Multi-stakeholder workshops will be used to define the requirements for LANSUPPORT tool and testing and improving it.

The beta-version of LANDSUPPORT tool will be made freely available in multilingual mode to users by ARIES for operational testing.

Task description

Task 6.1: Test of the system for European level policy needs. (Start: M13; End: M42; Lead: JRC; connected with D6.1)
 This task will test the LANDSUPPORT tool in terms of (i) its ability to achieve EU policies when applied at EU scale (including 7th Environmental Action Plan; COM 2006/231, Dir 2000/60/EC; Dir 2007/2/EC) and (ii) 2030 SDG’s land policies of both EU and UN agenda (SDG 2,3,13,15), with special emphasis to the key SDG15.3, “achieving a land degradation-neutral world” (LDN) and climate change (CC) mitigation goals. Functionality and applications for EU policy support at European scale will be assessed also in terms of interaction with other standard approaches in use at EC. Use for potential policy development will be evaluated. The main lead in this Task will be the JRC of the European Commission who - with the support of GSP, FAO (see SHG) - will closely evaluate the potential impact of LANDSUPPORT towards the above key SDG15.3, goal. ICARDA will contribute to the development of relevant conceptual framework and indicators for LDN, and by adapting the GeOC tool to generate policy relevant outputs (e.g. out-scaling of best agricultural and forestry practices to mitigate land degradation and assess the degree of LDN achievement).

JRC and ISPRA in collaboration with ECTP-CEU and INU stakeholders will evaluate the performance of DSS tools “k,l,m” over land take, SEA and green corridors at the European scale.

Task 6.2: Test the system for national scale policy needs. (Start: M30; End: M42; Lead: EAA; connected with D6.1)

This task will test the decision support tool in the three Member States of the European Union separately. Functionality and applications for current policy support will be demonstrated. Applicability for land use planning and potential policy development will be evaluated. Stakeholder needs will be channelled back to system development for enhancing the performance of the tool. To make sure that the decision support tool is suitable for different biophysical zones, land use systems, socioeconomic conditions and policy frameworks, LANDSUPPORT stakeholders of similar mandate (e.g. Confagricoltura, Hungarian Chamber of Agriculture) from different countries will test the tool. LANDSUPPORT will be tested in accordance to land policy national need as expressed in table 1.1.a. Testing will be performed as follows: ISPRA for Italy, EAA for Austria and the Hungarian Chamber of Agriculture for Hungary.

Specifically considering LANDSUPPORT impact over climate change (DSS tool b in table 1.1b) EAA and ISPRA will test the system (respectively in Austria and Italy) in relation to the national implementation of the LULUCF (European Decision n.529/2013 for climate change mitigation), mainly on reporting verification on changes of land cover. Furthermore, EAA and ISPRA will test and improve the information on grassland and settlement areas by using satellite data in order to make the calculations for the LULUCF reporting more robust.

EAA will also test and perform scenario analysis (e.g. land management change) to identify risk areas for nitrate pollution in order to support the Austrian Nitrate Action Programme (=implementation of the Nitrate Directive).

ISPRA and EAA - as land take is progressing - will test DSS tool “k” to (i) evaluate land take process over time and it will combine this information with soil quality information (ii) to perform spatial development scenarios in order to understand which soil-prone ecosystem services have been lost and may be lost in the future.

Additional EAA will evaluate the impact of future land take on the habitat distribution and high nature farmland in order to give recommendations for land planning towards the goal of Zero Net Land Take by 2050 and the goals of the Austrian Biodiversity Strategy 2020 (=implementation of EU Biodiversity Strategy) by testing tool “o”.

Task 6.3: Test the system at regional, local and farm scales for policy, land use allocation and land management needs. (Start: M30; End: M42; Lead: UPA; connected with D6.1)

ZALA, REGCAM, and EAA (in collaboration with SHG) will test LANDSUPPORT in accordance to all land policy regional needs (table 1.1b) and also considering priorities of regional and local stakeholders (SHG). Testing, in addition to the full regional scale, will be applied also to the regional/local sites of Valle Telesina (IT), Marchfeld (AT), Keszthely (HU) (detailed description in ANNEX 3) where the most relevant local policy needs will be evaluated in-depth. In addition, EAA will test the implementation of the LULUCF reporting verification changes of carbon on the information gained from the national project “Austrian Carbon Calculator” in which Marchfeld was one of the test areas. EAA test impacts of several different land management options on the building rate of soil carbon and also effects of future climate conditions. Also EAA will produce calculation of greenhouse gas emissions coupling more detailed data on land cover changes using satellite data.

REGCAM (and CNR) and EAA will test the pollution tools (DSS tool “i”) on available measurements of nitrogen in the soil in the Marchfeld area and in pilot sites of Regione Campania. On the base of these findings EAA, REGCAM and ZALA will test the delivery of advices to farmers about crop rotation, fertilisation and land management practices to lower nitrate leaching. Finally, in the three local sites EAA, REGCAM, ZALA and the INU stakeholder will test the use of the tool “k,l,m” on land take, SEA and EIA by analysing the landscape elements and other green infrastructure in the region combined with a prognosis of future land take in order to support the land planning and conserve or even improve biodiversity and ecosystem services.

Moreover, at the farm scale SHG (especially Confagricoltura-IT, Chamber of Agriculture-HU) will test both (i) the Farm Management and Information System (FMIS) in tool “d” and “g” (table 1.1c) and for (ii) tool “j” on nitrate and pesticide directive.

Most importantly, UNA will use the annually updated FADN socio-economy dataset (see also ANNEX 4) to test - over selected farms - at local/regional scale “if” and “how much” it is observed impact of LANDSUPPORT over farm management. This activity will be performed by analysing physical and structural data (e.g. crop areas, livestock numbers, labour force), economic data (e.g. value of production, production costs and subsidies).

Task 6.4: Meta-analysis of replicability and transferability of LANDSUPPORT to other European areas and outside Europe. (Start: M24; End: M42; Lead: UPA; connected with D6.2 and D6.3)

UPA and JRC will evaluate replicability and transferability of LANDSUPPORT DSS to European areas which are not directly participating in the project. In this process SHG (FAO, GSP) will be engaged. Outputs from Tasks 6.1, 6.2. and 6.3 will be used along with a close evaluation of quantity and quality of suitable database availability for other European areas. Results will be analysed also in terms of Policy implication of international conventions (IPCC, UNCCD) in divergent biophysical conditions.

Project partners CFF and ICARDA will evaluate the transferability outside Europe. More specifically CFF will test the use of the farm tools (FMIS) in tool “g” in tropical conditions while ICARDA will test in Rmel River watershed in TUNISIA the DSS tool “i” on land degradation. Land degradation and sustainable management of natural resources are

a high priority for Tunisia, as well as in the other Maghreb countries. A successful implementation of the tools in the case studies would generate a significant impact of LANDSUPPORT tools on current efforts on LDN achievement in the southern shore of the Mediterranean basin.

Participation per Partner

Partner number and short name	WP6 effort
1 - UNA	29.50
2 - ARIES	6.00
5 - CNR	1.00
6 - CFF	21.00
7 - ICARDA	8.50
9 - ISPRA	0.30
11 - JRC	10.00
12 - REGCAM	1.60
13 - UPA	23.00
15 - ZALA	22.00
18 - EAA	13.00
Total	135.90

List of deliverables

Deliverable Number ¹⁴	Deliverable Title	Lead beneficiary	Type ¹⁵	Dissemination level ¹⁶	Due Date (in months) ¹⁷
D6.1	Internal report on the DSS performance on EU, country, regional and local scales	18 - EAA	Report	Confidential, only for members of the consortium (including the Commission Services)	42
D6.2	Report on testing, validation, meta-analysis about replicability and transferability to other areas within the EU	13 - UPA	Report	Public	42
D6.3	Report on testing and meta-analysis about replicability and transferability to other areas outside Europe	13 - UPA	Report	Public	42

Description of deliverables

D6.1 : Internal report on the DSS performance on EU, country, regional and local scales [42]
 Internal report on the DSS performance on EU, country, regional and local scales

D6.2 : Report on testing, validation, meta-analysis about replicability and transferability to other areas within the EU [42]

Report on testing, validation, meta-analysis about replicability and transferability to other areas within the EU

D6.3 : Report on testing and meta-analysis about replicability and transferability to other areas outside Europe [42]

Report on testing and meta-analysis about replicability and transferability to other areas outside Europe

Schedule of relevant Milestones

Milestone number ¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS10	European level soil sealing case studies ready to be used by enduser	13 - UPA	18	European level soil sealing case studies ready to be used by enduser. Means of verification: All multiscale case studies can be freely used and tested on the LANDSUPPORT platform
MS16	Evaluation from public authorities Partners using LANDSUPPORT to simplify and verify land policies implementation	13 - UPA	30	Evaluation from public authorities Partners using LANDSUPPORT to simplify and verify land policies implementation. Means of verification: Evaluation Report (including evaluation comments from SHG). This report will also be included of D6.2
MS18	All European, National, Regional and local level case studies ready to be used by enduser	13 - UPA	30	All European, National, Regional and local level case studies ready to be used by enduser. Means of verification: All multiscale case studies can be freely used and tested on the LANDSUPPORT platform
MS19	Test of LANDSUPPORT replicability	13 - UPA	36	Test of LANDSUPPORT replicability. Means of verification: SC evaluation about replicability. If the replicability report (see also D6.2; D6.3) is considered fine by SC then the platform is ready for the next steps otherwise a feedback will be given to other WPs and specifically for WP5 for better platform tuning.
MS20	Final version of LANDSUPPORT platform available	1 - UNA	40	Final version of LANDSUPPORT platform available. Means of verification: Delivery through the web of the operational

Schedule of relevant Milestones

Milestone number¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
				final LANDSUPPORT DSS system (see also D5.4)
MS22	All European, National, Regional, Local case studies concluded	13 - UPA	40	All European, National, Regional, Local case studies concluded. Means of verification: All multiscale case studies have been completed and they can be freely used and tested on the LANDSUPPORT platform

Work package number ⁹	WP7	Lead beneficiary ¹⁰	17 - ACTEON
Work package title	Empowering end-users for supporting the development of the DSS and disseminating project		
Start month	1	End month	42

Objectives

The main objectives of this WP are the followings:

1. Establish a living lab process where final users and other stakeholders are continuously mobilized (from the start to the end of the project) in the co-development of the S-DSS tools in collaboration with the project team.
 2. Enhance capacity of prospective users through technical dissemination and capacity building activities (Tasks 7.4 and 7.5).
 3. Disseminate knowledge about the S-DSS tools, and the benefit that LANDSUPPORT is creating for Europe, to a wide audience, including both the general public and the EU scientific community (Tasks 7.6, 7.7 and 7.8).
- Overall, mobilising stakeholders throughout the process will be key to the success, added value and legacy of the project: in fact, potential users are very likely to use a platform that they contributed to and that is developed according to their feedback. In addition, training (e.g. young IT specialist, public body officers and scientists), technical dissemination, and capacity building will empower potential users so that they can autonomously use the S-DSS tools after the end of the project.

Description of work and role of partners

WP7 - Empowering end-users for supporting the development of the DSS and disseminating project [Months: 1-42]

ACTEON, UNA, ARIES, BSC, BOKU, CNR, CFF, ICARDA, iASK, ISPRA, RASDAMAN, JRC, REGCAM, UPA, UMI, ZALA, CMAST, EAA, SFI

Approach:

WP7 is an ambitious set of actions aimed at establishing a strong participatory process within the LANDSUPPORT project from its very beginning to the end. As shown in the figure, WP7 activities have been defined based on the identification of the main stakeholder groups concerned by the project, and namely: (i) Policy makers and public bodies responsible of land policies implementation at the regional, national and EU scale; (ii) users (and prospective users) for agriculture and environment (e.g. AGES, Confagricoltura, Marchfeld channel company) which are part of the project consortium, but also other potential core users outside the consortium; (iii) Other Users and prospective users (e.g. INU, urban planners, local ecotourism companies, local communities); (iv) Scientific community; (v) Broader public.

More in detail:

- A Stakeholder Group (SHG) will be created at the beginning of the project, bringing together all relevant stakeholders. The SHG will constitute one of the basis for all other participation and dissemination activities;
- Core users will be actively involved in the co-development of the S-DSS tools by using a living lab approach dealing with user-driven, open innovation ecosystems.
- Once the S-DSS tools are developed and operational in their final version, core users and other prospective users will be targeted by specific capacity building and technical dissemination activities (Tasks 7.4 and 7.5).
- Social media (Facebook, Twitter, YouTube and an interactive platform – Task 7.6), which are part of dissemination activities, will be directed at all stakeholder groups, as anyone interested in the project will be able to access them, although their main target will be the broader public;

Task description

Task 7.1: Participation and dissemination plan. (Start: M1; End: M6; Lead: ACTEon; connected with D7.1)

A detailed participation and dissemination plan will be developed (D7.1), to ensure that these activities are finely-tuned to project activities, and that their schedule closely matches activities carried out in other WPs. It will be drafted by ACTEon with contributions from all Partners.

Task 7.2 Creation, steering and facilitation of the Stakeholder Group (SHG). (Start: M1; End: M42; Lead: ACTEon; connected with D7.1)

A Stakeholder Group (SHG) will be established to help LANDSUPPORT maximizing its impact. The SHG brings together experts from science, farming and urban planning association, agro-tourism associations, citizen representatives beyond the project partners.

It will meet once annually during General Assembly meetings, and contribute in between these by electronic means to help steer research, knowledge transfer, dissemination, and outreach of the project in an openly engaged way. UNA with the assistance of CMAST will monitor this process, offering tools and methods for interaction, discussion and alignment between many different stakeholders.

The SHG will include relevant stakeholders identified by the LANDSUPPORT project, and namely:

- National farming communities (e.g. Confagricoltura, Hungarian Chamber of Agriculture, AGRYA, EIP Operational Groups as appropriate);
- Global and European organizations active as policy advisors - Global Soil Partnership, FAO, ECTP-CEU already confirmed their willingness to be part of the SHG
- Other National Organizations (AGES, ILWM, INU)
- Municipal authorities - Telese and Keszthely municipalities already confirmed their willingness to be part of the SHG;
- Environmental organizations – ELSA confirmed its interest to be part of the SHG;
- Ecotourism organizations (AGRITURIST) already confirmed its willingness to be part of the SHG.

The letters of support from those organizations which already confirmed their participation to the SHG are enclosed in Annex 1. Further members may be added, making the SHG evolve over the project's lifetime. The SHG will be also called to provide comment on the project Evaluation Report. The SHG will be created, maintained and facilitated by ACTeon staff (with contributions from partners if necessary).

Task 7.3 Preparatory workshops and focus groups with prospective users for agriculture and environment. (Start: M3; End: M12; Lead: ACTeon; connected with D7.2)

This task covers the first two phases of the living lab process, and it includes activities aimed at co-developing the S-DSS tools and at exploring potential usages and (if applicable) market opportunities. Distinct series of workshops will be implemented for the two groups of core users: policy makers and prospective users at the field level.

In both series of workshops, ACTeon will be in charge of coordinating and steering the whole process, as well as organizing and facilitating the EU and the plenary workshop. National workshop will be organized and facilitated by project partners (see below). Technical support will be provided by ARIES, UNA, CNR, BOKU and UPA involved in developing the S-DSS tools. For both series, CMAST will offer tools and working methods and will advise on the content of the workshops, based on their ample experience in workshop moderation.

Establishing an interface with the policy making community: The objective of this sub- task is to establish an interface between the technical-scientific components of the S-DSS tools and the policy making communities, and in particular to ensure that the S-DSS tools reflect the needs of policy makers by providing policy-relevant information and indicators. This is seen as being a crucial step for the S-DSS tools to become an integral part of the policy-making process after the end of the project. Activities will target policy makers in all relevant fields, thus including not only land management and agricultural policies but also policies in the area of water management, biodiversity, climate change, urban planning and development and potentially other related environmental domains. These will be discussed and answered at: (i) a workshop at the EU level, bringing together policy makers at the EU and national level; and (ii) three national workshops in IT, AT and HU bringing together policy makers at the national, regional and local level, organized by ISPRA, EAA and UPA.

Establishing an interface with potential users for agriculture and environment: The objective of this sub-task is to assess the potential contribution of LANDSUPPORT system to sustainable land resources management, by working with prospective users at the field level (AGES, Confagricoltura, Marchfeld channel company and INU). The relevant content will be discussed and answered at: (i) a plenary workshop bringing together all prospective users from the three countries which will be held at the kick-off meeting and (ii) by three more focused small groups at the regional level to be organized by REGCAM at Campania Region, by EAA and AGES at Marchfeld and by ZALA at Zala County.

Task 7.4: Technical dissemination, training and capacity building involving all relevant stakeholders. (Start: M36; End: M42; Lead: ACTeon; connected with D7.3)

These activities will contribute to the successful replication and transferability of project results, enabling an active use of LANDSUPPORT after the end of the project. Most activities will be carried out during the last year of the project, once the S-DSS tools are close to being finalized. Technical workshops will be coordinated and steered by ACTeon, which will also provide guidance to partners; the technical contents will be provided by ARIES.

Technical workshops with prospective users for agriculture and environment and connected IT experts: The workshops will be organized to illustrate how the S-DSS tools work and collect feedback from prospective users, both within (e.g. AGES, Confagricoltura, Marchfeld channel company and INU) and outside the project community. The workshops will be held and organised in Italy by REGCAM, in Austria by EEA and in Hungary by ZALA. The will includes practical sessions where participants can use the system and get familiar with it.

Technical workshops with policy makers: These series of workshops will present project results to the policy making community and, in particular, participants will be trained on the application of the S-DSS tools in land management policy design and implementation. More in detail, four workshops are planned: (i) three workshops at either national

or regional level (to be chosen at the kick-off meeting). The workshops will be held and organised in Italy by ISPRA, in Austria by EEA and in Hungary by UPA and (iv) a workshop at the EU level, involving both European and national policy makers (ideally, from all EU MS) to be organised by JRC.

ACTeon will be in charge of coordinating and steering these workshops, as well as providing guidance to LANDSUPPORT partners. The plenary workshop will be organized and facilitated by ACTeon. The technical content will be provided by ARIES and the above local partners.

Presentation of the S-DSS tools at EU workshops and meetings: The S-DSS tools and their potential for measures implementation will be presented at two relevant EU workshops or meetings, in Brussels (e.g. green week) or elsewhere in the EU. Workshops and meetings will be attended by ACTeon and JRC and by at least one of the following partners UNA, CNR, BOKU, UPA directly involved in the development of the S-DSS tools.

Wiki-like platform: An online wiki-like platform (created and moderated by ACTeon) will be built to allow communication between users and LANDSUPPORT developers, by enabling users to insert comments on the S-DSS tools both during the testing phase (WP6) and during the technical dissemination phase. The communication platform will be developed in M30 (when most testing activities of WP6 starts) and maintained until the end of the project.

Task 7.5 Engaging other potential users at the local level. (Start: M31; End: M42; Lead: ACTeon; connected with D7.4) Activities under this task target all those users which are not part of the “core” users’ groups, and by that we mean all those stakeholders whose activities can be supported by a targeted, thematic use of the LANDSUPPORT platform. These stakeholders include urban planners, local ecotourism companies and local communities.

Contribution to urban planners conferences: These are contributions at urban planners workshops (e.g. Annual INU conference) where it is expected to train urban planners on how the LANDSUPPORT platform can provide operational support to their planning activities. Three contributions are expected at the national level (IT, AT and HU), with a particular focus on the regions which are part of the LANDSUPPORT project. The following LANDSUPPORT partners will be in charge of these activities: in Italy by UNA, in Austria by BOKU and in Hungary by UPA

Workshop with local ecotourism companies: These workshops will train local ecotourism companies on how the platform can be used to plan tours. Three workshops will be organized at the local level (IT, AT and HU), with particular focus on the regions which are part of the LANDSUPPORT project. ACTeon will coordinate the process and provide guidance to local partners, whereas the workshops will be organized and facilitated by in Campania region by REGCAM, in Marchfeld by EAA and in Zala County by ZALA.

Engaging local communities: collaboration platforms with local schools: A specific LANDSUPPORT dashboard (tool “o” of table 1.1b chapter 1) will be used by some high and middle schools placed in Valle Telesina (IT) and collaborating with TELESIA high school participating at SHG. This activity will act as a test of the use of the system to increase landscape awareness for students. In a first stage of this collaboration a one-day session will be organized by REGCAM and UNA to demonstrate to teachers and pupils the importance of soil and landscape and the use of the tool to increase landscape awareness. After this activity the student multimedia lab of TELESIA will start specific activities to acquire georeferenced historical photos (.jpg file) of landscape and record (mp3, mp4) from elderly people stories about specific georeferenced point in the landscape. This information will be incorporated in the platform (WP5) for the DSS tool “o” (table 1.1c in chapter 1).

Task 7.6 Engaging the general public through social media. (Start: M1; End: M42; Lead: ACTeon; connected with D7.5) As soon as the project starts, ACTeon will set up several accounts of social media to promote project contents. Social media will give us the opportunity to connect to the most different groups on a broad level in a very resource-conscious manner. This will include:

- Twitter: A Twitter account under the name of @LANDSUPPORT will be established. Tweets about news and facts from the project will be released.
- Facebook: A facebook fanpage will allow users to connect to LANDSUPPORT.
- YouTube: A YouTube channel will provide additional contents such as interviews to project team members, prospective users, policy makers and other relevant stakeholders, as well as tutorials for both the information platform (for EU citizens) and prospective users of the S-DSS tools (technical tutorials); and
- Interactive platform: the platform will have a user-friendly interface and will be aimed at all EU citizens who are interested in finding out more about land management, land policies and their effects. For example, individuals will be able to visualize land changes over the last decades, or the impact of specific policies, on the area where they live;
- Creation of specific contents for the multi-functional LANDSUPPORT-app. These contents will target the general public and will be aimed at raising environmental awareness.

ACTeon is responsible for the development, content management and the regular activity on these accounts. All Partners on the case of their specific activities will gather and deliver content for the several feeds to ACTeon.

Task 7.7 Dissemination and communication to the broader public. (Start: M1; End: M42; Lead: ACTeon; connected with Milestone N.1)

This task includes the development of all types of communication and dissemination material intended for the broader public:

- Project logo;
- Project website: the project website will present the project and the project team; as well as brochures and other information material; and it will include a section on news from the project.;
- Brochures: three brochures will be produced: (i) project presentation (M1-2); (ii) midterm brochure (M21), illustrating mid-term achievements; and (iii) presentation of project results (M42).
- 2 press conferences to present project activities and first version of DSS tool ‘k’ on land take and spatial planning (M13) and results (at the end of the project).
- UNA will install a permanent exhibit on the importance S-DSS in sustainable land management based on LANDSUPPORT online platform at the permanent Soil Museum (Landscape section) of Pertosa, Italy (see MIDA supporting letter)

ACTeon will be in charge of developing these products, with technical contributions (e.g. contents of brochures, etc.) from all project partners. ACTeon and all project partners will be in charge of diffusing the products and thus promoting the project to a large audience. Brochures will be diffused across social media, the project website, the SHG partners’ network and on information platform.

Task 7.8 Engaging with the scientific community and training young scientists. (Start: M1; End: M42; Lead: ACTeon) These activities are aimed at disseminating project activities and results across the EU scientific community, by keeping regular contacts and exchanges of information. These include:

- Two international summers schools for PhD students and experts named “Geospatial Decision Support Systems to land management to make the world a better place” to teach them about the importance of Geospatial DSS and for land resource management. One introductory intensive spring school of 1 day at the EGU 2019 in Vienna conference; a 2nd summer school (5 working days) in Portici (Italy) in the last year of the project. The summer schools will be organised by UNA and taught by UNA and all other LANDSUPPORT research partners; furthermore, there will be a possibility to give out scholarships within the LANDSUPPORT framework.
- Networking with other relevant research projects across the EU: Beneficiaries of related H2020 projects, as well as participants to other relevant projects, will be contacted and informed about LANDSUPPORT. (Please see Chapter “Link with (inter)national research activities”, in 1.3), as well as invitation to the European Student Association for joining sessions during the GA meetings
- CFF will inform and advertise LANDSUPPORT findings through of Association of International Research and Development Centers for Agriculture (AIRCA) which is a nine-member alliance with 300 institutional locations around the world.
- Collaboration with EIP-Agri and EIP-Water: participation in conferences and EIP working groups. ACTeon will coordinate the activity, whereas LANDSUPPORT partners UNA, CNR, UPA, BOKU will participate to conferences and working group; Participation to information platforms related to the project objectives (both at the national and EU level). ACTeon will be in charge.

Participation per Partner

Partner number and short name	WP7 effort
1 - UNA	7.00
2 - ARIES	3.00
3 - BSC	8.00
4 - BOKU	15.00
5 - CNR	6.00
6 - CFF	1.00
7 - ICARDA	5.00
8 - iASK	9.00
9 - ISPRA	0.50
10 - RASDAMAN	6.00

Partner number and short name	WP7 effort
11 - JRC	10.42
12 - REGCAM	1.60
13 - UPA	4.00
14 - UMI	12.00
15 - ZALA	56.00
16 - CMAST	11.40
17 - ACTEON	30.00
18 - EAA	4.00
19 - SFI	2.00
Total	191.92

List of deliverables

Deliverable Number ¹⁴	Deliverable Title	Lead beneficiary	Type ¹⁵	Dissemination level ¹⁶	Due Date (in months) ¹⁷
D7.1	Launch of LANDSUPPORT website	17 - ACTEON	Websites, patents filling, etc.	Public	3
D7.2	Participation and dissemination plan (including list of SHG members)	17 - ACTEON	Report	Confidential, only for members of the consortium (including the Commission Services)	6
D7.3	How can the S-DSS tools best support land management at the field level? Synthesis report of focus groups and the workshop	17 - ACTEON	Report	Public	14
D7.4	Technical dissemination: activities, outcomes and suggestions for further research. Synthesis report of technical dissemination trainings and workshops	17 - ACTEON	Report	Public	42
D7.5	Engaging other potential users at the field level. Synthesis report of trainings and workshops with stakeholders whose activities can be supported by a targeted, thematic use of the LANDSUPPORT	17 - ACTEON	Report	Public	42

List of deliverables

Deliverable Number¹⁴	Deliverable Title	Lead beneficiary	Type¹⁵	Dissemination level¹⁶	Due Date (in months)¹⁷
	platform (urban planners, local ecotourism companies and local communities)				
D7.6	Report on social media use and number of followers on different channels, as well as on feedback	17 - ACTEON	Report	Public	42

Description of deliverables

<p>D7.1 : Launch of LANDSUPPORT website [3] Launch of LANDSUPPORT website</p> <p>D7.2 : Participation and dissemination plan (including list of SHG members) [6] Participation and dissemination plan (including list of SHG members)</p> <p>D7.3 : How can the S-DSS tools best support land management at the field level? Synthesis report of focus groups and the workshop [14] How can the S-DSS tools best support land management at the field level? Synthesis report of focus groups and the workshop</p> <p>D7.4 : Technical dissemination: activities, outcomes and suggestions for further research. Synthesis report of technical dissemination trainings and workshops [42] Technical dissemination: activities, outcomes and suggestions for further research. Synthesis report of technical dissemination trainings and workshops</p> <p>D7.5 : Engaging other potential users at the field level. Synthesis report of trainings and workshops with stakeholders whose activities can be supported by a targeted, thematic use of the LANDSUPPORT platform (urban planners, local ecotourism companies and local communities) [42] Engaging other potential users at the field level. Synthesis report of trainings and workshops with stakeholders whose activities can be supported by a targeted, thematic use of the LANDSUPPORT platform (urban planners, local ecotourism companies and local communities)</p> <p>D7.6 : Report on social media use and number of followers on different channels, as well as on feedback [42] Report on social media use and number of followers on different channels, as well as on feedback</p>

Schedule of relevant Milestones

Milestone number¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS1	Project kick-off meeting	1 - UNA	2	Project kick-off meeting; Means of verification: Report on kick-off meeting results: detailed workplan, assessment of SHG
MS5	Launch of the LANDSUPPORT Web platform (1st version). Promotional material is ready	17 - ACTEON	12	Launch of the LANDSUPPORT Web platform (1st version). Means of verification: Promotional

Schedule of relevant Milestones

Milestone number ¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
				material is ready to use for communication and dissemination
MS6	1st LANDSUPPORT press conference	17 - ACTEON	13	1st LANDSUPPORT press conference Mean of verification: Press release, Press review.
MS11	Training programs defined and validated	17 - ACTEON	18	Training programs defined and validated
MS16	Evaluation from public authorities Partners using LANDSUPPORT to simplify and verify land policies implementation	13 - UPA	30	Evaluation from public authorities Partners using LANDSUPPORT to simplify and verify land policies implementation. Means of verification: Evaluation Report (including evaluation comments from SHG). This report will also be included of D6.2
MS20	Final version of LANDSUPPORT platform available	1 - UNA	40	Final version of LANDSUPPORT platform available. Means of verification: Delivery through the web of the operational final LANDSUPPORT DSS system (see also D5.4)
MS23	4 scientific workshops/ conference co-organized	17 - ACTEON	40	4 scientific workshops/ conference co-organized. Means of verification: Workshop held (workshop proceedings, list of participants, dissemination material)
MS24	2 Summer school held	17 - ACTEON	40	2 Summer school held. Means of verification: list of participants, training material, feedback forms from participants
MS25	Final press conference	17 - ACTEON	42	Final press conference. Means of verification: Press release, Press review.

Work package number ⁹	WP8	Lead beneficiary ¹⁰	1 - UNA
Work package title	Project Management		
Start month	1	End month	42

Objectives

- Proper scientific management of the project to strengthen and support the Participants to achieve the objectives, complete the milestones in time and deliver the deliverables as well as managing risks.
- Proper administrative management of the project to comply with the rules of the European Commission (EC)
- Effective communication infrastructure and foster the integrative process within the consortium. (Task 8.4)
- Using EU resources efficiently and effectively, including maximizing links to relevant EU and national projects (table 1.3a)

Description of work and role of partners

WP8 - Project Management [Months: 1-42]

UNA, ARIES, BSC, BOKU, CNR, CFF, ICARDA, iASK, ISPRA, RASDAMAN, JRC, REGCAM, UPA, UMI, ZALA, CMAST, ACTEON, EAA, SFI

Approach:

This Workpackage will be led by the Project Coordinator 1 UNA (Fabio Terribile) as the core activity will be coordinating, monitoring and steering the scientific execution of the project activities. For the administrative Project Management, the Coordinator will also be supported by 16 CMAST, which has profound experience in managing multi-partner, pan-European research projects of various scopes. Furthermore, within the Project Management team, also Angelo Basile, Participant 5 CNR will support effectively, esp in scientific and technical related questions within the project.

Task description

Task 8.1: Scientific project coordination and management. (Start: M1; End: M42; Lead: UNA supported by CNR)

Management activities of the Coordinator:

Communicate with the European Commission (EC).

Coordinate the preparation of scientific reports and implementation plan, including aspects on quality of scientific work, as well as risk mitigation. Deliverable reports will be assembled by the WP leads with guidelines and support of CMAST; the compiled report will be reviewed by the Coordinator. These deliverables will be reported in detail during scientific meetings.

Monitor scientific activities and regularly check on the progress of scientific work. During regular telephone conferences with the Steering Committee (SC, consisting of all WP leads), the work plan will be further divided into sub-tasks (where appropriate). Progress of the work plan will be monitored and deliverables will be reviewed for completeness and accuracy before submission.

Scientific organisation of annual project meetings (kick-off and yearly GA meetings), drafting of minutes, ensuring efficient communication within LANDSUPPORT, coordinating scientific activities; communicating with Scientific Advisory Boards (SAB, EAB and DSMB).

Ensure that the EC and LANDSUPPORT are appropriately acknowledged on scientific publications originating from LANDSUPPORT. A publication policy will be established in the Consortium Agreement.

Task 8.2: Controlling. (Start: M1; End: M42; Lead: UNA)

UNA, with the assistance of CMAST, will monitor overall progress regarding milestones and deliverables on a day-to-day basis. Whenever necessary, the management team will assist the Participants in achieving their goals.

For the Project Periodic Reports, UNA will collect all information from the partners. CMAST will support UNA in accurately compiling all information and will doublecheck that the financials and content of the documents are according to reporting guidelines. UNA will submit the reports to the European Commission on time.

Task 8.3: Contractual management. (Start: M1; End: M42; Lead: UNA)

UNA, supported by CMAST will monitor the compliance of the project with EU provisions (Grant Agreement and its annexes) and the Consortium Agreement. Therefore, participants will be trained on EU provisions whenever relevant by CMAST. CMAST, as the non-technical partner, is best placed to ensure that the consortium complies with the rules on decision-making in LANDSUPPORT as defined in the Consortium Agreement. These procedures will be carefully

followed not only with respect to decisions on the implementation of work, but also funding and other decisions on crucial issues.

Task 8.4: Communication management. (Start: M1; End: M42; Lead: UNA)

The Project Office at CMAST stands as a permanent help desk for the participants, in support of the coordinator, and will serve as the centre of communication on administrative issues for all participants, with the coordinator always in the loop. It.

CMAST has developed a web-based tool for project management specifically for EU framework projects on Sharepoint. This tool combines functionalities for central document sharing, progress monitoring, accounting, and reporting in EU projects. The tool will be populated with data from the Technical Annex and data subsequently generated during the course of project implementation. All participants will have access to this platform.

CMAST will support UNA in the organisation of professional and efficient project meetings. Each meeting (General Assembly Meetings with the European Commission annually, Steering Committee Meetings six-monthly) will be planned carefully in accordance with the respective meeting’s objectives and will moreover serve as a platform to promote trust, collaboration and exchange of knowledge between the Consortium members. CMAST will advise on methods and tools for effective meetings, moderating discussions and keeping partners aligned.

Task 8.5: Resources management. (Start: M1; End: M42; Lead: UNA)

UNA will be supported by CMAST for the collection and preparation of all cost reports (i.e., management report, report on the distribution of funds, Form Cs, and audit certificates) from the participants, which will then be submitted to the European Commission by UNA.

Not only for the planning of subsequent periods, budget and expenditures need to be monitored, also new budgets must be calculated and be filled in the respective forms.

The Coordinator will ensure that correct payments are being made to the participants and can rely on in-depth advice by CMAST.

Task 8.6: Innovation Management (Start: M1; End: M42; Lead: UNA)

UNA, supported by CMAST, will ensure that innovations within LANDSUPPORT will be discussed fairly, openly and in an integrative manner. Innovation Management will be an essential component and discussed pro-actively among the Participants in order to remain updated in the innovation processes. UNA, with the assistance of CMAST, will monitor, safeguard and challenge any innovations and openly discuss these with the Steering Committee. Within innovation assessment, the following criteria will be applied:

- SWOT analysis of the innovations, giving indications on pitfalls and need for improvement
- Market analysis, clarifying the possibilities and boundaries of the target group
- Beneficiaries analysis from the innovations, meaning who is expected to benefit
- IP strategy, the necessary steps and actions to implement an effective and cost-efficient strategy for Intellectual Property
- And further indications analysis, e.g. “How far can the innovation reach”, “Who has the responsibility for the innovation”, “How much has to be invested to reach the innovation” and “How well does the innovation perform”

In summary, we are employing a modern approach to dissemination, exploitation and communication that enables us to promote and market science in a manner that truly proves the aim of the Horizon2020 programme.

Participation per Partner

Partner number and short name	WP8 effort
1 - UNA	32.50
2 - ARIES	2.00
3 - BSC	2.00
4 - BOKU	2.00
5 - CNR	4.00
6 - CFF	1.00
7 - ICARDA	4.00
8 - iASK	1.00
9 - ISPRA	0.80

Partner number and short name	WP8 effort
10 - RASDAMAN	1.00
11 - JRC	0.40
12 - REGCAM	1.10
13 - UPA	4.00
14 - UMI	2.00
15 - ZALA	4.00
16 - CMAST	18.00
17 - ACTEON	1.00
18 - EAA	2.00
19 - SFI	3.00
Total	85.80

List of deliverables

Deliverable Number ¹⁴	Deliverable Title	Lead beneficiary	Type ¹⁵	Dissemination level ¹⁶	Due Date (in months) ¹⁷
D8.1	Webtool for efficient document sharing and communication	1 - UNA	Websites, patents filling, etc.	Public	3
D8.2	Innovation Management Report	1 - UNA	Report	Confidential, only for members of the consortium (including the Commission Services)	36

Description of deliverables

D8.1 : Webtool for efficient document sharing and communication [3]
 Webtool for efficient document sharing and communication

D8.2 : Innovation Management Report [36]
 Innovation Management Report

Schedule of relevant Milestones

Milestone number ¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS1	Project kick-off meeting	1 - UNA	2	Project kick-off meeting; Means of verification: Report on kick-off meeting results: detailed workplan, assessment of SHG

Schedule of relevant Milestones

Milestone number¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS20	Final version of LANDSUPPORT platform available	1 - UNA	40	Final version of LANDSUPPORT platform available. Means of verification: Delivery through the web of the operational final LANDSUPPORT DSS system (see also D5.4)

Work package number ⁹	WP9	Lead beneficiary ¹⁰	1 - UNA
Work package title	Ethics requirements		
Start month	1	End month	42

Objectives

The objective is to ensure compliance with the 'ethics requirements' set out in this work package.

Description of work and role of partners

WP9 - Ethics requirements [Months: 1-42]

UNA

This work package sets out the 'ethics requirements' that the project must comply with.

List of deliverables

Deliverable Number ¹⁴	Deliverable Title	Lead beneficiary	Type ¹⁵	Dissemination level ¹⁶	Due Date (in months) ¹⁷
D9.1	H - Requirement No. 1	5 - CNR	Ethics	Confidential, only for members of the consortium (including the Commission Services)	3
D9.2	NEC - Requirement No. 2	5 - CNR	Ethics	Confidential, only for members of the consortium (including the Commission Services)	3
D9.3	M - Requirement No. 3	5 - CNR	Ethics	Confidential, only for members of the consortium (including the Commission Services)	6
D9.4	NEC - Requirement No. 4	5 - CNR	Ethics	Confidential, only for members of the consortium (including the Commission Services)	24

Description of deliverables

The 'ethics requirements' that the project must comply with are included as deliverables in this work package.

D9.1 : H - Requirement No. 1 [3]

- The informed consent procedures that will be implemented for the participation of humans must be submitted as a deliverable. - Templates of the informed consent/assent forms and information sheets (in language and terms intelligible to the participants) must be submitted as a deliverable. - Copies of opinions/approvals by ethics committees and/or competent authorities for the research with humans must be specified in the grant agreement.

D9.2 : NEC - Requirement No. 2 [3]

- Details on the materials which will be imported to/exported from the EU must be submitted as a deliverable. -
 In case activities undertaken in non-EU countries raise ethics issues, the applicants must confirm that the research conducted outside the EU is legal in at least one EU Member State. This must be submitted as a deliverable.

D9.3 : M - Requirement No. 3 [6]

- Risk assessment and details on measures to prevent misuse of research findings must be submitted as a deliverable before the commencement of relevant work or month 6, whichever comes first.

D9.4 : NEC - Requirement No. 4 [24]

- Detailed information to demonstrate that fair benefit-sharing arrangements with stakeholders from low and lower-middle income countries are ensured must be submitted as a deliverable.

Schedule of relevant Milestones

Milestone number¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
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1.3.4. WT4 List of milestones

Milestone number ¹⁸	Milestone title	WP number ⁹	Lead beneficiary	Due Date (in months) ¹⁷	Means of verification
MS1	Project kick-off meeting	WP7, WP8	1 - UNA	2	Project kick-off meeting; Means of verification: Report on kick-off meeting results: detailed workplan, assessment of SHG
MS2	Documentation and training material ready	WP2, WP3	10 - RASDAMAN	12	Documentation and training material ready Means of verification: Training material have been distributed to partners
MS3	Evaluation of outcomes of Land Policy SWOT, User Requirement and Impact Assessment completed	WP1	11 - JRC	12	Evaluation of outcomes of Land Policy SWOT, User Requirement and Impact Assessment completed – ready to integrate learnings in the DSS development Means of verification: Integration of learnings in the design and development plan for the DSS
MS4	Setup phase finished – databases are deployed “as is”, ready for use	WP2	10 - RASDAMAN	12	Setup phase finished – databases are deployed “as is”, ready for use. Means of verification: Crosscheck with the list of databases supplied in the LANDSUPPORT proposal annex
MS5	Launch of the LANDSUPPORT Web platform (1st version). Promotional material is ready	WP5, WP7	17 - ACTEON	12	Launch of the LANDSUPPORT Web platform (1st version). Means of verification: Promotional material is ready to use for communication and dissemination
MS6	1st LANDSUPPORT press conference	WP7	17 - ACTEON	13	1st LANDSUPPORT press conference Mean of verification: Press release, Press review.
MS7	Suitable satellite platforms and geo-indicators identified for continuous monitoring	WP4	4 - BOKU	18	Suitable satellite platforms and geo-indicators identified for continuous monitoring of dynamic high-resolution geodata. Means of verification: Data available on server
MS8	First set (10) of DSS tools	WP1, WP2, WP3,	2 - ARIES	18	First set (10) of DSS tools (mainly related to land take and agriculture) are ready for testing. Means of verification:

Milestone number ¹⁸	Milestone title	WP number ⁹	Lead beneficiary	Due Date (in months) ¹⁷	Means of verification
		WP4, WP5			they can be freely verified and tested by anyone through the LANDSUPPORT web site
MS9	Beta version of platform architecture designed and ready	WP5	2 - ARIES	18	Beta version of platform architecture designed and ready for integration of the LANDSUPPORT approaches, models and data. Means of verification: It can be freely verified by anyone through the LANDSUPPORT web site
MS10	European level soil sealing case studies ready to be used by enduser	WP6	13 - UPA	18	European level soil sealing case studies ready to be used by enduser. Means of verification: All multiscale case studies can be freely used and tested on the LANDSUPPORT platform
MS11	Training programs defined and validated	WP7	17 - ACTEON	18	Training programs defined and validated
MS12	Solutions developed for automated updates of European land cover and land use data layers	WP4	4 - BOKU	24	Solutions developed for automated updates of European land cover and land use data layers. Means of verification: Data available on server
MS13	Second set (20) of DSS tools	WP1, WP2, WP3, WP4, WP5	2 - ARIES	24	Second set (20) of DSS tools (mainly related to agriculture, land degradation and environment) ready for testing. Means of verification: They can be freely verified and tested by anyone through the LANDSUPPORT web site
MS14	Ready for consistency check of models	WP4	4 - BOKU	24	Ready for consistency check of models. Means of verification: Data sets and modules coming from different partners are organized for the following model consistency check
MS15	Best approaches for data assimilation selected	WP4	4 - BOKU	24	Best approaches for data assimilation selected for further development and optimization. Means of verification: Concise report on the chosen approaches for data assimilation according to different tools and scales of

Milestone number ¹⁸	Milestone title	WP number ⁹	Lead beneficiary	Due Date (in months) ¹⁷	Means of verification
					application. This report will also be part of D4.4
MS16	Evaluation from public authorities Partners using LANDSUPPORT to simplify and verify land policies implementation	WP6, WP7	13 - UPA	30	Evaluation from public authorities Partners using LANDSUPPORT to simplify and verify land policies implementation. Means of verification: Evaluation Report (including evaluation comments from SHG). This report will also be included of D6.2
MS17	Third set (20) of DSS tools	WP1, WP2, WP3, WP4, WP5	2 - ARIES	30	Third set (20) of DSS tools (mainly related to ecosystem service evaluation) ready for testing. Means of verification: they can be freely verified and tested by anyone through the LANDSUPPORT web site
MS18	All European, National, Regional and local level case studies ready to be used by enduser	WP6	13 - UPA	30	All European, National, Regional and local level case studies ready to be used by enduser. Means of verification: All multiscale case studies can be freely used and tested on the LANDSUPPORT platform
MS19	Test of LANDSUPPORT replicability	WP5, WP6	13 - UPA	36	Test of LANDSUPPORT replicability. Means of verification: SC evaluation about replicability. If the replicability report (see also D6.2; D6.3) is considered fine by SC then the platform is ready for the next steps otherwise a feedback will be given to other WPs and specifically for WP5 for better platform tuning.
MS20	Final version of LANDSUPPORT platform available	WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8	1 - UNA	40	Final version of LANDSUPPORT platform available. Means of verification: Delivery through the web of the operational final LANDSUPPORT DSS system (see also D5.4)
MS21	Final set (50) of DSS tools	WP1, WP2, WP3,	2 - ARIES	40	Final set (50) of DSS tools (mainly related to LULUCF models and spatial planning) ready. Means of verification:

Milestone number¹⁸	Milestone title	WP number⁹	Lead beneficiary	Due Date (in months)¹⁷	Means of verification
		WP4, WP5			they can be freely verified and tested by anyone through the LANDSUPPORT web site
MS22	All European, National, Regional, Local case studies concluded	WP6	13 - UPA	40	All European, National, Regional, Local case studies concluded. Means of verification: All multiscale case studies have been completed and they can be freely used and tested on the LANDSUPPORT platform
MS23	4 scientific workshops/ conference co-organized	WP7	17 - ACTEON	40	4 scientific workshops/ conference co-organized. Means of verification: Workshop held (workshop proceedings, list of participants, dissemination material)
MS24	2 Summer school held	WP7	17 - ACTEON	40	2 Summer school held. Means of verification: list of participants, training material, feedback forms from participants
MS25	Final press conference	WP7	17 - ACTEON	42	Final press conference. Means of verification: Press release, Press review.

1.3.5. WT5 Critical Implementation risks and mitigation actions

Risk number	Description of risk	WP Number	Proposed risk-mitigation measures
1	Complexity of the approach/ proposal (Low probability)	WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8	The ample depth and breadth of topics treated within the project demand to question the technical, economic and scientific feasibility of the project. However, the project structure is not endangered because i) four of the partners involved in this proposal have already successfully delivered – through the LIFE + project SOILCONSWEB – a similar fully operational system operating in the field of soil conservation; ii) an international scientific reputation of the partners for the most critical aspects of policies relate to agriculture and landscape; iii) the most advanced expertise on data management (rasdaman) and parallelisation (COMPs). - {UNA}
2	Low response to questionnaires / unbalanced response by different stakeholder groups (user requirements cannot be aligned) (Medium probability)	WP1, WP7	Active follow-up of data acquisition at every level – Distribute questionnaire to additional audiences – Revise questionnaire (e.g. shorter, more user-friendly) based on feedback {ACTeon}
3	Difficulty/ Delay of data collection in regional and local case studies (Low/ medium probability)	WP2	Contact additional data sources for data collection. In the extreme (and most unlikely) case, temporarily the regional and/or local database will be replaced by more aggregated data from already available National and European databases. This will enable to do not stop the data-modelling-GUI chain and related outputs. Once delayed data will be ready, they can be simply uploaded on the platform {RAS}
4	Delay in setup of modelling engines (Low/medium probability)	WP3, WP4	The large variety of modelling engines employed and the modular approach, will enable to replace the modelling engines affected by delays, with simplified modelling engines (e.g. simplified bucket-based replacing Richard-based models). This will enable to do not stop the data-modelling-GUI chain and related outputs. Once delayed models will be ready, they can be simply uploaded on the platform. {CNR}
5	Software Requirement change during the realization of software development project. The change of one or few requirements could affect the complete software solution and could damage software development process. Excessive rework and delayed product deliver. (Medium probability)	WP5	A specific strategy will be adopted to globally manage the complexity of requirements analysis and engineering, ensuring a coherent approach deployed from the system level and controlled through its evolution. To this end, more time will be allocated in collecting requirement specifications and early prototyping delivery. To this end, final users and stakeholders will be involved from the early stage of software development process to test each piece of working

Risk number	Description of risk	WP Number	Proposed risk-mitigation measures
			software which will be delivered (in typical agile approach). {ARIES}
6	Failures in the technical integration of the platform (Low probability)	WP5	The probability of this risk is considerably low due to the existence of strong software/hardware integration experience in the consortium. Crucial technologies (Rasdaman and COMPSs) are provided by Consortium's partners which ensures an high level of confidence for their integration. Besides, all the software components are based on well-known and proven technologies which provide standard OGC services to make sure the full integration. On top of this, the delivery of the first whole prototype at the end of the 1st year will minimize the risk of overall technical integration failure, giving the due time to overcome technical problems. {ARIES}
7	Failures in the integration of existing modelling software (Low probability)	WP5	The probability of this risk is considerably low due to the existence of open code for most of models included in the platform. Most partners have a long experience and knowledge in modelling and most of software are already used in previous projects. The risk arises from the porting process failure of such old modelling software. In these case the mitigation strategy consist in early identification of different code version for the same model in order to select the best candidate for porting. If no code version is suitable, an extra coding effort (in terms of PMs) will be allocated. {ARIES, BSC}
8	Failures in Software system performances. The performance of a software solution could be tested only when it is completely realized. Thus, it is necessary to make predictions about software system performance in the early development phases. (medium probability)	WP5	This risk will be addressed at two different levels. '(i) Developed codes, before their actual platform implementation, will be tested on already available datasets thanks to the specific Task4.2 '(ii) Currently available models need to be integrated in a different software architecture, therefore the performance of software solution is a critical aspect of the project development process. To minimize this risk will be adopted a prototyping technique which maximising use of simulations (e.g., GIS-based) to enable an early demonstration of potential performances of the model based processes to be generated to the users. {ARIES}
9	Critical flaws in the sDSS are uncovered during the validation in real test settings (Medium probability)	WP6	Ensure feedback loops between WP6 and other work packages (especially WPs 2-5), allowing for intermediate platform and tool reassessment and optimization {UPA}
10	Activities as foreseen by dissemination plan do not reach the envisioned audience and/ or have the	WP7	Intermediate evaluation of dissemination plan - Adapt dissemination plan on the go {ACTeon}

Risk number	Description of risk	WP Number	Proposed risk-mitigation measures
	expected impact (Medium probability)		
11	Delay(s) in the project timetable. (Low probability)	WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8	The Steering Committee discusses, agrees and applies contingency plans including if necessary, the: (i) re-allocation of resources, (ii) parallel execution of tasks and (iii) re-scheduling of activities {UNA}

1.3.6. WT6 Summary of project effort in person-months

	WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	WP9	Total Person/Months per Participant
1 - UNA	0.50	79	59	9	4	29.50	7	32.50		220.50
2 - ARIES	0	6	4	4	41	6	3	2		66
3 - BSC	0	0	34	0	18	0	8	2		62
4 - BOKU	0	3	0	58	2	0	15	2		80
5 - CNR	0	38	51	42	2	1	6	4		144
6 - CFF	0	18	15	16.50	1	21	1	1		73.50
7 - ICARDA	0	2	9	0	1	8.50	5	4		29.50
8 - iASK	12	10	0	0	0	0	9	1		32
9 - ISPRA	1.40	4.70	33.60	0	0.30	0.30	0.50	0.80		41.60
10 - RASDAMAN	0	9	0	0	2	0	6	1		18
11 - JRC	4	4	2	0	1	10	10.42	0.40		31.82
12 - REGCAM	0.90	0.50	0	0	0.90	1.60	1.60	1.10		6.60
13 - UPA	4	7	7	8	6	23	4	4		63
14 - UMI	0	0	38	20	2	0	12	2		74
15 - ZALA	22	8	0	0	8	22	56	4		120
16 - CMAST	0	0	0	0	0	0	11.40	18		29.40
17 - ACTEON	9	0	9	0	1	0	30	1		50
18 - EAA	6	1	1	0	1	13	4	2		28
19 - SFI	0	0	14	32	5	0	2	3		56
Total Person/Months	59.80	190.20	276.60	189.50	96.20	135.90	191.92	85.80		1225.92

1.3.7. WT7 Tentative schedule of project reviews

Review number ¹⁹	Tentative timing	Planned venue of review	Comments, if any
RV1	21	tbd	The Coordinator shall contact the REA project officer 3 months before the end of the 1st RP in order to set up the modalities of the review and/or review meeting.
RV2	33	tbd	The Coordinator shall contact the REA project officer 3 months before the end of the 2nd RP in order to set up the modalities of the review and/or review meeting.
RV3	42	tbd	The Coordinator shall contact the REA project officer 3 months before the end of the 3rd RP in order to set up the modalities of the review and/or review meeting.

1. Project number

The project number has been assigned by the Commission as the unique identifier for your project. It cannot be changed. The project number **should appear on each page of the grant agreement preparation documents (part A and part B)** to prevent errors during its handling.

2. Project acronym

Use the project acronym as given in the submitted proposal. It can generally not be changed. The same acronym **should appear on each page of the grant agreement preparation documents (part A and part B)** to prevent errors during its handling.

3. Project title

Use the title (preferably no longer than 200 characters) as indicated in the submitted proposal. Minor corrections are possible if agreed during the preparation of the grant agreement.

4. Starting date

Unless a specific (fixed) starting date is duly justified and agreed upon during the preparation of the Grant Agreement, the project will start on the first day of the month following the entry into force of the Grant Agreement (NB : entry into force = signature by the Commission). Please note that if a fixed starting date is used, you will be required to provide a written justification.

5. Duration

Insert the duration of the project in full months.

6. Call (part) identifier

The Call (part) identifier is the reference number given in the call or part of the call you were addressing, as indicated in the publication of the call in the Official Journal of the European Union. You have to use the identifier given by the Commission in the letter inviting to prepare the grant agreement.

7. Abstract

8. Project Entry Month

The month at which the participant joined the consortium, month 1 marking the start date of the project, and all other start dates being relative to this start date.

9. Work Package number

Work package number: WP1, WP2, WP3, ..., WPn

10. Lead beneficiary

This must be one of the beneficiaries in the grant (not a third party) - Number of the beneficiary leading the work in this work package

11. Person-months per work package

The total number of person-months allocated to each work package.

12. Start month

Relative start date for the work in the specific work packages, month 1 marking the start date of the project, and all other start dates being relative to this start date.

13. End month

Relative end date, month 1 marking the start date of the project, and all end dates being relative to this start date.

14. Deliverable number

Deliverable numbers: D1 - Dn

15. Type

Please indicate the type of the deliverable using one of the following codes:

- R Document, report
- DEM Demonstrator, pilot, prototype
- DEC Websites, patent filings, videos, etc.
- OTHER
- ETHICS Ethics requirement
- ORDP Open Research Data Pilot

16. Dissemination level

Please indicate the dissemination level using one of the following codes:

- PU Public
- CO Confidential, only for members of the consortium (including the Commission Services)
- EU-RES Classified Information: RESTREINT UE (Commission Decision 2005/444/EC)
- EU-CON Classified Information: CONFIDENTIEL UE (Commission Decision 2005/444/EC)
- EU-SEC Classified Information: SECRET UE (Commission Decision 2005/444/EC)

17. Delivery date for Deliverable

Month in which the deliverables will be available, month 1 marking the start date of the project, and all delivery dates being relative to this start date.

18. Milestone number

Milestone number: MS1, MS2, ..., MSn

19. Review number

Review number: RV1, RV2, ..., RVn

20. Installation Number

Number progressively the installations of a same infrastructure. An installation is a part of an infrastructure that could be used independently from the rest.

21. Installation country

Code of the country where the installation is located or IO if the access provider (the beneficiary or linked third party) is an international organization, an ERIC or a similar legal entity.

22. Type of access

- VA if virtual access,
- TA-uc if trans-national access with access costs declared on the basis of unit cost,
- TA-ac if trans-national access with access costs declared as actual costs, and
- TA-cb if trans-national access with access costs declared as a combination of actual costs and costs on the basis of unit cost.

23. Access costs

Cost of the access provided under the project. For virtual access fill only the second column. For trans-national access fill one of the two columns or both according to the way access costs are declared. Trans-national access costs on the basis of unit cost will result from the unit cost by the quantity of access to be provided.

INDEX

- ✓ History of changes
- ✓ DoA-B
- ✓ Annexes (including figures referring to DoA-A)

HISTORY OF CHANGES (main issues abbreviated)

Reference about main changes in the original DoA – Part A	DoA- Part A - Revised
New inserted text in WP1 description	WP1 is led by JRC because their large experience on land policy implementation, also in connection with DSS. A specific reasoning about the ZALA involvement is provided in “resource to be committed” in 3.4 (DoA part B)
New inserted text in WP2 description (Remark on the WP leadership)	<u>Remark on the WP leadership:</u> The WP leader role of RAS was decided considering the paramount importance of their task of integrating the handling of raster, vector and meta data, including query APIs allowing “any query, any time, on any size”. ...
New inserted text in WP2 description (month deliverables)	D2.2 Integrated Data Management Report. M18 D2.3 Data Ingest and Acquisition Report. M18 D2.4 Technical Support Report. M18
New inserted text in WP3 description (deliverables)	D3.1 Newly develop modules on crop productivity, agro-ecosystems, depicting agriculture relationships between applications and scale of concern. M24 D3.2 Newly develop modules on environmental issues and land degradation depicting environmental relationships between applications and scale of concern. M24 D3.3 Newly develop multiscale models for ecosystem services evaluation. M24 D3.4 Newly develop climate change resilience modules in biophysical models, LULUCF models and future LULC scenarios. M30 D3.5 Newly develop automatic spatial modelling capable of ingesting newly available information. M30 D3.6 Report on the final models implementation and optimization. The final release of the models will integrate all the optimizations in the modelling chains. M40
New inserted text in WP7 description	UNA with the assistance of CMAST will guide monitor this process, offering tools and methods for interaction, discussion and alignment between many different stakeholders.
New inserted text in WP7 description (deliverables)	D7.1 Launch of LANDSUPPORT website – M3 D7.2 Participation and dissemination plan (including list of SHG members) – M6 D7.3 Synthesis report of focus groups and the workshop. – M14 D7.4 Technical dissemination: activities, outcomes and suggestions... - M42 D7.5 Synthesis report of trainings and workshops with stakeholders.... - M42 D7.6 Report on social media use and number of followers on different channels, as well as on feedback. - M42
Change PM in WP8 description (person month)	UNA: 32,5 PM
New inserted text in WP8 description (task 8.2)	Task 8.2: Controlling. (Start: M1; End: M42; Lead: UNA) UNA, with the assistance of CMAST, will monitor overall progress regarding milestones and deliverables on a day-to-day basis. Whenever necessary, the management team will assist the Participants in achieving their goals.... For the Project Periodic Reports, UNA will collect all information from the partners. CMAST will support UNA in accurately compiling all information etc. etc..
New inserted text in WP8 description (task 8.3)	Task 8.3: Contractual management. (Start: M1; End: M42; Lead: UNA) UNA, supported by CMAST will monitor the compliance of the project with EU provisions (Grant Agreement and its annexes) and the Consortium Agreement. ...
New inserted WP9 and deliverables	WP9 Ethics requirements Deliverables (brief description and month of delivery) D9.1 H - Requirement No. 1 /D9.2 NEC - Requirement No. 2 /D9.3 M - Requirement No. 3

		/D9.4 NEC-requirement N.4
New inserted text in table 3.2a (list of milestones)	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25	Project kick-off meeting WP7,8 Documentation and training material ready WP2,3 Evaluation of outcomes of Land Policy SWOT, User Requirement and Impact Assessment WP1 Setup phase finished – databases are deployed “as is”, ready for use WP2 Launch of the LANDSUPPORT platform (1st version). Promotional material is ready WP5, 7 1st LANDSUPPORT press conference WP7 Suitable satellite platforms and geo-indicators identified for continuous monitoring WP4 First set (10) of DSS tools are ready for testing WP1, 2, 3, 4, 5 Beta version of platform architecture designed and ready for integration WP5 European level soil sealing case studies ready to be used by enduser WP6 Training programs defined and validated WP7 Solutions developed for automated updates of European land cover and land use data layers WP4 Second set (20) of DSS tools ready for testing WP1, 2, 3, 4, 5 Ready for consistency check of models WP4 Best approaches for data assimilation selected for further development and optimization WP4 Evaluation from public authorities Partners using LANDSUPPORT WP6, 7 Third set (20) of DSS tools ready for testing WP1, 2, 3, 4, 5 All European, National, Regional and local level case studies ready to be used by enduser WP6 Test of LANDSUPPORT replicability WP5, 6 Final version of LANDSUPPORT platform available All WPs Final set (50) of DSS tools ready WP1, 2, 3, 4, 5 All European, National, Regional, Local case studies concluded WP6 4 scientific workshops/conference co-organized WP7 2 Summer school held WP7 Final press conference WP7
New inserted text and table in: Resource to be committed (section 3.4)		<p>With respect to the total very high number of person month allocated to UNA for this project, we emphasise that</p> <p>(i) UNA is a strongly multidisciplinary Interdepartmental Research Center with experts (hydrogeologist, soil scientists, cultural heritage experts, economist, spatial planners, etc.) applying their research domain towards Decision Support Systems. This is rather unique and will strongly support the work of all other partners. Below it is provided a table reporting the details concerning these expertise against person/month for each WP;</p> <p>(ii) LANDSUPPORT is a very powerful but also complex project involving many different expertise and 19 partners each having a very different background. The UNA coordination requires to devote large energies and person months to be able to well-tune this complexity and facilitate this transdisciplinary collaboration.</p> <p>In 3.4 it is also reported a detailed accounting of expertise involvement and their PM distribution in different WPs.</p>
REQUEST OF COST BREAKDOWN		DONE IN RESOURCE TO BE COMMITTED (SECTION 3.4)
FINANCIAL ASPECTS RELATED TO SECTION 4.2 THIRD PARTIES (DoA/partB)		<p>Contract with CNR, CFF and ICARDA were fixed</p> <p>CNR: will activate one third party contract (art.11 GMA). Costs were placed in the personnel cost category. In the form of seconded personnel working on own premise (UNIBAS)</p> <p>CFF: will arrange contracts with the individual professors Crout and Karunaratne (not their institutions). The professors will then count as ‘natural persons working under a direct contract’. Costs were placed in the personnel cost category.</p> <p>ICARDA: The contract with INRGREF is NOT a “third party providing in kind contribution against payment”. It is a “normal” service contract, charging costs for specific support for ICARDA in the project tasks. Costs were placed in other goods and services cost category</p>
FINANCIAL ASPECTS RELATED TO RASDAMAN LICENSE (BSC partner)		In section 3.4 (Resource to be...) With respect to the rasdaman license (WP5), we recall that this license provision is strictly following the EC regulations for Background Knowledge. Partners will agreed to it in the Consortium Agreement before signature of the Grant Agreement, and the license is provided under fair favourable conditions

DoA-B

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Acronyms and glossary

AOI: Area of interest	LDN Land Degradation Neutrality
CAP Common Agriculture Policy	LULUCF Land Use Land Use Change Forestry
CC Climate Change	OGC Open Geospatial Consortium
^a COMPs	Rasdaman: "raster data manager" datacube engine technology
DMP Data Management Plan	SAB Scientific Advisory Board
DOC Controlled Designation of Origin	^e SCAR – Standing Committee for Agricultural Research
DSS Decision Support System	SDG Strategic Development Goals
^b ECZ: Earth Critical Zone	S-DSS Spatial Decision Support System
EIA Environmental Impact Assessment	SEA Strategic Environmental Assessment
^c EIP European Innovation Partnership	SHG Stakeholder Group
EO: Earth Observation	SO Specific Objective
ES: Ecosystem services	STC Steering Committee
FADN Farm Accountancy Network	T Task (in workpackage description)
GA: General Assembly	UN United Nations
^d GCI Geospatial CyberInfrastructure	WCPS Web Coverage Processing Service
GPU Graphics Processing Unit	WCS Web Coverage Services
GUI Geospatial User Interface	^f Wicked problem
HPC High Performance Computing	WMS Web Map Service
IPCC Intergovernmental Panel on Climate Change	
LD Land degradation	

^a a task-based programming model designed to facilitate the development of applications for distributed computing infrastructures

^b Earth's Critical Zone is the heterogeneous, near surface environment where complex interactions (rock, soil, water, air, and organisms) occur (National Research Council, 2001)

^c European Innovation Partnership for Agricultural productivity and Sustainability (EIP-AGRI) and on water (EIP-WATER) were launched by the EC to foster a competitive and sustainable agriculture and forestry sector and address major European and global water challenges.

^d Geospatial CyberInfrastructure is a combination of geodata resources, network protocols, computing platforms, and computational services that brings people, information, and computational tools together to perform science or other data-rich applications. (Yang et al. 2010)

^e Standing Committee on Agricultural Research Working Group on Agricultural Knowledge and Innovation Systems (SCAR-AKIS 2016) by EC. https://ec.europa.eu/research/scar/pdf/akis-3_end_report.pdf;

^f A wicked problem is a problem that is difficult or impossible to solve because of incomplete, contradictory, and changing requirements that are often difficult to recognize (Kassim et al. 2013; The European Commission of the 21st Century; Oxford University Press)

1. Excellence

1.1. Objectives

The objective of LANDSUPPORT is building a smart geoSpatial Decision Support System (S-DSS), sketched as a 4-wheel car in fig. 1.1a, providing a powerful set of decision supporting tools – that will be open and freely accessible through the web – devoted to:

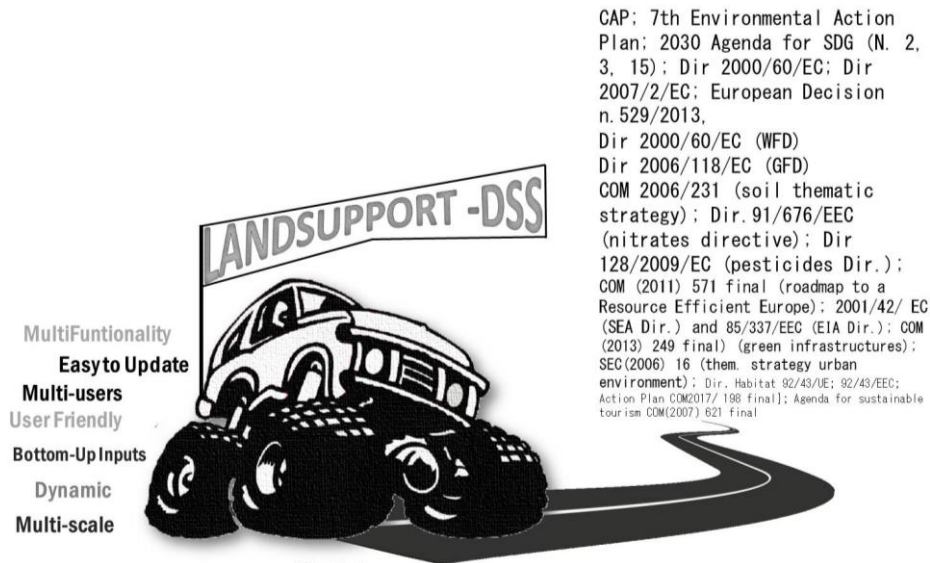


Fig. 1.1a

(i) support sustainable agriculture and forestry, (ii) evaluate their interaction and trade-off with other land uses, including spatial planning and (iii) support the achievement of selected CAP and 2030 SDG's land policies of both EU and UN agenda (SDG 2,3,13,15), with special emphasis to the key SDG15.3, "achieving a land degradation-neutral world" (LDN) and climate change (CC) mitigation and adaptation goals. By doing that, LANDSUPPORT will reconcile grand agriculture and environmental sustainability policy ambitions with operational reality addressing the overlooked support for planning/management actions at the very local scale. In fact, only by this approach incorporating the local dimension it is possible to produce DSS tools to simultaneously fulfil all high demanding specific challenges required by this RUR-03-2017 call such as the evaluation of "land use trade-offs", "incentivising real actions / behaviour / investments" contributing to "sustainable management of land resource" and considering societal needs. This is exactly what the high performing LANDSUPPORT integrated scientific approach promises to do, unlike both simplified aggregated Territorial Modelling Platform already in use for the ex-ante evaluation of EC policies and the many available specialised models or DSS systems (e.g. climate change adaptation/mitigation models and forestry DSS). By doing the above LANDSUPPORT "links between science and practice exploring the vast potential of e-science in agriculture" (SCAR) and demonstrates that the vision of reconciliation of agriculture and environment by managing the land as a resource, is not simply a wicked problem impossible to be solved but rather a complex reality that can be challenged using appropriate DSS tools! The general above objective is performed by developing S-DSS over a smart Geospatial CyberInfrastructure (GCI) which combine a set of innovative **scientific, technical and land policy oriented** specific objectives (SO) into one large **integrated objective**: namely the implementation of **100 operational LANDSUPPORT trans-disciplinary DSS tools**. These tools refer to multilevel applications to three rather different physical, socio-economic, cultural environments including Mediterranean, Central Europe and Eastern Europe countries reinforcing transferability. The one integrated objective also produces the expected results and impacts reported in the table 1.1.a (next page). The specific objectives reported in table 1.1a are measurable and achievable within the 42-months project duration, as detailed in chapter 3.1.

Moreover the evidence that these objectives are realistic is guaranteed (please See Chapter 3.3 for details) by the following facts: (i) the outstanding transnational, trans-disciplinary international technical and scientific reputation, (ii) experts from 5 partners already coordinated and success-fully delivered (e.g. LIFE+) two Geospatial DSS fully operational systems operating in land management and land conservation, (iii) combination of parallel computing (COMPSS) and massive multidimensional arrays (rasdaman), (iv) tight connection with European databases, approaches and policies (JRC partner), (v) 4 European public bodies partners will test and then employ the platform in their multilevel land policy implementation duties, (vi) high level international cooperation on sustainable land management and crops diversification (ICARDA, CFF), (vii) Multilevel application of LANDSUPPORT to three European rather different physical, socio-economic, cultural environments including Mediterranean, Central Europe and Eastern Europe countries; and even more, an application in North Africa (Tunisia), thus further reinforcing transferability and replicability.

SO	Description of Specific Objective: (WP=workpackage given in chapter 3.1)	Measurable Expected Results	Target
Scientific	<p>1. Concept and architecture of the Geospatial Cyberinfrastructure platform to manage land resource (WP5) combining all key features in Fig.1.1a</p> <p>2. Developing integrated interdisciplinary modelling chains and approaches for informed decision making (WP3)</p> <p>3. Data management (WP2, WP4) and modelling (WP3) capable to handle very high spatial detail (e.g. Cadastral scale; 3D, 4D petabyte) and using, as far as possible, physically based modelling engines (including HPC codes) such as biophysical modelling thus including evaluation of uncertainty.</p> <p>4. Development of procedures (type of modelling, data, open source, HPC) to allow LANDSUPPORT replicability elsewhere (WP6)</p>	% LANDSUPPORT platform completion (e.g. Alpha/ Beta/final versions) against project timing	(20/30/100)
		% completion of interdisciplinary modelling/ HPC codes developed in years 1/2/3/4 versus their total number	40 / 70 / 90 / 100
		N. of DSS tools developed each year	30
		N of modelling engines used in the platform	35
		N. of multi-purpose deliveries ordered for agriculture/ environ. / spatial planning	200/150/50
		N. decision makers (and their % of satisfaction) evaluating the environ. and agric. impacts of agric. management actions	700 (80%)
Technical	<p>5. Developing applications in sustainable agriculture, environment and spatial planning.</p> <p>6. Applying LANDSUPPORT over 4 geographic scales: European Union (NUTS0), 3 Nations (Italy, Hungary, Austria) (NUTS1), 3 European Regions (Campania region, Zala County, Marchfeld) (NUTS2,3), 3 pilot sites (Valle Telesina (IT), Keszthely (HU), RMEL (Tunisia) (groups of LAU2). (WP5,6). Selected applications will be also available at experimental farms (EU and Malaysia)</p>	N. multilevel public authorities (and their % of satisfaction) using LANDSUPPORT as integrated common knowledge base to simplify land policy implementation	10 (70%)
		N. multilevel public authorities/ stakeholders using LANDSUPPORT for its capacity building benefits	10
		N. of implemented contributions produced by the participatory "bottom-up" approach (including from LANDSUPPORT-app)	80
Policy	<p>7. LANDSUPPORT – by achieving the above interconnected scientific and technical objectives – will deliver RUR03-2017 challenges/scope and by doing that will contribute to implementation of about 20 European land policies – listed in table 1.1b – including European Decision n.529/2013 on LULUCF, RDPs (Pillar I and II); CAP; COM(2013) 659 final; 7th Environmental Action Plan; 2030 Agenda for SDG (N. 2, 3, 15.3); Dir 2000/60/EC; Dir 2007/2/EC; COM 2006/231, COM (2011) 571 final, 2001/42/EC and 85/337/EEC, Habitat Directive 92/43/EEC and connected National and Regional policies. (all WPs;)</p>	Evaluation report on potential replicability/ transferability of LANDSUPPORT to any other European areas.	1
		Evaluation report about Replicability/ transferability of LANDSUPPORT in two pilot areas in Tunisia and Malaysia	1
		<p>8. Integrated Specific Objective: Development of about 100 DSS tools producing 400 multi-beneficial deliveries for farmers, agriculture, environment and urban planning stakeholders, public bodies/institutions (WP5)</p>	
Expected Impacts	<p>LANDSUPPORT generate a large variety of impacts: Improve knowledge of land resource availability, use and management at 4 geographic scales; improve climate resilience of agriculture and forestry, provide an integrated platform for land resources management, policies and awareness at local/regional/national/EU levels, improve cooperation with Internat. Organization and with respect to socio-economic and humanities sciences. Provide a set of additional impact of key importance (chapter 2.1)</p>		

Table 1.1.a

In order to further clarify the *land policy* objectives of LANDSUPPORT and its resulting outcomes, in tables 1.1b and 1.1c the connections between LANDSUPPORT tools against EU/National/Regional land policy levels and specific achievements and tangible outputs are provided. The project will be applied across **4 geographic scales**: European Union (NUTS0), 3 Nations (Italy, Hungary, Austria) (NUTS1), 3 European Regions (Campania region, Zala County, Marchfeld) (NUTS2,3, tens of LAU2), 3 local sites (Valle Telesina-IT, Keszthely-HU, RMEL-Tunisia) (LAU2). For the sake of this proposal they will be briefly named as "pilot sites".

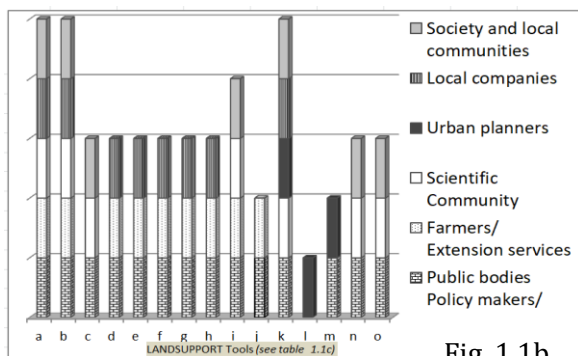
Theme	Main features of LANDSUPPORT tools– aggregated by theme- impacting over multilevel thematic land policies	Level of policy implemented by the S-DSS		
		EUROPEAN	NATIONAL (A+H+I: applied to Austria, Hungary and Italy)	REGION
General	a. Support implementation, impact and delivery of current CAP and SDGs policies by developing a smart S-DSS including i) a high-quality multi-purpose delivery mechanism (environment, climate, landscape), ii) long term sustainability, iii) replicability and transferability, iv) capacity building for competent authorities, (v) resource use efficiency	CAP; 7 th Environmental Action Plan; 2030 Agenda for SDG (N. 2, 3, 15); Dir 2000/60/EC; Dir 2007/2/EC – Inspire; European Decision n.529/2013	A+H+I: European Decision n.529/2013 on LULUCF reporting and accounting for climate change mitigation and adaptation; National Strategy for Adaptation to Climate Change Austria: Austrian Strategy for Sustainable Development (2002; 2010) Hungary: new National Sustainable Development Framework Strategy (NSDFS) Italy: dlgs 152/06 (Codice Ambiente); Law 183/1989; Law 221/2015 (Collegato Ambientale); Legislative Decree 27/01/2010 no. 32 (Inspire); DDL 1181; DDL 2039; National Strategy for SDG;	REGCAM (Italy)/Zala (Hungary)/Marchfeld (Austria); Rural Development Plan PSR 2014-2020 // Water Management Plan// Action plan for vulnerable zones to nitrates. //REGCAM: General Forestry Plan 2009 – 2013Zala County: CAP Regional applications //Marchfeld: Nature and andscape protection Law
	b. Support developing robust knowledge support to take informed decisions and improve climate resilience of agriculture and forestry			
	c. Support alignment of actors involved in land planning/management (e.g. ministries, NGOs, farming community) using an harmonised approach			
Agriculture Forestry CAP	d. Support institutions in Rural Development Plan and designation of origin of specific agrifood/land use	RDPs (Pillar I and II); CAP; Reg. 1698/05 1974/06 (rural development) Reg. 1306/2013 (cross-compliance)	A+H+I: CAP Greening Payment Requirements and GAEP Cross-Compliance Standards //CAP Rural Development Plans 2014-2020 Austria: Federal Forest law; Austrian Programme of agricultural environmental measures Hungary: Act on the Protection of Cultivated Soil Italy: Legislative Decree on Orientation and Modernization of the Forestry Sector; Agricultural policy instruments; Regional RDP; dlgs 18/05/01 no. 227	
	e. Supporting farmers for Cross-Compliance and greening			
	f. Improve water status, ecosystem services and resilience to climate change	Dir 2000/60/EC (WFD) Dir 2006/118/EC (GFD)		
SDG and Land Degradation Neutrality, biodiversity	g. Making water use more efficient and sustainable, also adopting best management practices in agriculture			
	h. Supporting sustainable forestry as required by EU Forestry Strategy and Supporting forest owners knowledge to adopt best practices	COM (2013) 659 final; (forest strategy)		
	Land degradation: i. Evaluating, at different scales, the soil threats as requested by Soil Thematic Strategy and proposing adoption of best management practices j. Reinforcing Nitrates and Pesticide Directives implementation including adoption of the best management practices	COM 2006/231 (soil thematic strategy); Dir.91/676/EEC (nitrates directive); Dir 128/2009/EC (pesticides Dir.);	A+H+I: Protection of Waters against Nitrates and pesticide pollution. Austria: Austrian Plant Protection Act, Austrian Fertiliser Act, Guideline for appropriate fertilization, Federal States Soil Protection Acts, Soil Protection Protocol of the Alpine Convention; Hungary: Act on the protection of Cultivated soil (CXXIX. Of 2007); Nitrates 27/2006 (II.7.) and Law 59/2008; Groundwaters 219/2004 (VII. 21.); Italy: Decree 19/04/1999 (good practice); DDL 1181; soil law; Ministerial Decree 25/02/2016 no. 5046; dlgs 14/08/2012 no. 150; National Plan on the Sustainable Use of Pesticides;	
	Land take and landscape/urban planning: k. Supporting stakeholders to achieve Zero Net Land Take by 2050 l. Supporting towards the implementation of Strategic Environmental Assessment and Environmental Impact Assessment Directives m. Supporting planning of green infrastructure (Communication on green infrastructure).	COM (2011) 571 final (roadmap to a Resource Efficient Europe); 2001/42/ EC (SEA Dir.) and 85/337/EEC (EIA Dir.); COM (2013) 249 final (green infrastructures urban environment);	Austria: Austrian EIA Act, Austrian Conference on Spatial Planning Recommendation No. 56 on Land take reduction, land management and soil policy Hungary: Decree No. 314/2005 (XII.25) for environmental impact assessments. Italy: dlgs 152/06; (Codice Ambiente DDL 2039 on Land Take; dlgs 31/03/1998, 112 (Bassanini)	
Biodiversity and ecosystem services: n. Supporting decision making over MAES (Mapping/Assessment Ecosystems and their Services) action under the EU Biodiversity Strategy to 2020	Dir. Habitat 92/43/EEC; Reg. 477/2011 (birds and natural habitats)	Austria: Austrian Biodiversity Strategy 2020+ Hungary: National Strategy for the Conservation of Biodiversity (2015-2020) Italy: National Strategy for Biodiversity (SNBD);		
Additional obj.	o. Supporting issues related to Natura 2000; Improve knowledge, and online digital technology to support EU Action Plan Nature, People, Economy, and Sustainable tourism	Dir. Habitat 92/43/UE; 92/43/EEC; Action Plan COM2017/ 198 final]; Agenda for sustainable tourism COM(2007) 621 final		

Table1.1b. Connection between LANDSUPPORT tools (from “a” to “o”) and EU, National and Regional land policy levels

Theme	Abbreviation of LANDSUPPORT tools listed in table 1.1.b	LANDSUPPORT Achievement	LANDSUPPORT TANGIBLE PRODUCTS (list not exhaustive)	Scale		
General	a. Ameliorate implementation of multilevel land policies	An operational interactive web tool supporting many public authorities in implementing CAP, SDG policies and improve climate resilience in agriculture/forestry and Land Use, Land-Use Change and Forestry (LULUCF)-accounting . This include scenario analysis, what if modelling, on the fly complex queries over a very large set of databases, and reporting; One unique platform – having a very strong scientific and technical bases - to align many different actors involved in land management;	Each partner institutions implementing land policies will have a tailored digital dashboard designed to support its institutional duties towards CAP, SDG. A tool enabling to test current LULUCF country accountability with LANDSUPPORT products including (i) Sentinel derived inter-annual land use change matrix and reporting, (ii) newly SOC maps; (iii) on-the-fly SOC management and climate change scenarios; (iv) computing future trends of land use change;	E,N R,L		
	b. climate resilience agriculture /LULUCF			N		
Agriculture Forestry CAP	c. Aligning actors in land planning/management	Interactive tools to support regions in RDP by: i) support a participative approach to rural development through the involvement of citizens, rural communities, scientific community, students, etc; ii) make available databases queries to support agro-climatic services through the use of common platform; iii) Identify correct sustainable agri-environmental practices in protected territorial areas. iv) reinforce designation of origin of specific agrifood/land use	Multilevel Land actors can participate to LANDSUPPORT populating the platform with their own evaluation, comments and data (see FIMS). E.g. farmers can insert their own plant /soil data to feed model producing personalized outputs (e.g yield) Free queries over very complex databases to evaluate the site specific potential performance of new crops (on-the-fly report, maps) Maps/reports to better management (e.g. winkler index, soil suitability to new rootstock) and marketing of selected DOC products (viticulture and olive tree)	R,L		
	d. Support institutions in Rural Development Plan and designation of origin of agrifood/land use			Farmers, once defined an AOI (area of interest), can evaluate their own level of compliance with the system of conditionality and greening by checking an interactive list of the “obligations” especially related to the so-called EFA (Ecological, Focus, Areas);	R,L	
	e. Supporting farmers for Cross-Compliance and greening				Simulations of alternative agri-environmental scenario . The user can freely draws (i) his area of interest (e.g. farm, municipality) and (ii) insert his management data (when required) and (iii) obtain (on the fly) current (and forecast) quantification/report/map of biomass production, soil water storage capacity, soil carbon stock capacity, soil water stress, irrigation and all the above considering climate change scenarios	R,L
	f. Improve ecosystem services resilience, g. Making water use more efficient				Yearly National Maps and reporting of forest productivity and -quantification of forest ecosystem services. -Simulate different scenario of forestry practices to enhance climate change resilience.	N, R, L
SDG, Land Degradation Neutrality, Preserve Biodiversity	h. Supporting sustainable forestry	Modelling and mapping tools designed to support sustainable forestry by: i) identifying forestry zones having high biodiversity indexes, ii) monitoring productivity and regeneration capacity, iii) quantifying forestry ecosystem services, iv) identify forestry best practices to increase climate change resilience.	Interactive queries over existing LD European and National maps Proposal of scale appropriate solutions to land/soil degradation after GEOCC methodology (see WP3 in chapter 3.1) Interactive mapping of simulated land use change over LD intensity	(G), E, N		
	i. Evaluating, multilevel land/soil degradation (LD) threats	Reporting and geospatial accounting, modelling, monitoring and mapping tools designed to: i) interactive LD mapping and best practices (ii) quantify and find scale appropriate solutions to land/soil degradation problems affecting the ecosystem services (e.g. soil erosion and decline in organic matter and land-biodiversity, soil sealing, compaction);		R		
Additional obj.	j. Nitrates and Pesticide Directives	i) simulate nitrate balances and best management practices to lower nitrate and pesticide leaching in farm systems	Simulations of alternative farm management scenario over nitrate and pesticide leaching , thus obtaining quantification/report/map	(R), L		
	k. Zero Net Land Take by 2050	Modelling, monitoring and mapping tools designed to: i) evaluate and quantify land take process over time, ii) quantify the effects of new urbanizations on ecosystem services; and on landscape metrics for planning purposes; ; iii) quantify the gain in ecosystem services following the implementation of agri-environmental measures, green infrastructures, etc. iv) providing assessments reporting for SEA and EIA procedures	Interactive mapping/reporting/accounting of current or newly simulated land take or new green corridor over landscape metrics (e.g. sprawl) and ecosystem services ((MAES, INVEST approaches) Interactive tool to support SEA and EIA procedures . Here the planner can test (uploading a shp file) his own plan against land use changes and ecosystem services and biodiversity impacts	R,L		
	l. SEA and EIA	Tools to exploit LANDSUPPORT potential for education , land resource awareness and sustainable tourism and agro-tourism.		L		

Table 1.1c. Connection between LANDSUPPORT tools and specific achievements and tangible outputs that will be produced by the project at different scales
Abbrev. G= global interest; E= N= national scale; R= regional scale; L= local scale. In brackets (scale)= implementation of selected models at specific scale

On the base of its specific features, each of the available tools (from “a” to “o”) can be used by a specific “group” or set of groups of end-users (see fig 1.1b). Despite these users-base differences, all tools work similarly. In fact, on the base of the specific chosen application, the user (i) selects its area of interest (also named AOI, ranging from entire Europe to a specific farm), (ii) runs the DSS tool, (iii) obtains (and analyse) the results. As shown in table 1.1c (last column) not all applications are available at all four scales but rather they are adapted and tuned to the relevant scale for the specific chosen land policy applications. Thus, for instance the soil sealing tool can be delivered at high spatial resolution (20 m) for entire Europe while nitrate leaching can be only applied at regional or even local scales, where suitable soil hydrology data are available.



It is evident now that the LANDSUPPORT integrated specific objectives are strictly linked with land policies implementation by means of S-DSS tools/achievements at specific scales. In table 1.1c a synoptic description demonstrating all the above connections is provided while below 3 short examples are reported to show more in detailed how LANDSUPPORT will meet the general objectives and thus how the system would actually work from the end-user perspective.

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Theme: Land take at European (DSS tools ‘k,l’ in table 1.1.b and 1.1c)

LANDSUPPORT will address the land take issue through several tools whose engines will be based essentially on the processing of: i) past and present land use/land cover maps; ii) maps of soil sealing; iii) thematic layers such as soil maps, Ecosystem Services maps, etc.

Type of endusers: Municipalities and urban planners.

What. Evaluating the impact (e.g. ecosystem services,) of a new spatial plan by Strategic Environmental Assessment.

How it is currently done. Urban planners attempt to collect all available environmental data then hopefully they should require the support of agronomist and environmental experts who will use both manual procedures and dedicated software (e.g. ARCGIS, fragstat) to build a SEA procedure with very limited - if any - standardization about how to process agriculture and environmental data.

How it will be done using LANDSUPPORT. The user can: i) selects from a drop-down menu the area of interest (AOI) which will be represented by the boundaries of the Municipality, or ii) draws a specific AOI, or iii) uploads an own vector GIS file with his new owned plan. Once the AOI is defined, the user queries the system about the land use change occurred within the Municipality’s boundaries during a specific time interval selectable from a list.

Output 1. Reports showing statistical data & graphs on land use change (e.g. agriculture areas towards forestation or urbanization) within the selected time interval (e.g. in the figure below left from 1950 to today). By drawing an AOI or uploading a vector-GIS file of a new spatial plan the system will allow the user to apply a detailed scale tools, designed to provide data and indexes related to environmental metrics (e.g. rural fragmentation map below at the left frame, urban sprawl) and Ecosystem Services.

Output 2. i) data and maps concerning several environmental metrics within the AOI (left frame below); ii) quantitative loss of ecosystem services in 2 alternative new urban areas (e.g. loss of biodiversity, loss of soil water storage capacity, etc.). (right frame below).

Loss of Soil Hydrological Functions		
Avareged soil water capacity (m³/year)*10³		
Position 1	23.29	
Position 2	18.88	

Loss of biological quality		
	Organic matter (Carbon *10³)	Biodiversity (Shannon index)
Position 1	0.91	0.77
Position 2	0.94	0.98

Theme: Accounting of emissions and removals from LULUCF at National scale (DSS tool “b” in table 1.1.b and 1.1c)

With respect to climate change mitigation policies in Europe and to use of land use, land-use change and forestry (LULUCF) sector to mitigate national greenhouse gas emissions (EU decision 529/2013) LANDSUPPORT will support EEA and ISPRA public bodies to address the issue of the accounting of greenhouse emissions and removals from LULUCF sector by developing DSS tools based on processing of EO images (Sentinel 1,2) and modelling the C sink processes;

Type of endusers: public authority in charge of carbon accounting at national scale (e.g. SPRA, REA, AT) (18)1548916 - 21/03/2018

What. (i) Verify the accuracy of the current reporting of emissions and removals about land use, land-use change and forestry (LULUCF) activities; ii) evaluate best practices in land use management in terms of impacts on C stock and sink.

How it is currently done. In most EU countries LULUCF accounting and reporting are made on the base of a large activity data collection, including inventories and statistical sampling point spread in each country.

How it will be done using LANDSUPPORT. The procedure for monitoring LULUCF is based on processing of EO images (mostly Sentinel). The user: i) selects the entire national territory (e.g. Italy, Austria) or ii) draws an own area of interest (AOI). Once the AOI is selected, the user queries the system about the inter-annual land use change (starting from 2018) and related C stock changes at national scale. Moreover, LANDSUPPORT will enable to simulate in self defined areas specific land use changes selectable from a drop down list to discover the effects of these changes in terms of C stock and Ecosystem Services changes. Drawing an AOI the user will apply more detailed spatial tools based on modelling procedures and can query LANDSUPPORT about several LU management scenarios. A second tool will also enable to evaluate and compare best practices to enhance the C sink in agriculture but this will be simulated at local scale (where suitable data are available) but possibly applied elsewhere. In this case the user will be able to choose from a drop-down list several potential LU management practices (e.g. organic fertilizer instead of chemicals, grassing instead of bare soil, etc.) and query LANDSUPPORT about the impacts in terms of C stock.

Output 1. Pdf reports and interactive map showing the C variation related to LU changes at national scale, occurred within the time interval selected.

Output 2. Comparative data & graphs about effects of LU change on C stock changes and ecosystem services at landscape scale.

Output 3. Comparative data & graphs related to the effects of LU management on C stock also at local scale.

Theme: Nitrate issue at local scale (DSS tool “j” in table 1.1.b and 1.1c)

LANDSUPPORT will address “nitrates pollution towards the groundwater” issue at the local scale by means of dynamic modelling tools whose functioning is based essentially on: i) soil properties (e.g. hydraulic, chemical), ii) climate data (e.g. rains and temperatures); iii) soil use management, crop management and crop parameterization in terms of N balances (e.g. crop uptake, N input); iv) groundwater features.

Type of enduser: farmer, farmer associations, local authority for agriculture.

What. Evaluation of the effects of land use change and land management in terms of risk of nitrates pollution towards groundwater.

How it is currently done. Currently it is not done unless a farmer or an association of farmers engage and finance an interdisciplinary team of scientist (working in the field, lab and modelling) to support their decision making.

How it will be done using LANDSUPPORT. The user: i) selects an AOI (e.g. cadastral unit map) or directly draws his own specific area of interest (AOI) and ii) simulates a change in land use (e.g. crop type) and/or change in crop management (e.g. different irrigation scheme or different fertilization) by choosing from drop down lists.

Output. LANDSUPPORT will run the models and provides data and graphs related to the potential risk of groundwater nitrates pollution (e.g. through a risk index) and to a comparison between this potential risk and the current risk.



1.2. Relation to the work programme

LANDSUPPORT addresses the topic “RUR-03-2017: Towards 2030 - policies and decision support tools for an integrated

approach to the management of land as a resource” within the Horizon 2020 societal challenge 9, under the call “Rural Renaissance - Fostering innovation and business opportunities. LANDSUPPORT fits with the priorities of this work programme, as it focuses on *outbreaking innovation as driver for rural development, with a particular emphasis on developing framework conditions for innovation and new business models adapted to the rural context, and support for skills development in rural communities*. In particular, targeting subareas 1 **new approaches towards policies and governance** LANDSUPPORT activities will aim at improving implementation of policies and governance at *various geographic scales* to support sustainable growth in rural areas. As additional remark it also delivers towards the area of Sustainable Food Security.

The project addresses **specific challenges** and **scopes as follows:** (*in italics the quotes of the topic*)

Challenge: “To ensure sustainable management... there is a need for an integrated framework that addresses all society's objectives ...by understanding trade-offs between uses and by incentivising actions / behaviour / investments.”

LANDSUPPORT sits within the specific challenge of the call. The proposed DSS will in fact capitalize on existing European (but also National and Regional) databases (see WP2) and knowledge by developing an integrated S-DSS system with modelling engines designed to compare trade-off between land uses and supporting actions at local scales. (WP5)

Challenge: “Appropriate Decision-support tools are needed to help implement such an integrated and systemic approach”

DSS tools adapted to the type of multilevel users are specifically designed to implement this integrated approach. LANDSUPPORT will be specifically conceived to deliver operational support to factual multilevel land policies implementation.

Scope: “Activities will take place on various geographic scales reflecting levels of policy from regional to EU”

LANDSUPPORT produces results over 4 different geographic scales (EU, Nation, Region, Local) and connected land policies. This is feasible by analysing and tuning, at each scale, (i) land policy requirement (WP1), (ii) data availability (WP2) and modelling (WP3), also by combining open source geospatial codes with HPC (WP5) as described in chapter 3.1.

Scope: “decision tools will be fully participatory so as to ensure the involvement of the society at large.”

Web-based Geospatial CyberInfrastructures (WP5) have an intrinsic strong potential for treating and incorporating bottom-up contributions thus allowing participatory planning approaches. To this end, LANDSUPPORT benefits from participation of society representative institutions as project partners. Interactive workshops and participatory communication activities will be set up to ensure full stakeholder participation and also citizens (WP7). This will be empowered the by LANDSUPPORT multi-stakeholders (e.g. Confagricoltura, INU, Marchfeld Region, AGES, Chamber of Agriculture of Hungary).

LANDSUPPORT will implement a multi-stakeholder approach since this adds to the benefit and impact of the project and furthermore, it is in line with the H2020 framework. LANDSUPPORT adopting such approach crosses the boundary between knowledge users and generators (SCAR, 2012) thus inducing the formation of a multi-actor innovation network in rural areas. This is possible thanks to the intrinsic nature and potential of the Web-based Geospatial CyberInfrastructure (WP5) incorporating bottom-

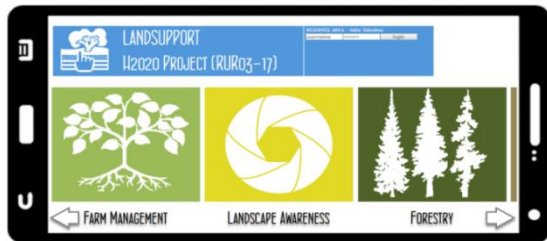


Fig.1.2a

up contributions, such as gathering data, data sharing (albeit respecting data privacy) and interpreting results by end-users (including public bodies, farmers, extension services, scientific community, urban planners, local companies, society; in Table 1.1b). Moreover – thanks to the platform – LANDSUPPORT will also deliver education to end-users (e.g. a large set of short webinar will explain the different tools) with limited investments. All the above will be empowered also thanks to the evidence that many of the DSS-tools can be used over mobile devices and that – especially at the local scale – a specialised app (example in fig. 1.2a) will enable local users

to upload:

- (i) specific plant (e.g. LAI) and soil (e.g. SOC) georeferenced data/observation that will automatically be used by LANDSUPPORT to ameliorate modelling performance over specific end user request;
- (ii) comments and suggestions about tools;
- (iii) upload multimedia files (e.g. mp3, mp4) for the landscape awareness tools (WP7). For the Valle Telesina site the High school of Telesse stakeholder will be engaged (see SHG).

Thus, this data/knowledge sharing/exchange will incorporate “citizen science” elements (SCAR 2012) in LANDSUPPORT, see chapter 2.2).

This approach has been undertaken in order to further empower LANDSUPPORT to both deliver the very high demanding challenges/scope of RUR-03-2017 and to actively involve local communities in the LANDSUPPORT construction and deliveries.

More specifically, knowledge transfer from researchers to end-users is ensured by the use of the LANDSUPPORT platform (depicted as mode 1 in fig.1.2b). While, at the 3 local sites (Valle Telesina, Marchfeld, Keszthely), general meeting and face-to-face meetings with both farmer and municipalities will ensure knowledge transfer from end-users to researchers (mode 2 in fig.1.2b). This will be ensured from the start of the project to ensure that complementary types of knowledge (scientific and practical) and needs (challenges, incentives) are taken into account to transform project external threat into concrete opportunities.

The “glue” between science and stakeholders is provided by the Stakeholder Group (SHG, see below) that will assist their interaction. Moreover, an integrated approach to land awareness raising and capacity building (WP7) will be further facilitated by the Web-based Geospatial CyberInfrastructure where researchers’ findings will be accessible to end-users and to the wide public and this will stimulate further interaction with farmers and other agriculture and non-agriculture stakeholders.

Scope: “take account of all current and expected major societal needs as regards land resources and their use in terms of products, ecosystem services and other types of goods, services and functions”

The project includes state of the art modelling chains (WP3) using both physically based and empirical models. This approach will enable to quantify a large set of products and ecosystem services/functions including food and other biomass production, C storage and dynamics, water storage and filtering, biological habitat, source of raw materials, physical and cultural heritage, platform for man-made structures.

Some high demanding models (e.g. planning crop adaptation to climate change, crop productivity, agriculture best practices for nitrate leaching) will be implemented using parallel frameworks (WP5) and most advanced remote sensing processing (WP4).

Scope: S-DSS tools and models will help prioritise multiple land uses at various geographic scales taking advantage of existing databases and tools ... on the basis of modern capabilities... approach proposed will be compatible with and/or improve existing databases and tools used at the European Commission

LANDSUPPORT will have the capability to simulate (e.g. crop modelling) different uses of land and trade-off quantification between different scenario (WP3) thanks to its large databases (WP2), highly advanced database queries technology (rasdaman in WP2 and WP5), a scalable programming framework (COMPSs framework in WP5) and most advanced remote sensing processing (WP4).

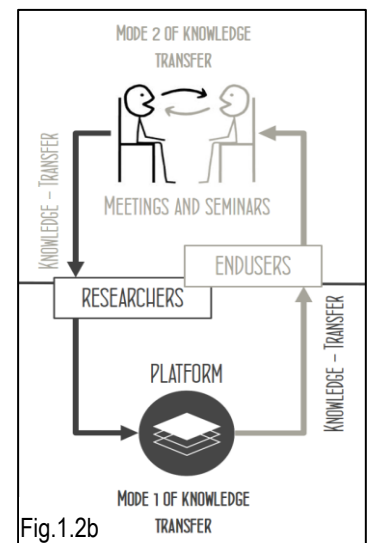


Fig.1.2b

Datasets referring to different geographical scales will be combined in the DSS to obtain a multilevel database so that it can serve land policies and spatial planning at different levels, from local to European. At the EU level, in particular, JRC and BOKU partners will ensure compatibility between databases and tools used at the European Commission (e.g. LUCAS, Copernicus dataset and Sentinel Collaborative Ground Segment). In doing the above, special attention will be paid (i) to follow the FAIR principles for open data and use semantic technology to help with findability, provenance and interoperability as requested by SCAR (2016) and (ii) to ensure very efficient data backup (RAID5/10 and 2 data hosts at UNA and BSC). Most importantly – data accuracy and reliability of multilevel databases (including a special focus over local/regional soil data) – will be especially addressed (WP2) because of their paramount importance for LANDSUPPORT modelling (WP3).

Scope: Activities will mainly include agriculture and forest land use/cover and will extend to interactions of the former with other main land uses/covers. ...

Many LANDSUPPORT activities focus on the broad domain of agriculture and forest land use/cover. Their interaction with spatial planning has been included considering the paramount importance of planning over land use change dynamics in all EU countries. To achieve the above goals, special attention is devoted to LANDSUPPORT testing (WP6) by public bodies partners (having institutional duties in agriculture, forestry and environment) and also by urban planner stakeholders (e.g. INU).

Scope: While focusing on Europe, proposals are encouraged to draw on good examples from elsewhere.

LANDSUPPORT employs two good examples from outside EU with respect to agriculture and forest land use and land degradation. These examples refer to the incorporation in LANDSUPPORT of: (i) the CROPBASE system (<https://cropbase.org/>; developed at CFF and incorporated in WP2 (Task 2.2) aiming to evaluate the adaptability of a specific territory to a large range of major and underutilised crops and (ii) the GeOC tool about extrapolation (spatially explicit) of good practices in new areas (scaling-out in WP3 Task3.3). In addition to the above, ICARDA was chosen because its mission is towards North-Africa countries which is a strategic area for the European interests including agriculture, while CFF was chosen because of its mission toward technology transfer for agricultural diversification and because of its chair role in AIRCA consortium, by which over 300 institutional locations around the world can be accessed.

1.3. Concept and methodology

1.3.1. Concept

Overall concept

The following figure 1.3.1a is shows the overall view about LANDSUPPORT concepts; below further explanations are provided:

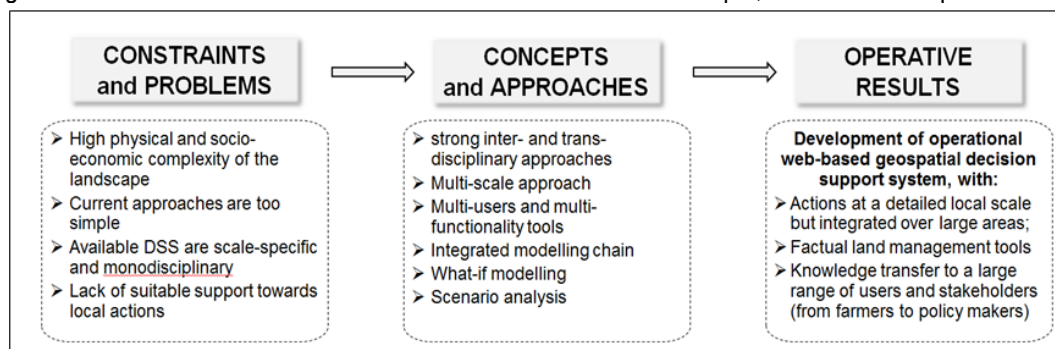


Fig. 1.3.1 a

A large number of European directives (as reported in table 1.1b) are indeed aiming to achieve a better environment and agriculture preserving natural resources and adapting to climate change (e.g. WFD directive). However **full implementation of these Directives** (and Communications, Regulations) **is still challenging** (e.g. COM2015/120; COM2013/683). The same occurs in the factual application for strategic high policy documents towards sustainable landscape management (7th EAP, FAO Agenda, 17 SDG of 2030 UN Agenda). These challenges are explained by three elements:

1. **The embedded – overlooked – high physical and socio-economic multi-faceted complexity of the landscape** including its spatial variability, its multi-functionalities (e.g. agriculture/environment), its site specific dynamic nature (e.g. rainfall varies continuously in time and space; then its influence over many agriculture and environmental processes is very dynamic). In addition, this complexity is often dealt with by sector-specific Directives and policies, whose design and implementation is not fully integrated: this can result in counterproductive cross-sectorial effects, as well as in missed opportunities in terms of lack of synergies among different policies;
2. **The lack of a truly integrated physical approach to many agriculture/ environmental problems.** In fact, these problems are often addressed by simple overlapping (as in a standard GIS system) of environmental data layers/knowledge (vegetation, soil etc.) instead of a truly integration as in the case of the “Earth Critical Zone” approach and modelling.
3. **The lack of factual support to farmers for the adoption of sustainable agriculture practices** and to regional governments to manage agriculture, forest lands and many environmental issues.

Successful policies implementation would. Indeed, require addressing this physical and socio-economic landscape complexity thus supporting positive **actions at a very detailed local scale but integrated over very large areas**. Current approaches are not challenging this complexity, offering a simplistic aggregated view of the problem. **In such framework, the development of operational web-based geospatial decision support system is the answer and LANDSUPPORT will provide it, thus achieving simultaneously factual sustainable land management with integrated policy implementation for agriculture, environment and land use planning.** This is made possible thanks to currently already available scientific and technological advances and to the expected new strong inter- and trans-disciplinary results which the project will

produce (e.g. on-the-fly applications).

There is a large variety of DSS, but typically they have been developed to address specific problems for particular end-user groups. Thus, they are of little use for delivering the integrated approach required by this call. In contrast, LANDSUPPORT (also thanks to HPC) will develop **integrated modelling approach supplying multiple applications and benefits** to support sustainable management of land resource and sustainable agriculture/forestry practices.

The Fig.1.3.1b aims to show this critical issue. At the bottom of the figure (grey background), there are many cars, each one representing an example of the many currently available specialised model/DSS systems designed to achieve a specific goal (e.g. climate change impact assessment, state of land degradation, crop productivity). It would be extremely important that each of these models/DSSs were connected with the others, unfortunately this is not the case (grey roads are not interconnected). In fact, the current scenario (grey-background) is very fragmented with many available models/DSSs systems not interacting with each other.

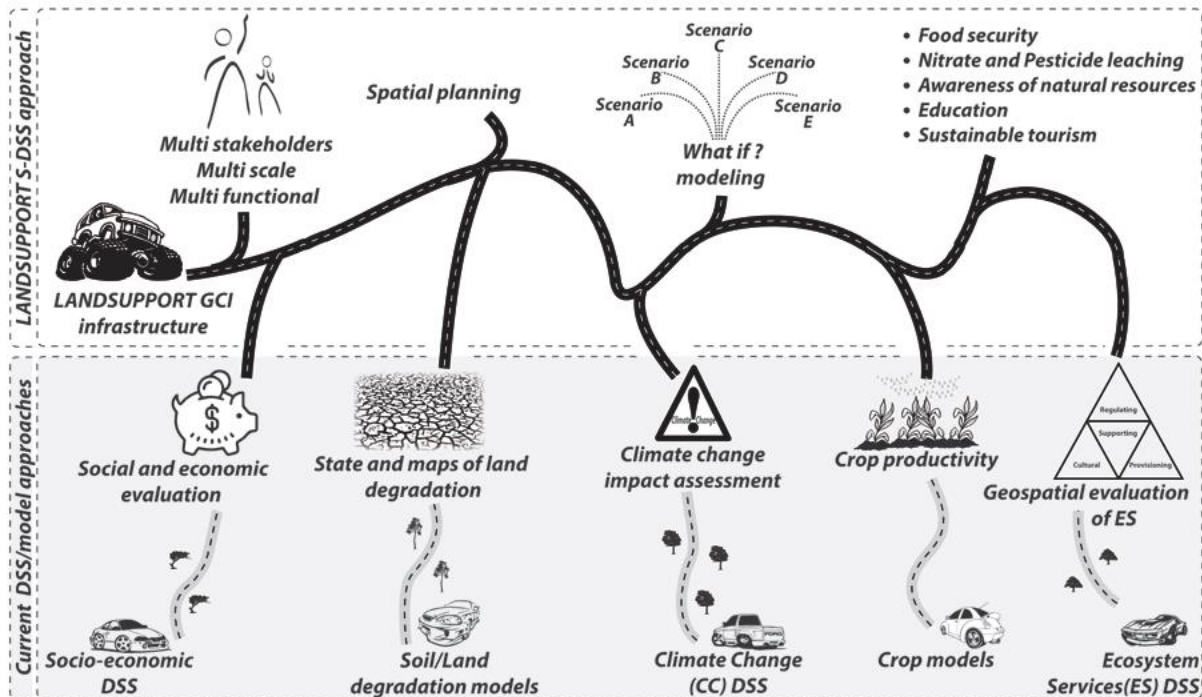


Fig.1.3.1b

Differently, at the top of the figure is given the single LANDSUPPORT (S-DSS) 4-wheel car – which thanks to its very unique engines – is able to deliver (black road) simultaneously multiple objectives; thus, overcoming current fragmentation of tools and land policies implementation. Most importantly the very same LANDSUPPORT 4-wheel car, without any further investments, is also able to reach many new and crucially important additional objectives (e.g. socio-economy evaluation, spatial planning, what if modelling, water use efficiency, etc.). All the above is indeed possible thanks to the intrinsic optimization of LANDSUPPORT where the marginal cost to develop each new single engine is low because each engine is used for multiple purposes. For instance, the high cost for developing the “soil-plant-atmosphere (SPA) hydrologic simulation modelling (see fig 1.3.1c) working on HPC parallel processing” is counterbalanced by the evidence that this model is used for many different things

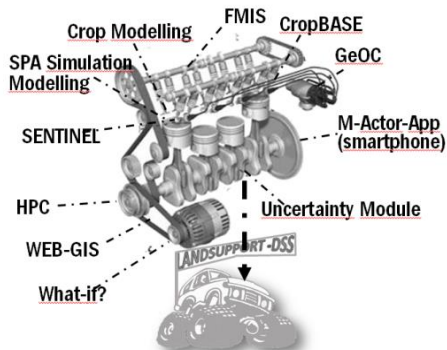


Fig.1.3.1c

such as (i) in evaluating ecosystem services, (ii) farm management, (iii) soil compaction, (iv,v) nitrate and pollutant leaching, (vi) food security, (vii) impact of climate change, (viii) spatial planning, etc. The same applies also to other modelling engines; thus the outcome of this approach being the extraordinary high value for money of LANDSUPPORT.

Moreover, the totality of already existing DSS are typically limited towards a specific scale. **LANDSUPPORT will provide S-DSS deliveries tuned in accordance to four geographic scales and data availability** matching all relevant policy levels (local, to regional, national and EU levels) with special attention to the EU subsidiarity principle. For the entire **European** territory LANDSUPPORT will deliver results on specific issues (e.g. Land Use Change) using European databases. At the **national** scale, it will deliver results over a larger set of issues (e.g. soil sealing, landscape fragmentation) whereas an even broader set of results will be produced at **regional** and **local** scales (Regional and District spatial plans, Rural Development Programmes). Most importantly, thanks to parallel processing and HPC the project will enable to tackle actions at the local scale where the largest multi-beneficial agriculture and 2030 SDGs deliveries will be produced. **This will be the major breakthrough transforming S-DSS outputs in potential practical actions to really improve agriculture, environment and other land uses.**

But how all the above is achievable? Indeed, LANDSUPPORT will make all above achievements and those reported in table 1.1c

thanks to both (i) the specifically smart set of engines (depicted in fig. 1.3.1c) empowering the LANDSUPPORT core and (ii) the LANDSUPPORT concept architecture reported in fig. 1.3.1d.

Furthermore, these features along with the smart project infrastructure freely accessible through the web enable **LANDSUPPORT to deliver knowledge transfer to a large range of users and stakeholders** and to engage an important multi-actor approach (from farmers to policy makers).

Following the recommendations of the SCAR (2012) the multi-actor process of learning and co-innovation in LANDSUPPORT will have the following characteristics: (i) agriculture and environment **challenge-oriented**; (ii) **trans-disciplinary**, (iii) **“reflexive” and socially-distributed** (dialogue among actors and use of stakeholder knowledge, open access and open innovation will guide the LANDSUPPORT R&D process implementation) (iv) **promote** outstanding development of **new set of skills and competencies** by using Geospatial-DSS resources for many different needs of participating actors. All the above will be possible thanks to LANDSUPPORT dashboards interfaces (WP5) customized for a large set of end-users while the Knowledge Transfer (including georeferenced data) from end-users (farmers and companies) and stakeholders to the LANDSUPPORT system is achieved by (i) a specific component of the platform, (ii) the LANDSUPPORT-app and (iii) the large set of activities planned in WP7 and reported in chapter 2.2. This will also include open-access, respecting data privacy, by researchers and stakeholders for data mining and model testing.

LANDSUPPORT involves key relevant actors in a process of knowledge co-creation engaging them from the very beginning. Key actors are represented in the project consortium: public bodies implementing land policies in agriculture at the regional level (Regione Campania, Zala County); public bodies implementing environmental land policies at the country level (ISPRA, EAA), public bodies implementing environmental land policies at European level and producing policy recommendations (JRC), researchers (UNA, BSC, BOKU, CNR, iASK, RASDAMAN, UPA, UMI); International Organizations (CFF, ICARDA), agro-tech SMEs (ARIES); organizations (JRC, ISPRA); consultancy SME involved in project & innovation management and communication (ACTeon, CMAST).

In addition, a **Stakeholder Group (SHG)** (see WP7) will be established to help LANDSUPPORT maximizing its impact. The SHG brings together actors reported in fig. 1.3.1e and experts from science, institutions involved in land policy implementation, farming and urban planning association, agro-tourism associations, citizen representatives beyond the project partners.

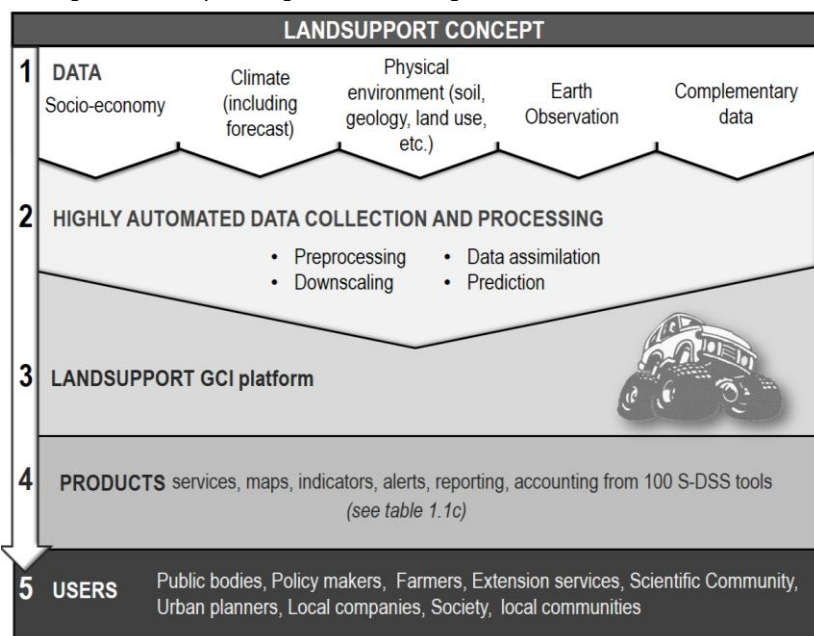


Fig. 1.3.1d

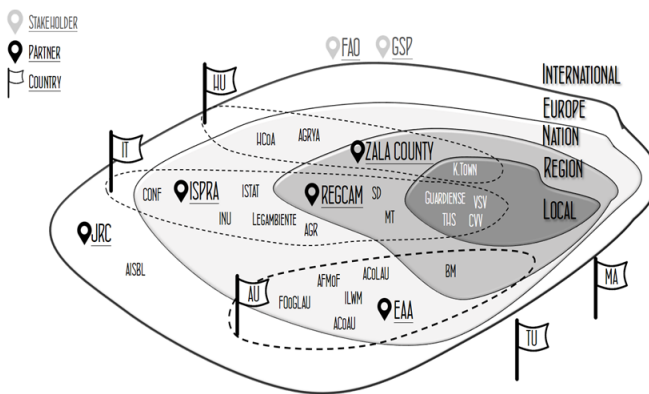


Fig. 1.3.1e. Composition of SHG. Abbrev: European council of spatial planners *ectp-ceu* = AISBL; *Confagricoltura* = CONF; *Agriturist* - Regional Association for Agritourism, Landscape and Environment (Italy) = AGR; *Istituto nazionale urbanistica* = INU; *Comune di Telesse* = MT; *Telesia high school* = THS; *Cantina di Guardia Sanframondi* = GUARDIENSE; *Regione Campania* = REGCAM; *Sannio DOP* = SD; *Vita Salernum Vites* = VSV; *Consorzio Tutela Vini Vesuvio* = CVV ; *Hungarian chamber of agriculture*= HCOA; *Zala megye municipality*= ZALA COUNTY; *Keszthely town*= K. TOWN; *Agricultural and Rural Youth Association* = AGRIA; *Austrian federal ministry of agriculture, forestry, environment and water management*= AFMOF; *Federal office of the government of lower Austria*=FOOGLA; *Agricultural chamber of Austria*=ACOAU; *Agricultural chamber of lower Austria*=ACOLAU; *Betriebsgesellschaft marchfeldkanal*= BM; *Environmental Agency of Austria*=EAA; *Institute for Land and Water Management research* = ILWM

Positioning from lab-to-market and/or TRL

LANDSUPPORT will bridge (as depicted in Fig.1.3.1f) the crucial gap between science and society, well recognized in the Technology Readiness Levels between TRL3 and TRL7, the so called “valley of death”.

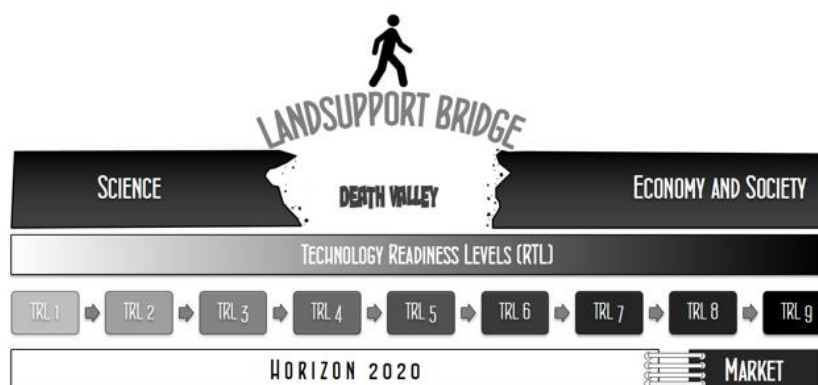


Fig.1.3.1f

Accordingly, hereafter the most important technological advances to be attained in the LANDSUPPORT project are specified:

- Implementation of a Geospatial CyberInfrastructure and multiuser GUI in WP5. A large set of dedicated models (e.g. viticulture degree sum, climate change scenario, nitrate leaching etc.) are available and positioned at high TRL levels while their key functional interconnection is typically lacking. Moreover, it is also lacking the ability to deliver simultaneously highly spatial detailed information for very large areas. **Then the complexity of multiuser and multiscale LANDSUPPORT GCI will move from the current TRL3/TRL4 state to TRL7.**
- Optimize the integration of rasdaman and COMPSs as an open-source project deliverable. This end-product can be used in any context having the same requirements of parallel computing (COMPSs) together with massive multidimensional arrays handling (rasdaman). **The technology readiness will move from the current TRL3 state towards TRL6/7.**
- In LANDSUPPORT the automatic digital mapping (WP3) engine will implement key and advanced geospatial tools in order to fill the spatial and/or the temporal domains to represent an environmental variable (e.g. air temperature). **Currently this is performed by building digital soil maps rather than climatic data cubes covering a region of interest (TRL4/TRL5); in LANDSUPPORT this engine will reach a stable system development (TRL7/TRL8) thanks to the inclusion of the engine within a GCI.**
- Developing high performance agriculture, forestry and land degradation modelling engines including scenario analysis in WP3. Some modules of the modelling chain are at TRL 3/TRL 4 (e.g. Soil-Plant-Atmosphere modelling implemented under GPU), some others (TRL 5) have been validated in relevant environment (e.g. vine water stress using weather forecast data) while other modules (TRL 6) have been well demonstrated in operational environment (e.g. on-the-fly erosion estimate by RUSLE). **LANDSUPPORT will test all the above, validating and demonstrating the single modules in relevant environment, reaching an overall TRL6.**
- Deployment of a web application that can scale the calculations according to the available server configuration. **In this context, LANDSUPPORT runs validated modelling chains composed by validated and modular models at each geographical scale, with a technological readiness increase from the basic (TRL2/TRL3) towards a mature operational system (TRL7).**
- Similarly, high performance land and soil monitoring engines using satellite remote sensing (including assimilation data in models) from local to national and European scale will register a move from TRL4 to TRL7.
- The integration of data estimates (e.g. Leaf Area Index, Organic carbon) coming from simple low cost Apps employed at field scale (this individual technology is already positioned at TRL 9) and developed in WP4 will move from the current TRL3/TRL4 state to TRL7.
- Use of the Geospatial Decision Support system as a tool to both support specific land management and guide policy making at specific scales (European, Regional, Local) in WP5 and WP7 is already available at TRL7.
- Overall Transferability of Geospatial Decision Support system to new European areas in WP6 typically will move from current TRL3 towards TRL7. This is possible because LANDSUPPORT – at its core – rely on (bio-) physically-based modelling rather than empirical one. This specific approach makes the LANDSUPPORT system much more performant in transferability.

Link with (inter)national research activities

Tab. 1.3a Research and Innovation (R&I) activities in correlation with LANDSUPPORT.

Project name/link (LANDSUPPORT partner involved as Lead=leader; Part.=partner) Time and Size:	Scope	How LANDSUPPORT is linked with this activity
SOILCONSWEB (LIFE08/ENV/408) http://www.landconsultingweb.eu/ : Lead: UNA, Part CNR, ARIES, REGCAM. Time and Size: 2010-2014 (3.2 m€)	Soil Conservation and Land Management through the Development of a Web Based Spatial Decision Supporting System	Geospatial data concerning the <i>Italian Local scale pilot site will feed LANDSUPPORT. Data/models are validated at local scale</i>

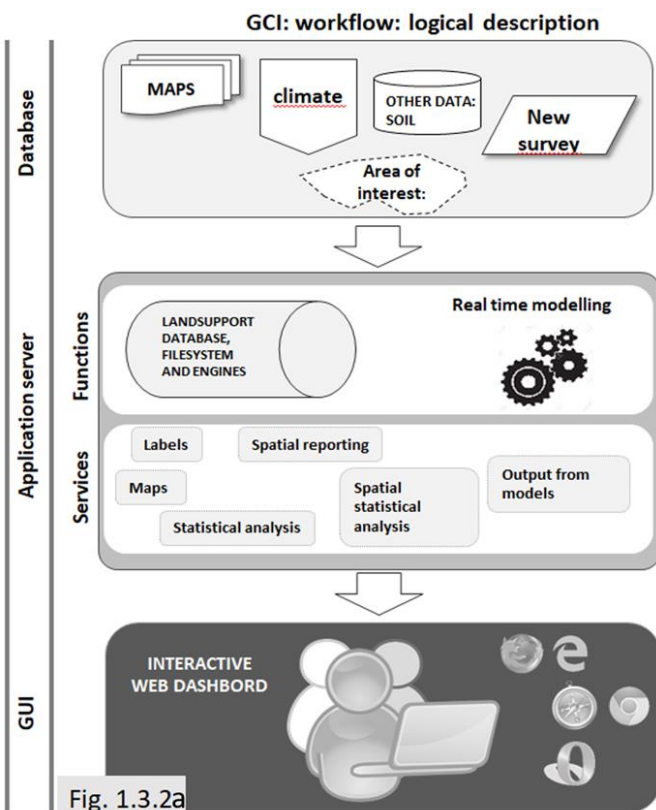
SOIL MONITOR (www.soilmonitor.it). Lead: UNA , Part ISPR , CNR Time and Size: 2015-2017 (UNA own funding)	A Geospatial CyberInfrastructure to quantify soil sealing in Italy	Data models will be transferred to the LANDSUPPORT platform for developing the country case study for urban planning
HQ-S2 (High Quality Sentinel-2 data) (Austrian Space Application Programme -12 FFG) Part. (EOC) BOKU . Time Size: 2016-2018 (0.47 m€)	Complements the exploitation of the Sentinel-2 missions and creates value added products for vegetation, urban and forest monitoring	BOKU Sentinel-2 metadata catalogue; Atmospherically corrected Sentinel-2 data; production of wall-to-wall image composites
MAES - Part. JRC (http://biodiversity.europa.eu/maes). Time and size: 2013-present day (MAES Program) JRC	Mapping and Assessment of Ecosystems and their Services	New MAES mapping should be delivered by 2018. Data and approaches will be considered and where appropriate incorporated into LANDSUPPORT
LANDMARK (H2020) Part. JRC and AGES stakeholder Time and size: 2015-2019 (5 m€)	sustainable land <i>management practice in Europe</i>	The approach for sustainable land <i>management practice</i> will partly feed the land management tool
EarthServer 1,2 (FP7 and H2020- EINFRA) Lead RASDAMAN . Time and size: 2011-2014, (4.2 m€) //2015–2018 (2.8 m€)	Unleashing the potential of Big Data (<i>queries for Petabyte 3D and 4D spatio-temporal datacubes</i>)	LANDSUPPORT will use the datacube technology, rasdaman, advanced in EarthServer and continue the datacube standardization work of EarthServer
BigPicture (German BMVI), time and size: 2016-2018, 300k€. and BigDataCube (German BMVI), time and size: 2017-2019, 300k€. RASDAMAN	BigPicture and BigDataCube establishes agile decision support (particularly, timeseries analysis) based on EO, meteo, and in-situ data calibrated by 500 farmers.	RASDAMAN will bring in its BigPicture experience in designing datacube services specifically for agriculture and use enhanced rasdaman technology and federate with CODE-DE and CloudEO
SIRIUS (FP-7 SPACE-2010-1, www.sirius-gmes.es) Part. ARIES . Time and size: 2010-2013 (2.5 m€)	Developing <i>Copernicus services for irrigation management</i> in 8 pilot areas on four continents	User community analysed in the Italian regional scale; methodologies to estimate Crop Water Requirements are validated.
EUBra-BIGSEA (H2020) Part. BSC , http://www.eubra-bigsea.eu Time and size: 1/1/2016 – 31/12/2017 (1.5 m€)	Integrated, elastic and dynamic fast and Big Data cloud platform to address critical challenges from a data management perspective	The integration with the data analytics layer in BIGSEA will be transferred and extended in the proposal
MUG (H2020) Part. BSC , https://www.multiscalegenomics.eu/MuGVRE/ Time and size: 1/11/2015 – 30/10/2018 (2.9 m€)	Development and deployment of service-driven digital research environments, services and tools tailored to the 3D/4D genomics community needs.	MUG is extending the PyCOMPSs / COMPSs programming model and its execution environment. This extension will be transferred to LANDSUPPORT
FATIMA (H2020 - H2020-SFS-2014-2, http://fatima-h2020.eu/) Part. ARIES , BOKU Time and size: 2015 – 2018 (8 m€)	Establishing innovative farm tools based on Earth Observation for intensive farming in optimizing external input (nutrients and water)	User community analysed in the Austrian regional scale
CropMon (Austrian Space Application Programme ASAP-8 & -10 FFG) Part. BOKU . Time and size: 2012-2016 (0.5 m€)	Development of an operational crop monitoring service and interactive platform based on Sentinel-2 data. Method developed to smooth and gap-fill satellite time series similar to S-2.	Production of cloud-free time series of Sentinel-2 data; Crop classification capacities
D-e-METER (NKFP) Part UPA Time and size 2001-2004 and 2004-2007 (2.8m €)	Developing a web-based land evaluation and farm data collection system to integrate environmental resources appraisal and agricultural management	The entire local case for Hungary will Feed LANDSUPPORT and also data/models validated at local scale
DIANA (European Commission Horizon 2020 IA Topic: EO-1-2016, http://diana-h2020.eu/it/home-3/). Part. ARIES . Time and size: 2017–19 (3 m€)	Detection and integrated assessment of non-authorized water abstractions using EO: based on Sentinel 2 data and on-field iperspectral acquisition	Methodologies to perform classification for mapping crop types and irrigation schedules dedicated to water managers.
CropBASE-Global knowledge base 2015-ongoing CropBASE-SelectCrop and CONNECT crop value-chain prototypes, 2016-ongoing (lead = CFF ; own funding), https://cropbase.org .	Analytical database for crops (3000 variables): crops; agronomy, ecology, nutrition, socio-economics for 2700 species. Innovative Location-based crop selection, yield and income estimation	Crop Data will be used by the (CropBASE-SelectCrop) – LandSUPPORT logic to optimise cropping and agro-forestry systems. Crop suitability modelling and mapping
Global Geoinformatic Tool for Sustainable Land Management Practices (SLM) (GeOC): http://drylandsystems.cqi-ar.org/ . Lead: ICARDA . Time and size: Oct/2016 – Oct/2017) (210k €)	GeOC tool that integrated standardized SLM data (like WOCAT) to global WebGIS allowing users to compare SLM options by context, and extrapolate potential areas for best SLM options.	Incorporation of GeOC for SLM practices into LANDSUPPORT)

LANDSUPPORT will also establish a cooperative network with EIP-Agri and EIP-Water expertise aiming to contribute to EIP work:

i) **Forest practices and Climate change group:** LANDSUPPORT tools can support good practices to improve climate change resilience (tools “b,h”) ; ii) **Precision farming group:** LANDSUPPORT by organizing data capture and processing enables – especially at local scale – to support inputs optimisation (e.g. fertilisers) iii) **Water and Agriculture group:** LANDSUPPORT can support farm level adaptation strategies and water scarcity (tool “g”); iv) **ESE - Ecosystem Services for Europe group:** LANDSUPPORT (tool “f”) can support ecosystem services quantification.

1.3.2. Methodology

Overall methodology



Due to the large number of LANDSUPPORT methods and techniques, a detailed methodological description is given in ANNEX 5 while a shortened comprehensive version is hereafter reported. Detailed description of case studies is given in ANNEX 3.

Introduction. The applied methodology aims to achieve the LANDSUPPORT GCI workflow as depicted in fig. 1.3.2a where the strong linkage between databases, modelling and graphical user interface (GUI) provides both large and powerful set of DSS tools applied to land resource management and connected land policies. This is then implemented through 8 interconnected (see *chapter 3.1*) work packages (WP) that will develop and test the LANDSUPPORT Geospatial Cyberinfrastructure platform.

The project will last 42 months, and it is structured in (i) the preliminary land policy and socioeconomic investigation of WP1, (ii) four R&D work packages (WP2, WP3, WP4, WP5) to develop the LANDSUPPORT platform, (iii) WP6 to better adapt LANDSUPPORT for the sake of multilevel land policies public bodies, WP7 for demonstration, dissemination and outreach activities and eventually WP8 for project coordination.

Methods

A. Analysis of requirements: A detailed analysis of the needs of LANDSUPPORT users and stakeholders will be performed by open-ended semi-restrictive interview approach in order to identify

(i) the type of their requirement, (ii) the potential degree of acceptance, (iii) the impact on their activities. In the pilot sites face-to-face online interview (e.g. skype like) will also be performed. The knowledge obtained after interviews will be further implemented by LANDSUPPORT participatory activities with co-creation workshop (see WP7) at each studied site. Finally, on the base of all the above results a detailed and demand-driven specification will be produced for each of the LANDSUPPORT DSS tools

B. Evaluation of potential socio-economic impacts: The evaluation of the potential socio-economic impact of the DSS tools will be performed by the preliminary geospatial analysis of the socio-economy context. The geospatial analysis will be based by processing a set of datasets fully described in ANNEX4. The source data will be the open source EuroStat maps (<http://ec.europa.eu/eurostat/web/gisco/geodata/reference-data/administrative-units-statistical-units>) (NUTS0,1,2,3) and National Statistical Offices data (HU: STATINFO; AT: STATISTIK.AT; IT: ISTAT). The 139 FADN regions are freely available (http://ec.europa.eu/agriculture/rica//othermaps_en.cfm) while LAU2 level maps will be obtained for each of the countries. Indices will include: agriculture statistics, demographic statistics, economic accounts, education statistics, science and technology statistics, tourism statistics, labour market statistics, labour costs statistics, digital economy and society, environmental statistics, poverty and social exclusion statistics.

C. Databases: key methodological issues: Raster data management. We employ the rasdaman ("raster data manager") datacube engine technology. It is a scalable, distributed array engine which has pioneered the spatio-temporal datacube paradigm as an easy-to-use, powerful means to provide EO data analysis ready. Internally, incoming queries are heavily optimized, parallelized, and distributed over a rasdaman peer network which effectively scales rasdaman from laptop to cloud and to federations of data centers (such as being established by the EarthServer initiative, www.earthserver.eu). Rasdaman will take on management of the "Big EO Data", i.e., 2D imagery, elevation, and thematic data, 3D x/y/t image timeseries, and 4D x/y/z/t weather data. These data will partially be stored locally (i.e., in the LANDSUPPORT store one copy at BSC and the other one at UNA) or federated (e.g., DIAS, EarthServer).

Data pre-processing. EO data acquired from the Copernicus Sentinel satellites (S-1 and S-2) allows to monitor rapid changes of the land surface properties at the European scale with a pixel size of up to 10 meters. S-1 provides a C-band Synthetic Aperture Radar (SAR) that images the Earth every six days through clouds, rain and during night. S-2 provides an optical multispectral instrument (MSI) with 13 spectral channels (visible to short wave infrared) that images the Earth every five days. They require extensive processing before being able to derive spatially and temporally consistent information. LANDSUPPORT will use open source software and a series of toolboxes for satellite data exploitation developed by different contractors for the European Space Agency. In particular, **ESA Sen2Cor** for atmospheric correction and cloud masking; **BFAST** algorithm for trend analysis and change detection already in use in the ESA ForMoSa (Forest Degradation Monitoring with Satellite Data) project. For crop type mapping, we will test the **ESA Sen2-Agri** toolbox developing customized solutions using **Random Forest** classification for the generation of crop type maps and **Random Forest** regression for the yearly update of Forest land, Grassland, Wetlands and Settlements layers.

Field and lab analysis. Soil profile description (FAO guidelines 2014) and standard soil chemical analysis (SISS methods, 2015)

will be performed. Soil water retention curve will be determined through a combination of three “steady-state” techniques will be applied covering wet (tension table), intermediate (Richards apparatus) and very dry (WP4-T) branches of the curve. Saturated hydraulic conductivity will be determined directly in the field and in the lab by applying standard techniques. Hydraulic conductivity curve will be determined by applying the Mualem – van Genuchten model. Dispersivity will be measured on large undisturbed soil samples by inflow-outflow experiments. Where measured hydraulic properties will not be available, they will be estimated by texture analysis and applying pedo-transfer functions (see Dane J. and Topp G. 2002).

D. Modelling Engines and Output: The digital mapping engine (Task 3.1) - transforming a vector of sparse geospatial points into a raster of grid points - will automatically perform spatial interpolation by applying models such as the inverse distance squared weighted average, the multilinear stepwise regression, the regression trees, artificial neural networks, kriging and other multivariate geostatistical methods such as regression kriging.

The choice is tackled according to the type of environmental variable (climatic, socio-economic, etc.), to the size and density of the vector of geospatial points, to the geographical extent being mapped, and to the availability of auxiliary covariates to include in multivariate statistical approaches. In particular, climatic data are dynamic and must be pre-processed using basic statistical procedures enabling the quality checks of incoming raw data measured at ground stations at regular time intervals (day, hour, 10-minutes) or the infilling of missing and anomalous data. Moreover, this digital mapping engine will allow the automatic update of digital maps by including newly available measurements.

The uncertainty module (Task 3.1) requires a preliminary Sensitivity Analysis by making small perturbations in selected parameters and data (e.g. water flow and crop growth parameters) recognizing how uncertainty propagates from model parameters and input data to the desired output. Based on previous list of parameters and on the datasets coming from WP2, probability density functions (PDFs) of each of these driving parameters will be defined. The uncertainty module will use a classical stratified sampling technique based on the Latin Hypercube Sampling to generate a set of parameters (to be used in a simulation run) from the PDFs.

The physically-based soil-water balance module is grounded on the SWAP model and is based on the solution of the Richards' equation that is solved integrally for the unsaturated-saturated zone using an implicit finite difference scheme for numerical integration. Alternatively, a simpler cascade (bucket) approach could be applied as that one implemented in AQUACROP where only few parameters are required (e.g. soil layering thickness, water content at saturation, field capacity, wilting point, saturated hydraulic conductivity). Upper boundary conditions are described by the potential evapotranspiration ET_p calculated from reference evapotranspiration (ET_o) and a crop factor (CF): $ET_p = ET_o \times CF$. Then ET_p is partitioned in potential evaporation (E_p) and transpiration (T_p) according to the LAI evolution. Root water uptake will be taken into account as a sink term in the flow equation.

The crop growth modules will be developed among the following approaches:

- Carbon-driven (or photosynthesis) approach: A process-oriented approach where intercepted photoactive radiation and CO₂ assimilation are calculated by considering direct and diffusive radiation components, shaded and sunlit leaves and also different spatial layers within the canopy as in SUCROS and WOFOST.
- Solar-driven approaches: A) The Light use efficiency (LUE) is a simplified approach applied in the LINTUL (Light INTERception and Utilisation) family models. LINTUL model uses the linear relationship between biomass production and the amount of radiation intercepted by the crop canopy. B) The radiation use efficiency (RUE) is used in the CERES model family and CropSyst.
- The water-driven approach: This approach is based on the relationship between cumulative biomass and cumulative canopy transpiration. It is applied in AquaCrop and in CropSyst models. Perennial crops such as orchards and grapevine will be simulated with the CropSyst model codes.

The detailed C-N module will be mainly based on the solution proposed in the SOILN and ARMOSA models, in which the soil mineral nitrogen pools receive nitrogen by mineralisation of litter and humus, nitrification, fertilization and deposition and loose nitrogen by immobilization to litter, nitrification, leaching, denitrification and plant uptake. Leaves take up carbon as roots take up the nitrogen. The leaf area captures the radiation for the photosynthesis. Tillage operations affect soil organic carbon evolution. The module will predict NO₃ leached to groundwater, soil carbon sequestration, ecosystem CO₂-C respiration, and in turn the impact of the tested scenarios on the agro- ecosystems. The simplified C-N module, based on Roth-C codes will be a medium to long-term soil organic matter turnover model. Accordingly, this module requires monthly long-term climate information (rainfall, open pan evaporation, mean air temperature) and other data input as: clay content, soil cover fraction (0/1), monthly input of plant residues and farmyard manure. The environmental variable simulated by this module will be the total organic C content of top soil over a few decades with monthly time step.

The Pollutants modelling:

The approach for describing the fate of pollutants from the soil surface to the vadose zone at local scale will be based on the well-established advection–dispersion equation (ADE) including adsorption for non-reactive solutes. In order to simulate the complexity of reactive solutes (e.g. pesticides) a module for solute transport mostly tracing the 1-D HYDRUS model approach will be developed. The module may simulate nitrogen, phosphorus, pesticides and other-contaminant transport processes, adding a sink term S_s to the ADE equation including nonlinear and/or non-equilibrium reactions between the solid and liquid phases, linear equilibrium reactions between the liquid and gaseous phases, zero order production and first order decomposition.

At Regional/national scale a simpler “index and overlay” models (e.g. DRASTIC-like approach) will be used. An intermediate approach based on the Type Transfer Function (TTF) - allowing upscale (using lognormal) of classical Transfer Function model - will also be considered and implemented at regional scale. Pollutant decay and sorption are modelled by scaling the PDF travel time of the conservative solute with a first-order decay function and a retardation factor.

Land degradation is the reduction or loss of utility of land and will be measured using physical parameters. Some examples follow such as the calculation of *urban sprawl* which generates an indicator of urban dispersion in the region of interest (ROI) defined by

the end user. Another example is given by calculation of the *fragmentation* of the rural landscape in which the input data are the search radius (e.g. 200 meters), a ROI (e.g. a large metropolitan area) and a high resolution (i.e. 5/10 meters) binary image representing the spatial distribution of urbanization. This indicator can be very useful to recognize ecological corridors that were lost (and than that can be recovered by policy) or that can be potentially lost if no action is taken to preserve the land resources. The *land take* compares the states of the land (by distinguishing urban and non-urban pixels) in two contrasting times: the process of land take (and conversely of land gain) can be viewed in the form of a digital map within the GUI and by an aggregated indicator which accounts for the overall take of land within the selected ROI and between the two dates. More than 20 indicators will be developed using the CUDA-C technology.

Soil erosion and Landslides will be approached by very simple models like RUSLE and classical Land Evaluation procedure.

Models developed outside EU. Original CropBASE model () developed by CFF will be adapted to LANDSUPPORT by writing a linking procedure. Original global GeOC tool (Miyasaka et al. 2017 see ICARDA publications) developed by ICARDA to evaluate sustainable land management (SLM) options fitted to a particular social-ecological context will be adapted to LANDSUPPORT requirements. The tool will enable, for each pilot site where land degradation occurs and where a best practice is implemented successfully, to know where this can be replicated with similar conditions of success (N. of places, ha).

Algorithms concerning LULUCF. These include (i) matrixes of land use change (IPCC categories), (ii) land management for SOC modelling (see above) and a model based on cellular automata and combines digital terrain modelling (derivatives of the digital elevation model such as slope and hillshade) with land cover modelling. It calibrates using a set of past land use (including urbanization) images and builds different urban growth scenarios according to either a set of already defined restrictions on land transformation or a specific restriction layer created by the end user of the LANDSUPPORT GUI.

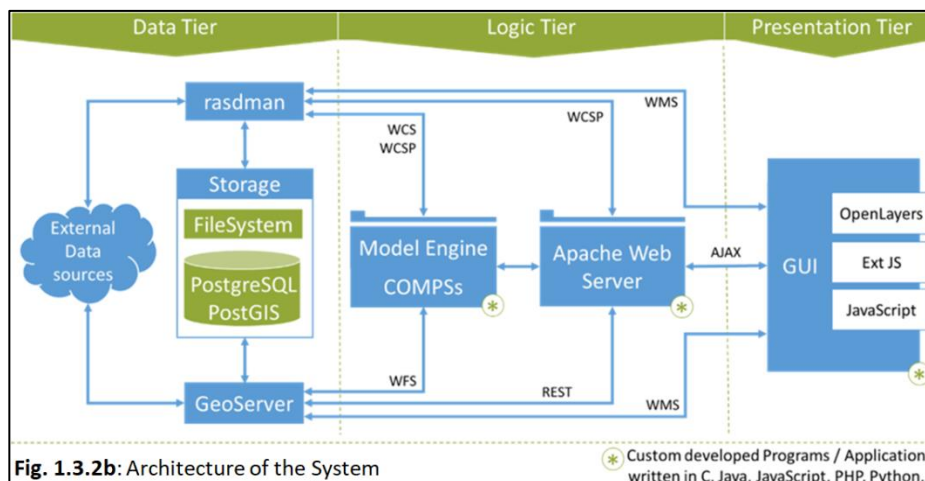
Ecosystem Services (e.g. productivity of crops, carbon storage, Regulation of water flows, provision of nutrients) - where the most demanding applications are required (e.g. SEA, farm management) – will be produced by applying the models developed in WP3 and the remote sensing data of WP4. At coarser scale (e.g. nation) more empirical approaches will be employed by applying simpler procedures as those of INVEST.

The monetary evaluation of ESs will result in a parametric value of each type of ES as a function, for example, of dimensional characteristics (euro/m or euro/m²) or of the number of stakeholders involved (euro/person). We shall use the Common International Classification for Ecosystem Services (CICES; <http://cices.eu/>). For monetary valuation will be considered both direct methods (defensive/repair costs, replacement cost, production cost, hedonic price, travel cost) and indirect methods (contingent valuation; Conjoint Choice). The valuation will take account of the uncertainty of variable analyzed as resulting from WP3, in order to include them in the economic model through risk assessment methodology (EC guidelines by European Commission, 2014).

The modelling algorithms will be parallelized adopting COMPSs, a task-based programming model designed to facilitate the development of applications for distributed infrastructures, such as Clusters, Grids and Clouds. Starting from the original sequential application, written using different programming languages (Python, Java, C++), the COMPSs runtime exploits the parallelism of the code execution by detecting and taking care of the data dependencies between invocation of different parts of code.

Data assimilation: Two conceptual frameworks for data assimilations are employed: (a) Top-down: Time series of vegetation indexes (i.e. Normalized Difference Vegetation Index, NDVI) will be used to estimate critical phenological stages during the cropping season (e.g. Greenup, crop maturity) based on changes in the curvature of the NDVI time series. The Kalman filter algorithm will be employed for gradient smoothing of such curvatures to estimate the 30m LAI and then to assimilate it into the LANDSUPPORT crop model to drive the simulation of crop growth. The soil moisture of topsoil (i.e. 5 cm depth) will be estimated by satellite sensors (e.g. Soil Moisture Active Passive) using passive microwave techniques at a spatial resolution of 25 to 40 km and high temporal resolution (2-3 days). (b) Bottom-up: model state variables (e.g. LAI, Soil Carbon via soil color or punctual analysis) and ancillary data (e.g. irrigation volumes, Nitrogen application, yield) are obtained directly from farmers using smartphone applications at field level. Via using pre-defined forms, the information is submitted to the data server generating reports on many management issues.

E) The LANDSUPPORT Architecture: The logical architecture (fig. 1.3.2b) of LANDSUPPORT DSS will be a classical web-enabled multi-tier schema in which presentation tier, the logic tier and the data tier are logically separate processes. The main advantage is the ability of developing alternative GUI for specific purposes or user requirements: it permits to match the needs of new users, enabling the system portability and transferability in different environment and context (stand-alone application, smartphone apps, etc.).



From the technological point of view, it will be established with the following components: i) Rasdaman which allows storing and querying massive multi-dimensional arrays, ii) Geoserver which allows users to share and edit vector data and iii) the file system and iv)

PostgreSQL along with its spatial extension PostGIS for storing physical data. Rasdaman and Geoserver oversee data abstraction and data rendering in graphic format for the GUI needs. They provide all access interface and services needed for the upper tiers and to guarantee the interoperability with external sources of data. Access interfaces will consist of a versatile query API (Application Programming Interface) based on the open OGC standards WMS (map navigation), WFS (vector data access), WCS (raster data access), and WCPS (combined raster/metadata processing), CSW (Catalog Services for Web), REST (REpresentational State Transfer).

Logic tier. It is the core of the system providing the capabilities for running several models to produce “on-the-fly” results, supervising the management of systems and jobs scheduling. It comprises two subsystems: i) orchestration controller of the system (based on custom code developed in PHP inside the Web Apache server, ii) Model engine which implements the algorithms for the data elaboration exploiting the capability of High Performances Computing thanks to the COMPs framework. COMPs provides the system with an easy-to-use programming model and a runtime to develop the applications in distributed environment. The connections with the data tier are achieved by the upon mentioned access interfaces.

Presentation tier. It represents the Graphical User Interface (GUI) to interact with the system. It will be developed using open sources libraries such as OpenLayers, ExtJs and AJAX. The GUI will be implemented as a modular dashboard: system administrator and user will be able to configure the GUI to adapt the systems to distinct contexts and user requirement. Thanks to this approach, the transferability for each case study will be strongly supported in order to achieve the more appropriate solution according to each case study.

The dashboard design will include graphical tools, procedures to combine spatial data (analysis and visualization), and the production of tables and maps. Moreover, it will also enable the activation of algorithms based on different programming languages, databases, graphics packages, architectures, etc. Indeed, the dashboard will enable easy and intuitive navigation, and, above all, it will make the user happy to operate it and, it will be equipped with tools to provide feedback to core developers (ticketing system, customer happiness, etc.).

F) DSS Tools dashboard: LANDSUPPORT achievements requires the development of customised DSS dashboard for every type of user. The dashboard design will include graphical tools, procedures to combine spatial data (analysis and visualization), and the production of tables and maps and it will enable the activation of algorithms based on different programming languages, databases, graphics packages, architectures, etc.

Specific meetings will be organized for each type of end user/stakeholder in WP7 and in close cooperation with SHG to identify the best architecture of the menu dashboards.

G) Test of the system for level policy needs: We adopt a mixture of quantitative and qualitative techniques to test LANDSUPPORT with respect to multilevel policy needs. A measure of (i) quantity of services produced, (ii) efficiency of production and (iii) outcome (results from the provision of these services) will be co-defined and checked. Employed performance indicators will include usability, accessibility, interoperability, reliability and operational capabilities of LANDSUPPORT services and user satisfaction. These performance indicators will be compiled by public bodies users when using the web platform. In addition, we complement these indicators with qualitative data obtained by stakeholder open-ended semi-restrictive and in-depth interviews. For some critical tools, a detailed cost-benefit analysis of the results obtained with the LANDSUPPORT digital platform will be carried out with respect to existing alternatives. All the above results will also be discussed and validated with SHG and Scientific Advisory Board (virtual validation workshops).

SHORT DESCRIPTION OF CASE STUDIED (see detailed information in Annex3)

NUTS (LAU)	Site	Area (km ²)	Schematic geographical overview	Main problems addressed by LANDSUPPORT
0	EU	4,326,000	Not needed	Implement CAP and SDG policies
1	Italy	301,340		Improve climate resilience in agriculture; Ameliorate LULUCF and Land Degradation reporting
	Austria	83,879		
	Hungary	93,000		
2	Campania Region (IT)	13,590	Most densely populated in the country, very diverse landscape from mountain, volcanoes to alluvial plain. Highly productive agriculture in fragile environments often threatened by land degradation phenomena.	Planning and management of agriculture and environmental resource.
(13 LAU2)	Valle Telesina (Campania Region, IT)	200	Landscape with five complex landscape systems: hills, mountains, alluvial plain, pediment plain, ancient fluvial terraces. The area is devoted to the production of high quality wines and olive oil.	Support high quality agriculture and land management. Special focus on: viticulture and land resources awareness;
2,3	Zala County (HU)	3,784	Diverse landscape with hills and brook valleys. Fertile region with dense river network and large woodland. Fertile agricultural soils are located in the Northeast.	Ameliorate agricultural and environmental farms management and performance.
(LAU2)	Keszthely (HU)	200	Located on the shore of one of the biggest lakes in Central Europe the area is surrounded by forests and rolling hills to the north, plains to the south east and the lake. Strong tourism interest affecting land take.	Support high quality forestry and land management. Special focus on: forestry resilience and soil sealing
3 & (set of LAU2)	Marchfeld-Region (AT)	600	Semi-arid agricultural production area mainly cropped with vegetables, sugar beet, potatoes and cereals. Large and professional farms as the only source of income. Groundwater pollution problems.	Support high quality agriculture and land management. Focus on nitrate/pesticide pollution and soil sealing.

Rmel watershed (Tunisia)	670	It is a watershed characterized by hills with gentle slopes and agricultural plains suited for crops such as barley, oat and wheat. There is also extensive grazing.	Ameliorate agric. and environ. farms management. Focus on soil erosion and sustainable land management
CFF exper. farm (Malaysia)	0.5	The experimental farm is devoted to research crops including underutilised crops.	Test of Farm Management and Information System (FMIS) under tropical condition

Relevance of Sex and Gender analysis

From a science-related angle, the gender aspect in both LANDSUPPORT system (e.g. use of DSS tools) and project (e.g. training material) do not play a role. With respect to the LANDSUPPORT consortium, we have 2 female WP leaders, which mirrors the scarcity of leading female scientists in the EU (She Figures 2015, EC) – at least in technical scientific fields. Gender balance will also be implemented in the Scientific Advisory board which will have 50% female. In order to foster gender balance in the research team, LANDSUPPORT intends to support junior female scientists in the groups assigning – when it is possible by the specific rule of recruitment – a performance reserve in calls for the award of scholarships, research grant, etc. The objective is to assign a quote between 50 and 66% of such contracts to female. Moreover, LANDSUPPORT will meet gender balance in the decision-making bodies of the management structure. Finally, to promote the gender balance each time a user interacts with the tool and gets registered, the system will profile her/him in terms of sex and age. Similarly, when LANDSUPPORT partners will interact with public in dissemination and training activities, feed-backs and reactions will be recorded by sex, age, etc.

1.4. Ambition

1.4.1. Advance beyond the state of the art

1st state of art issue quoted by RUR 03-17: *Policies influencing land management have widened to meet societal needs for food security, environment, climate change, etc. However, this process has been fragmented and incomplete (from RUR03/17).*

1st LANDSUPPORT (general) ambition: Overcoming the fragmentation and incompleteness of the policies influencing land management.

Why? (The WHY? is the state of the art). Policies influencing land management have widened (e.g. food security, environment, climate change, etc.) however, this process has been fragmented and incomplete. Examples of this pivotal policies are:

- Paris Agreement, which sets out a global action plan to put the world on track to avoid dangerous climate change by limiting global warming to well below 2°C.
- EU “policy framework for climate and energy in the period from 2020 to 2030” and its framework which sets 40% cuts in greenhouse gas emissions for the year 2030 and the demand for an environmentally-friendly agriculture and stockbreeding made by PROJECT EUROPE 2030.
- SDG 3, 13, 15, 15.3, 16.7 of the UN 2030 agenda¹ – signed by EU – for its focus towards (i) an integrated approach to land and agriculture resources, (ii) the sustainable use of terrestrial ecosystems then “achieving a land degradation-neutral world” and (iii) the importance to support decision making and participatory tools.
- 7th EAP and FAO Strategic Objectives to combine productivity with more sustainable landscape management.

The huge complexity in achieving all the objectives of the above inspiring policies is self-evident. This is also reflected by the several challenges encountered so far in the full implementation of many Environmental EU Directives/Regulations (e.g. COM2015/120; COM2013/683).

What is lacking are instruments capable to support the development and the application of the policies; they should have the capability to integrate the different level of the policies requirements and, consequently, the inherent huge complexity of the land resources management. To the best knowledge of LANDSUPPORT partners, a tool addressing all above exists², but only for a small area.

How? (The HOW? is the advance beyond the state of the art). LANDSUPPORT will develop a unique, interactive, smart multi-objective (Fig. 1.3.1b) Geospatial CyberInfrastructure³ platform, freely accessible on the web, that will:

- contribute to overcome current challenges and fragmentation⁴ in the implementation of existing and new policies for sustainable land resources management.
- produce multi-functional/users/scales S-DSS tools addressing multiple land policy objectives (including “incentivising real actions/behaviour /investments” – as requested by the call).

This smart approach performing S-DSSs for sustainable agriculture and forestry will be developed by a strong inter- and trans-disciplinary team that will address the most important “research bottle necks” currently hampering the implementation of multilevel land policies (Table 1.1b). Between them:


- (i) A truly integrated DSS system challenging local scale (high spatial resolution) for very large areas
- (ii) The required LANDSUPPORT complex and real time queries will be achieved by high performance raster data manager allowing store and query of massive multi-dimensional arrays. More specifically The datacube paradigm implemented by

¹ <http://www.un.org/sustainabledevelopment/sustainable-development-goals/>

² Terribile et al. (2015). A Web-based spatial decision supporting system for land management and soil conservation. *Solid Earth*, vol. 6, p. 903-928, ISSN: 1869-9510, doi: 10.5194/se-6-903-2015

³ Yang, C. and Raskin, R.: Geospatial cyberinfrastructure (GCI), *Computers Environment and Urban Systems*, 34, 263, 2010.

⁴ Skjærseth et al. (2016). Linking EU Climate and Energy Policies: Decision-making and Implementation. *New horizon in environmental politics*. EE Elgar Publisher.

rasdaman leads to a novel way of accessing data, enabled by -state technology in the server, enabling a paradigm of “what you get is what you need” by providing data in an analysis-ready manner. This is made possible by overcoming limits of both traditional grid system (e.g. Google Earth Engine) and standard MapReduce approaches and implement Array Databases representing a horizontal platform technology which enable flexibility, scalability, and information integration.

- (iii) The required real time dynamic models will be possible thanks to On-the-fly spatial inference mapping of climate, land and soil data which in turn will feed models.
- (iv) Modelling of land, soil, water and crops to simulate on-the-fly scenarios (including spatial interpolation and uncertainty) on very large areas and under varying management conditions will be performed thanks to HPC technology.
- (v) Monitoring of land cover dynamics will be performed by moving from static land cover classes (soil, vegetation) towards biophysical properties of the land cover types (Albedo, LAI, etc.).
- (vi) Mapping and monitoring of land surfaces from regional to national and European scales (thus collaborating to Sentinel Ground Segment) will be performed by using new algorithm for data assimilation and new generation of satellite EO data.

2nd state of art issue quoted by RUR 03-17: *Decision-support tools and models will help prioritise multiple land uses at various geographic scales (meso level and related regional strategies + policies at regional/national/EU level)*

2nd LANDSUPPORT (specific) ambition: Developing many decision-support tools and models providing information at various geographic scales, thus tackling the complexity of the landscape and its multiple use.

Why? In literature a very large range of available DSS tools can be found for facing agriculture, forestry and environmental issues. However, these are typically designed to tackle a specific problem/scale/enduser group⁵ (see *Fig.1.3.1b*).

Therefore, although these DSS tools can be very performing in their own circumscribed field of application, they are not suitable to meet the many complex interconnected requests of the land resources management and consequently those required by this call such as how to “*prioritise multiple land uses at various geographic scales*”. Moreover, approaches such as standard Web-GIS tools or also simplified aggregated systems fail in providing DSS tools able to support the complex (often requiring interactive operations) implementation of EU land policies. In fact, these tools cannot address both landscape dynamic complexity (e.g. daily climate variation) and practical actions, typically occurring at local scales.

How? LANDSUPPORT smart approach performing S-DSSs for sustainable agriculture and forestry will be developed by a strong inter- and trans-disciplinary team. LANDSUPPORT has on board modelling expertise on agriculture (UMI, BOKU, CNR, CFF), forestry (SFI, CNR), land resources and degradation (UNA, CNR, ICARDA, UPA), socio-economic and ecosystem services (ACTeon, Iask, UNA). The competence and skills of these groups are strongly interconnected (see in WP1,2,3,4 month persons) and exploited by the multiuser and multiscale GCI platform reaching a high technology level (TRL 7) and thank to the high-specialised technical component in developing such platforms (BSC, RASDAMAN, ARIES, UNA, CNR).

3rd state of art issue quoted by RUR 03-17: *Proposals should ensure that the integrated framework and systemic approach proposed will be compatible with and/or improve existing databases and tools used at the European Commission*

3rd LANDSUPPORT (specific) ambition: Applying a systemic approach both (i) compatible with existing databases and tools used at the EC and (ii) contributing to their improvement.

Why? Several EU large datasets and tools are available such as Corine Land Cover, GMES/Copernicus, Land and Ecosystem Accounting (LEAC) applications and relevant indicators, PRELUDE, and other datasets from EUROSTAT, ESA, JRC-LUCAS, METEO-GAEC. Unfortunately, most of these databases do not interact with databases available at regional and local scales. But those local scale datasets are indeed those required to evaluate (i) trade-off between land uses, (ii) to promote actions/behaviour/investment as requested by this call. Above all SCAR states “*that enormous iceberg of data that are available for agriculture. However, at present, a large part of this information is simply not useable.*”

How? The required LANDSUPPORT complex and real time queries will be achieved by high performance raster data manager allowing store and query of massive multi-dimensional arrays but also by HPC modelling. Most importantly LANDSUPPORT is built with a strong interoperability and FAIR character (e.g. WP2 Sentinel data in chapter 3.1) to create a functional linkage with existing databases and tools used at the EC. It is important to stress that the tight connection with EU databases will be guaranteed in LANDSUPPORT by the JRC partner.

Moreover, the modularity of the modelling system will imply the coherency and effectiveness of the chain “data available-model to be applied-output required”. Furthermore, mapping and monitoring of land surfaces from regional to national and European scales (thus collaborating to Sentinel Ground Segment) will be performed by using new algorithm for data assimilation and new generation of satellite EO data.

Therefore, all the elements above will be combined into a coherent platform based on open source approach that will implement the SCAR view about dataset: “*To make data useable, they must be properly structured. In that way, others than the original authors can find, understand, analyse and integrate existing data to derive new facts*”.

4th state of art issue quoted by RUR 03-17: In the impact section. *The project results are expected to: (i) improve knowledge of land resource availability and use at various geographic scales; (ii) improve decision support tools for the management of land as a resource; (iii) improve climate resilience of agriculture and forestry, and (iv) provide the basis for a coherent and integrated policy framework for the management of land resources at regional / national / EU levels.*

4th LANDSUPPORT (specific) ambition: To be addressing the extraordinary complexity described above, LANDSUPPORT has to tackle agriculture/environmental problems over large areas (e.g. Europe, Country) while preserving a relative high spatial detail, thus enabling land management at local scale.

⁵ Spatial Decision Support Systems: Principles and Practices (2010). Ramanathan Sugumaran, John Degroote CRC Press.

Why? The trade-off between the spatial extent to be investigated and the spatial detail is an old research challenge. Classic (prudential) approaches solve this trade-off by averaging data and applying very simplified models at large geographic scales resulting in huge approximation. A well-known example of this kind of approach – among a plenty of many others – is GAEZ⁶, a FAO model aiming to support strategy, management, planning, rational use and sustainable development to ensure food security at global level. Despite it is the most consolidated approach for land assessment used by United Nations, there is an evident gap between the scale at which GAEZ returns aggregated outputs and the locale scale where many land policies need implementation and typically require action.

How? LANDSUPPORT GCI implements a nested multi-scale approach in which modules of the modelling chain can be chosen according to the scale of interest, filling the gap between large scale issues and local scale policies implementation and actions. This can be achieved thanks to the use of the state-of-the-art in computer science and technologies which allows to optimally address (i) the spatial extent (e.g. Country/Region scale) versus the spatial detail (e.g. results at cadastral scale) trade-off and (ii) the opportunity to run models bridging the gap between large areas, policies implementation and local actions. LANDSUPPORT can deliver these points thanks to an advanced computing platform whose transferability applies at relative low-costs also thanks to the specific COMPSs architecture (see WP3 in chapter 3.1). These technical capabilities are also reflected in the overcoming of the classical and prudential approach that physically-based model can be applied only at farm scale.

Moreover, few critical GCI procedures will be implemented in GPU computing resulting in higher speedups and very low costs in hardware (for some applications up to 500 times) and in electric power required by the GCI system to run. This is a key factor guiding our preference (where possible) towards a GPU parallelism in place of a CPU parallelism. Some members of the LANDSUPPORT partnership have already demonstrated the feasibility of this approach by the EU project SOILCONSWEB (www.landconsultingweb.eu) and the Italian project SOILMONITOR (www.soilmonitor.it).

5th state of art issue quoted by RUR 03-17: *Investigations relating to both policy and decision tools will be fully participatory so as to ensure the involvement of the society at large.*

5th LANDSUPPORT (specific) ambition: Applying effective participative multi-actor approach and developing landscape awareness tools.

Why? The participative and multi-actor approach will ensure that: (i) the LANDSUPPORT tools and their outcomes are finely tuned to the needs of prospective users, such as for example policy makers and agricultural organizations; (ii) prospective users are enabled to use the LANDSUPPORT tools on their own, after the end of the project; and (iii) the scientific community and the society at large are fully informed about the existence, use and functioning of the LANDSUPPORT tools.

How? Besides the required procedures for raising awareness on the land resources and establishing an interface between science and society, LANDSUPPORT has a distinctive, participatory approach to the “communication and dissemination” phases, including for example: (i) the creation of a stakeholder group (SHG) at the very beginning of the project; (ii) preparatory workshops with prospective users (policy makers at all levels, agricultural users) in year 1 of the project; (iii) technical trainings for prospective users; and (iv) specific activities targeting prospective users outside of the core group (urban planners, local ecotourism companies, local communities). In fact, LANDSUPPORT has some features that make it particularly adaptable to participatory processes. Among them, (a) the functioning on the web, (b) the required real time dynamic models will be possible thanks to On-the-fly spatial inference mapping of climate, land and soil data which in turn will feed models, (c) the developing of apps for smartphone allowing an effective participatory activity of local user, and (d) modelling of land, soil, water and crops to simulate on-the-fly scenarios on very large areas and under varying management conditions will be performed thanks to HPC and GPU technology

1.4.2. Innovation potential and novelty

Innovation potential sits both in the combined development of recent and radically novel approaches (e.g. optimization of massive queries by rasdaman, HPC applied to agriculture modelling, high quality outputs over very large area) and in the strength and trans-disciplinarity of the consortium. In particular, innovation will be fostered by the following elements:

- **Completely novel approaches reconciling agriculture and environment.** This will be achieved by providing a unique massive operational support with about 100 DSS services over a set of critical issues for agriculture and environment (see table 1.1.b and 1.1.c and Chapter 2.2 exploitation).
- The smart **Web-based Geospatial CyberInfrastructure will further implement and explore the concept of e-science in agriculture by implementing the Geospatial Decision Support System (S-DSS) with Farm Management and Information System (FMIS)** as suggested by SCAR⁷.
- **LANDSUPPORT bridging the divide between local practitioners and researchers** will enable the reconciliation of environmental policy requirements with local agriculture communities by providing operational support to farmers for sustainable farm management, by strong Dissemination, Communication and Exploitation measures, described in WP7 and Chapter 2.2.
- **Converting research into useful knowledge and practices and the task of transferring research knowledge and practice to farmers**, particularly smallholder farmers, is an intrinsic feature of the LANDSUPPORT platform that will strengthen the capacities of farmers to make use of new agricultural knowledge and it put into operation the SCAR concept of ‘quantified farmer’ (farmer who has access to hard figures about his/her business to guide his/her decision making).

⁶ <http://www.fao.org/nr/gaez/en/>

⁷ SCAR-AKIS 2016. The Standing Committee on Agricultural Research Working Group on Agricultural Knowledge and Innovation Systems (SCAR-AKIS 2016) by EC. https://ec.europa.eu/research/scar/pdf/akis-3_end_report.pdf.

- **Optimization of land management techniques (e.g. crops type, rotation) and UIC estimation and better reporting and verification to improve resilience to climate change (adaptation and mitigation strategies).**
- **LANDSUPPORT for its intrinsic nature – over the relevant case studies (e.g. regional and local scales) – may also produce “data of all farms, real time, that results in individually customized advice for individual farms” (as requested by SCAR) such as in the case of LANDSUPPORT-app by automatically inserting soil and plant field parameters (or new certified soil analysis) thus obtaining tailored results.**
- **Just as the Web-based Geospatial CyberInfrastructure can assist decision-making, it also assists in making dissemination easier and thus perfectly suited to the modern global agricultural challenges.**

Inter- and trans-disciplinary knowledge transfer between researchers, farmers, extension services and stakeholders, to maximise the project impact.

Highly innovative improvement (list not exhaustive)	Impact by these improvements (list not exhaustive)
Integrated interconnected databases for GCI (WP2) including fully integrated array analytics enabling flexibility, performance, and scalability as required for the most demanding applications.	The high-performance integrated databases for GCI is a completely new opportunity for agric. and forestry DSS multi-deliveries applications.
HPC codes (WP3) applied to optimize processing of high demanding water balance and crop modelling. This will enable trade-off analysis of best practices and land management.	These new codes will make feasible the delivery of high detailed outputs over very large areas as requested by the factual implementation of many agriculture policies.
Harmonize environmental, economic and social objectives in land management, agricultural and forestry practices and policies.	A factual contribution to make feasible and operational agriculture sustainability.
A unique coherent GCI platform - fully connected with European databases - for multilevel and multi-beneficial deliveries (WP5).	Optimize multiple land policies deliveries making integrated policies operational.
On-the-fly scenario analysis (WP5) (climate change, C-sequestration, testing multiscale application of land policies).	Produce a unique set of on-the-fly tools for decision support for real-time multiscale agric., forestry and policy making.

These activities touch upon important areas for agricultural innovation and market development.

LANDSUPPORT expects an increase in the economic competitiveness of:

- participating **SMEs** after the acquisition of new competences and support in R&D activities (including strategies for dissemination and exploitation of results for further business development, *chapter 2.2.1*) to develop innovations towards the needs of European and global markets.
- many **local business** activities (e.g. spatial planners, agri-tourism, eno-tourism⁸ working at the local and regional scales), including those participating in the SHG (INU, AGRITURIST), will benefit at local and regional scales from the availability of the LANDSUPPORT platform.

2. Impact

2.1. Expected impacts

2.1.1. Contribution to expected impacts mentioned in topic RUR-03

LANDSUPPORT Geospatial Cyber Infrastructure – due to its intrinsic web-based DSS architecture – is expected to have a very large number of impacts. For instance, it can supply at no cost – and for a very large number of users – otherwise expensive consultancy in agriculture, environment and planning.

In all tables (this 2.1.1 section) below we report (*in italic*) some significant examples of quantified impacts.

Expected impact 1: Improving the knowledge of land resource availability and use at four geographic scales.

LANDSUPPORT is conceived to make freely available – through the web – new static and dynamic data at multiple scales (e.g. remote sensing, modelling, soil) and newly connections between different datasets. This will drastically improve the knowledge of land resource availability – in agreement to both project objective and scales (tables 1.1a, b, c. *in chapter 1*) – for the benefit of farmers (supporting land use management), public bodies (better landscape governance and monitoring), spatial planners (plans to mitigate soil sealing) and scientists (new geospatial research).

Key results (list not exclusive)	Impact and target groups
(WP2) - New data from land use/spatial modelling/ and new connection between different datasets will improve our knowledge of land resource availability. For instance, at local/regional scales new maps of climate, land use will be update every month, parameters for best land management will be available on a daily base	Farmers and stakeholders that have solid information for taking their management decisions (e.g. alternative cropping, etc.). Public bodies governing agriculture, forestry and environment that can use it for their land use monitoring.
(WP4) - Collecting, storing, handling and extracting valuable information from large volume of data (Petabyte 3D and 4D spatio-temporal datacubes); - definition of best practices for efficient exploitation of	Modellers, Technology developers and Scientists will improve the testing of (i) codes for 12 key tools and (ii) procedures of data assimilation. This will improve

⁸ <https://en.wikipedia.org/wiki/Enotourism>

BigData and complex models; - increase capacities/examples of HPC Bigdata use for earth sciences	Assessment of the impact of the use of HPC on the environment and the development of tools and methodology and create a suitable access to data for modelling and analysis
(WP4) - EO data from different satellite platforms (sentinel-1, 2, 3) come in different spatio-temporal resolutions and spatial coverage. This makes exploitation of data for non-expert very challenging. We propose a data handling model to access observations	Farmers. <i>Example: EO use will produce a reduction of irrigation water quantity up to 30%; this is reflected in a cost saving of about 200 euro/ha/year for south Italy districts.</i>

Expected impact 2: Improving decision support tools for the management of land as a resource

LANDSUPPORT is specifically built to improve decision making taking on-board a large set of land resource features. LANDSUPPORT does not propose “solutions” but rather “options” (i.e. alternative scenarios) to be chosen by a large set of users on the base of both knowledge and quantification of trade-off between alternative use of the land. For example, policy makers can evaluate ex-ante the likely impact of different (also competing) policy options; similarly, public bodies and farmer associations can evaluate ex-ante the economic impact after the application of specific CAP measures. In the case of farmers, being able to predict the likely socio-economic impacts of CAP measures is particularly important: for example, the implementation of EU greening measures in some South Italian districts resulted in a 2% decrease of farmers’ net income (Cortignani & Dono, 2015).

Key results (list not exclusive)	Impact and target groups
(WP5, WP6 and WP7). Development of a web-based DSS at European, National (Italy, Hungary, Austria), Regional and Local scales	Public bodies governing agriculture, forestry and environment, by providing them a tool to test the environmental impacts of agriculture measures ; Farmers, by providing them a tool for managing good environmental practices (e.g. timely reuse in agriculture of waste disposal or timely application of organic and mineral fertilisers mitigating nitrate leaching). <i>Example: At the local scale, it is expected a reduction of fertilisers cost of about 20% due to the timely and correct application of organic and mineral fertilisers</i> ; Policy makers, by providing them with an integrated common knowledge base for multilevel land policy implementation and supporting their capacity building; The enhanced “bottom-up” contribution for participative land management and planning; All European municipalities and other public bodies dealing with spatial planning and agriculture and not having specialised expertise. Thanks to LANDSUPPORT website, on-the-fly they can assess metrics/map/statistics/reports about soil consumption/land fragmentation, simulate land use change scenario, land use change and <i>much more at no cost!</i>

Expected impact 3: improve climate resilience of agriculture and forestry

LANDSUPPORT will explore climate resilience and carbon sequestration scenarios by incorporating the most prominent international and national climate change datasets into the modelling engines.

More specifically climate resilience in agriculture will be implemented in terms of both climate change adaptation (change of crop type) or mitigation and soil carbon management. But also by improving land use change (LULUCF) reporting and its verification. Moreover, indicators of climate change resilience will be adopted for the main land use type at regional and local scales.

Key results (list not exclusive)	Impact and target groups
(WP2, WP3 and WP7) - Many tools will be provided to use future climate data according with two different IPCC emission scenarios, namely RCP 4.5 and 8.5. (e.g. high resolution climate projections derived with the regional model COSMO-CLM; or https://www.medcord.eu/)	Farmers can simulate and evaluate climate change adaptation actions by simulating the performance of different crops and cultivars, water and thermal requirement, climate resilience of best practices and carbon sequestration. For instance, a farmer can query the system and identify, for its specific area, the best hybrid of maize able to face the changing in terms of thermal regime (e.g. a reduction of growing season length) and water availability. In this case, the system will provide several information to the user, as the list of possible crop cultivars adapted to the climate change (e.g. 3 maize hybrids belonging to 2 classes of FAO maturity) as well as the amount of minimum irrigation volume need for each one (e.g. irrigation amount during the cropping season, number of irrigation events, the % of optimum irrigation able to guarantee the best water use efficiency). It is self-evident that <i>this information has a direct effect on farmer incomes allowing to reduce one of the larger cost in agriculture</i> . Moreover, the system will be able to provide several options for different crops and cultivars (e.g. maize, tomato, wheat, etc.) in accordance to farmer’s requirements. Public bodies governing agriculture, forestry and environment that, at Regional and sub-regional scale, can undertake scenario analysis (e.g. towards 2030) for the optimal allocation of natural resources and land use change under climatic change scenarios. National Agencies (EAA, ISPRA) are in charge of reporting LULUCF activities in the mitigation of climate change. Since mitigation can be achieved through activities in the LULUCF sector that increase the removals of greenhouse gases from the atmosphere or decrease emissions by sources leading to an accumulation of carbon stocks. LANDSUPPORT will provide to EAA and ISPRA an evidence base approach (rooted in EO and modelling) to verify the methodologies and data currently used in the LULUCF.

Expected impact 4: Providing the basis for a coherent and integrated policy framework for the management of land resources at regional / national / EU levels

LANDSUPPORT will provide an integrated platform to factual support land resources management at all policy levels (local, regional, national and EU). At the same time, it will not duplicate existing approaches to assess land policy trade-offs in spatially

aggregated scenarios, but it will rather retain a highly detailed spatial scale while empowering the operational implementation of integrated land policy at different geographical scales.

Key results (list not exclusive)	Impact and target groups
(WP1, WP5, WP7) - Large databases interoperability and large web availability of LANDSUPPORT platform	Policy makers and public bodies governing agriculture and environment will have an operational freely available tool capable to connect them and their policies. The tool support assessing trade-off in land policy implementation also at detailed scale, while supporting integrated land policies at the national and EU scale. <i>When evaluating alternative land use trade-off, at the local scale (due to unique outputs of LANDSUPPORT) it is expected that public bodies have to pay only 3% of the current consultancy costs for a much more quantitative evaluation.</i>

Cross-cutting impacts

International cooperation: LANDSUPPORT will have a positive impact on international cooperation by involving two international partners: (i) the “Crop for Future “CFF” Research Centre based in Malaysia has a key role in the study of underutilised crops, and (ii) the ICARDA international research centre in Lebanon.

Socio-economic science and humanities:

LANDSUPPORT will cover both, the socioeconomic sciences and humanities through the following participants: UNA (culture heritage and humanities), iASK and ACTeon (socio-economic development). More specifically LANDSUPPORT will include elements of socioeconomic science by tuning the DSS tools (e.g. using EuroStat, National Statistical Offices and FADN databases in WP1), data (WP2), modelling (WP3) and implementing (WP5) research activities, and in particular by including socio-economy geospatial layer and the ex-ante evaluation of socio-economic impacts of competing policies and land management practices, such as for example the application of specific CAP and environmental measures. The incorporation of socio-economic scientific criteria into an operational multiscale DSS will represent an important opportunity for socio-economist scientists and also for EC which can evaluate new approaches to assess land policies impact, thus better integrating current EC sectorial evaluation such as FADN. Cultural heritage and humanities will be incorporated into DSS tools designed for increasing landscape awareness (see WP5, WP6)

2.1.2. Other expected impacts

SME partners: The SME partners will be empowered to develop new expertise towards DSS dedicated to agriculture and environment. Participating companies will adapt LANDSUPPORT solutions either upscaling or downscaling, thus increasing their own commercial competitiveness. Commercial exploitation of results will also extend to third countries. The expertise built thanks to LANDSUPPORT will enforce SMEs to (i) create new jobs (new consultancy in agriculture, environment and ecotourism), (ii) increase their market potential thus increasing their potential revenue. Moreover, SME may (iii) gain insights into new data for their own use and (iv) expand their network with a strong potential increases of building new business connections and new contacts to potential future employees.

Environmental improvement: Some of the tools will have a major short and long-term impact on the European environment.

For instance, in the short term (by the end of year 1):

- **European scale:** LANDSUPPORT will make available to all European Spatial Planners and for the entire EU territory an operational DSS beta version devoted to mitigating impact by land take.
- **National scale:** LANDSUPPORT will activate an operational alpha version of land use change matrix that can be tested for increase the accuracy of the LULUCF reporting
- **Regional and local scale:** LANDSUPPORT will activate an operational alpha DSS tool which will have an impact in terms of drastic amelioration of the geospatial knowledge of land resource

In the long term (by the end of year 3)

- **European scale:** Fully operational Land take DSS devoted to mitigating European land take in spatial planning, thus promising to change the work of European spatial planners (INU in SHG). For instance, the land take tool will enable an ex-ante assessment of new urban development actions or new green corridors in the hands of European spatial and urban planners and planning public bodies.
- **National scale:** LANDSUPPORT will fully activate the land use change matrix that can be tested to increase the accuracy of the LULUCF reporting.
- **Regional and local scale:** LANDSUPPORT will activate the fully operational DSS tool from all the list a) to o) reported in table 1.1.b

By the end of the project, all above large range of environmental impacts are expected to have a large impact towards better implementation of land environmental policies by institutions and by farmers and also an increase in the environmental awareness of local communities.

Impact on research: LANDSUPPORT will make available to both European scientists and experts (in agriculture, environment and climate change, planning, socio-economy) new data (e.g. output from modelling) on land use change and its integrated impact on ecosystems. At global scale, the project will demonstrate a new powerful methodology to implement both research and trans-disciplinarity into an operational tool which will overall advance the field drastically. Due to the LANDSUPPORT vision, a strong network is achieved that can apply worldwide for many new projects. Moreover, thanks to the two summer schools named “Geospatial Decision Support Systems for land management to make the world a better place” (see WP7) LANDSUPPORT will provide concrete research education but also opportunity for young scientists. PhD students deciding to work on LANDSUPPORT at CRISP Interdepartmental Centre - University of Napoli will receive free bench-fee for performing their work.

Socio-economic impact and creation of market opportunities. LANDSUPPORT will incorporate socioeconomic impact by evaluating ex-ante the economic impact after the application of specific CAP and environmental measures. At the local scale, we expect an impact over the improved acceptance of agriculture products obtained using LANDSUPPORT land information also through the development of a “environmental label” which produce – in real time – a .pdf file reporting the main land/soil/plant feature of the specific site of interested selected by the user.

Moreover, a special impact is foreseen towards sustainable tourism and agritourist at local scale (e.g. Valle Telesina). LANDSUPPORT system will enable to obtain – for a specific area of interest (e.g. a specific agritourist farm) – a .pdf report (on-the-fly) illustrating the main environmental and cultural features of that specific site. The same .pdf report will be obtained (by querying LANDSUPPORT platform) when planning a tour between different geographical points (moving in the landscape from point A to point B) in the landscape. In this case at each site the main environmental features will be described. In this way the user can – interactively – select his best tour.

Impact on innovation capacity, and capacity building: Furthermore, it is widely recognised that there is a paucity of scientists and experts with respect to the gravity of the challenges agriculture is facing worldwide, due to climate change conditions and growing population (www.soil-journal.net/2/135/2016). LANDSUPPORT will contribute to fill this gap by proving an online web based factual support and also through the technical training (see chapter 2.2 and T7.4, T7.8) offered to scientists/technicians/practitioners within and outside the consortium. Additionally, its communication strategy specifically aims at raising the awareness in society about such challenges, and at recruiting the youngest to ECZ and S-DSS sciences to face societal challenges. LANDSUPPORT is thus expected to build EU capacity both directly and indirectly.

Impact on new cropping systems: LANDSUPPORT is perfectly suited for the transfer of data and modelling to new crop, new crop management and production systems. Transfer may be relatively easy by inserting new crop parameters in the crop modelling engines. To this aim, demonstration and dissemination (WP7) will be targeted to farmers active in diverse cropping systems, as are the farmers’ organizations stakeholders in the consortium.

Impact of multiple users: LANDSUPPORT has been designed to deliver multiple objectives to multiple users thus having large multi-faceted impact on EU policy and policymakers, institutions implementing agriculture and environmental policies, society, organic and conventional farmers, extension services and professional advisors, companies promoting territories (e.g. agritourist). Policymakers request (i) sustainable agriculture and environment, (ii) low agricultural environmental resource use, (iii) a clear move towards reaching zero net land take by 2050. LANDSUPPORT will strongly contribute to this vision thanks to the special combination of databases-model-interface(GUI)-outputs all combined in a smart Geospatial DSS designed for different users. Most importantly the platform will contribute to the factual implementation of a large range of land policies (tables 1.1a,1.1b) and by a dedicated deliverable (D6.1 and D1.2) policy briefs as LANDSUPPORT opinion) will deliver policy making advice in potential amelioration towards evidence-based policy of a set of specific directives/regulations/communications (e.g. better delineation of Nitrate Vulnerable Zones using soil information, marginal areas, etc.).

Institutions implementing agriculture and environmental policies – through their dedicated dashboard –will use the LANDSUPPORT system as a geospatial support to better implement land policies. For instance, identifying climate change criticalities (e.g. geographic area), best areas where to support quality production (e.g. olive tree and viticulture), support to better identify green corridors, etc. Basically, LANDSUPPORT system because of its intrinsic modularity and easy updating (data and models) will enable to maintain state of art technical and scientific level of results in order to enable multilevel institutions (and other actors) to better respond to global and local changes and also to enhance their entrepreneurial skills as suggested by AKIS (2009)⁹.

Society and consumers demand sustainable environment including water and food. LANDSUPPORT will deliver solutions for (i) making water use more efficient and sustainable will contribute to environmental sustainability (ii) sustainable forestry, (iii) evaluating soil threats, (iv) nitrate and pesticide leaching, (v) better urban planning. The use of the platform will be explored, also in terms of assessing the feasibility of developing a “terroir label” (WP4) for better marketing agriculture products. LANDSUPPORT will inform society at large through leaflets (T7.7) and visual communication material (T7.6).

Organic farmers ask for natural and effective alternative to synthetic fertilizers and pesticides. At the local scale, organic farmers (e.g. viticulture) can profit by the LANDSUPPORT system by identifying areas having best pedoclimatic conditions for a specific crop: for instance, viticulture geographic areas receiving high solar radiation and subject to moderate water stress, thus improving wine quality).

Conventional farmers need practical solutions for increasing agriculture resilience to climate change. On the local scale, by using LANDSUPPORT (tool developed in WP3, WP5) they can produce their own scenario analysis simulating the performance of new crops and/or management practices. Farmers will actively seek and receive information through social media (T7.6) and other dissemination material (T7.7).

Extension services and professional advisors require data, models, outputs to support farmers on agriculture challenges but also a large community of users (e.g. municipalities) facing agro-environmental problems (e.g. nitrate pollution, sewage sludge derogations, etc.). LANDSUPPORT will also communicate with them via social media and dissemination material (T7.6).

Impact on global agriculture: In the long term, LANDSUPPORT – thanks to its replicable design – has a large potential to demonstrate the “way ahead” for global agriculture. This will be demonstrated at FAO also due to the involvement of one of the partners to the Global Soil Partnership (FAO) network and also using both the Malaysia and Tunisia pilot sites.

Impact on global society: The project will show that it is possible to reconcile agriculture and forestry with environmental sustainability, thus supporting the simultaneous implementation of several EU Land Policies. This paramount objective will not be

⁹ Proposal for a new CWG on Agriculture Knowledge and Innovation Systems (2009). http://ec.europa.eu/research/scar/pdf/akis_rationale.pdf

achieved by a top-down approach but rather by empowering any end-user (from policy makers to farmers) about the landscape, its evolution, the impact of planning and management choices and, eventually, they will have free access to many critical information (e.g. “what-if” scenarios). This will empower the democratic process on one hand (by taking informed decisions and distributed knowledge about the landscape) and it will represent a strong push towards integrated territorial development also beyond agriculture/forestry to include spatial planning and even ecotourism on the other.

Impact on future perspectives of the LANDSUPPORT vision: The vision of LANDSUPPORT is rooted in a change in paradigm for both soil/landscape scientists and also public institutions. In fact, LANDSUPPORT shows that it is possible to overcome both current disciplinary and policy fragmentation over landscape issues and to offer – through a smart Web-based system – a truly integrated geospatial knowledge archive which can be used directly and freely by any end user and institution. We believe that this enable to overcome the divide which, for too many years, has separated scientists working on the landscape from end users and institutions.

Most importantly, the successful delivery of LANDSUPPORT can lead towards a future perspective to apply the LANDSUPPORT approach over global databases to deliver over global issues thus attempting to make true the naïve aspiration of a better world. Considering that obviously LANDSUPPORT will not ever have the power of google or similar multinational technology platforms, then the only chance to make such global aspiration achievable is only through a tight connection with United Nations mechanisms. It is exactly to achieve such global perspective that LANDSUPPORT has obtained the prestigious support from a UN global network which is the Global Soil Partnership (see Global Soil Partnership in SHG). Could all this pave the way for a new more sustainable era? LANDSUPPORT team is eager to demonstrate that this concrete opportunity exists.

The many diverse impacts reported above can be aggregated in the much simpler and aggregated Key Performance Indicators (KPI) reported below:

Simplified Key Performance Indicators (KPI) after the delivery of expected results by the end of the project

Indicator of success	EU scale	Nation	Region	Local
Number of public bodies applying (and/or contributing to) LANDSUPPORT	3	12	10	12
Number of agriculture stakeholder applying (and/or contributing to) LANDSUPPORT	N/A	6	15	20
Number of environmental stakeholder applying (and/or contributing to) LANDSUPPORT	10	20	10	10
Number of spatial planning stakeholder applying (and/or contributing to) LANDSUPPORT	5	10	10	10
Total number of endusers applying (and/or contributing to) LANDSUPPORT	700			

2.1.3. Expected barriers, obstacles, framework conditions in terms of achieving impact

LANDSUPPORT will support the implementation of many EU policies and strategies by increasing the efficiency on water, nutrient and pesticides use in agriculture, and by quantifying risks and negative pressures on ecosystems.

Nevertheless, barriers/obstacles to achieve this objective exist, between them:

- **In most European countries, the “institutional fragmentation”** is a critical aspect in applying most land policies (e.g. WFD) and this is well known by the European Commission (e.g. EU PILOT 6011/14/ENVI). This can create problems over LANDSUPPORT impact in practical implementation (e.g. nitrate pollution is a typical conflicting issue between agricultural and environmental bodies). This problem will be mitigated since LANDSUPPORT – supplying a unique DSS system for many different decision – simplifies interaction between institutions and provide a factual help to align actors involved in land planning/management (e.g. ministries, agencies, NGOs, farming community) by a harmonized approach (point c in Table 1.1b)
- Regional partners have to face a **major impact obstacle in terms whether/when they will get and distribute funds** (e.g. new Regional RDP) **to subsidy farmers to adopted the suggested concrete actions** (e.g. land use and land management change to achieve climate change adaptation/mitigation). Regional partners (REGCM, ZALA) – thanks to the platform – will be able to evaluate the trade-off of a large set of concrete actions to be adopted at the local scale to ameliorate agricultural and environmental farms performance. At the same time, LANDSUPPORT, for its intrinsic architecture, is designed to support also all end-user decision makings over a certain landscape thus even if institutions may have funding difficulties, final end-users can activate by themselves with a bottom-up contribution to governance. Moreover, SHG will monitor the occurrence and possible solutions of such situations.
- **Distortion of land market:** LANDSUPPORT will generate land suitability evaluations depending on the tools applied. In this context to prevent potential influences of LANDSUPPORT on land market and subsequent disputes, attention will be given to show the results in terms of their “potentialities” (e.g. area vulnerable, advantages of land use change, etc.), also indicating uncertainty of the model outcomes. A participatory approach toward the implementation of the executive measures will always be pursued. These aspects will be taken into account in DMP (D2.1)
- **Data privacy:** LANDSUPPORT will deal with a massive amount of data, including private data during the functioning of specific applications (e.g. users which upload proper farm data), being potentially in conflict with the European Legislation on Data protection (Directive 95/46/EC). To avoid such situation LANDSUPPORT embody the following features: (i) the system will collect data in a visible way by informing the users through dialog boxes; (ii) the user can choose to use the system (e.g. model simulation) without any data storage; then basically he receive on-the-fly his own results and the system does store neither inserted data neither results; (iii) the users – through a specific certified procedure – insert his own certified data (e.g. georeferenced soil analysis performed in certified lab). These inserted georeferenced data can be processed by the LANDSUPPORT platform to ameliorate model performance over the landscape but these georeferenced data will never be delivered to users as such, but only in a very spatially aggregated level thus from data it cannot be traced the performance of

individual farmers. Also, a data expert is present in the SAB ensuring that LANDSUPPORT will adhere to the data processing rules of the Member States.

Moreover data layers that will be used will not contain information subject to the existing National legislation (e.g. D.Lgs n. 196 - 30.06.2003 and successive modifications) as they will refer only to data regularly issued by the local authorities directly involved in their collection.

- Eventually certain data will only be available to certain data users and so access restrictions are necessary. Even data that are available to everyone will be protected, since only authorised users can make revisions and corrections, while other users cannot alter data. These aspects will be taken into account in DMP (T2.1)
- **Negative interference with existing official tools:** All LANDSUPPORT partner institutions (from EU to regional) implementing land policies have their own GIS system LANDSUPPORT does not aim to duplicate or replace such existing instrument/approaches already in use to apply multilevel land policies for land management, but rather it will provide an additional integrated and operational freely available tool capable to support decision making by the same institutions in their multilevel land policy implementation (local, regional, national and EU). Policy makers and public bodies governing agriculture and environment will have a tool connecting them and their policies.
Moreover, LANDSUPPORT will closely follow relevant policy development during project implementation by interacting with key project SHG (Stakeholder Group) members and partners having a key role in land policy such as the JRC. LANDSUPPORT is expected to provide scientific inputs to contribute to evidence-based policy development in relevant fields (policy briefs, see also chapters 2.2.1 and 3.2.2.)
- **Possible obstacles about progresses and financing of follow-up LANDSUPPORT steps after the end of the project.** LANDSUPPORT has the clear ambition and vision to deliver multi-beneficial services to different target groups after the end of the project. There is clear need for this financing to ensure continued fostering of the LANDSUPPORT results. To this respect, a specific project activity will be established towards LANDSUPPORT follow-up steps with the involvement of SHG and advices from SAB. This follow-up activity will consider the following elements:
 - o The coordinator UNA with its CRISP Research Center has a special interest in keeping the platform alive and well-functioning after the end of the project. This already applied to other platforms developed and maintained by UNA such as SOILCONSWEB DSS funded by EU-LIFE. This platform is still perfectly functioning after 3 years from the end of the project (www.landconsultingweb.eu).
 - o In fact, this will act as a perfect promotion for the economic and social benefit of the project and for H2020 framework funding as a whole. It will be a perfect demonstrator as such. On the base of the amount of connected end user UNA through the CRISP will evaluate whether the platform could have advertising news to support platform maintenance, to ensure self-financing to a good extent.
 - o Another possible solution is to transfer the tool to one of the LANDSUPPORT companies to develop the tool into a product. To do this, business cases, will be produced by the 3 SME LANDSUPPORT partners; on these cases, a specific written advice from the Scientific Advisory Board will also be requested and the final evaluation will be made by General Assembly before the end of year 3 of the project.
 - o Moreover, five public institutions (JRC, ISPRA, EAA, REGCAM and ZALA) using the LANDSUPPORT tool for their institutional duties, are already LANDSUPPORT partners. To this respect these institutions have already expressed their interest to keep the platform alive for their own sake.

2.2. Measures to maximise impact

2.2.1. Dissemination and exploitation of results

Participation and dissemination strategy:

LANDSUPPORT has developed a strong participation and dissemination strategy, where activities have been defined based on the identification of the main stakeholder groups concerned by the project.

First of all, the LANDSUPPORT project will establish a strong participatory process from the beginning to the end, mainly through WP7 actions but also through WP6. This participatory process will involve users and prospective users of the S-DSS tools at all levels and namely: (i) Policy makers and public bodies responsible of land policies implementation at the regional, national and EU scale; (ii) users (and prospective users) for agriculture and environment (e.g. AGES, Confagricoltura, Marchfeld) which are part of the project consortium, but also other potential core users outside the consortium; (iii) Other Users and prospective users (e.g. INU, urban planners, local ecotourism companies, local communities); (iv) Scientific community; (v) Broader public.

The participatory process will include: (i) a living lab phase, where the S-DSS tools will be co-developed, tested and evaluated by users and prospective users (shared among WP7 and WP6); and (ii) a capacity building phase, where technical trainings will be organized for users and prospective users (WP7). Actions included in the participatory process cannot be defined as dissemination actions, because dissemination imply a top-down approach (i.e. the project consortium develops a product and then it shows it to potential users), whereas in LANDSUPPORT participation is intended, and will be implemented, as a bottom-up process actively engaging stakeholder in project activities. Nevertheless, these actions are key to the success of the LANDSUPPORT platform, they are aimed at ensuring a continued use of the platform after the end of the project and, in the first place, they are key to spread awareness and knowledge of the LANDSUPPORT platform across users communities.

In addition to the participatory process, WP7 includes a series of actual dissemination actions to spread the consortium's research efforts and results to the scientific community and the broader public.

Actions included in the participation and dissemination strategy will be defined in detail in the Participation and Dissemination Plan (D7.1), drafted at the very beginning of the project. A stakeholder group (SHG) will be formed at the beginning of the project and will include all relevant stakeholders; the SHG will be maintained throughout the project duration, and it will meet regularly. The SHG will serve as a basis for all participation and dissemination activities.

Stakeholder group	Objectives regarding stakeholders	How LANDSUPPORT will reach the stakeholders
Policy makers and public bodies responsible for multilevel land policies implementation	<u>User requirement</u> : Discussion of the proposed structure and outputs of the S-DSS tools, to ensure that the tools will provide policy-relevant information and indicators (WP1)	Preparatory workshops (Task 7.3a)
Users (and prospective users) for agriculture and environ.	<u>User requirement</u> : Discussions with prospective users to ensure that LANDSUPPORT reflects the needs of prospective users (WP7 - Task 7.2)	Workshops and focus groups (Task 7.3b)
Users (and prospective users) for agriculture and environ.	<u>Testing</u> the alpha and beta versions of the S-DSS (WP6)	Alpha and beta versions of the S-DSS (WP6)
Policy makers and public bodies responsible for land policies implementation	<u>Testing</u> the alpha and beta versions of the S-DSS (WP6)	Alpha and beta versions of the S-DSS (WP6)
Policy makers and public bodies responsible for multilevel land policies implementation	<u>Applying LANDSUPPORT</u> : Prospective users can effectively use the S-DSS tools as a support to improve the implementation of European policies and scenario evaluation (regional and local level)	Training and technical workshops (WP7, Task 7.4)
Users (and prospective users) for agriculture and environment	<u>Applying LANDSUPPORT</u> : Prospective users can effectively use the S-DSS tools as a support to agriculture and environmental planning and management	Training and technical workshops (WP7, Task 7.4) Wiki-like platform for users to insert comments about the tools (WP7, Task 7.4)
Urban planners	<u>Train</u> urban planners on how the LANDSUPPORT platform can provide operational support to their planning activities	Participation to urban planners' workshops (Task 7.5). Wiki-like platform for users to insert comments about the tools (Task 7.4)
Local companies (ecotourism) at local scale	<u>Train</u> local ecotourism companies on how the platform can be used to plan tours	Workshops (WP7, Task 7.5)
EU young scientific community (PhD students and young scientists)	<u>Train</u> : The young community is educated on the importance of Earth Critical Zone connected to Geospatial Decision Support Systems (S-DSS)	Two summer schools (1 day and 5 days) Participation of representatives of the International Forestry Student Association at project general meetings (WP7, Task 7.8)
Society and local communities:	<u>Agro-environmental awareness</u> : Increasing landscape awareness and collaboration platform with high schools at local scales	Workshop and interactive exhibition (WP7, Task 7.5)
Broader public	<u>Agro-environmental awareness</u> : The general public is aware of the LANDSUPPORT platform and can interact with the S-DSS tool, and learns how the tool can interact with people's daily life	Interactive on-line platform showing land use changes and its effects to citizens; Social media: YouTube, Facebook, Twitter; Provision of contents for the LANDSUPPORT-app targeting the general public; Simple webinars for each category of end users and stakeholders will be available as YouTube videos. (Task 7.6)
Broader public	<u>Awareness</u> : The public is informed about project activities	Logo; Brochures; Newsletters; Website Two press conferences (at the end of year 1 and at the end of the project) (WP7 - Task 7.7)
Scientific community	<u>Awareness</u> : The scientific community is aware of project activities and can interact with the project team	Networking with other related projects Participation to information platforms Participation to relevant events (WP7 - Task 7.8)
Scientific community (EU and worldwide)	<u>Disseminate and exploit project results</u>	Scientific articles (all WPs)

Progress report in scientific symposia: These will be organized at appropriate scientific conferences. Partners will also seek to afford visibility and discussion of LANDSUPPORT's work at national and international events organized by relevant professional

societies. The researchers in LANDSUPPORT take it as their duty to represent the project at the most important and relevant conferences in the research fields of geospatial decision support systems, Earth Critical Zone, agriculture and environmental modelling, database management, science and policy-making, science and policy implementation.

Young investigators: Many researchers of the LANDSUPPORT consortium are actively involved in teaching activities at their institution. Partners will aim to showcase the LANDSUPPORT project in lectures and seminars where appropriate to inform young researchers about the possibilities and benefits of international collaborative research and highlight European cutting-edge science. Moreover, two summer schools will be organised in Vienna and Napoli.

Scientific publications: The researchers of the LANDSUPPORT consortium hold strong publication records. Many of the partners have already published together. Many of the LANDSUPPORT partners serve/have served as editors/reviewers of leading scientific journals and advisors to national or international agencies. To reach the widest scientific and non-scientific readership, LANDSUPPORT partners will ensure publications of their research results in “Open Access” journals

The Project consortium acknowledges that the research and new knowledge generated is of societal benefit, and could potentially contribute toward solutions of societal challenges. As such, the foreground knowledge needs to be disseminated in an optimum way for impact and re-use of results, according to Responsible Research & Innovation (RRI) principles.

Resulting research publications (refer to tasks/WP most likely to publish) will also be made openly available via e-Infrastructure OpenAIRE (DG CONNECT; request letters of support), predominantly relying on the Green Open Access strategy (self-archiving) for maximum return on investment for project and funder, and actively linked to underlying data objects, in support of the EC Open Data Pilot.

Focus will be placed on demonstrating that Open Access and RRI are not only for societal and community benefit, but also directly support the career needs for impact, visibility and multiplying collaborations for individual researchers. Aligning the societal and research impact of knowledge generation can in the long-term bridge the gap between science and society.

Project outcome/ Publishable data	Results/data available by	Target audience	Potential scientific Open Access journal(s)
Geospatial DSS applied to Land take at European scale	M20	Spatial planners and environmentalists	European Journal of spatial development
Geospatial DSS to fight against land degradation	M36	Scientists working in land degradation	Soil and environment
Geospatial DSS applied to forestry	M42	Forest community	Forest systems
Climate change resilience supported by Geospatial DSS.	M42	Scientist working in climate change adaptation and mitigation	Solid Earth

The results of the research in LANDSUPPORT will be made available to the larger scientific community via peer-reviewed publications in scientific journals, presentations at scientific meetings and presentation on the LANDSUPPORT website. Publication policy within the LANDSUPPORT consortium is such that collaborative results will be jointly analysed and published. All partners are committed to the principles of good scientific practice. Manuscripts including work funded by LANDSUPPORT will be pre-circulated to all partners in advance of submission; partners will be invited to comment or contribute additional information or data. Notwithstanding this, absolute confidentiality will be enforced, also so as not to jeopardize individual partners or the consortium to claim intellectual property rights.

Title of conference	Date of conference	Location	Target audience
European Geosciences Union – Soil Science Systems Symposia	2019	Vienna	Scientists
European Geoscience Union – Big data in Geoscience Symposia	2020	Vienna	Scientists
European Society of Agronomy	2021	Not yet known	Scientists
International conference on frontiers in decision support systems applied to agriculture and environment	2022	Portici, Napoli	Scientists

All references to ongoing or published work originating fully or partly from LANDSUPPORT will acknowledge funding by the European Union, and when appropriate, a statement to the effect that the European Union has not influenced the design or outcome of the work; this will apply irrespective of the medium (print, electronic, TV/radio) used for public awareness.

The major objectives of the proposed dissemination strategy are to:

- Establish a living lab process where final users and other stakeholders are continuously mobilized (from the start to the end of the project) in the co-development of the S-DSS tools in collaboration with the project team. This will ensure that: (i) the needs of prospective users guide the development of the S-DSS tools; and (ii) the alpha and beta version of the S-DSS tools will be modified according to prospective users' feedback;
- Enhance capacity of prospective users through technical dissemination and capacity building activities. This will enable a large set of stakeholders to be self-sufficient in evaluating a large set of land management policies and practices, as well as their impact on agriculture, environment and climate change resilience, with the support of the LANDSUPPORT platform; and

- Disseminate knowledge about the S-DSS tools, and the benefits that LANDSUPPORT is creating for Europe to a wide audience, including both the general public and the EU scientific community. Engaging with the scientific community will place the LANDSUPPORT project in the scientific landscape as a major stakeholder. Dissemination to the broader public, in turn, will improve citizens' knowledge and awareness of land management practices and their impacts on the environment.
- Overall, all participation and dissemination actions are aimed at maximizing the impact of the project and at ensuring that the LANDSUPPORT platform will be used after the end of the project.

Exploitation:

During and up to four years after the project, as stated in the Model Grant Agreement Article 28, all partners ensure to exploit project findings and results in both the commercial and scientific dimension.

The project aims to specifically address multipliers in the different target/stakeholder/special interest groups to let the ideas of project gain traction and ensure their diffusion on a broad level. This will ensure a visibility and prominence in order to attract new partners for next steps in the development of S-DSS tool.

Innovation	Target group	Targeted Market (geographically)	Estimated time required for DSS availability (thus, exploitation for commercial used by local companies)	Benefit compared to existing product/practise
Better consultancy in agriculture	Extension services, private companies, freelance	Marchfeld, Regione Campania, Zala County	M42	Smart geospatial consultancy in real time
Better consultancy in environmental issues				Smart geospatial consultancy in real time
Better consultancy in ecotourism				Smart geospatial consultancy in real time
Better consultancy in urban planning and land take		Europe	M42	Smart geospatial consultancy in real time

Scientific exploitation

It is a major focus of the LANDSUPPORT consortium to achieve the highest possible scientific outcome of the project. As described above a targeted dissemination strategy will be used to reach the highest possible audience. Moreover, scientific knowledge, skills and methods which have been gained within the project will be transported to other scientists/physicians/students via educational trainings and workshops. Skills and knowledge which has been generated in the LANDSUPPORT project, will serve as a basis for further internal and collaborative research. Wherever possible, high effort will be made to transfer the results to other scientific fields.

WP7 activities include networking with other related projects, participation to information platforms, participation to relevant events (WP7 - Task 7.5), to raise awareness in the scientific communities about the platform.

Commercial exploitation

The coordinator UNA research center has a special interest in keeping the platform alive and well functioning after the end of the project. Five institutions using the LANDSUPPORT tool (JRC, ISPRA, EAA, REGCAM, ZALA) are already LANDSUPPORT partners. To this respect these institutions have already expressed their interest to keep the platform alive for their own needs and their consultancy cost-saving. Another possible solution is to transfer the tool to one of the LANDSUPPORT companies to develop the tool into a product. To do this, a viable business case, will be evaluated (see chapter 2.1.3) at a later stage during the project evolution and results.

Since the platform can be used for free, prospective users of the platform include public authorities / policy makers; farmers, farmers' associations and extension services; local companies. Trainings and technical workshops will be organized for prospective users (Task 7.3), and these include: (i) policy makers at the EU, national and regional/local level; and (ii) prospective users at the field level, including AGES, Confagricoltura, Marchfeld, INU, but also potential users not collaborating with the project.

Guidance and policies

The aim of the LANDSUPPORT tool is precisely to support policy making and policy implementation at the EU, **national and regional** level in the domain of land resource management. Thus, project activities include the followings:

- **Preparatory workshops** with policy makers at the EU, national and regional level to discuss the proposed structure and outputs of the S-DSS tools, to ensure that the S-DSS tools properly reflect the needs of policy makers at all levels (WP1);
- **Training and technical workshops** for both prospective users and policy-makers at all relevant levels, to ensure that the S-DSS tools are used after the end of the project;
- **Summer school** to educate the young scientific community on the importance of Earth Critical Zone based Geospatial Decision Support Systems toward EU policies implementation
- **Interactive exhibition to disseminate landscape awareness among very young people** (local school)

- **Final presentations of project outcomes and products to the policy-making community** (one presentation at the EU level, targeted presentations in IT, HU, AT) (WP7 - Task 7.7), to demonstrate to policy makers how the LANDSUPPORT platform can effectively support policy design and implementation.

Knowledge management and Intellectual Property protection:

All scientists/ developers and our SME partners will include their tangible (such as materials, database, techniques) and intangible (data, know how or patents) background as basis for the LANDSUPPORT project. To protect confidential information such as research output and strategies which are generated by the consortium, a non-disclosure agreement will be signed by all external persons taking part in the LANDSUPPORT project, at the time when the LANDSUPPORT Consortium Agreement is finalized. In case of transfer of material between parties of the LANDSUPPORT project, a Material Transfer Agreement (MTA) shall be implemented. Ownership and access rights to Background will be identified and laid down in the Consortium Agreement during the project negotiation phase. The Consortium Agreement will be negotiated on the base of the DESCA2020 model, respecting the interests of all partners and following the rules of the Grant Agreement. An internal IP specialist or patent attorney will be consulted in all aspects of commercial and/or industrial exploitation. Unforeseen foreground will be treated under fair and reasonable conditions.

A patent strategy will be developed for the tools and platform developed inside LANDSUPPORT. The patent strategy will also serve as basis to assess business relevance and exploit marketing possibilities before investing in patenting and will support defining further research directions. To protect intellectual property (IP), prevent infringement and ensure freedom to operate a patent will be obtained for all patentable inventions. Prior to this application the competitive patent landscape will be analysed to

- Identify research trends inside LANDSUPPORT
- Identify patent gaps
- Analyze Freedom to Operate
- Plan LANDSUPPORT's patent and in/out licensing strategies
- Secure LANDSUPPORT's competitive advantages and know who are competitors and where are they active
- Monitor potential infringer
- Find potential industry partners for a common patent application

Data Management and data sharing:

Data management and data sharing is a key issue in the LANDSUPPORT project. Data handling is based on the Guidelines for Data Management in Horizon 2020.

Non-scientific data

For the execution of their tasks as described in this proposal, project partners will have access to a) contractual data b) documentation of project status c) all documents required for fulfilment of the consortiums obligation towards the EC and d) personal data from partners in the LANDSUPPORT project associated with their role within the consortium. Personnel employed at individual partners will be bound by their employment contract to adhere to national legislation on Data Protection and the provisions of the Consortium Agreement, which will follow the Directive 2002/58/EC of the European Parliament and of the Council of 12 July 2002 concerning the processing of personal data and the protection of privacy in the electronic communications sector (Directive on privacy and electronic communications) and Directive 95/46/EC of the European Parliament and of the Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data and national legislation subsequently enacted.

Scientific data

Data generated during the project will be collected, stored, shared and archived according to a Data Management Plan (DMP) to be agreed within the Consortium in the first 6 months of the project. The provisions of the DMP are summarized here:

Types of data generated/collected: During the project lifetime 3 kind of data set will be utilized: 1) key data required for the provision of LANDWEBSUPPORT services such as: data that must feed the system (Data about physical environment as soil, geology, land use, Cartographic maps, Climate data, Satellite Data and Satellite image processing products, User data related to a farmer's plants, Compliance data related to compliance requirements); output of calculation model; auxiliary data from various sources as well as to be collected and utilized throughout the project. 2) data gathered through the interview-based survey of the project aimed at revealing the needs and requirements of LANDSUPPORT users and stakeholders. 3) data collected during the pilots of the project necessary for the co-evaluation and validation of our services and business case, etc.

Employed standards Existing suitable standards will be considered. In fact, several open data standards are currently available and can be applied in the framework of LANDSUPPORT including the EU Directive 2007/2/EC on Infrastructure for Spatial Information in the European Community (INSPIRE) which addresses spatial data themes required for environmental applications. For datasets that do not have standards, the consortium will provide metadata to help secondary users understand and reuse them.

How data will be exploited and/or shared/made accessible for verification and re-use. Project participants will deposit their data in a research data repository and take measures to make the data available to third parties. The third parties should be able to access, mine, exploit, reproduce and disseminate the data. This should also help to validate the results presented in scientific

publications. Data sharing and accessibility for verification and re-use will be available also through the LANDSUPPORT project platform, open to anyone: the platform will be the first form of repository. The use of open standards and architecture will also allow other uses of this data and their integration with other related applications. At the moment, we consider the use of Zenodo (<https://zenodo.org/>) as one of the best online and open services to enable open access to LANDSUPPORT datasets but similar repositories will also be considered.

How data be curated and preserved. The use of Zenodo will safeguard the preservation of openly available LANDSUPPORT datasets beyond the project lifetime. The DMP will provide a clear description of procedures for long-term data curation and preservation.

For the protection of personal data collected as part of the projects research activities, please refer to section 5.1.4.

No collection of personal data is foreseen as part of the research activities within LANDSUPPORT.

Legacy

The participative process established by LANDSUPPORT will mobilize prospective users at all levels from the very beginning of the project, and they will be actively engaged in co-developing the S-DSS tools. This will be key to the success and legacy of the project: in fact, potential users are very likely to use a platform that they contributed to create and that is developed according to their feedback. In addition, technical dissemination and capacity building will empower potential users so that they can autonomously use the S-DSS tools after the end of the project.

The major aim of the proposed exploitation strategy is to:

- Achieve the highest possible scientific outcome and increase lasting effects of supported activities
- Assure a continued use of the S-DSS tools in policy making and by prospective users on the field
- Ponder the possibility of reaching further funding either from public or private sources
- Ensure the sustainability of project efforts in opening up the findings to further investigations
- Boost transferability of results

Both the dissemination and the exploitation strategy will be reviewed on a regular basis and revised if needed. An update will be included in the interim and final reporting of the LANDSUPPORT project.

2.2.2. Communication activities

Objectives of communication

- Effective and efficient communication paths within the project and to the outside of the project
- Information and update of all relevant partners and parties on LANDSUPPORT evolution and processes
- Input of valuable input, responses, feedback and criticism from internal and external to the project
- Improvement of project mechanisms and processes due to constructive criticism stemming from communication

Internal communication:

Internal communication and dissemination will aim at sharing information; building team spirit; strengthening complementarity of the partners and developing mutual specialization; supporting management; and offering training.

The LANDSUPPORT consortium will ensure and further internal communication through a list of measures that will be applied regularly and continuously throughout the project lifetime. These are:

Consortium meetings:

The project will start with a kick-off meeting, and this will include an open session with relevant stakeholders (farmers, students, policy makers, prospective users at the field level, urban planners etc.) to liaise partners (in particular, strongly technology-focused ones) with potential users and other stakeholders. LANDSUPPORT will hold annual meetings to which all participants will be expected to contribute. The meetings will last 1-3 days, and consist mostly of presentations and discussions of the scientific achievements within LANDSUPPORT. At each annual meeting, sufficient time will be allocated for informal discussions between participants (and guest speakers) which are also foster building trust and collaborations as well as help younger scientists identify other competent European labs for their next career moves. The Commission's responsible Scientific Officer will be invited to all annual meetings and will be asked to provide her/his personal opinion on the consortium's work and to identify needs as they develop (the Scientific Officer will be requested to fulfil these tasks in an informal manner and independently of the Consortium's Scientific Advisory Board and the Commission's appointed External Assessors).

In addition, LANDSUPPORT's WP Leaders will meet at least once per year to evaluate and discuss scientific progress, develop new or remedial strategies, and to be informed about administrative matters. They will organize telephone conferences to share and discuss data, results and other relevant issues and to strengthen collaborative efforts.

Regular telephone- or web-based conferences: CMAST will set up and host regular remote-access conferences to update and link all partners or WPs and ensure the exchange of important project issues as well as further discussions on open questions.

E-mail correspondence: CMAST will establish a data base of project participants' contact details and generate mailing lists to inform and update the different groups of the consortium on all project-related matters. Researchers will keep in regular bi- and multi-lateral email contact.

Internet website: The LANDSUPPORT homepage will be launched in the first project period. It will be maintained by ACTeon under the direct supervision of the Coordinator or other designated scientists. The website will have 'open' and 'restricted' areas. The restricted area of the website will serve to facilitate regular, programmed, collation and dissemination of data, sharing of protocols and other resources, and will generally promote dialogue between investigators.

External communication:

In agreement with the Regulation (EU) No 1291/2013 of the European Parliament and of the Council of 11 December 2013, the consortium aims at the deepening of the relationship between science and society. Besides the measures taken to foster an extensive dissemination of the project results, the consortium seeks the dialogue with the European citizens and media.

Communication products and activities are an integral part of the participation and dissemination strategy. As the strategy was described in detail at the beginning of this chapter, this section will only focus on such specific communication products and actions.

Several LANDSUPPORT partners have experience in communicating science to the public in a responsible manner. The Coordinator and the whole consortium will continue to endeavour to publicize and report on the activities of the LANDSUPPORT project and the role of the European Commission within it. This includes press releases, www releases, and provision of information to appropriate stakeholders such as policy makers, prospective users at the field level, the EU scientific community and European citizens.

The LANDSUPPORT project will start with communication and dissemination activities from the very beginning of the project and the strategies will be regularly reviewed and revised if needed. Partners take great pride in making the public and scientific audience aware of our efforts and innovations.

Year 1	Year 2	Year 3	Year 4 (until Month 42)
Project flyer		Possibly update with interim achievements	Final version with achievements
Project poster		Possibly update with interim achievements	Final version with achievements
Project website	Continuous Updates	Continuous Updates	Continuous Updates
Facebook page – creation and regular update	Facebook page –regular update	Facebook page –regular update	Facebook page –regular update
Youtube channel – creation and regular update	Youtube channel –regular update	Youtube channel –regular update	Youtube channel –regular update
Project newsletter (2 issues)	Project newsletter (2 issues)	Project newsletter (2 issues)	Project newsletter (2 issues)
Participation in information platforms	Participation in information platforms	Participation in information platforms	Participation to information platforms

Public relations: ACTeon, in liaison with the Coordinator and press officers of the individual partner organisations/institutions, will be responsible for all communication activities and the release of information from the consortium. Partner scientists will help ACTeon identify 'newsworthy' items and will also indicate appropriate media through which information should be disseminated. LANDSUPPORT scientists are committed to public awareness of science, but at the same time, will ensure that information is transmitted in a responsible and ethical manner. Ultimate responsibility for disseminating LANDSUPPORT-generated knowledge to the public will lie with the Coordinator who is an experienced and recognized expert in communicating science to the public.

Internet website: The public-accessible area will include information for specialists (academic and industrial researchers), as well as information for the press and for the lay public, the latter will fulfil the consortium's recognition of the importance of public awareness of science as well as accountability to tax payers. The website will also include regularly updated 'consensus statements' that represent the views of the consortium on study design and reporting, as well as review articles by senior LANDSUPPORT investigators. Job postings for postdocs and PhD students in partner and other labs/organisations working in the areas of interest will also be featured in this section.

Project Flyers: A project flyer will be developed within the first year of the LANDSUPPORT project. It will contain detailed information on the project and the consortium. It will be distributed among all partners and presented at scientific conferences, open information days, symposia and other scientific and non-scientific events. Moreover, a tool information flyer with detailed information about the project in an easy, comprehensible language will be designed to inform prospective users. The tool flyer will be adjusted to the national languages and will be available for each scientific, dissemination and communication event.

Stakeholder meetings: As appropriate, the consortium may, from time-to-time, organize or participate in 'information days'. Stakeholders, especially those from local, national and European parliaments, will be invited to participate. Such 'information days' may for example include 'meet-the-expert' sessions, open forum discussions, public lectures or poster sessions. All lectures and materials will be designed in a way which is comprehensible for a broad audience. The main target of the Open Day is to attract and inform a large group of both scientists and other interested persons.

Social Media: As soon as the project starts, ACTeon will set up accounts of social media to promote project contents. Social media gives us the opportunity to connect to the most different groups on a broad level in a very resource-conscious manner. This includes:

1. **Twitter:** A Twitter account under the name of @LANDSUPPORT will be established. Tweets about news and facts from the project will be released (e.g. project researchers speaking on conferences, dissemination and communication activities, press articles etc.)
2. **Facebook:** A Facebook fanpage will allow users to connect to LANDSUPPORT. Connections to users' organisations, individuals and related pages will be made.
3. **YouTube:** A YouTube channel will provide additional contents such as interviews to project team members, prospective users, policy makers and other relevant stakeholders, as well as tutorials for both the information platform (for EU citizens) and prospective users of the S-DSS tools (technical tutorials).
4. **Interactive platform:** the platform will have a user-friendly interface and will be aimed at all EU citizens who are interested in knowing more about land management, land policies and their effects. For example, individuals will be able to visualize land changes over the last decades, or the impact of specific policies, on the area where they live.

ACTeon is responsible for the content management and the regular activity on these accounts. All Partners on the case of their specific activities will gather and deliver content for the several feeds to ACTeon. Connections to other accounts of relevant individuals and groups will lead to a network for sharing and promoting the innovations in LANDSUPPORT.

The major aim of the proposed communication strategy is to:

- Create a good working atmosphere and communication structure within the consortium
- Reach the highest potential audience, keep them up to date and inform them about the benefit of the project
- Create awareness about land changes and the importance of sound land management policies in the wider public and (take advantage of social media to) foster the dialogue with the wider public
- Popularize the knowledge about the S-DSS tool and the benefit that the LANDSUPPORT is creating for Europe
- Communicate how European research funding helps people and societies and furthers the economy as well as the well-being of citizens
- Enhance positive trends in public perception of EU and research activities

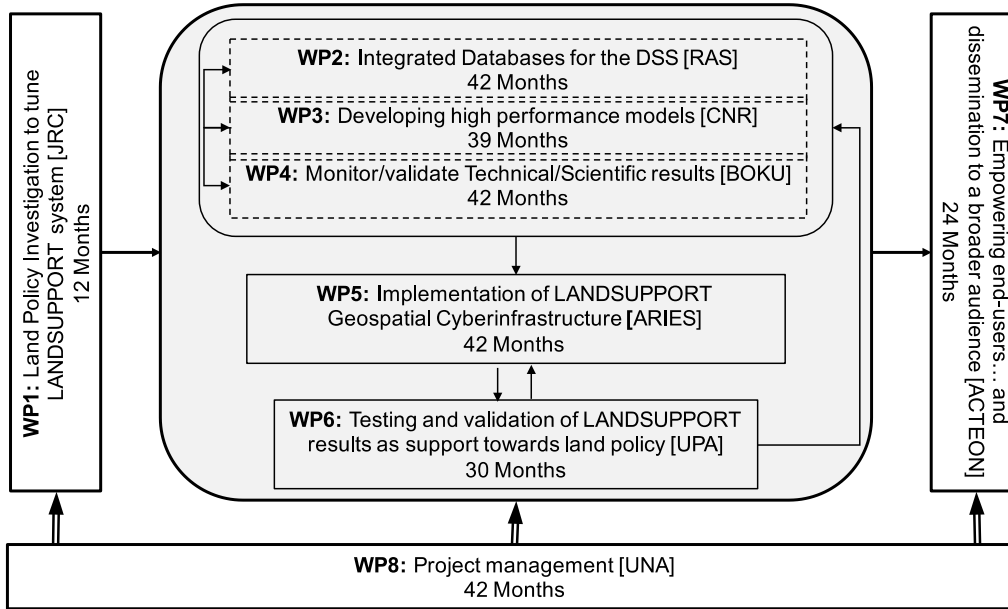
Summary: The LANDSUPPORT consortium will apply a participation, dissemination, exploitation and communication strategy that justifies the funds and resources put into the project by the EC and that places the participating institutions in the eye of the scientific community and the European population. By engaging prospective users in project activities from the beginning through innovative participatory approaches (e.g. living labs), the LANDSUPPORT consortium aims at maximising the impact of the LANDSUPPORT platform on policy making and land management in Europe, by producing useful, user-tailored S-DSS tools which can be used after the end of the project. In addition, dissemination and communication activities will raise awareness and stimulate discussion on the contributions that the S-DSS tools can offer to policy making and land management, as well as their informative potential on land use changes and its impacts for citizens.

3. Implementation

3.1. Work plan — Work packages, deliverables

3.1.1. Overall structure of the work plan

The project is structured in 8 interconnected (see figure 3.1.1) R&D work packages (WP) that will develop and test the LANDSUPPORT Geospatial Cyberinfrastructure platform.



† Arrows with standard thickness represent DATA transfer - bold thickness KNOWLEDGE transfer - double line MATERIAL transfer

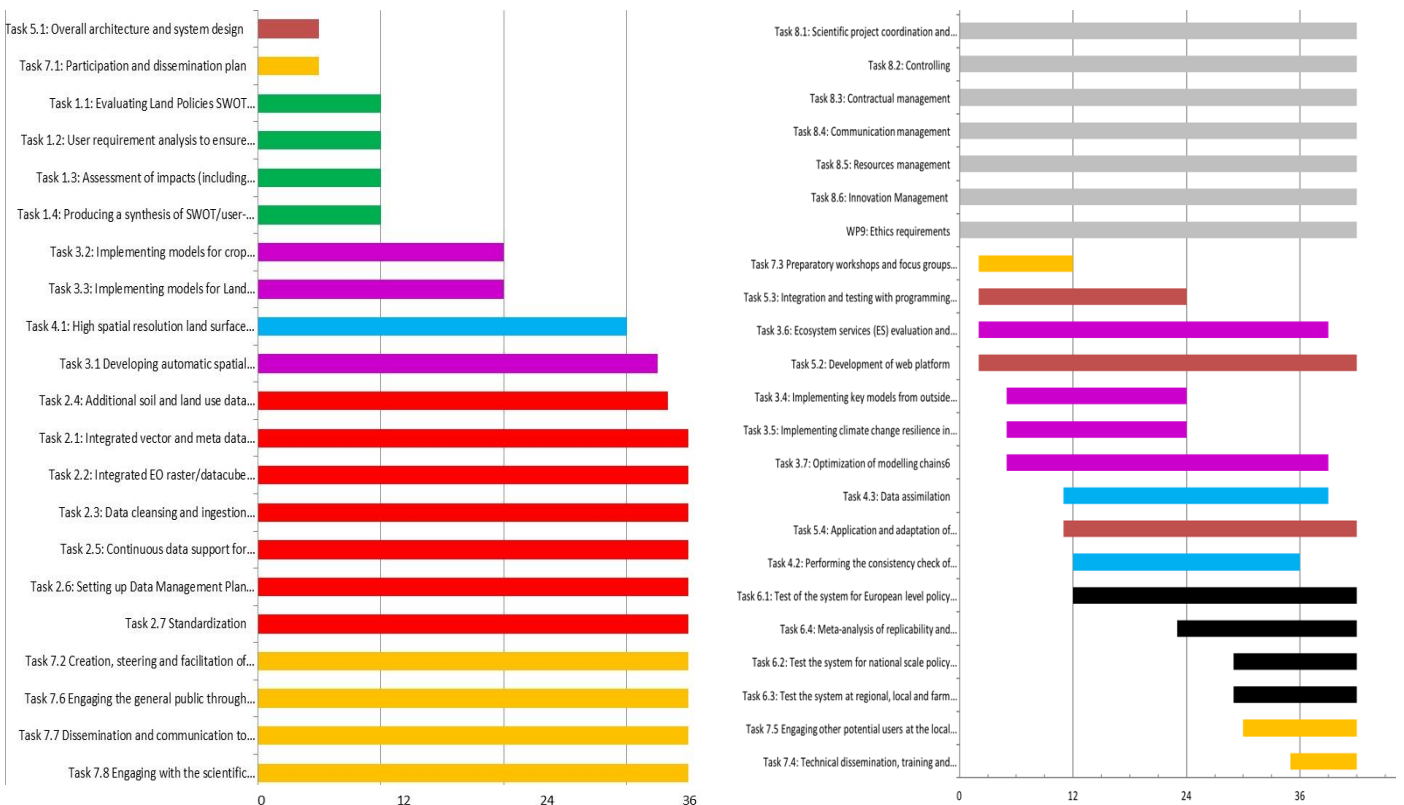
3.1.2. Detailed work description

Tables 3.1a: Work package descriptions (in DoA PART A)

Table 3.1b: List of work packages (in DoA PART A)

Table 3.1c: List of major deliverables (in DoA PART A)

Gantt chart (showing tasks in chronological order along the project months as given on the x-axis)



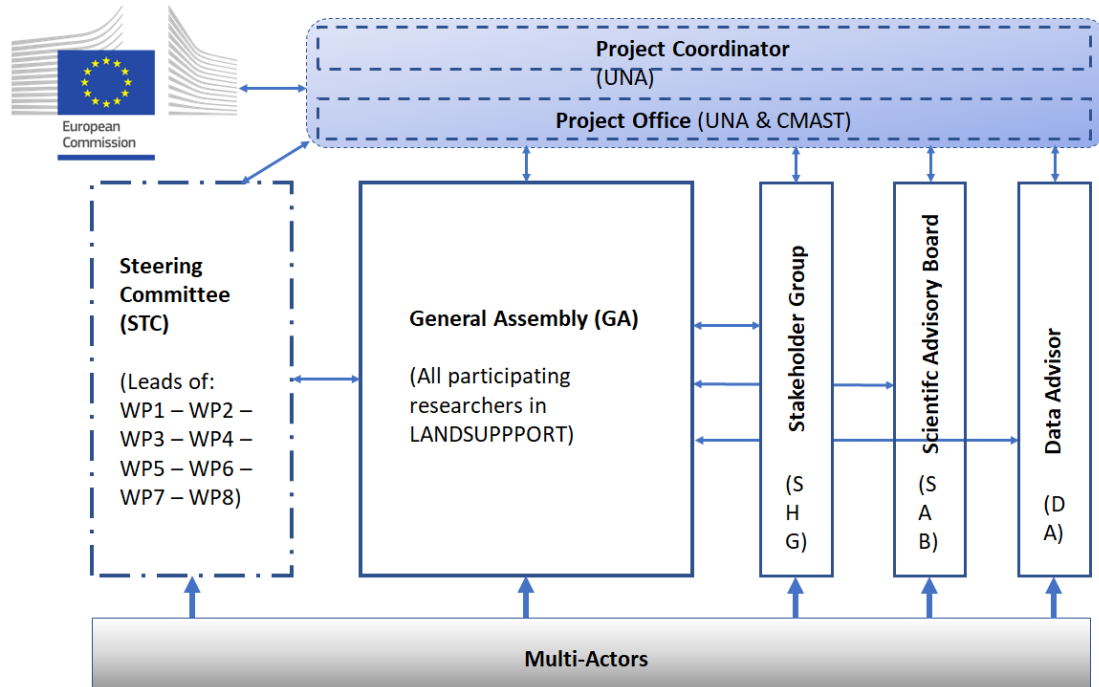
3.2. Management structure, milestones and procedures

3.2.1. Organisational structure and decision-making

Organisational structure and management bodies

This overall organisational structure of the project identifies the bodies responsible for specific aspects of project management, and outlines the procedures for decision-making.

The management structure of LANDSUPPORT is depicted in the following figure.



Project Coordinator Prof Fabio Terribile from the University of Naples will be the Project Coordinator of **LANDSUPPORT**. He is the intermediary between the European Commission and the consortium as well as **the first supervisor of the overall progress of the project**.

Tasks:

- Scientific supervisor of the overall project
- Chairperson of the General Assembly and Steering Committee
- Monitoring proper and correct decision-making within the consortium bodies
- Ensuring focus of all dedicated efforts and resources towards the completion of the project objectives
- Ultimate responsible contact person towards the European Commission in all LANDSUPPORT matters
- Further responsible for the correct, timely and complete submission of Deliverables, Reports and financial statement to the European Commission
- Ensuring bidirectional information and communication with the consortium bodies
- Close collaborator with the Project Office, Steering Committee and General Assembly, as well as official representative of LANDSUPPORT towards the public

LANDSUPPORT Project Office

The LANDSUPPORT Project Office combines forces at the Coordinator, University of Naples as well as CMAST and CNR.

Tasks:

- Coordinator: scientific management and monitoring of all research activities (supported by CNR and by a research assistant scientific manager)
- Coordinator: administrative, financial and contractual management (supported by CMAST)

LANDSUPPORT Participants

Members: At the time of application, the LANDSUPPORT project consists of participants who are defined by the terms and conditions of:

- the Horizon 2020 Grant Agreement which sets out the rights and obligations of all Participants and consortium bodies in the project
- the Consortium Agreement which sets out the rights and obligations of the Participants towards one another

It is possible, that after a phase of consolidation, LANDSUPPORT will be open to new Participants, in particular if one of the founding Participants should drop out or new tasks should be encountered that cannot be fulfilled by any of the existing Participants. In this case, the rules for inclusion of new Participants will be followed and all existing legal documents will be adjusted accordingly.

LANDSUPPORT Work Packages (WP) and Work Package Leads (WP Leads)

To facilitate the organization and management, the Scientific Program of the project is structured in Work Packages (WP) which together comprises the project. Each Work Package will be headed and coordinated by an experienced principal investigator as Work Package Lead. The Work Package Leads are responsible for the management of their WP.

Tasks:

- Supervising and managing the scientific process flow
- Steering the communication flow and integration within the WP
- Reporting on status of Deliverables and Milestones to the Steering Committee, General Assembly and Coordinator
- Member of the Steering Committee and responsible for making informed decisions in case of disagreements within the Work Package
- Pro-active consultation with the Coordinator in necessary cases

Decision-making procedures

The General Assembly (GA)

Members: The General Assembly – chaired by the coordinator - is composed of all involved Participants. Each Participant has one vote.

Tasks: The General Assembly consists of one representative of each Participant with authority to vote. All other non-voting researchers working for this project shall join the meetings and discussions. The main tasks of the General Assembly are:

- Grant proper implementation of the Participants respective rights and obligations in accordance with the contractual framework of the project and the Consortium Agreement;
- Decide upon withdrawal, inclusion and exclusion of Participants to the project;
- Take preliminary decisions on the amendment of the Consortium Agreement (subject to ratification by the authorised legal representatives);
- Agree on standard operation procedures within LANDSUPPORT, in relation to reporting procedures;
- Agree on procedures and policies in accordance with the Grant Agreement, Articles 23, 28 and 29 for dissemination of foreground and IPR;
- Approve the provisional budgets, discuss and approve the annual executive budget and cost claims prepared by the Steering Committee including the reimbursements to the Participants.

Decisions:

- The General Assembly shall meet once a year unless the interest of the project may require intermediate meetings. Proper decision-making procedures according to the Grant Agreement and the Consortium Agreement (convocation, agenda, minutes, quorum and voting rules) will be ensured.
- Ordinary and extraordinary meetings of the General Assembly shall constitute a quorum if at least 2/3 (two-third) of its members are present or duly represented by proxy.
- A two-thirds majority of the voting representatives of those Participants in attendance is required for all decisions apart from decisions relating the exclusion of a Participant. The exclusion of a Participant may be decided by a two-thirds majority of the votes minus the vote of the concerned Participant. The accession of a Participant may also be decided by a two-thirds majority.
- The decisions of the General Assembly in the project-related matters shall be legally binding to all Participants.
- A Participant may issue its veto particular in the case of a decision:
 - To accept a new Participant in the Project if a substantial threat to its commercial or strategic interests is likely.
 - To the withdrawal of another Participant, if this significantly affects its workload set down in the Work Plan and if this cannot be resolved by any other measures.
- In all cases where a Participant wants to appeal against a decision, it has to address its concern at the same General Assembly meeting. The meeting will not be closed until a decision has been reached. In case of a tie, the Coordinator shall have the casting vote.
- Urgent decisions may be taken via teleconference, and/or via e-mail, phone at the request of the Coordinator or of one third of the Participants if none of the Participants has reasonable objections to this way of deciding.

Steering Committee (STC)

Members: All WP Leads and chaired by the coordinator -

Tasks: The Steering Committee is in charge of monitoring all activities towards the objective of the project in order to deliver as promised, in due time and in the budget. The Steering Committee shall thus:

- Control the execution of the project with regards to the project schedule and the description of work annexed to the Grant Agreement and to monitor corrective actions;
- Propose all significant modifications of the work plan, the Grant Agreement, the Consortium Agreement to the General Assembly for approval;
- Propose changes in work sharing and membership to the Work Packages to the General Assembly.
- Propose the global and detailed provisional budget to the General Assembly for approval
- Report and be accountable to the General Assembly.

Stakeholder Group (SHG)

Members: The Stakeholder Group will be comprised of the groups reported in the list below: 20 representing all the key stakeholder interests in the LANDSUPPORT project, as indicated by the topic in the work programme as well as by the research

fields as such. The **20 Stakeholder Group Members** have been notified before the initiation of the project and have gladly agreed to take on the responsibility. Please see the Letters of Support in the Annex 1.

Tasks: The Stakeholder Group – in coherence with the multi-actor approach - will ensure continuous interaction and exchange on research and stakeholder interests, to ensure that objectives within the project are achieved taking into account all players. Serving stakeholder interests, LANDSUPPORT will actively integrate the Stakeholder Group Members in the annual General Meetings (deputies to invited beforehand) as well as Dissemination Activities to implement close collaboration and input. Whenever necessary and appropriate, the Stakeholder Group Members will give recommendations and advice to adjust and correct the activities and process flow in the project.

The agreed members thus far include:

SHG member	Role, area of expertise	Role in LANDSUPPORT testing and cooperating in addition to SHG activities in WP7 (dissemination...)
GSP- Global Soil Partnership (FAO-United Nations)	Global Partnership	WP1 and Test LANDSUPPORT scaling up of appropriate solutions to soil degradation problems (WP6)
FAO-RNE (Regional Office for Near East and North Africa)	FAO office	WP1, and WP3, 6, collaboration to test tool on agriculture and AQUACROP model
ECTP-CEU European Council of Spatial Planners	European Association of urban planners	Test spatial and urban planning tool for Europe and Italy (WP6)
ELSA European Land and Soil Alliance	Largest European city network dedicated to soil protection	Test evaluation land take impacts and land degradation on some ecosystem services (WP6)
Hungarian Chamber of Agriculture (HU)	National Public body for agriculture, rural development.	Test Agriculture DSS tools for Hungary (WP1, WP6)
AGRYA-HU Agricultural and Rural Youth Association (HU)	National Association of young farmers	Test land planning and management agriculture practices (WP6)
ILWM-AU Institute for Land and Water Management research	Federal Agency	Test evaluation of land management effect on soil and water quality at local scale (WP6)
AGES-AU Austrian Agency for Health and Food Safety	Federal Agency	Test evaluation of environmental tools (WP6)
ALR-AU Authority Land Reform Lower Austria	Regional Authority on Land	Test evaluation land take impacts on the environment (WP6)
Confagricoltura (Italy)	National farmer association	Collaboration to WP6 and test land planning and management over agriculture practices
INU – National Institute for Urban Planning (Italy)	The largest Italian Association of urban planners	Collaboration WP6, test spatial and urban planning and SEA and EIA for the Italian territory
General Directorate of planning and Conservation of agricultural lands (Ministry of Agriculture - TUNISIA)	Land Use & Conservation Agricultural Land management, National scale	Test land planning DSS tools at local scale including impacts on ecosystem services under land use/management and climate change scenarios (WP6)
Institut National de Recherches en Genie Rural, Eaux et Forets, Tunisia	Research body	Test integrated management of Rmel study site (WP6)
BM-AU Betriebsgesellschaft Marchfeldkanal (AU)	National Company in land and water management	Test of soil sealing impacts and agricultural activities on ecosystem services at Marchfeld (WP6)
Agriturist - Campania (Italy)	Regional Association of agritourist farms	Collaboration within WP6 and WP7. Test for ecotourism activities at local and regional scales
Telese Municipality (Italy)	Municipality	Local Test impact of soil sealing over agricultural activities and ecosystem services (WP6)
Keszthely Municipality	Municipality	Local Test impact of soil sealing over agriculture WP6
Telesia Multifunctional High school (Italy)	Education Institution	Collaboration to landscape awareness activities planned in WP7 and implemented DSS tool “o”.
Local vine-winemaking associations (Vita Salernum, Sannio DOP, Consorzio Tutela Vini Vesuvio)	Winemakers Consortium	Test best vineyard management practices from local to landscape scale, including soil water stress monitoring, irrigation, viticulture zonation and valorisation of productions

Scientific Advisory Board (SAB)

Members: The Scientific Advisory Board will consist of **4 experts** (50% females) representing the 4 aspects of activities of the project, as indicated by the Work Packages. As such, the Scientific Advisory Board Members represent **leaders in the fields of**

land policy, land modelling, sustainable agriculture and geospatial databases. The members have been nominated before the initiation of the project and have agreed to take on the responsibility. Please see the Letters of Support in the Annex 2.

Tasks: The Scientific Advisory Board will ensure a high standard of research and monitor the progress of the project by taking part in the annual General Assembly meetings. Whenever appropriate, it will consult the consortium and make recommendations as to improve their performance.

The members invited thus far who have agreed to participate on the SAB are all leaders in their fields and will **further enrich the knowledge** of the project participants and provide an important 'birds' eye view' of the activities, aims and objectives of LANDSUPPORT. Each member of the SAB has experience as a competent external reviewer and will provide crucial critical feedback throughout the period of LANDSUPPORT's programme.

The agreed members thus far include:

SAB member	Role and (area of expertise)
Helena Gomez Macpherson	Deputy Director IAS-CSIC (Spain); Chief Agronomy Department (Sustainable agriculture and food security)
Johan Bouma	Emeritus Prof. at University of Wageningen (NL) (Land evaluation and land policy expert)
Kris Van Looy	Scientific Coordinator of International Soil Modelling Consortium (DE) (modelling expert)
Monika Ruzszecka	Head of the GIS Unit UNEP/GRID-Warsaw Centre; Data Advisor (expert in geospatial databases and data privacy and data standardization)

Table 3.2a: List of milestones

3.2.2. Appropriate to the complexity and scale of the project

The organisational structure of the project, with a coordinator and Project Office, a GA and an STC as main management bodies and the WP Leaders as operational managers, is set-up to be lean and flexible. Yet, it allows for adequate steering and coordination on multiple levels of hierarchy, while safeguarding the interests of many different types of organizations.

- With 19 partners and 8 WPs with highly challenging goals and objectives, the project constitutes a considerable budget, with a requested funding of 7 m Euro. This requires a highly professional coordination and administrative management of the project. The coordinator has profound experience in managing large consortium projects, and will be supported in the administrative, legal and financial management by CMAST, an SME partner with considerable professional experience in the project management of large-budget, complex, multi-partner projects. They will offer guidelines throughout the scientific and financial reporting process and will take actions to ensure this runs smoothly (e.g. training on time reporting on EU projects, intermediary financial audits when necessary, installing a PM website with document sharing tools and automated notifications on deliverables and milestones).
- The roles and responsibilities are clearly divided over the different coordinating levels: the GA (strategic management), the STC (operational management) and the WP leaders (daily coordination of WP activities). The WPs are set up as much as possible to function as self-steering teams, all the while taking into account that the WPs are often interrelated, requiring feedback loops. WP leaders can set-up individual or joint WP meetings ad hoc, in function of the WP progress. Decisions in one WP that considerably impact any of the other WPs will first be discussed in-depth in joint WP meetings or the STC. If needed, the input of the SAB and/or the Stakeholder Group can be requested before taking such decisions. The coordinator will keep an overview of the interrelating activities taking on a mediating role in conflicts, intervening whenever necessary to safeguard the project objectives.
- This challenging and complex call topic expects projects to aim for far-reaching impact at multiple operational and policy levels. In order to generate the promised impact, the project results need to be suitable for the needs of a variety of stakeholders, including academic researchers, policy makers at different (geographic) policy levels, high-tech SMEs as well as end users in agriculture, forestry and other economic activities impacting land use. The interests of the EC are directly ensured via the participation of JRC in the consortium, thereby directly impacting the decision-making process. Other relevant stakeholders are (and will be) included as much as possible in the SAB and Stakeholder Group, allowing for their indirect impact on decision-making via regular interaction with the WP participants and/or attendance to the GA meetings.
- The development and implementation of the LANDSUPPORT platform requires a very large collection of local and regional data. A dedicated data manager will be appointed to ensure overall proper data management, who will maintain an overview across the WPs and join the STC and GA meetings. By incorporating a responsible scientist of every partner in the GA as well as the STC, big data management across different partners can be warranted in a structured manner.

3.2.3. Innovation management

LANDSUPPORT understands and offers answers to the market needs and technical challenges concerning land use policy support.

Activities will aim at improving implementation of policies and governance at various geographic scales to support sustainable growth in rural areas. LANDSUPPORT acts at a very detailed local scale but integrated over very large areas. Current approaches are not challenging this complexity, offering a simplistic aggregated view of the problem. In such framework, the development of operational web-based geospatial decision support system is the answer and LANDSUPPORT will provide it, thus achieving factual sustainable land management with integrated policy implementation for agriculture, environment and land use planning.

LANDSUPPORT will continuously collect stakeholder feedback and perform technology scouting, which may lead to adapting the final DSS support system to better address changing or newly emerging user needs

LANDSUPPORT aims to create an open, free to use internet platform with an interdisciplinary approach and special attention to testing (WP6) by public partners, as well as urban planner stakeholders. Inter- and trans-disciplinary knowledge is transferred between researchers, farmers, industry and stakeholders, in line with a multi-actor approach concept to maximise the project impact. With this open mindset and broad perspective, all means for innovative input by third parties is kept open. **Innovation management is incorporated in WP8 Project Management**, as a core task to be carried out during the entire project duration and ensuring that innovations are dealt with properly within the consortium among the concerned participants. Active and modern innovation assessments will be performed by WP8 together with the Steering Committee in order to meet requirements and seek further innovation improvement.

3.2.4. Risk management

Table 3.2.b: Critical risks and mitigation actions (in DoA PART A)

3.3. Consortium as a whole

3.3.1. Expertise of the consortium in line with project objectives

The combined expertise of the partners in the consortium is excellently suited to meet the project's main objectives:

- The partners involved in the consortium have an international technical and scientific reputation for the critical aspects of:
 - o land policy (JRC, EAA, ISPRA, ACTEon, REGCAM) also considering socioeconomic conditions (iASK, ACTEON) and humanities (UNA), land use planning (UNA), land degradation (JRC, UPA)
 - o forestry (SFI) and agriculture (UMI, ICARDA), hydrology (CNR), soil sciences and geology (UNA)
 - o numerical modelling (CNR, UMI), remote sensing (BOKU), data management and sDSS (ARIES, UNA, RASDAMAN).
- More in particular, ACTEon ensures a strong expertise in environmental strategies and multilevel policies, by mobilizing skills in environmental sciences, economics, sociology, political sciences, environmental law and spatial planning.

Several partners have very relevant prior experience in the development and application of land use related sDSS:

- Experts from four of the partners (UNA, CNR, ARIES, REGCAM) have already coordinated and successfully delivered – through the LIFE+ project SOILCONSWEB – a similar fully operational system (over 20,000 ha; 4 sites) operating in the field of soil conservation (<http://www.landconsultingweb.eu/>).
- Three of the partners (UNA, CNR, ISPRA) have already produced a country-based S-DSS system to support urban planning for the whole of Italy working at high spatial detail (20m) (<http://www.soilmonitor.it/>).

Additionally, through several partners the consortium can ensure the access to and application of relevant knowledge produced elsewhere and learnt from experience in other domains¹⁰ including:

- top level of massive raster data management (RASDAMAN),
- top level HPC and GPU computing (BSC),
- DSS incorporation of both CROPPBASE from the CFF (Malaysia) and GEOCC system from ICARDA (Lebanon).

3.3.2. Complementarity of the consortium members and how they cover the value chain

The **complementarity** of the partners in this **multi-disciplinary** consortium, is evidenced by their respective excellence in their scientific fields, mainly including land policies, land use planning, social sciences, land degradation, forestry, agriculture, hydrology, soil sciences, geology, modelling, remote sensing and sDSS (see 4.3.1).

With academic, public, SME and international partners on board, the consortium ensures that the relevant **value chain** is covered, including the coverage of multiple **geographical and policy levels** as well as the involvement of and link to important **stakeholders** to the project objectives. More specifically:

- EEA, ISPRA, REGCAM and ZALA guarantee both country and regional based transferability actions, allowing to test the developed S-DSS system in appropriate real settings.
- The involvement of JRC ensures (a) tight connection with European databases and infrastructure, (b) very close connection to European policy making and (c) access to prior data and knowledge on land values (e.g. Land productivity map of Europe).
- High level international cooperation on both land degradation and sustainable land management and underutilized crops is guaranteed by International Centre for Agricultural Research in Dry Areas (ICARDA, Lebanon) and Crops For the Future (CFF, Malaysia) partners.
- Leading stakeholder associations in agriculture and urban planning (e.g. Confagricoltura, INU and ECTP-CEU) will guarantee the use of the developed system in test cases of their user communities.
- Three SME partners (ARIES, RASDAMAN, ACTEON) will continuously align the project research and development activities with their commercial interests for the project results, ensuring the viability of a commercial exploitation after the project end

Moreover, a **highly experienced and professional project management** company (CMAST) will be supporting the Coordinator in the efficient execution of management tasks by engaging senior project managers with long-standing experience in the research projects field.

3.3.3. Industrial and commercial involvement to ensure exploitation

¹⁰ SCAR-AKIS (2016)

The coordinator, UNA research center, as well as five LANDSUPPORT partners (JRC, ISRA, EAA, REGCAM, ZALA) want the platform to remain alive and well functioning after the end of the project, to support their own commercial consultancy activities. The project results will also be turned into one or several products or consultancy tools, to be commercialized by the **three LANDSUPPORT company partners** (ARIES, ACTEON, RASDAMAN). These partners will therefore be involved in the main activities that are being planned to ensure a proper exploitation potential for the project results:

- The main requirement to ensure a successful exploitation of the project results, is to have a systematic collaboration with LANDSUPPORT users and stakeholders from the beginning until the end of the project. WP1 (involvement of ACTEON) and WP7 (involvement of RASDAMAN) will therefore be dedicated to activities towards identifying the end user requirements, co-creating with end-users, in order to best tune the LANDSUPPORT DSS tools for the different users at different geographical scales, and offering trainings and technical workshops on the final tools to the users.
- As an important intermediate step towards safeguarding the exploitation of the project results, the consortium aims at multilevel applications of LANDSUPPORT in three rather distinct physical, socio-economic and cultural environments, including Mediterranean countries, Central European countries and Eastern European countries, which should reinforce the transferability of the project results in multiple geographical settings (WP6, involvement of ARIES).

As an additional part of this effort, suitable business models, that ensure a sustainability of the project results as well as a viable commercialization, will be discussed and developed jointly, by those partners interested in a commercial exploitation, at a later stage of the project. The feasibility of such business models can also be evaluated by the stakeholders (end users).

3.3.4. Other countries and international organisations

In LANDSUPPORT, the two following Participants from non-European countries are involved:

1. Participant 6, Crops For the Future, CFF, based in Malaysia
2. Participant 7, International Center for Agricultural Research in the Dry Areas, ICARDA, based in Lebanon

Both Participants are fully integrated into the project work plan and objectives and will contribute to the success of LANDSUPPORT. Their knowledge and expertise is essential and crucial for the project; moreover, their inclusion is fully in line with the requirements of the call topic.

3.4. Resources to be committed

All partners confirmed by email that *“the consumables can be independently directly measured and can be supported by the beneficiary accountancy policy /practice.”*

With respect to the total very high number of person month allocated to UNA for this project, we emphasise that

- (iii) UNA is a **strongly multidisciplinary Interdepartmental Research Center** with experts (hydrogeologist, soil scientists, cultural heritage experts, economist, spatial planners, etc.) applying their research domain **towards Decision Support Systems**. This is rather unique and will strongly support the work of all other partners. Below it is provided a table reporting the details concerning these expertise against person/month for each WP;
- (iv) LANDSUPPORT is a very powerful but also complex project involving many different expertise and 19 partners each having a very different background. The UNA coordination requires to devote large energies and person months to be able to well-tune this complexity and facilitate this transdisciplinary collaboration.

PERSONNEL CATEGORY	PERSON MONTHS								Total
	WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	
Full Professors (Project Leader, Soil chemistry expert, Applied geologist, Land use and Landscape cultural heritage experts, Agriculture Economist)	0,50	3,00	3,00	3,00	1,00	2,50	4,00	10,00	27,00
Researcher (soil survey expert)		3,00	1,00	2,00					6,00
Associate Professor (Hydrogeologist)		1,00	1,00	1,00					3,00
Officer (Administrative officer)								7,50	7,50
Researcher (Assistant Scientific Manager)		3,00	3,00	3,00	3,00	3,00	3,00	15,00	33,00
Research fellow (Database harmonization)		36,00							36,00
Research fellow (Spatial planning)		6,00	18,00						24,00
Research fellow (Hydrogeology)		3,00	9,00						12,00
Research fellow (Applied geology)		3,00	9,00						12,00
Research fellow (Landscape cultural heritage)		18,00	6,00						24,00
Research fellow (Soil fertility)		3,00	9,00						12,00
Research fellow (Farm accounting database-FADN)						24,00			24,00
									0,00
									0,00
									0,00
									0,00
	0,50	79,00	59,00	9,00	4,00	29,50	7,00	32,50	220,50

With respect to the high person months allocation of ZALA in WP1, we must emphasise:

- that WP1 is led by JRC because their large experience on land policy implementation, also in connection with DSS.

- that the regional scale is of paramount importance in LANDSUPPORT applications. This scale is the largest implementation level for land policies. However, the Zala region, differently from the other regional partner of Regione Campania, has no previous experience in the use and development of DSS systems applied to policy implementation. This implies that ZALA requires a large amount of person-months in WP1, especially for achieving the Task 1.2: User requirement analysis to ensure that the final S-DSS tools reflect the need of policy implementation, policy-makers local communities and stakeholders and also for Task 1.3: Assessment of impacts of LANDSUPPORT potential deliveries in multilevel land policies.

Moreover, ZALA aims to give a strong contribution in communication activities throughout its own territory in WP7. This is because we expect a large impact on this region. Zala will mostly contribute towards establishing an interface with potential users for agriculture and environment, technical workshops and workshop with local ecotourism companies.

FINANCIAL ASPECTS AND COST BREAKDOWN

Below are reported 'Other direct costs' (travel, equipment, other goods and services, large research infrastructure) for participants where those costs exceed 15% of the personnel costs

Other direct costs:


In the table 3.4a below is reported the following:

- In the table (horizontal view) are displayed the justification for other direct costs for participants where those costs exceed 15% of the personnel costs. The breakdown of all other direct costs are divided in 4 categories (Consumables, Other good and services, Equipment, Travel) with a clear link to which WP is referred.

TABLE 3.4a


01 - UNA	TOTAL COST	DESCRIPTION	WP 1	WP 2	WP 3	WP 4	WP 5	WP 6	WP 7	WP 8	Total	
CONSUMABLES	9 000	Reagents for chemical analysis		4 000							4 000	
		Aerial photos of the 50s of the Campania Region (DSS tool on landscape awareness)		5 000								5 000
OTHER GOODS AND SERVICES	28 600	Dissemination costs (incl. Open access during the action) and conference fees (2 conferences) for presenting project-related research							3 500		3 500	
		Catering for kick-off meeting in Naples (about 60 persons) and final conference (about 100 persons) in Italy						3 000	3 600		6 600	
		1 contract for the installation of a multimedial exhibition of the LANDSUPPORT project - at the "Landscape sector" of the "Museum of the Soil" in Pertosa (SA, Italy)							4 000			4 000
		Final conference organization of the project to be held in Italy							3 000			3 000
		Fees for 4 scientific publications							6 000			6 000
		Audit									4 000	4 000
		Database integration for Campanian agriculture farms (for tool "e")			1 500							
EQUIPMENT / INFRASTRUCTURE	66 000	1 Server including UPS, FTP upgrade (~10TB), rack chassis (>100 TB), HPC (2x server with CPU (>24 cores) / GPU (>2GPU). National depreciation rules are applied for all the equipment items					60 000				60 000	
		Software MatLab. National depreciation rules are applied for all the equipment items			6 000							6 000
TRAVEL	63 400	Travel expenses for Una-participants, Advisory Board (4 persons living in EU) and 6 SHG members (2 for AT, HU and IT), for kick-off meeting, intermediate project meetings (including review meetings for UNA), and final conference to be held in Italy (2), Hungary (1) and Austria (1)							12 000	36 000	48 000	
		Meeting with partners by the coordinator staff - 2 trips / 3 persons / 3 days								7 200	7 200	
		6 trips / 2 persons / 1 days in Campania for soil and environmental survey in the 25 regional sites		1 000								1 000
		3 scientific conference in EU - 3 days - 2 persons							7 200			7 200
TOTALE	167 000											

03 - BSC	TOTAL COST	DESCRIPTION	WP 1	WP 2	WP 3	WP 4	WP 5	WP 6	WP 7	WP 8	Total
CONSUMABLES	-										-
OTHER GOODS AND SERVICES											
EQUIPMENT /	54 000	Licence for Rasdaman. National depreciation rules are applied for all the					54 000				54 000

INFRASTRUCTURE		equipment items. This license provision is strictly following the EC regulations for Background Knowledge: partners have agreed to it in the Consortium Agreement before signature of the Grant Agreement, and the license is provided under fair favourable conditions.						Associated with document Ref. Ares(2018)1548916 - 21/03/2018		
TRAVEL	14 000	Kick-off meeting, 2 intermediate Project Meetings and project review meetings, and final conference (1-2 persons)							10 000	10 000
		dissemination events							4 000	4 000
TOTALE	68 000									

04 - BOKU	TOTAL COST	DESCRIPTION	WP 1	WP 2	WP 3	WP 4	WP 5	WP 6	WP 7	WP 8	Total
CONSUMABLES	-										-
OTHER GOODS AND SERVICES	74 376	Support to the evaluation of the project results (contract with AGES)						7 000			7 000
		Support to the dissemination of the project results (contract with AGES)							7 000		7 000
		Soil and cartographic data collection & acquisition from local institutions, from existing databases and from field work					40 000				40 000
		36 months cloud computing infrastructure for satellite data acquisition and processing (EODC - EO-COMPUTE Cat eo. expert)				15 746					15 746
		Audit								4 630	4 630
EQUIPMENT INFRASTRUCTURE	-										-
TRAVEL	10 000	Travel expenses for 1 technical (relative to WP2) meeting within EU (1 person / 2 days) and for 2 technical (relative to WP4) meetings within EU (2 people / 2 days). Travel to 2 project meetings (1 person / 2 days) within EU.		1 000		5 000				1 000	7 000
		3 National dissemination events							500		500
		2 International scientific conferences							2 500		2 500
TOTALE	84 376										

05 - CNR	TOTAL COST	DESCRIPTION	WP 1	WP 2	WP 3	WP 4	WP 5	WP 6	WP 7	WP 8	Total
CONSUMABLES	14 350	Materials for assembling the devices (3) to measure in the field the saturated hydraulic conductivity (e.g. soil auger with suitable diameter, extension rods with connecting pieces, bailer or pump, folding rule, measuring tape, measuring tape holder and float, stopwatch).		2 250							2 250
		2 Kit for soil sampling		1 400							1 400
		Iron cylinders for collect undisturbed soil and then measured hydraulic properties for the study site in IT and AU (about 400).		5 500							5 500
		Consumables for soil hydrology lab (tensiometers, tubing, fitting, filters, etc.)		2 500							2 500
		4 lens for laser granulometer		1 500							1 500

		Reagents for textural analysis and for solute transport experiments (e.g. calgon, hydrogen peroxide, etc.).		1 200			Associated with document Ref. Ares(2018)1548912001/03/2018							
OTHER GOODS AND SERVICES	35 100	Maintenance costs for truck and excavator during the year of the soil sampling		3 000								3 000		
		Shipment of iron cylinders to AU and HU		300									300	
		Fees for presenting project results in EU and international meetings (eg EGU, AGU, etc.). The estimate is for 4 attendance.							1 800				1 800	
		Costs for English review of 3 manuscript for publication of the project results in international journals							1 500				1 500	
		Costs for publication of the project results in international journals (3 manuscripts)							4 500				4 500	
		Assembling a device (software included) based on fiber optic sensors and Fresnel reflection to measure the solute concentration to obtain solute transport parameters.			20 000									20 000
		Audit										4 000		4 000
EQUIPMENT INFRASTRUCTURE	-											-		
TRAVEL	17 100	Kick-off meeting, 2 intermediate Project Meetings and project review meetings, and final conference (2 persons)								4 800		4 800		
		EUROPE, 1500 Km, 4 days, scientific conference (e.g. EGU), 2 trips for 2 persons							4 800				4 800	
		CAMPANIA (IT), 50-100 Km, 1 day, local meeting for dissemination and communication, 6 trips for 3 persons								1 800			1 800	
		Valle Telesina (IT), 150 Km, 1 day, soil and environmental survey for measure uncertainty at local scale, 6 trips for 3 person			1 200									1 200
		CAMPANIA (IT), 300 Km, 1 day, soil and environmental survey for soil survey and sampling in 25 sites, 6 trips for 2 persons			1 500									1 500
		AUSTRIA and HUNGARY, 4 days, taking by the truck undisturbed soil sampled in AU/HU and to be processed at CNR lab, 2 trips, 2 persons			3 000									3 000
TOTALE	66 550													


06 - CFF	TOTAL COST	DESCRIPTION	WP 1	WP 2	WP 3	WP 4	WP 5	WP 6	WP 7	WP 8	Total
CONSUMABLES	5 500	Fertiliser and chemical cost (T6.4)						1 000			1 000
		Soil sampling and analysis cost (T6.4)						2 500			2 500
		Nutritional analysis of food products (T6.4)						2 000			2 000
OTHER GOODS AND SERVICES	34 900	Equipment rental for land preparation (T6.4)						3 000			3 000
		Equipment rental for cultivation (T6.4)						2 500			2 500
		Equipment rental for harvest (T6.4)						2 000			2 000
		Equipment rental for post-harvest (T6.4)						1 000			1 000
		Data purchase for soil and imagery for testing field (T6.3)			5 000						

		Land Rental (12 month x 200€, T6.4)					2 400		2 400
		Computer rental for 3 years 100%	2 000	2 000	2 000		2 000		8 000
		Cloud service rental	1 000	1 000	1 000				3 000
		Dissemination costs conference fees (1 conferences for 2 persons) for presenting project-related research						4 000	4 000
		Local technology transfer workshops 2 workshops 1 day each						2 000	2 000
		Fees for 2 scientific publications						2 000	2 000
EQUIPMENT INFRASTRUCTURE	10 000	Powerful workstations for computational requirement Intel Core i7 Extreme 6950x, 128 GB of RAM >50TB (Tasks 3.1, 3.4) National depreciation rules are applied for all the equipment items		10 000					10 000
TRAVEL	20 000	Exploratory studies in 3 sites (within Malaysia) to collect survey data total of 10 trips for data collection, T4.2, T6.4)				2 500	2 500		5 000
		Kick-off meeting, 2 intermediate Project Meetings and project review meetings, and final conference (2 persons)						10 000	10 000
		2 scientific conference in EU - 3 days - 2 persons						5 000	5 000
TOTALE	70 400								

Associated with document Ref. Ares(2018)1548916 - 21/03/2018


07 - ICARDA	TOTAL COST	DESCRIPTION	WP 1	WP 2	WP 3	WP 4	WP 5	WP 6	WP 7	WP 8	Total
CONSUMABLES	-										-
OTHER GOODS AND SERVICES	24 000	Service for one contract support and advice (where needed) by INRGREF (National Institute of Rural engineering research, Water and Forests, http://www.inrgref.agrinet.tn/an/) for local research organization involved in case study implementation in Tunisia. Specifically INRGREF will support (i) the establishment and management of local stakeholders and organization of stakeholders workshops/training sessions that will be used by ICARDA to evaluate the transferability of LANDSUPPORT outside Europe (WP6-7), (ii) provide feed-back for platform development (WP5) furthermore (iii) they will be involved in local support for erosion model implementation including data acquisition. INRGREF will work under the coordination of ICARDA. . INRGREF activities will include organization of local events including venue, meal, coffee breaks, etc (WP 7) .					2 000	10 000	12 000		24 000
EQUIPMENT / INFRASTRUCTURE	-										-
TRAVEL	17 309	Kick-off meeting, 2 intermediate Project Meetings and project review meetings, and final conference (2 persons)								9 309	9 309
		Travel expenses for team members (2 persons) to the study site in Tunisia from respective ICARDA duty stations (Morocco and Jordan headquarter; 7 missions all together): implementation of project activities in Tunisia						4 000	4 000		8 000
TOTALE	41 309										

08 - IASK	TOTAL COST	DESCRIPTION	WP 1	WP 2	WP 3	WP 4	WP 5	WP 6	WP 7	WP 8	Total
CONSUMABLES	-										-
OTHER GOODS AND SERVICES	102 100	Data mining from socio-demographic databases Basic socio-demographic dataset (population and agricultural census) and administrative maps (NUTS0 to NUTS5) are required at different levels in Austria, Hungary and Italy for the analysis of the socio-demographic impacts. Some of them are free from EuroStat, FADN, FAO, but most of them are proprietary datasets and not freely available (Gfk, WiGeoGIS, national statistical offices). Besides the procurement of the maps and datasets the harmonization and processing of them into geospatial databases are also external tasks. The low resolution, 1*1 km grid data is available from Eurostat, but high		102 100							102 100

		resolution (100*100, 250*250 m) geospatial grid data must be produced for the test areas. The relevant Point of Interest databases regarding to the infrastructure in the test areas must be collected and harmonized					 Associated with document Ref. Ares(2018)1548916 - 21/03/2018				
EQUIPMENT INFRASTRUCTURE	/	-								-	
TRAVEL		4 800	Kick-off meeting, 2 intermediate Project Meetings and project review meetings, and final conference							4 800	4 800
TOTALE		106 900									

09 - ISPRA	TOTAL COST	DESCRIPTION	WP 1	WP 2	WP 3	WP 4	WP 5	WP 6	WP 7	WP 8	Total
CONSUMABLES	-										-
OTHER GOODS AND SERVICES	32 000	Data processing of (i) national land cover acquired data, (ii) land take and soil sealing maps and (iii) updating with datasets and services setting in order to update content and format toward INSPIRE compliance and for land degradation and ecosystem services models input		32 000							32 000
EQUIPMENT INFRASTRUCTURE /	5 000	workstation for GIS data management and 3 notebooks for technical workshop/meeting and dissemination National depreciation rules are applied for all the equipment items			3 000				2 000		5 000
TRAVEL	10 000	Travel expenses for meetings with other partners, revision meeting and coordinator staff/project meetings	500	500	1 500			1 000		2 500	6 000
		Kick-off meeting, 2 intermediate Project Meetings and project review meetings, and final conference to be held in Italy - 2 days - 3 persons;								1 000	1 000
		3 scientific conference in EU - 2 days - 2 persons;							3 000		3 000
TOTALE	47 000										

10 - RASDAMAN	TOTAL COST	DESCRIPTION	WP 1	WP 2	WP 3	WP 4	WP 5	WP 6	WP 7	WP 8	Total
CONSUMABLES	6 600	fast disk storage system for storing Big Data of the project for development, testing, partner software support		1 500							1 500
		backup storage for the Big Data used in the project		1 000							1 000
		server computer hosting the disks		1 000							1 000
		replacement parts for developer machines (hard disks etc.)		500							500
OTHER GOODS AND SERVICES	-	outreach material (flyers, rollups, etc.)							2 600		2600 -
EQUIPMENT INFRASTRUCTURE /	-										-
TRAVEL	78 400	RDA Plenary, 2x/yr = 8 intercontinental travels RDA (Research Data Alliance) is a global organization (6400 members) established by EU, USA, AUS to reduce barriers to data sharing and exchange. Peter Baumann is engaged in the Agricultural Interest Group (IG) and co-chair of 3 relevant working groups: Big Data, Geospatial, and Array Database Assessment. Further, his participation is being sought by many other WGs where these aspects play a role. RDA convenes twice per year internationally in "Plenaries", for which the travel budget is requested.							16 000		16 000

		OGC Technical Committee Meetings, 4x/yr = 16 intl travels - The Open Geospatial Consortium (OGC) is the main standardization body for geo data and location-based services, in close alliance with ISO, INSPIRE, and other bodies. Peter Baumann is leading, since 10+ years, standardization of raster data and services, including datacubes. He is member of the OGC Architectural Board and chair of the Big Data DWG, Coverages. DWG, WCS.SWG, and contributing to Landinfra WG and many others. As such, he is exercising critical European impact on the key enabling geo standards. OGC convenes 4x/y in Technical Committee (TC) meetings where specifications are developed, discussed, and adopted. Hence, it is critical for continued European impact to actively participate in these meetings.					 Associated with document Ref. Ares(2018)1548916 - 21/03/2018			32 000	32 000	
		ISO TC211 standardization meetings, 2x/yr = 8 intl travels - ISO TC211 is the geo standards section of ISO, working in close synchronization with OGC. Peter Baumann has been tasked to establish the forthcoming standard ISO 19123-1 "Abstract Coverage Model", which requires collaboration with the further ISO experts in their direct meetings, 2x/y. This ensures European impact on this standardization. (Notably, this requires joint efforts in both OGC and ISO as both are tightly connected)								16 000	16 000	
		INSPIRE travels, 2x/yr = 8 European travels The European Legal Framework for a Common Spatial Data Infrastructure, INSPIRE, homogenizes European data, based on the OGC standards. Peter Baumann is National Delegate / Germany to INSPIRE, and a main facilitator for the proper adoption of the OGC standards, thereby ensuring interoperability of software and data. There is one annual INSPIRE conference in Europe, and on average one extra technical meeting (e.g., at JRC).								4 800	4 800	
		Kick-off meeting, 2 intermediate Project Meetings and project review meetings, and final conference									9 600	9 600
TOTALE	85 000											

12 - REGCAM	TOTAL COST	DESCRIPTION	WP 1	WP 2	WP 3	WP 4	WP 5	WP 6	WP 7	WP 8	Total
CONSUMABLES	-										-
OTHER GOODS AND SERVICES	45 000	Organization of n. 5 workshops/seminars/conferences in Campania							15 000		15 000
		Specialist technical assistance supporting REGCAM partner in the interaction with regional stakeholders and local users collaborating mainly in the following activities: <ul style="list-style-type: none"> User requirement analysis (task 1.2), technical dissemination and training involving all relevant stakeholders (task 7.4), engaging other potential users at the local level (task 7.5) (workshop with local ecotourism companies and local schools) supporting REGCAM in editing LANDSUPPORT reports. 	8 000					18 000	4 000	30 000	
EQUIPMENT INFRASTRUCTURE	15 000	2 Interactive whiteboards to facilitate the collaborative testing phases at the headquarter of Regione Campania and 2 Lap Top for dissemination at other locations of Campania region, .National depreciation rules are applied for all the equipment items						8 000	7000		15 000
TRAVEL	7 800	Naples and Rome - IT, 0-200 Km, 1 day, kick-off meeting and final conference, 2 trips, 2 persons								400	400
		AUSTRIA and HUNGARY, 1500 Km, 3 days, project meetings and review meeting, 2 trips, 2 persons								4 000	4 000
		CAMPANIA, 200 Km, 1 day, dissemination and testing of LANDSUPPORT GCI, 8 trips, 2 persons						1 600	1 800		3 400
TOTALE	67 800										

13 - UPA	TOTAL COST	DESCRIPTION	WP 1	WP 2	WP 3	WP 4	WP 5	WP 6	WP 7	WP 8	Total
CONSUMABLES	3 500	Field/lab consumables for soil sampling, physical and chemical laboratory tests		3 500							3 500
OTHER GOODS AND SERVICES	49 900	Workshop costs (1 plenary meeting including review meeting (WP8) and thematic workshops (WP 2-6))		2 000				2 000		10 000	14 000
		Improvement of (GIS) laboratory facilities: IT network upgrade and related goods and services to improve coverage, speed and security for the functioning of the research infrastructure		26 900							26 900
		Publication costs and registration fees for conferences							4 000		4 000
		Software license		1 000							1 000
		Audit								4 000	4 000

EQUIPMENT INFRASTRUCTURE /	38 000	Powerful computer workstations for the project, including 1 high performance data server for big data processing, workstations and peripherals National depreciation rules are applied for all the equipment items	14 000									Associated with document Ref. Ares(2018)1548916 - 21/03/2018	14 000	
		Furniture for (GIS) laboratory (integration, testing, validation) including server shelter. National depreciation rules are applied for all the equipment items	19 000											19 000
		2 (durable) tablets for additional soil and land use data acquisition. National depreciation rules are applied for all the equipment items	4 000											4 000
		Precision GPS device for additional soil and land use data acquisition. National depreciation rules are applied for all the equipment items	1 000											1 000
TRAVEL	10 000	Kick-off meeting, 2 intermediate Project Meetings and project review meetings, and final conference										6 000	6 000	
		Travel to international and national conferences for results dissemination							2 000				2 000	
		Soil and environmental survey on the selected 25+10 representative sites	1 000											1 000
		Study site visits and stakeholder consultation							1 000					1 000
TOTALE	101 400													

14 - UMI	TOTAL COST	DESCRIPTION	WP 1	WP 2	WP 3	WP 4	WP 5	WP 6	WP 7	WP 8	Total
CONSUMABLES	-										-
OTHER GOODS AND SERVICES	29 000	Service of simulation model's code editing and smartphone application development			20 000						20 000
		Software licences n. 4 (Didger 5 for 3 years, Surfer v14 for 3 years, Voxler v4 for 3 years, ArcGIS for 2 years)				9 000					9 000
EQUIPMENT INFRASTRUCTURE /	-										-
TRAVEL	24 800	Kick-off meeting, 2 intermediate Project Meetings and project review meetings, and final conference								7 000	7 000
		Technical / scientific meeting with WP-partners - 2 trips / 3 persons / 3 days			3 000	3 000					6 000
		10 trips / 2 persons / 1 days in Lombardy for field observation in at least 20 regional sites				2 000					2 000
		4 Attendance to scientific conference in EU - 3 days each			3 000	3 000					6 000
		Dissemination events (n. of events=2, 1 day each, 3 persons)								3 800	
TOTALE	53 800										

4. Members of the consortium

4.1. Participants (applicants)

Participant 01: University of Naples Federico II, UNA, Italy

Paragraph description of the organisation in light of the project content and main tasks

CRISP is an **Interdepartmental** Centre of UNA specifically devoted to transdisciplinary research in Geospatial Decision Support System also incorporating the Earth Critical Zone concept (Regolith-Soil-Plant-Atmosphere) and addressing applications in sustainable agriculture and environment. The CRISP centre takes advantage of the transdisciplinary professionals present at University of Napoli and implements this transdisciplinary research potential into operational Geospatial Decision Support System using the powerful approach of Geospatial CyberInfrastructure architecture.

CRISP, as an Interdepartmental Centre involves experts from many departments of UNA, such as the DIA (Agricultural Sciences Dept.), the DISTAR (Earth Sciences, Environment and Resources Dept), Department of Architecture and Department of Human Studies. All the people involved in this project are part of CRISP, which is why only CRISP is mentioned in Part A. The Director of the CRISP is Prof. Fabio Terribile from DIA, who directs the research unit in applied pedology and soil science. Prof. Fabio Terribile has also been the coordinator of the EU LIFE+ SOILCONSWEB project devoted to the development of a web-based spatial decision supporting land policies. The CRISP team has obtained both international scientific credit and much contract work to handle practical landscape issues. CRISP has already delivered two important DSS operational system on “Multifunctional soil conservation and land management” at www.landconsultingweb.eu and on land take mitigation and spatial planning at www.soilmonitor.it, the latter been connected to the implementation of Italian legislation and presented at the Italian Parliament (28th June 2016). The CRISP team has also delivered an important scientific consultancy at FAO on the evaluation of tools, models and DSS in use at FAO for Land Assessment.

CV or description of persons involved

Prof. Fabio Terribile, male, is Director of CRISP and Full Professor of Soil Science at UNA. He obtained a PhD in Soil Science at the University of Aberdeen (UK). He is life member of the International Union of Soil Science, he has been both president (6 years) of the Italian Society of Pedology and member (3 years) of the Presidency of the Italian Association of Scientific Agricultural Societies (AISSA), component of many international evaluation boards (e.g. FP7 reviewer). He is expert in soil science and in multilevel and multiuser decision supporting systems for soil and landscape management. He is currently involved in many national and international scientific project, he has also been Italian delegate for COST 622 and he was (2010-2014) scientific leader and coordinator of EU LIFE+ ENV/IT/000408 “Multifunctional soil conservation and land management through the development of a web-based spatial decision Supporting System”. He has a large interest in connecting scientific research and policy. To this respect he coordinated (i) a board of all Italian scientific associations working in the field of agriculture/forestry/agrifood to produce a proposal for a soil framework law for Italy. This proposal (ddl 1181) is at the discussion phase at the Italian Senate and (ii) he was also the promoter of a petition – signed by about 1400 European soil scientists of all EU countries - addressed to the EU presidency to do not withdraw the European Soil Framework Directive proposal.

Dr. Simona Vingiani is staff member of CRISP, female, research scientist in Pedology at Agricultural Sciences Department, UNA. Ph.D. in Agricultural Chemistry at UNA. She was President of the Soil Mineralogy Commission of the Italian Society of Soil Science (2011-2013). She is an expert in soil genesis and soil chemical properties, especially of volcanic soils and of soils involved in landslide events; soil survey and soil mapping. She is expert of the following techniques: X- ray diffractometry (XRD), FT-IR spectroscopy, optical (OM) and electron (SEM/EDS) microscopy. She is currently involved in many national and international research projects with specific role in soil mapping, analysis of soil chemical and mineralogical properties and evaluation of relationship between soils properties and landscape.

Prof. Francesco Domenico Moccia is staff member of CRISP, male, is full professor in Urban and Regional Planning at Department of Architecture, UNA. Currently he is President of the National Institute of Urban Planning (INU) in Campania. He was founding partner of the Italian Society of Planning, COREP member of Association of European School of Planning, vice-president of Matrex, and a member of many national and international association of planning. He is an expert in strategic environmental assessment and large area planning. He was coordinator of local research unit in PRIN Itaten and Returb, over urbanization process in Italy and a national research for assessment of Urban Program in Italy; study on Planning Stormwater Resilient Urban Open Spaces and ecologic regeneration of cities. He is consultant of many local administrations for local planning and Environmental Strategic Assessment.

<p>Prof. Domenico Calcaterra is staff member of CRISP, male, is full professor in Engineering Geology at the Department of Earth Sciences, Environment and Resources (DiSTAR), UNA. Since January 2017 he is the Head of DiSTAR. He is member of several scientific societies, both international (Intern. Ass. of Engineering Geology) and Italian (Association of Engineering and Environmental Geology, Geological Society). He is an expert in causes, processes and effects of weathering -related geomorphological and engineering-geological aspects and landslides. He is author and co-author of about 250 articles dealing with: landslides in the Campanian Apennine and in the Calabrian Arc (southern Italy); geomechanical and hydrogeological features of carbonate massifs of the Campanian Apennine; weathering-related geomorphological and engineering-geological aspects of the crystalline massifs of Calabria region; causes, processes and effects of weathering affecting building stones.</p>
<p>Prof. Pantaleone De Vita is staff member of CRISP, male, is Associate Professor in Engineering Geology at the Department of Earth, Environment and Resources Sciences (DiSTAR), UNA. He is an expert in hydrogeological analyses and mapping, with particular expertise in analyzing and monitoring of hydrological factors controlling shallow landslide susceptibility. He has collaborated with the Department of Land, Air and Water Resources (L.A.W.R.) of the University of California in Davis (CA – USA) and the USGS' Landslide Hazard Program in Golden (CO - USA). He is currently member of principal national and international associations (AIGA – Italian Association of Engineering Geology and Environment, IAEG – International Association of Engineering Geology, IAH – International Association of Hydrogeology, SGI – Italian Geological Society). He has been involved as leader, coordinator or participant in many national and international scientific projects. He is author of more than 70 papers published in international and national journal and proceedings.</p>
<p>Prof. Marco Pacciarelli is staff member of CRISP, male, is Associate professor of Paleontology and Prehistory at Department of Humanistic Studies of UNA. In 2013, he has received the qualification as Full professor in Archaeology. He is strongly involved in culturale heritage issues. Since 1976 he has been involved in many archaeological reconnaissance projects, including landscape archeology, editing of archaeological maps for which geo-archaeological surveying and mapping techniques were adopted. Since 2014 is Director of the School of Specialization in Archaeological Sciences of UNA and Director of the Interdepartmental Center for Studies of Magna Grecia at UNA. He is currently the director and scientific coordinator of many archaeological excavations in several Italian locations and he is Scientific Director of International Excavation Projects under concession of UNA.</p>
<p>Prof. Paola Adamo is staff member of CRISP, female, is Full Professor of Agricultural Chemistry at Department of Agricultural Sciences, UNA. She is Vice President (incoming President) of Italian Society of Soil Science (SISS). She has written and co-written over 90 scientific works, mainly on the following themes: soil chemical fertility, monitoring and mitigation of potentially toxic elements in soils and sediments of agricultural, urban and industrial areas; soil-plant interactions and effects on nutrient/pollutants biogeochemical cycling; bioweathering and biomineralization; soil-based indicators of food traceability; biomonitoring of air pollution. She has taken part and led many environmental monitoring projects. She currently is Associate Editor for Geochemistry Exploration, Environment, Analysis (GEEA), The Geological Society of London.</p>
<p>Prof. Gianni Cicia is staff member of CRISP, male, is Full Professor in Agriculture and Environmental Economy at Department of Agricultural Sciences, UNA. He is Associate editor of International Journal on Food System Dynamics, editor of the Agricultural and Food Economics Journal. He is expert Sustainable Food Chain, Non market valuation and socio-economy databases. He has written and co-written over 130 scientific works.</p>
<p>5 relevant publications, products, services, datasets, software, achievements</p>
<p>1. Terribile F., Agrillo A., Bonfante A., Buscemi G., Colandrea M., D'Antonio A., De Mascellis R., De Michele C., Langella G., Manna P., Marotta L., Mileti F. A., Minieri L., Orefice N., Valentini S., Vingiani S., Basile A. (2015). A Web-based spatial decision supporting system for land management and soil conservation. SOLID EARTH, vol. 6, p. 903-928, ISSN: 1869-9510, doi: 10.5194/se-6-903-2015</p>
<p>2. Terribile F., Bonfante A., D'Antonio A., de Mascellis R., De Michele C., Langella G., Manna P., Mileti F.A., Vingiani S., Basile A. (2017). A geospatial decision support system for supporting quality viticulture at the landscape scale. Computers and Electronics in Agriculture, 140, pp. 88-102. doi.org/10.1016/j.compag.2017.05.028</p>
<p>3. Terribile F., Coppola A., Langella G., Martina M., and Basile A. (2011). Potential and limitations of using soil mapping information to understand landscape hydrology. Hydrol. Earth Syst. Sci., 15, 3895–3933, 2011.</p>
<p>4. Manna P., Basile A, Bonfante A., D'Antonio A., De Michele C., Iamarino M., Langella G., Mileti F. A., Pileri P. S., Vingiani S., Terribile F., 2017 Soil Sealing: Quantifying Impacts on Soil Functions by a Geospatial Decision Support System. In LAND DEGRADATION AND DEVELOPMENT doi: 10.1002/ldr.2802</p>
<p>5. Moccia F. D. (2017,) Settlement dispersion, informal urban planning and land management. Proposals (Dispersione insediativa, urbanistica informale e governo del territorio. Proposte normative), in Arcidiacono A., Di Simine D., Oliva F., Ronchi S., Salata S. (curatori), Rapporto CRCS 2017. The European dimension of soil sealing and national policies (La dimensione europea del consumo di suolo e le politiche nazionali), Roma INU Edizioni, p. 223-227</p>
<p>5 relevant previous projects, activities</p>

<p>1. "Multifunctional soil conservation and land management through the development of a web-based spatial decision Supporting System", EU LIFE+. Ref. No. LIFE08 ENV/IT/000408 (2010-2014) - LEAD</p>	21/03/2018
<p>2. "Soil Monitor: an innovative web tool for assessing land take at high spatial resolution on a national scale" Lead: UNA, Part ISPRA, CNR, UNA own funding, (2015-2017) LEAD</p>	
<p>3. "Evaluation and Assessment of FAO Tools for Planning of the Use and Management of Natural Resources by Agriculture at the National, Regional and Global Scales", agreement with FAO (2012-2014) LEAD</p>	
<p>4. Three National research projects on " Pedological methodologies for study of soil spatial variability", funding by Ministry of Research (MIUR) - PRIN 2001 (ref. 2001075511); PRIN 2003 (ref. N. 2003075523); PRIN 2005 (ref. N. 2005073972). Such project is in collaboration with the University of Milan, Turin, Palermo, Florence, Cagliari, National Research Council CNR ISAFoM (Naples) and the Agronomic Experimental Institute (IAM) of Bari. LEAD</p>	
<p>5. Three regional project on soil nitrate pollution (i) "Messa a punto di metodologie per la quantificazione della vulnerabilità all'inquinamento da nitrati i origine agricola in due areali della Regione Campania", agreement with Regione Campania - SeSIRCA (2003-2009); (ii) Studio della vulnerabilità dei suoli all'inquinamento da nitrati di origine agricola, agreement with Regione Calabria – ARSSA (2006-2007); (iii) "Attivazione di una rete di monitoraggio della qualità del sistema suolo/acqua della Lombardia (ARMOSA-idro)", agreement with Regione Lombardia – ERSAF (2004-2007). LEAD and CO-LEAD</p>	
<p>Significant infrastructure, major items of technical equipment</p>	
<p>CRISP has access to many technical equipment available by the two University Departments DIA and DISTAR to implement and support the proposed research activities. In detail, CRISP - by its own – has computer infrastructure that includes FTP server to exchange data and server for CPU and GPU computing. CRISP has GIS, remote sensing and soil chemistry laboratories. CRISP also has field laboratory equipment including: equipped van for soil survey, small excavator. In addition, for proximal sensing prospecting it has: frequency domain electromagnetic induction (Profilers EMP400); portable X-ray fluorescence spectrometer (Olympus Delta Professional Handheld XRF Analyzers); portable Gamma-ray spectrometry (compact gamma surveyor - GF Instruments).</p>	

Paragraph description of the organisation in light of the project content and main tasks

ARIESPACE (S.R.L.) is a small-sized enterprise (SME), established in the year 2006 as the first spin-off company of the University of Naples "Federico II". ARIESPACE aims to overcome the gap between the large amount of available spatial information and final users, such as farmers, water authority, managers and consultants. To this end, ARIESPACE develops innovative and operational geo-solutions dedicated to monitor and manage agricultural, forest and water resources.

ARIESPACE innovative technologies and competitive advantages are based on the conjunction of competences developed in different contexts and unified in a young, dynamic and multi-disciplinary working team which involves researchers, agronomists, engineers and computer scientists. Company has more of ten years of experience in the field of earth observation, crop biophysical modelling, GIS and IT Technologies dedicated to agricultural sector. By close cooperation with customers and partners and thanks to multidisciplinary expertise, ARIESPACE realized operative solutions to fulfil the requirements of customers and partners which have achieved a substantial improvements in environmental performance.

Our experience has been consolidated in the context of many national and international projects funded (since 2006) by EU FP6, EU FP7, H2020 and LIFE+ program, National and International Institutions (Research Council of Italy, CNR; South Australia Murray Darling Basin Board, Australia Campania Region Government, Italy) and public irrigation water user associations (WUA).

In LANDSUPPORT, the experience in developing operative Web Map Tools to investigate the effects of soil degradation and land cover change on environmental resources, available on www.landconsultingweb.eu (LIFE+ project SoilConsWeb, as project partner) and www.soilpro.eu (LIFE+ project SoilPro, as subcontractor), make ARIESPACE the appropriate partner to lead the work package dedicated to developing the innovative Geospatial CyberInfrastructure.

CV or description of persons involved

Carlo De Michele (male), Senior Engineer, M.Sc. (Cum Laude) in Hydraulic Engineering and Ph.D on management of agricultural resources and forests. His work has been focused on developing decision support systems for Environmental and Agricultural monitoring based on Earth Observation data and GIS (FP7 SIRIUS-GMES, FP7 CEOP AEGIS, LIFE+ Soilconsweb, H2020 FATIMA, H2020 DIANA, Campania Region PSR 2007/2014 - IRRISAT). In the company, he is in charge of designing and managing European and National research projects.

Marco Colandrea (male), Electronic and ICT Engineer, with more of twenty years of experience in software engineering, web development and design with specialization in multi-tier applications both for desktop and the web. His expertise is focused on developing spatial decision support systems by combining physical based numerical models, large geo-databases, embedded solution for data acquisition, gridded algorithms. He has been in the core developers for implementation of several interactive decision support systems for management and monitoring of agricultural resources and environmental issues (FP7 CEOP AEGIS; LIFE+ Soilconsweb, LIFE+ SoilPro; IRRISAT; Agrosceinari" project which uses an original porting of SWAP code). He have extensive knowledge of general-purpose programming language (C, C++, Fortran, Basic, Java, VisualBasic, Ada, Assembler, Qt, Phyton) and dedicated to web (PHP, HTML, Javascript).

Luigi Marotta (male), Software Architet and Developer with more of ten years of experience in multi-tier applications for web. His expertise is focused on developing web map applications, starting from the determination of requirements and design up to coding, deploying and integrating of final product. He has extensive knowledge of frameworks for the design of efficient GUI (Sencha ExtJs framework, Google Chart Tools API, Angular JS). He has been in the core developers for implementation of several interactive decision support systems for management and monitoring of agricultural resources (FP7 CEOP AEGIS; LIFE+ Soilconsweb, LIFE+ SoilPro; IRRISAT). He have extensive knowledge of programming language dedicated to web (PHP, HTML, Javascript), RDBMS (Postges-PostGis) and web mapping services (Geoserver, Mapserver).

Guido D'Urso (male), Full Professor of Hydraulics and Water Management, GIS and Remote Sensing at the University of Naples Federico II, with a PhD in Environmental Sciences from the Agricultural University of Wageningen, the Netherlands. He has been working since early '90s on the development of new methodologies for the interpretation of Earth Observation data for water management in agriculture and for spatial analysis of hydrological processes. He has coordinated several international research projects in the field of remote sensing for water management. More than 70 publications on scientific journal, congress proceedings and specialized books. In the company, he is in charge of scientific supervising of the research and innovation projects. In the framework of LANDSUPPORT project, Guido D'Urso will work only for the ARIESPACE beneficiary.

5 relevant publications, products, services, datasets, software, achievements

1. Terribile, F., Bonfante, A., D'Antonio, A., De Mascellis, R., De Michele, C., Langella, G., ... & Basile, A. (2017). A geospatial decision support system for supporting quality viticulture at the landscape scale. *Computers and Electronics in Agriculture*, 140, 88-102.

2. Terribile, F., Agrillo, A., Bonfante, A., Buscemi, G., Colandrea, M., Antonio, A., De Masoellis, R., De Michele, C., Langella, G., Manna P, Marotta L., Mileti, F A., Minieri, L., Orefice N., Valentini S., Vingiani, S. And Basile, A., (2015). A Web-based spatial decision supporting system for land management and soil conservation. *Solid Earth*, 6(3), 903.
3. Menenti M., Alfieri S. M., Bonfante A., M. Riccardi, Basile A., Monaco E., De Michele C. and De Lorenzi F.. (2014). Adaptation of irrigated and rainfed agriculture to climate change: The vulnerability of production systems and the potential of intraspecific biodiversity (Case studies in Italy). *Handbook of climate change adaptation*. Berlin Heidelberg: Springer-Verlag. http://link.springer.com/referenceworkentry/10.1007/978-3-642-40455-9_54-1.
4. Vuolo F., D'Urso G., De Michele C., Bianchi B., & Cutting M. (2015). Satellite-based irrigation advisory services: A common tool for different experiences from Europe to Australia. *Agricultural Water Management*, 147, 82-95.
5. Vanino, S., Pulighe, G., Nino, P., De Michele, C., Bolognesi, S. F., & D'Urso, G. (2015). Estimation of evapotranspiration and crop coefficients of Tendone Vineyards using multi-sensor remote sensing data in a Mediterranean environment. *Remote Sensing*, 7(11), 14708-14730.

5 relevant previous projects, activities

1. European Commission: H2020 IA project "Detection and Integrated Assessment of Non-authorized water Abstractions using EO" (DIANA GA no. 730109 2017-2019) - <http://diana-h2020.eu/>
2. European Commission: H2020 RIA project "Farming Tools for external nutrient Inputs and water Management" (FATIMA GA no. 633945, 2015-2018). - <http://fatima-h2020.eu/>
3. Campania Region PSR 2007/2013 misura 124 – "Pilotaggio dell'Irrigazione a Scala Aziendale e Consortile Assistito da Satellite - IRRISAT" (2011-2014). - <https://www.irrisat.com/>
4. European Commission: FP7 RTD project Sustainable Irrigation water management and River-basin governance: Implementing User-driven Services (SIRIUS GA no. 262902, 2010-2014). - <http://sirius-gmes.es/>
5. European Commission: LIFE08 ENV/IT/000408 SOILCONSWEB multifunctional soil conservation and land management through the development of a web based spatial decision supporting system - http://www.landconsultingweb.eu/EN_index.html

Significant infrastructure, major items of technical equipment

Sencha ExtJs Architect: graphic tool to build feature-rich cross-platform web apps for desktop, tablets, and smartphones;
Original Software Implementation of SWAP model (<http://www.swap.alterra.nl>) based on linux porting in GIS environment.

Participant 03: Barcelona Supercomputing Center, BSC, Spain

Paragraph description of the organisation in light of the project content and main tasks

The Barcelona Supercomputing Center (BSC) was established in 2005 and is the Spanish national supercomputing facility and a hosting member of the PRACE distributed supercomputing infrastructure. The Center houses MareNostrum, one of the most powerful supercomputers in Europe. The mission of BSC is to research, develop and manage information technologies in order to facilitate scientific progress.

BSC was a pioneer in combining HPC service provision, and R&D into both computer and computational science (life, earth and engineering sciences) under one roof. The centre fosters multidisciplinary scientific collaboration and innovation and currently has over 400 staff from 41 countries. In 2011, BSC was one of only eight Spanish research centres recognized by the national government as a "Severo Ochoa Centre of Excellence".

BSC has collaborated with industry since its creation, and has participated in projects with companies such as ARM, Bull and Airbus as well as numerous SMEs. BSC also participates in various bilateral joint research centers with companies such as IBM, Microsoft, Intel, NVIDIA and Spanish oil company Repsol. The centre has been extremely active in the EC Framework Programmes and has participated in over one hundred projects funded by it. BSC is a founding member of HiPEAC, the ETP4HPC and participates in the most relevant international roadmapping and discussion forums and has strong links to Latin America.

Education and Training is a priority for the centre and many of BSCs researchers are also university lecturers. BSC offers courses as a PRACE Advanced Training Centre, and through the Spanish national supercomputing network among others.

- Computer Science Department: The BSC-CNS Computer Science Department focuses on building upon currently available hardware and software technologies and adapting these technologies to make efficient use of supercomputing infrastructures. The department proposes novel architectures for processors and memory hierarchy and develops programming models and innovative implementation approaches for these models as well as tools for performance analysis and prediction.

CV or description of persons involved

Dr. Daniele Lezzi (male) received the B.Sc. degree in computer engineering in 2002 and the Ph.D. in Information Technology Engineering in 2007 from the University of Salento, Italy. From 2002 to 2006 he has been team member of the Center for Advanced Computing Technologies division of the National Nanotechnology Laboratory of the University of Salento and has been also lecturing on computer science fundamentals. From 2006 to June 2008 he was a researcher in the Euro-Mediterranean Centre for Climate Changes (Italy) involved in the design of the computational infrastructure and worked as consultant of the SPACI (Southern Partnership for Advanced Computing Infrastructure) consortium, Italy. Since 2008 he is researcher in the Computer Sciences department of Barcelona Supercomputing Center. His research interest covers High Performance, Distributed, Grid and Cloud Computing and programming models. In particular this research addresses the design of programming frameworks for the porting and execution of scientific applications on distributed computing infrastructures like Grid and Clouds with special emphasis on interoperability.

He participated in several EC funded projects like GridLab, CoreGRID, BEinGRID, OGF-Europe, SIENA, VENUS-C, IS-ENES, EU-Brazil OpenBio and EU-Brazil Cloud Connect. He is currently involved in the EU-Brazil BIGSEA project, in the mF2C (mobile For to Cloud) project and in the BioExcel Center of Excellence for Computational Biomolecular Research. He is also contributing to the EGI Federated Cloud Task Force whose goal is to deliver a blueprint that, targeting at both resource providers and user communities, defines how federated virtualized environments can be implemented; the Task Force is also producing a proof-of-concept workable test bed.

Jorge Ejarque (male) holds a PhD on Computer Science (2015) a MSc. on Computer Architecture Networks and Systems (2009) and an engineering degree on Telecommunications (2005) from the Technical University of Catalonia (UPC). In 2005, he worked as IT consultant in Better Consulting. Since the end of 2005 to 2008, he worked as research support engineer at UPC and at the end of 2008, he joined to the Grid Computing group at BSC.

During his career at the BSC, he has contributed in the design and development of different tools and programming models for HPC in distributed platforms. He has been involved in several National and European R&D projects. He has been member of a program committee of several international conferences and reviewer of journal articles. He was a member of the Spanish National Grid Initiative panel. His current research interests are focused on introducing energy efficiency in parallel programming models for heterogeneous parallel distributed computing environments and semantic interoperability between distributed computing platforms. He has participated in several European projects during his research career, such as BREIN, OPTIMIS, ASCETIC, EUROSERVER and is currently the BSC IP in TANGO.

5 relevant publications, products, services, datasets, software, achievements

1. F. Lordan, E. Tejedor, J. Ejarque, R. Rafanell, J. Álvarez, F. Marozzo, D. Lezzi, R. Sirvent, D. Talia, R. M. Badia ServiceSs: An Interoperable Programming Framework for the Cloud. Journal of Grid Computing (2014), Volume 12, Issue 1, pp.1267-91 .doi:10.1007/s10723-013-9272-5. Impact Factor: 1.507 (SCI 2014). Journal ranking: COMPUTER SCIENCE, INFORMATION SYSTEMS 43/139 Q2; COMPUTER SCIENCE, THEORY & METHODS

2. COMP Superscalar, an interoperable programming framework, SoftwareX, Volumes 3–4, December 2015, Pages 32–36, Badia, R. M., J. Conejero, C. Diaz, J. Ejarque, D. Lezzi, F. Lordan, C. Ramon-Cortes, and R. Sirvent, DOI: 10.1016/j.softx.2015.10.004

3. Vivas, José Luis, Francisco Vilar Brasileiro, Abmar Barros, Giovanni Arias da Silva, Marcos Nóbrega Jr, Francisco Germano de Araújo Neto, Ignacio Blanquer, Erik Torres, Giovanni Aloisio, Rosa M. Badia, Daniele Lezzi, Antonio Tadeu A. Gomes, Jacek Cała, Maria Julia de Lima and Cristina Ururahy. "EUBrazilCC Federated Cloud: A Transatlantic Multi-Cloud Infrastructure." Developing Interoperable and Federated Cloud Architecture. IGI Global, 2016. 220-251. Web. 22 Apr. 2016. doi:10.4018/978-1-5225-0153-4.ch008

Sánchez-Expósito, S., Martín, P., Ruiz, J. E., Verdes-Montenegro, L., Garrido, J., Sirvent, R., Ruiz Falcó, A., Badia, R. M., Lezzi, D., "Web Services as Building Blocks for Science Gateways in Astrophysics", 2016, Journal of Grid Computing, pp. 1-13, doi:10.1007/s10723-016-9382-y

5. COMPSs web: <http://compss.bsc.es>

5 relevant previous projects, activities

1. MuG - Multi-Scale Complex Genomics (GA 676556)

2. BioExcel - Centre of Excellence for Biomolecular Research (GA 675728)

3. EUBra-BIGSEA- EUrope-BRAZIL Collaboration on BIG Data Scientific REsearch through Cloud-Centric Applications (GA690116)

4. JLESC - Joint Laboratory on Extreme Scale Computing: international collaboration

5. EUBrazilOpenBio - EU-Brazil Open Data and Cloud Computing e-Infrastructure for Biodiversity (GA 288754)

Significant infrastructure, major items of technical equipment

COMPSs is available in production in Cloud computing infrastructure as Chameleon Cloud in the USA and the EGI Federated Cloud in Europe. Chameleon is a NSF funded project which provide a configurable experimental environment for large-scale cloud research. The Chameleon Cloud provides two types of infrastructure services: a traditional cloud managed by OpenStack over KVM and Bare-metal reconfiguration, where you can reserve a set of bare-metal nodes flavored with the image that the user selects.

The EGI Federated Cloud is a private cloud infrastructure open to any research community. It has been developed in the framework of EGI.eu and currently federates about 20 sites whose computing and storage resources are owned by different academic European institutions.

MareNostrum supercomputer - BSC operates the most powerful supercomputer in Spain. In March 2004 the Spanish government and IBM signed an agreement to build one of the fastest computers in Europe. In November 2006 its capacity was increased due to the large demand from scientific projects. MareNostrum increased its calculation capacity to 94.21 Teraflops (94.21 trillion operations per second), doubling its previous capacity (42.35 Teraflops). In order to achieve this, it increased its number of processors from 4.812 to 10.240.

The centre has just approved the purchase of a new supercomputer, MareNostrum 4, that will have a performance capacity of 13,7 Petaflop/s and will be located in the Torre Girona chapel, home to its predecessors, the MareNostrum 1, 2, and 3. The new machine will have two distinct parts. The general-purpose element, provided by Lenovo, will have 48 racks with more than 3,400 nodes with next generation Intel Xeon processors and a central memory of 390 Terabytes. Its peak power will be over 11 Petaflop/s, i.e. it will be able to perform more than 11,000 trillion operations per second, ten times more than the MareNostrum 3, which was installed between 2012 and 2013. Despite this increase in capacity, it will consume only 30% more power, reaching 1.3 MW/year.

The second element of MareNostrum 4 will be formed of clusters of three different technologies that will be added and updated as they become available. These are technologies currently being developed in the USA and Japan to accelerate the arrival of the new generation of pre-exascale supercomputers. One of these clusters will consist of IBM POWER9 processors and NVIDIA GPUs, which are the same components that IBM and NVIDIA will use for the Summit and Sierra supercomputers, commissioned by the U.S. Department of Energy for the Oak Ridge and Lawrence Livermore National Laboratories. Its computing power will be over 1.5 Petaflop/s. The second cluster will be made up of Intel Knights Landing (KNL) and Intel Knights Hill (KNH) processors provided by Fujitsu and Lenovo respectively. They are the same processors that will be inside the Theta and Aurora supercomputers purchased by the U.S. Department of Energy for the Argonne National Laboratory. Its computing power will be in excess of 0.5 Petaflop/s. Finally, a third cluster will be formed of the same 64 bit ARMv8 processors that Fujitsu will provide in a prototype machine, using state-of-the-art technologies from the Japanese Post-K supercomputer. This cluster's computing power will be of more than 0.5 Petaflop/s. MareNostrum 4 will have a disk storage capacity exceeding 10 Petabytes and will be connected to the Big Data infrastructures of BSC, which have a total capacity of 24.6 Petabytes.

Participant 04: Universität für Bodenkultur Wien, BOKU, Austria
Paragraph description of the organisation in light of the project content and main tasks

The BOKU Institute of Surveying, Remote Sensing and Land Information (IVFL) attends - in teaching and research - to technical disciplines that are required for the ecologically and economically sustainable utilization of natural resources in a harmonic cultural landscape.

In light of LANDSUPPORT, BOKU focuses on applied remote sensing and geo-spatial technologies related to agriculture, forestry and landscape planning (time series analysis, land use mapping, forest monitoring and mapping, landscape ecological interpretation, yield forecasts, drought monitoring). The expertise deployed for this project includes Sentinel-1, -2 and -3 data processing, crop biophysical parameter retrieval, field measurements for calibration and validation, use case and testing. The project team has developed operative solutions for vegetation monitoring for agricultural applications, including transfer of technology (for irrigation, drought, yield monitoring). This includes the implementation of advisory services for agriculture. Data processed this way are currently used to assess crop water requirements in Austria (EO4Water), agricultural productivity in Brazil and to monitor drought occurrence and strength in Kenya. The team has also investigated and developed methods for the exploitation of new sensors data (e.g. PROBA-V, Sentinel-2 & -3 missions, hyperspectral sensors) and has a wide practical experience in field campaigns for validation of satellite products. Advanced modelling skills include: i) radiative transfer modelling of vegetation for deriving biophysical variables of vegetation, ii) EO data assimilation in evapotranspiration and crop growth models, and iii) use of machine learning techniques for mapping of quantitative variables (e.g. yield) and change detection. Infrastructure at the Institute includes computer and software facilities for processing EO datasets. The Institute has a spectroradiometer for field measurements (full-spectrum ASD and Spectral evolution), one device for LAI sampling (Li-cor LAI-2200) and various instruments for mapping and field survey. A laboratory for set-up and maintenance of agro-meteorological equipment and the realization of low-cost data logger for soil water content measurements is also available. The institute owns proprietary code for time series (pre)processing and radiative transfer modelling.

CV or description of persons involved

Francesco VUOLO, Male, completed his Ph.D. on Management of agricultural resources and forests at the University of Naples Federico II, Italy, in 2007. He is currently senior scientist at the Institute for Surveying, Remote Sensing and Land Information (IVFL) at the University of Natural Resources and Life Sciences, Vienna (BOKU), Austria. He has an advanced experience of satellite-based technologies and their application in irrigation water management. Since 2003, he has notably been involved in 18 field experimental activities around this topic, and has worked in several European and nationally funded projects. He was responsible for validation and field work activities within the EU FP5 DEMETER and FP6 PLEIADeS projects and for service providers and business development in the FP7 SIRIUS-GMES project. He has also spent almost two years at the University of Southampton (UK) in 2009-11, working on the validation of biophysical parameter retrieval algorithms for the Sentinel-2 and -3 missions.

Clement ATZBERGER, Male, received his Ph.D. degree on crop growth modeling and remote sensing data assimilation from Trier University, Germany, in 1997. He is now full Professor and Head of the Institute for Surveying, Remote Sensing and Land Information (IVFL) at the University of Natural Resources and Life Sciences, Vienna (BOKU). His previous international working experience includes a two years assignment as Assistant Professor at ITC, Enschede, The Netherlands, and further two years in private industry (GeoSys SA, Toulouse, France). From 2007 to 2010 he worked at the Joint Research Centre (JRC) of the European Commission, Ispra, Italy.

His main expertise is in the following fields: radiative transfer modeling (forward and inverse) in agriculture and forestry, time series analysis (including noise removal and retrieval of phenological markers), crop growth modeling and data assimilation, imaging spectroscopy, and machine learning.

5 relevant publications, products, services, datasets, software, achievements

1. Processing facility for global Sentinel-2 L2A and value added products <https://ivfl-arc.boku.ac.at/eodc/>
2. Processing facility for global MODIS NDVI time series filtering <http://ivfl-info.boku.ac.at/>
3. Vuolo, F.; Žóttak, M.; Pipitone, C.; Zappa, L.; Wenng, H.; Immitzer, M.; Weiss, M.; Baret, F.; Atzberger, C. (2016) Data Service Platform for Sentinel-2 Surface Reflectance and Value-Added Products: System Use and Examples. *Remote Sens.* 2016, 8, 938.
4. Vuolo, F., Ng, W.-T., Atzberger, C. Example data: Smoothing and gap-filling of high resolution multi-spectral time series: Example of Landsat data. *Int. J. Appl. Earth Obs. Geoinf.* 2017, 57, 202–213.
5. Immitzer, M., Vuolo, F., Atzberger, C. (2016): First Experience with Sentinel-2 Data for Crop and Tree Species Classifications in Central Europe. *Remote Sens.* 8, 166.

5 relevant previous projects, activities

1. EO4Water (Austrian Space Application Programme)
2. FATIMA (H2020)
3. HQ-S2 (Austrian Space Application Programme)
4. CropMon (Austrian Space Application Programme)
5. LandMon (Austrian Space Application Programme)

Significant infrastructure, major items of technical equipment

BOKU is principle cooperation partner of the EODC, the Earth Observation Data Center where it developed the Sentinel-2 data service platform.

The University of Natural Resources and Life Science, BOKU, has a data service platform (<https://s2.boku.eodc.eu/>) providing access to individual Sentinel-2 granules (ortho-rectified image tiles of 100 × 100 km² in UTM/WGS84 projection) processed at bottom-of-atmosphere (BoA) reflectance (Level-2A). The service runs on the Earth Observation Data Centre (EODC), which is a collaborative IT infrastructure for archiving, processing, and distributing Earth observation (EO) data. Within the day of the satellite acquisition, Sentinel-2 Level-1C scenes are pulled from the national mirror site and archived at EODC. As soon as the images are available, processing of Level-2A and value-added products is performed. The data service platform processes the Sentinel-2 Level-1C images into Level-2A data using the ESA's Sen2Cor atmospheric correction algorithm in order to minimize atmospheric interference for all value-added product.

Paragraph description of the organisation in light of the project content and main tasks

The CNR-ISAFOM (Institute for Mediterranean Agricultural and Forestry Systems) was established in 2001 and it has a staff of 89 people.

The mission is to pursue better understanding of biophysical processes in agro-system environments for improving the productivity of agriculture and forests through a sustainable land use, developing tools for: water and vegetation resources management, innovation of agro-food and forestry production, effects of the atmosphere and climate change on agricultural and forestry systems.

Specifically, temporal and spatial multi-scale crop and soil management is the largest topic of research that involves researchers and technicians across to the four units of ISAFOM. The group dealing with this topic investigates on soil-crop-atmosphere processes at several spatial scales (from national, to regional, to farm and plot scale). The main focus are on: (i) the primary production of southern Italy strategic crops in relation with stability of yield and quality, by addressing on the optimization of the resources use and tolerance to abiotic stresses; (ii) traceability of some products (oil, wine) to link the territory to the quality; (iii) environmental sustainability (e.g. water requirements and quality, N deficiency/leaching, erosion); (iv) adaptation of irrigated and rain-fed agriculture to climate change, addressing the biophysical dimension of adaptation relied on existing crops intra-specific biodiversity; (v) precision farming to vary agricultural management practices spatially to match specific soils, crops and other conditions in unique zones within a field. All these topics are addressed by a large use of physically-based modelling of the natural and agricultural systems coupled with advanced numerical techniques of data spatialization.

The Institute is involved in several national and international projects on innovative research and technologies, in partnership with many institutions and private partners.

With respect to the specific project, CNR-ISAFOM has high expertise on soil hydrology, soil and climate spatial variability, modelling of the soil-vegetation-atmosphere system, GIS and DSS. It has also a fully equipped soil hydrology lab and a GIS lab.

This expertise has been consolidated in the context of many national and international projects funded by EU (e.g. LIFE+: SOILCONSWEB, ERANET: SALTFREE), Italian Ministry, Regional in the area of soil hydrology, soil protection and conservation and nitrate pollution.

ISAFOM research activities resulted, in recent years, in the production of more than 150 scientific papers.

CV or description of persons involved

Angelo Basile (male) is a Researcher at CNR-ISAFOM since 1996. He got the degree in Agriculture Science (110/110) at the University of Naples Federico II. He was (2009-2014) President of the Soil Physics Commission of the Italian Society of Soil Science (SISS). He is currently a member of CNR-ISAFOM's board.

The main interests are related to the flows and balance of water and solutes in the soil-plant-atmosphere system for the sustainable management of soil and water resources in the agro-environment. Both deterministic, with extensive use of physically-based modeling, and stochastic approaches are applied.

The research moves through different scales of application: at laboratory scale (micro – scale of the pore) and at field scale (pedon, parcel experimental) prevails the use of deterministic models; at landscape scale a mix between deterministic and stochastic approaches for the study of the spatial variability of the physical and/or functional soil properties is applied.

Recently these modelling approaches were merged in developing geo-spatial decision support systems (web-SDSS) for the soil management and soil conservation.

The research activity is presented mainly in peer-reviewed high IF journal (35), HI=13.

Over the past 10 years, he was coordinator of three projects on pollution from nitrates (funded by Regione Campania, Lombardy and Calabria 500 000 €) and a project on the hydrological characterization of soils (Campania Region, 32 000 €). He was responsible of a research unit on "the role of soils in the floods prevision" (MIUR, 96 000 €) and "ZOVisA: vineyard/wine zoning at farm scale" (PSR L124, 140 000 €). More recently he was the coordinator of a project on "quality of local products in relation to the territory: innovative and integrated approaches to strengthen the competitiveness of the Agribusiness - QUARC" (ERDF 2007-2013, € 370 000) and head of research units in the project "Multifunctional soil conservation and land management through the development of a web-based spatial decision support system - SOILCONSWEB" (EU-LIFE + environment, € 600 000). Actually, he is the coordinator of the CNR unit in the Arimnet project: Saltfree, € 90 000.

Antonio Coppola (male) is Full Professor at University of Basilicata in Agricultural and Forestry Watershed Hydrology. And he is Associate Researcher of the Italian National Council of Researches – Institute for the Mediterranean Agricultural and Forestry Systems (ISAFOM). He got the Degree in Agricultural Sciences and Technologies at the Agricultural Faculty of the University of Napoli. Scientific responsible of the hydraulics laboratory at the agricultural faculty of the University of Basilicata. HI=14. For the sake of the LANDSUPPORT project he will provide in-kind contribution against payment (ART. 11 AGA) (see Resource to be Committed).


COORDINATION AND/OR PARTICIPATION IN NATIONAL AND INTERNATIONAL PROJECTS: - University and Research Ministry National Projects (PRIN) 2002 (Heavy metals transport in soils irrigated with urban wastewater: Experiments and modeling at the mesoscale); - PRIN 2004 (Modeling agricultural pollutants dynamics at plot scale) - PRIN 2007 (Fate of pesticides in soils at field scale) - PRIN 2012 (Monitoring and modelling of organic and inorganic contaminants transport in the soil-bedrock system); - National Research Council (CNR) project (Remotely sensed surface soil water content in the project by aircraft transported active sensors); - Bilateral Italy/China 2010 (Experimental quantification and numerical modelling of groundwater recharge in the Minquin basin; - Cooperation Italy/Syria 2012 (Rational use of natural resources to improve agricultural productions in Syria) – Cooperation Italy/Egypt 2015 (Matrouh Rural Sustainable Development Project, MARSADEV) – ARIMnet2 2016 (Salinization in irrigated areas: risk evaluation and prevention – SALTFREE).

Member of the scientific committee of the hydrological sciences and of the soil system sciences of the European Geosciences Union (EGU). 2013-2015: Chair of the Soil Physics Division of the EGU. Associate editor of Ecohydrology. Current research focuses on measuring and modeling water and - especially - solute transport in unsaturated heterogeneous and layered porous media. Specific topics include: Soil Hydrological characterization; Spatial variability of soil hydrological properties and stochastic approaches in natural porous media; Conceptualization, modelling and prediction of preferential flow velocity, pathways and patterns on forest and agricultural hillslopes; Numerical modelling of soil water and solute transport in the Soil-Plant-Atmosphere continuum system; Irrigation in arid conditions and with non-conventional water resources; Mapping groundwater pollution risk within agricultural watershed using modelling, geostatistics and GIS.

Antonello Bonfante (male) is a Researcher at CNR-ISAFOM (since 2011) and contract Professor in Pedology at University of Salerno (Dep. of Chemistry and Biology, Degree course in Environmental Science, since 2013). He got the degree in Agricultural Science and Technology (110/110 and praise) in March 2002 at the University of Naples Federico II, Faculty of Agriculture of Portici (NA). PhD in "Valorization and management of the Agro-Forest Resources". He was (2009-2014) member of the Soil Physics Commission of the Italian Society of Soil Science (SISS); actually, he is member of the "Use and Soil management" division of the Italian Society of Soil Science (SISS). For years now turns his attention to the study of problems relating to water pollution caused by nitrate from agricultural sources, through the application of models physically based (SWAP, CropSyst ed ANIMO) and participating actively on the calibration, validation and spatial application of models in 3 CNR research project at regional scale funded by Regione Lombardia, Campania and Calabria. He worked on crop adaptability to climate change under the national project AGROSCENARI (MIPAAF, DM 8608/7303/2008) and he was keynote speaker of session "Soil ecosystem under climate change" at the 20th World Congress of Soil Science in South Korea in 2014.

Recently, his interest are focussed on viticultural zoning at farm and landscape scale. He was a component of the joint group CNR-University of Naples for the evaluation of FAO "Land Assessment" models (GAEZ, MOSAICC, AQUACROP...etc..), He participates to develop geo-spatial decision support systems (web-SDSS) for the soil management and soil conservation in the European project LIFE+ "SoilCons Web" (2010-2014). Recently he has worked on the use of bioenergy crops (*Arundo donax* L.) to support farming communities' and crop production resilience to climate change. Currently he is the coordinator of an Industrial track project between Italy and Israel (LCIS -An Advanced Low Cost system for farm Irrigation Support). He is scientific reviewer for several national and international journal as Geoderma, AWM, Plant and Soil, Pedosphere, Env. Modelling and Software's and AEE. The research activity is presented mainly in peer-reviewed high IF journal (25), HI=8.

<p>Piero Manna (male) is a currently TS Researcher at CNR-ISAFOM. He got the degree in Agricultural Science and Technology (110/110) in 2002 at the University of Naples Federico II, discussing a thesis on Phytopathology entitled "Searching for resistance to <i>Phytophthora infestans</i> in <i>Solanum tuberosum</i> and wild <i>Solanum</i> varieties". In February 2006 he got the PhD degree in applied Pedology on the general theme "Valorization and management of the Agro-Forest Resources", at the University of Naples "Federico II", discussing the thesis entitled "New approaches to the Land Evaluation: a case study in Lodi plain".</p> <p>The main interests are related to applied pedology (soil sampling and description, field measurements), soil hydrology (field sampling, measurements, monitoring), hydrological modelling (in particular soil-plant-atmosphere system modelling), Land Evaluation with traditional and hybrid approaches (modelling application), Geostatistics (spatial interpolation of environmental variables), GIS application, Viticultural zoning, development of Spatial-DSS (Decision Support Systems). From 2010 to 2014 he has been fully involved in an interdisciplinary European project (LIFE+ "SoilConsWeb"), whose aim was the realization of a Web Based Spatial Decision Support System for soil protection and land management. His main role was to collaborate to the technical coordination of the different research groups involved in the project. He coordinated the production of data (thematic maps, modelling simulation, soil data) and was involved in verifying their accuracy. He was also involved in the implementation of the DSS system user-interface.</p> <p>Recently, he was also involved in a group of researchers and experts from CNR and University of Naples, identified by FAO to produce a technical evaluation of the Land Assessment models applied by the Organization itself (internal report), by which the limits and advantages in the application of each model were showed and explained (review work).</p>
<p>Roberto De Mascellis (male) since 2005 till now is a Technologist within National Research Council, Inst. for Agricultural and Forest Mediterranean Systems, Italy; he is the manager of the Laboratory of Hydrology and Physics of Porous Media. He got the Master Degree in Geology and PhD Degree in Environmental and Applied Geology.</p> <p>Research topic: Soil survey; Determination of soil hydraulic properties by field and laboratory experiments; Determination of the soil's solutes transport parameters; Assembly and use of monitoring and data acquisition systems.</p> <p>Recent supported Research Projects: 2008 – 2010: research project SWUP-MED "sustainable water use securing food production in dry areas of the mediterranean region". 2008 – 2010: research project "Study of soil properties and hydro-pedological processes at different spatial scales". Ministry for Education, University and Research MIUR: 2007HBTS85_004. 2010 – 2014: research project "Multifunctional Soil Conservation and Land Management through the Development of a Web Based Spatial Decision Supporting System". Europ. Comm. Direct.-General Env. Direct. E-Intern. Affairs, LIFE ENV.E-4 – Life. 2013 – 2015: research project "QUARC - Qualità delle produzioni tipiche campane ed il suo territorio: approcci innovativi ed integrati per rafforzare la competitività del sistema Agroalimentare". Campania Region Public Authority Ob. Op 2.1 and 2.2. - POR Campania 2007/2013. 2014 – 2015: research project "SEGIS: Expert System for the Management of Irrigation in Greenhouse". Campania Region Public Authority. Bando di attuazione del Programma di Sviluppo Rurale Campania 2007-2013 - Misura 124 HC "Cooperazione per lo sviluppo di nuovi prodotti, processi e tecnologie nei settori agricolo e alimentare e settore forestale". 2016 – today: Salinization in irrigated areas: risk evaluation and prevention (SALTFREE). European Commission (EC) - ARIMnet2 2014.</p>
<p>GIULIANO LANGELLA (male) is a Postdoctoral researcher at the CNR-ISAFOM. He got his PhD in Applied Pedology: Spatial analysis of pedological and environmental features by means of digital soil mapping, University of Naples Federico II. Main activities concern the development of a program for the mechanistic simulation of water and solute transport in the soil-plant-atmosphere system further embedded in a web application by means of an ad-hoc middleware to build spatial decision support systems; development of a prototype national-wide, real-time and open-source SDSS (Spatial Decision Support System) on Soil Sealing via a server GIS cyber-infrastructure; development of a web application for the real-time calculation of land use/change matrices of variation between two selected times at the European scale; development of the WeatherProg program for the climatic data handling within the SOILCONS-WEB project (LIFE08 ENV/IT/000408); development of an "engine" called cvSISE (Spatial Inference Selector Engine with cross validation) for the automatic digital mapping of soil and climate parameters applied in the web based spatial decision support system developed in the SOILCONS-WEB LIFE08 ENV/IT/000408 Project with continuous digital soil maps; Digital Terrain Analysis (DTA) for characterizing morphology of land surface in the stochastic modeling of soil spatial variability; use of multivariate statistical techniques such as regression, geostatistics, and artificial neural networks for the spatial analysis and inference of soil properties and climate data; genetic algorithms in optimization problems.</p>
<p>5 relevant publications, products, services, datasets, software, achievements</p>
<p>1. Langella G., Basile A., Bonfante A., Terribile F. (2010). High-resolution space-time rainfall analysis using integrated ANN inference systems. <i>Journal of Hydrology</i> 387, 328-342. DOI: 10.1016/j.jhydrol.2010.04.027</p>
<p>2. Terribile, F., Agrillo, A., Bonfante, A., Buscemi, G., Colandrea, M., D'Antonio, A., De Mascellis, R., De Michele, C., Langella, G., Manna P., Marotta L., Mileti, F A., Minieri, L., Orefice N., Valentini S., Vingiani, S. And Basile, A., (2015). A Web-based spatial decision supporting system for land management and soil conservation. <i>Solid Earth</i>, 6(3), 903.</p>
<p>3. Bonfante, A., Basile, A., Acutis, M., De Mascellis, R., Manna, P., Perego, A., & Terribile, F. (2010). SWAP, CropSyst and MACRO comparison in two contrasting soils cropped with maize in Northern Italy. <i>Agricultural Water Management</i>, 97(7), 1051-1062.</p>
<p>4. Coppola, G. Dragonetti, A. Comegna, P. Zdruli, N. Lamaddalena, S. Pace and L. De Simone, 2014. Mapping solute deep percolation fluxes at regional scale by integrating a process-based vadose zone model in a Monte Carlo approach, <i>Soil Science and Plant Nutrition</i>, DOI: 10.1080/00380768.2013.855615N.</p>

5. Bonfante, A., Monaco, E., Alfieri, S.M., De Lorenzi, F., Manna, P.,  Sila, A., Bouma, J., Climate change effects on the suitability of an agricultural area to maize cultivation: Application of a new hybrid land evaluation system (2015) *Advances in Agronomy*, 133, pp. 33-69

5 relevant previous projects, activities

1. Multifunctional soil conservation and land management through the development of a web-based spatial decision support system - SOILCONSWEB - (EU-LIFE+08 ENV/000408) 2010-2014.
2. Salinization in irrigated areas: risk evaluation and prevention - SALTFREE - (EU ERANET ARIMNET 2014) 2016-2018.
3. Adaptation scenarios of Italian agriculture to climate change - AGROSCENARI - (Italian Ministry MIPAF) 2008-2013.
4. Developing methodologies for quantifying the vulnerability to nitrate pollution of agricultural origin in the Campania region - (SESIRCA, Regione Campania) 2003-2007.
5. Adaptation to Climate Change of Mediterranean Agricultural Systems - ACLIMAS - (EuropeAid/131046/C/ACT/Multi) 2011-2015.

Significant infrastructure, major items of technical equipment

1. Soil hydrology laboratory (Wind apparatus for water retention and hydraulic conductivity curves; disc infiltrometer, permeameter, table tension, TDR, solute transport device, laser granulometer)
2. Soil survey (excavator, penetrometer for deep and surface soil sampling, penetrometer for compaction measurements, kit for soil sampling and profile description)
3. GIS and cartography laboratory

Paragraph description of the organisation in light of the project content and main tasks

Crops For the Future (CFF) is an organisation dedicated to research and promotion of agricultural diversification. Based in Malaysia, its research focuses on new potentials and prototypes for food, feed and non-food uses at the global scale. Its research delivers “disruptive” innovations, scalable prototypes, new knowledge and technology transfer for the agricultural diversification. CFF has established CropBASE as a unique data-driven programme in charge of documenting, collating and organizing information related to crops and all aspects of food system. The programme is also building prototypes of integrated modelling and simulation systems and geospatial databases and tools for aiding agricultural diversification. CFF has accumulated crop performance and geospatial modelling capacity in collaboration with Sabaragamuwa University Sri Lanka, University of Nottingham (UK and Malaysia), FAO, AgMIP and others. CFF is chair of Association of International Research and Development Centers for Agriculture (AIRCA) which is a nine-member alliance focused on increasing food security by supporting smallholder agriculture and rural enterprise within healthy, sustainable and climate-smart landscapes. Through the AIRCA consortium, CFF gains access to over 300 institutional locations around the world.

CV or description of persons involved

Prof. Sayed Azam-Ali, Male, Chief Executive Officer, CFF

After completing his PhD in Environmental Physics at the University of Nottingham in 1983, Prof. Sayed worked as a plant physiologist at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Hyderabad, India. In 1988, he returned to Nottingham and in 2006 became Professor of Tropical Agronomy. He was instrumental in the establishment of the Tropical Crops Research Unit at the University of Nottingham for controlled-environment and field research on environmental factors limiting the growth of crops in hostile, tropical environments. He coordinated four major EU-funded Projects (STD3, FP5, FP6) and partner in two others. He was the Principal Investigator for six UK DFID/ODA projects, and was the Principal Investigator of the Newton-Ungku Omar funded project “Insect and Underutilised Crops Aquafeed Project (IUCAP)” in 2015. He has supervised 27 PhD students and became an external examiner for 15 PhD theses. In 2008, he was appointed as Chair in Global Food Security and, later that year, was appointed as Vice-Provost (Research and Internationalisation) at the University of Nottingham Malaysia Campus. **In 2011, he became the founding CEO of the Crops For the Future Research Centre.** In February 2012, Prof. Sayed was given the honour to accompany the Vice-Chancellor of the University of Nottingham to receive the Queens Anniversary Award for research in Global Food Security from HRH Queen Elizabeth II at a ceremony at Buckingham Palace, London. He is currently the Chair of the Association of International Research and Development Centers for Agriculture (AIRCA), a nine-member alliance of leading international centres focused on increasing global food security by supporting smallholder agriculture within healthy, sustainable and climate-smart landscapes. In 2017, Prof. Sayed was appointed as the Food Security Subject Matter Expert for the Government of Malaysia’s new “Transformasi Nasional” (TN50) national plan.

Ebrahim Jahanshiri, male, Sr programme coordinator, CFF

Experience: **Dr. Ebrahim Jahanshiri is senior coordinator of the CropBASE research programme at Crops For the Future.** He is responsible for the design, development and delivery of data-driven products and services that includes first ever analytical database for crops that spans over all aspects of value chain and a suite of decision support tools for agriculture. He has a PhD in GIS and Geomatics Engineering and Masters in Precision Farming. He has received scholarship grant under the graduate fellowship for both his Master and PhD degrees. Through his career, he has been involved with teaching (geostatistics and GIS), data modelling and software development projects such as “The development of a spatial decision support system for precision farming of rice in Malaysia” and “Enhancing Productivity and Sustainability of Palm Oil Milling Industry”. He has been awarded 2 patents and 3 copyrights regarding the algorithm and software for the above projects. His main research projects are developing combined soil-climate indices for crop suitability mapping at the global scale, crop modelling using AquaCrop software, developing remote sensing systems for crop monitoring as well as development of ontologies for underutilised crops. His programme has recently been chosen as the only data driven startup that is active in agriculture by the Open Data Institute (UK) and Malaysia Digital Economy Corporation (MDEC) and been given a grant worth for further development of the programme.

Niel Crout, male, Professor in Environmental Modelling, Faculty of Science, Nottingham University UK, will count as ‘natural person working under a direct contract’ and his cost is a part of the personnel costs. The place of secondment will be at the CFF premise.

Neil's work is in the development and application of simulation models of environmental and agricultural systems. His work is highly collaborative with a close integration between modelling and experimental/observational work. Neil is also particularly interested in the predictive performance of environmental models, especially in relation to their complexity and the development of methods to create 'parsimonious' models. Major areas of work include:

- predicting the food chain transfer of radioactive contamination;
- predicting the bioavailability and plant uptake of trace elements;
- modelling the growth of crops in response to their environment;
- development of methods for the creation of reliable models.

<p>Asha Karunaratne, female, Professor in Soil Science, Agricultural Plant Science, Environmental Science, Sabaragamuwa University of Sri Lanka, she will count as 'natural person working under a direct contract' and her cost is a part of the personnel costs. The place of secondment will be at the CFF premise. .</p> <p>Prof Asha attended the University of Peradeniya, where she obtained BSc. Agriculture (Hons) and M.Phil. In 2005, she was awarded the Commonwealth Scholarship for PhD at the University of Nottingham, UK. Over the last 18 years' of service to the Sabaragamuwa University, she has worked as the International Relations Coordinator, member of the editorial board at the third, and fourth international symposiums, student counsellor, head of the department and UGC focal point member. Further she has contributed to the design and revision of curriculum at the Faculty of Agricultural Sciences both in 2005 and 2016 as a committee member. Currently, she is chairing various committees at the University and a member of the University Research Committee. Prof Asha is the Director of Internal Quality Assurance Unit (IQAU) of the University since 2016. She has been working for more than 15 years on agronomy and quantitative crop physiology, with a focus on yield responses to water scarcity, crop-climate modelling for abiotic stress and climate change scenarios. She has postdoctoral research experience on crop-climate modelling from the Walker Institute for Climate System Research, University of Reading and University of Nottingham, UK under the purview of Commonwealth Fellowship Plan in 2011 and 2014. Over the last 15 years she had been engaged with various national and international research projects that enhanced her academic merits. Currently Prof Asha is collaborative scientist of C3MP project with NASA Godard Space Institute, AgMIP. FAO AquaCrop network and Crops for the Future.</p>
<p>Sean Mayes, male, Theme Leader Biotechnology and Crop Genetics, CFF and University of Nottingham UK</p> <p>25 years of understanding crop genetic diversity, developing molecular markers for marker-assisted selection and applied crop breeding. Worked primarily in wheat, oil palm and bambara groundnut, but also have small current projects in rice, winged bean, amaranths, Proso millet and have worked on over a dozen other crops. Have worked in industry (Unilever, tea, barley, wheat), as a self-employed consultant (oil palm, <i>Ononis spinosa</i>) and as an academic.</p>
<p>Peter J. Gregory, male, Research Advisor</p> <p>Peter joined CFF as Research Adviser in September 2016 with the task of revising CFF's research strategy and encouraging research activity. He is Emeritus Professor of Global Food Security at the University of Reading at which he also held the position of Professor of Soil Science from 1994 until 2005. He was Chief Executive at the Scottish Crop Research Institute, Dundee for six years, and his recent employment includes being Chief Executive of East Malling Research and various consultancy roles developing science and research strategies. He is engaged with the UK agriculture and horticulture industries via his chairmanship of the Recommended List Board for the AHDB and the Science Advisory Committee of the Royal Horticultural Society. He also chairs the Advisory Committee for Novel Foods and Processes (ACNFP) for the Food Standards Agency which undertakes risk assessments of new foods to inform the Agency's position in Europe. His research interests focus on the interaction of plant roots with soil and he is currently a Visiting Scientist at the Forschungszentrum Jülich, Germany and President of the International Society of Root Research.</p>
<p>Ayman Salama, male, Sr Application architect</p> <p>Expeirce: Ayman Salama is the Senior Application Architect of CropBASE Program at Crops For the Future. He is a specialist in designing software and hardware architecture backbone for complex Data systems. Ayman's focus on designing and developing CropBASE database architecture, data management system and Decision support tools. Ayman was awarded MSc from University of Nottingham Malaysia Campus in Computer Science and his research is on "Dimensional informatics for complex Data structures." Ayman has spent over 10 years in developing and operating complex computer architectures in Multinational corporates IBM and Orange "France Telecom" in Egypt, China and France that serve over 38 Million customers with yearly net profit over 2 Billion Euros. Ayman is an expert in cutting edge technologies of massive data processing systems from largest technological institutions Oracle, IBM, HP, Ericsson, Sun, Huawei and others. Ayman is a member of IEEE.</p>
<p>5 relevant publications, products, services, datasets, software, achievements</p>
<p>1 - Lawson, G. J., Crout, N. M. J., Levy, P. E., Mobbs, D. C., Wallace, J. S., Cannell, M. G. R., & Bradley, R. G. (1995). The tree-crop interface: representation by coupling of forest and crop process-models. <i>Agroforestry systems</i>, 30(1-2), 199-221.</p>
<p>2 - Karunaratne, A. S., Azam-Ali, S. N., Izzi, G., & Steduto, P. (2011). Calibration and validation of FAO-AquaCrop model for irrigated and water deficient bambara groundnut. <i>Experimental Agriculture</i>, 47(3), 509-527.</p>
<p>3 - McDermid, S. P., Ruane, A. C., Hudson, N. I., Rosenzweig, C., Gbegbelegbe17, V. G., Gerardeaux19, E., ... & Lieferring57, M. (2015). The AgMIP coordinated climate-crop modeling project (C3MP): methods and protocols. <i>Handbook of Climate Change and Agroecosystems: The Agricultural Model Intercomparison and Improvement Project (AgMIP) Integrated Crop and Economic Assessments, Part, 1</i>, 191-220.</p>
<p>4 - Norasma, C. Y. N., Shariff, A. R. M., Jahanshiri, E., Amin, M. S. M., Khairunniza-Bejo, S., & Mahmud, A. R. (2013). Web-Based Decision Support System for Paddy Planting Management. <i>Pertanika J. Sci. Technol.</i>, 21.</p>
<p>5 - Lai, H. M., May, S. T., & Mayes, S. (2014). Pigeons: A novel GUI software for analysing and parsing high density heterologous oligonucleotide microarray probe level data. <i>Microarrays</i>, 3(1), 1-23.</p>
<p>5 relevant previous projects, activities</p>
<p>Project name, Amount USD, Type, Person involved, Role, country, year</p>

1. The development of a spatial decision support system for precision farming of rice in Malaysia, 300000, Research project, Ebrahim Jahanshiri, Researcher, Malaysia, 2008
2. Enhancing Productivity and Sustainability of Palm Oil Milling Industry, 1000000, Research project, Ebrahim Jahanshiri, Researcher, Malaysia, 2015
3. Developing a cellular automata-based planning decision support system, 40000, Research project, Ebrahim Jahanshiri, Project designer, Malaysia, 2009
4. A Web Based Agricultural Data Management System And Methods of Managing Thereof, Patent pending, Ebrahim Jahanshiri, Researcher, Malaysia, 2008
5. An Automated Valuation System for real estate appraisal based on geospatial regression techniques, Prototype, software, Ebrahim Jahanshiri, Researcher, programmer, Malaysia, 2013
Significant infrastructure, major items of technical equipment
1. CFF Field research centre, for testing LANDSUPPORT
2. Database and IT infrastructure currently at CFF headquarters
3. Controlled-environments (CE) for crop/climate studies

Paragraph description of the organisation in light of the project content and main tasks

The International Center for Agricultural Research in the Dry Areas (ICARDA) is a global research-for-development organization. ICARDA has one legal entity with its head office and legal address is in Lebanon, but ICARDA is active in several other locations including Morocco and Jordan (all on the same legal entity), where a part of the research activities will be carried out.

ICARDA's mission is to provide innovative science-based solutions for improving the resilience and livelihoods of the resource-poor developing countries. ICARDA's aim is to enhance food and water security through the sustainable management of natural resources in the face of global change. Partnering with countries through national research and extension systems (NARS) has been a cornerstone of ICARDA's research-for-development initiatives. These partnerships entail ICARDA's scientists working closely with NARS, extension, and local research institutions and universities, taking into considerations the national policy frameworks. With the center's decentralization strategy starting in 2012, ICARDA's partnership programs cover about 50 countries across Africa and Asia, including Tunisia.

ICARDA has developed advanced capacities and infrastructure to manage geospatial data to provide tailored land management and planning solutions at different spatial scales, spanning from sub-national to regional. Recently ICARDA has developed the Option by Context web-based geospatial tool to provide contextual extrapolation domains to support decisions on how the best practices implemented locally/contextually can find application over large scale, and what benefits can be generated (thus supporting scaling-up). Thanks to this long-lasting experience ICARDA will contribute to the development of the Land Decision Support Tools, and will test them in a north Africa case study..

CV or description of persons involved

Dr. Claudio Zucca, PhD in Pedology, Soil Conservation and Land Management specialist at ICARDA (Integrated Water and Land Management program), formerly senior researcher at Sassari University (Italy). He has extensive experience in management of European projects as he was previously involved in one H2020 and in several FP7, FP6, and FP5 projects. He has more than 15 years of R&D experience in land and soil management. His research mainly addressed sustainable land management, soil and land degradation, and desertification, and was based on interdisciplinary and multi-scale approaches integrating fieldwork and geomatics (GIS, remote sensing, territorial modelling). Some of his most recent works were focused on assessing the impacts of land restoration and soil conservation practices on soil functions and ecosystem goods and services in view of achieving land degradation neutrality. He published 40+ peer-reviewed publications.

Quang Bao Le is a Senior Scientist on Geoinformatics, Integrated Systems Analysis and Modelling at ICARDA (Diversification and Sustainable Intensification of Production Systems program). He obtained his Ph.D. from the University of Bonn (2005), and was a postdoc and senior researcher at University of Bonn and ETH Zurich (2006 -2014) before joining ICARDA. His research has focused on the development and application of spatially explicit methods and tools for integrated assessment and scenarios development for supporting environmental management and planning. He published 60+ peer-reviewed publications, had extensive experiences in field research and supervisions of 12+ graduate students from Africa, Asia, Europe, North and Latin America

Chandrashekhar Biradar is principal agro-ecosystems scientist and head of Geoinformatics Unit at ICARDA. His expertise spans in the field of geospatial science, technology and application for agro-ecosystem research and outreach. Core expertise in satellite sensor based innovative methods for mapping global croplands, water and land productivity, land degradation, impact assessments of agro-ecological dynamics in the face of climate change. He has authored/co-authored over 160 publications which include 45 peer reviewed journal publications, 18 books/chapters, over 100 other publications. His current research focus is on developing digital agriculture, bigdata analytics, resilient agro-ecosystems, sustainable intensification, enhancing input use efficiency for delivering better interventions and package of practices to reach out to smallholding farmers to improve food security and livelihood in the dry areas.

5 relevant publications, products, services, datasets, software, achievements

1. Miyasaka, T., Le, Q.B., Okuro, T., Zhao, X., Takeuchi, K., 2017. Agent-based modeling of complex social-ecological feedback loops to assess multidimensional trade-offs in dryland ecosystem services. *Landscape Ecology*, 32, 707-727

2. Low, F., Biradar, C., Fliemann, E., Lamers, J. and Conrad, C. 2017. Assessing gaps in irrigated agricultural productivity through satellite earth observations- A case study of the Fergana Valley, Central Asia. *International Journal of Applied Earth Observation and Geoinformation*. 59, 118-134

3. Le, Q.B., Nkonya, E., Mirzabaev, A., 2016. Biomass Productivity-Based Mapping of Global Land Degradation Hotspots. In: Nkonya, E., Mirzabaev, A., von Braun, J. (Eds.), *Economics of Land Degradation and Improvement – A Global Assessment for Sustainable Development*. Springer International Publishing, pp. 55-84.

4. Vu, Q.M., Le, Q.B., Vlek, P.L.G., 2014. Hotspots of human-induced biomass productivity decline and their social-ecological types toward supporting national policy and local studies on combating land degradation. *Global and Planetary Change* 121, 64-77. DOI: <http://dx.doi.org/10.1016/j.gloplacha.2014.07.007>

5. Zucca, C., Della Peruta, R., Salvia, R., Sommer, S., Cherlet, M., 2012. Towards a World Desertification Atlas. Relating and selecting indicators and datasets to represent complex issues. *Ecological Indicators* 15, 157-170. doi:10.1016/j.ecolind.2011.09.012. ISSN: 1470-160X.

5 relevant previous projects, activities
 Associated with document Ref. Ares(2018)1548916 - 21/03/2018

1. Impact Evaluation of SLM Options to Achieve Land Degradation Neutrality in Tunisia; Jan/2017 – Oct/2017; funded by BMZ/GIZ (German Government)
2. Global Geoinformatic Options by Context (GeOC) for better targeting and out-scaling of Sustainable Land Management practices; Jan/2016 – April/2017; funded by CGIAR (CRP Dryland Systems)
3. Adapting conservation agriculture for rapid adoption by smallholder farmers in North Africa
Mapping Site Similarity and Land Suitability for CA Outscaling
4. Development of Geospatial Science, Technology and Application (GeSTA) geo-portal and services; 2013-2016; funded by CGIAR (CRP Dryland Systems)
5. CGIAR Platform for Big Data in Agriculture (ICARDA is as a main research partner); 2017-2022; funded by CGIAR Core Fund

Significant infrastructure, major items of technical equipment

ICARDA has a strong geoinformatic infrastructure including skilled staff and several Computer Servers, Web Servers, and a Data Repository. The hardware and software features of these facilities are described at <http://geoagro.icarda.org/en/default/index/facilities>. The data repository stores GIS and EO data covering several themes at multiple scales, as detailed at <http://geoagro.icarda.org/en/gis/details/index>. An on-line data distribution service is provided.

Paragraph description of the organisation in light of the project content and main tasks

The Institute of Advanced Studies (iASK) Kőszeg was founded in 2015 and according to its mission it aims to conduct socially relevant, applicable research as well as basic research mostly in the social sciences. The institute focuses on four main umbrella topics: 1. sustainable urban and regional development, 2. current global economic, social and political transformations, 3. the study of interdisciplinarity 4. innovative methods for the development of education, health and cultural management. The research focuses on the development and integration of mathematical modeling, machine learning, process mining, network science and open data techniques to support the understanding of complex socioeconomic systems and the analysis of the sustainability of technical and social systems. The Big Data team is involved in several research projects including the development of monitoring systems for complex processes, providing an additional viewpoint to the socioeconomic analysis of regional development (including the creative cities and sustainable regions) by studying how networks of companies relate to settlement hierarchy. Combining text and data mining, researchers develop novel analytical approaches to evaluate models and strategic documents related to the problem of sustainability. In order to support evidence based public policy, novel techniques for data-driven development of education and public health systems are being worked out.

CV or description of persons involved

László Morzsa, Java Developer at GeoX Kft. & Software Engineer at iASK

Institute of Advanced Studies Kőszeg - Big Data Centre and College of Dunaujvaros. He holds a Bsc degree from College of Dunaujvaros in Information Technology, with a specialization in Software Technology Specialization and a BSc from Budapest Tech - Óbuda University in Information Technology. Before committing to iASK to be senior software engineer, Morzsa has been working as Java Developer GeoX Kft 2009 up until the Present.

Dr. Zoltán Gaál, CSC is a professor emeritus at the Institute of Management, University of Pannonia and is currently a full-time researcher and coordinator for the KRAFT research centre at iASK (on payroll)..

He is a chemical engineer (MSc from University of Chemical Engineering 1971) and economic engineer (MSc Budapest University of Technology 1975). He received his candidacy from the Hungarian Academy of Science in 1984 and his habilitation from the University of Miskolc in 1996. His research interests include the relationship of organisational culture and strategy and the interaction of knowledge management, knowledge transfer and culture. He served as Dean of the Faculty of Engineering between 1991 and 1998 and as the Rector of the University of Pannonia between 1998 and 2007. He was president of the Hungarian Rectors' Conference between 2002 and 2004 and has served as chair of the Board of Directors at the Herend Porcelain Manufactory since 2005 up until today. He is member of the "Verband der Hochschullehrer für Betriebswirtschaftslehre".

Prof. Dr. Sándor Kerekes, is currently permanent fellow and the lead researcher at the Sustainability Science unit at iASK's Polányi Centre. . **Since he is not receiving a salary, his efforts are not included into the budget.**

He got his MSc in Chemistry (in 1971), PhD in Management (in 1984) and DSc from Hungarian Academy of Sciences (in 2003). In 1986 he was a Visiting Research Fellow in Moscow in the World Economic Institute. He finished the Advanced Management Program at Harvard Business School in 1994, later he was a City Bank Fellow at Kenan Institute in Chapel Hill USA.

Prof. Kerekes introduced Environmental Education at the Corvinus University of Budapest in the early 1990's, founding the Department of Environmental Economics and Technology, and he has published dozens of textbooks, books and articles in environmental economics and management. He used to work as a trainer for UNDP between 1990-1992 in Ukraine, Belarus, Kyrgyzstan and Kazakhstan preparing and evaluating different development projects. Kerekes has led a number of international and domestic projects in the fields of environmental regulation, resource economics and environmental management.

5 relevant publications, products, services, datasets, software, achievements

1. **KRAFT - Creative Cities - Sustainable Regions**: methodology for a novel integrated regional development strategy - became a program of national excellence and is currently being exported to other regions to facilitate development based on their own, inherent features. (There is a series of **KRAFT volumes** that iASK publishes annually. Available at <http://www.iask.hu/hu/publikaciok/225>)

2. **www.enviromind.hu** - a monitoring system for environmental protection (in English and Hungarian) developed by iASK's Big Data team. It is also a service aiming to promote an active e-participation of citizens in ensuring a healthier environment in their neighborhoods.

3. **Volume: "Jót s jól! 26 Tanulmány a Fenntarthatóságról" [Do good! Do it well! 26 Essays on Sustainability] (ed. Sándor Kerekes, Savaria University Press - iASK, 2017)** - the chapters of this truly interdisciplinary volume address environmental and economic and social aspects of sustainability - considering the UN SDGs and their regional applicability in Central Europe.

4. **Monograph: Nagy, Judit: Social Innovation on Pannon Cities I.** (iASK, 2017)

5. **Tourism chatbot** (developed by iASK's Big Data team)

5 relevant previous projects, activities

1. **Living Labs:** Started with 2 specific experimental pilot micro-regions in 2016: Keszthely and its surroundings, Keszeg and its surroundings) a complex quality of life measurement model has been being developed. Using a combination of sensor technologies and big data digital observation, combined with qualitative participative fieldwork with local stakeholders, we have been exploring the feasibility of handling information on large and complex social systems. The "Living Labs" project is a natural social innovation experiment comparing the wellbeing effects of local development efforts and learning about the impact of various social programs that are co-created with the local actors in the framework of KRAFT.

2. **Policy Labs:** applying big data analytics to large and complex systems. This includes, for example: 1. **Edumining** (i.e. analysis linked data sources that connect the public education evaluation data, the tracking data of graduates and the large application database of the higher education system). The Lab works together with educational researchers and others to utilize this unique linked information resource. 2. **Public health and healthcare data mining:** we work with the anonymized data of decades of patient records in three regional hospitals. Linking expenditure and health outcome information can inform crucial public policy decisions. 3. **Regional development in cooperation with KRAFT:** linking the various data sources at the local level can deliver a new information resource for bottom up regional development planning.

3. **KRAFT (Creative Cities - Sustainable Regions):** innovative regional development concept and complex methodology, the key to which is the effective cooperation between the socio-economic stakeholders in the region. We developed **The KRAFT Index**, which proposes an integrated framework for evaluation and interpretation which takes into account individual (company, city, university, community) interests, and provides a complex and deep understanding of long and medium term development objectives. This integrative approach is of vital importance for success and the simultaneous creation of socio-economic and ecological sustainability.

Significant infrastructure, major items of technical equipment

For this tasks significant infrastructure includes Datasets for Austria, Italy and Hungary such as the following:

1. Spatial data (Aggregation level, NUTS level and LAU2 level)
 2. Attribute data (European Union NUTS0, NUTS2, NUTS3)
 - 2.1. National level (Annual data, Statistical Yearbook LAU2, Census NUTS3, LAU2, Agricultural census and survey data NUTS3, LAU2, Purchasing power LAU2)
 - 2.2. European regions (LAU2)
 - 2.2.1. Population (1*1 km grid, Address level, Agricultural companies, Other indexes 1*1 km grid, POI point)
 - 2.3. 4 European pilot sites
- No other infrastructure is needed.

Paragraph description of the organisation in light of the project content and main tasks

ISPRA is a public body, with technical, scientific, organizational, managerial, administrative and financial autonomy, subject to the vigilance of the Ministry for the Environment, Land and Sea. It is the institutional and technical-scientific reference point for the whole country in environmental and land monitoring and information fields.

Long-term experience in land monitoring, land take/soil sealing monitoring, land degradation studies and reporting, with emphasis on in-situ observations with state-of-the-art infrastructure and synergies with remote sensing (ground based and satellite).

Eionet National Reference Centre for spatial analysis and land cover, ISPRA is part and coordinates the Italian National System for Environmental Protection (SNPA), where Regional and Provincial Environmental Protection Agencies are the reference agencies at local level.

The Institute is also active in several EC projects and international Programmes (e.g., Copernicus, GEO).

CV or description of persons involved

Michele Munafo, PI at ISPRA (Dipartimento per il Servizio Geologico), is responsible for the Italian Land Monitoring Reference Network and for Land Take National Report, National Reference Centre of the European Environment Information and Observation Network (European Environment Agency), INSPIRE MIG - Maintenance and Implementation Group - member and National Reporter, GEO - Intergovernmental Group on Earth Observation - Program Board member, member of the National Copernicus User Forum, involved in the production of Italian Corine Land Cover since 2000 and in the validation of Copernicus High Resolution Layers since 2012, and project manager for several projects regarding land monitoring and environmental information.

He holds a master degree in Environmental Engineering and a PhD in Urban Planning at the University of Rome Sapienza.

He is temporary Professor in Regional and Urban Planning, Strategic Environmental Assessment and Geographical Information Systems at the University of Rome Sapienza and member of the scientific committee of PhD in Landscape and Environment.

Marco Di Leginio, male

In ISPRA (Dipartimento per il Servizio Geologico) since 2003, working on:

- land degradation processes (desertification, soil erosion, organic carbon content reduction);
- hydro-geological risk (monitoring of mitigation measures financed by Ministry of the Environment and Protection of Land and Sea and updating of ReNDiS database);
- environmental reporting (coordination of chapter "geosphere" within Environmental Data Yearbook edit by ISPRA).

Ines Marinosci, female

In ISPRA (Dipartimento per il Servizio Geologico) since 2006, Expert in GIS and remote sensing.

Involved in several GMES/Copernicus and European projects related to earth observation, land monitoring, GIS, environmental information and reporting.

Involved in institutional activities concerning land cover/land use at national and local level, earth observation and environmental analysis related to urban sprawl and soil sealing monitoring and assessment.

Marina Vitullo, female

Senior researcher at ISPRA (Dipartimento per la valutazione, i controlli e la sostenibilità ambientale), with scientific background in Electronic Engineering and PhD in Forest Ecology.

Responsible for compilation and reporting the LULUCF sector of the national greenhouse gas inventories under UNFCCC/Kyoto Protocol. Lead Author of the 2013 IPCC Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol (KP Supplement).

Reviewer for the UNFCCC in the area of greenhouse gas inventories, with focus on LULUCF sector. Contributing author to the Italian National Communications under the UNFCCC. Part of the Italian Delegation in the negotiations at UNFCCC and EU level. Member of FAO-FRA (Forest Resource Assessment) expert panel. Her research is focussed on the development of methodologies to estimate of removals and emissions of greenhouse gases in the LULUCF, collecting, analysing and elaborating data concerning different processes affecting atmospheric emission at national and local level.

5 relevant publications, products, services, datasets, software, achievements

1. Manes F., Marando F., Capotorti G., Blasi C., Salvatori E., Fusaro L., Ciancarella L., Marchetti M., Chirici G., Munafò M. (2016), Regulating Ecosystem Services of Forests in the ten Italian Metropolitan Cities: Air quality improvement by PM10 and O3 removal. *Ecological Indicators* 67 (2016) 425–440

2. L. Sallustio, M. Munafò, N. Riitano, B. Lasserre, L. Fattorini, M. Marchetti (2016), Integration of land use and land cover inventories for landscape management and planning in Italy. *Environmental Monitoring and Assessment* 2016 188:1-20

3. Munafò M., L. Salvati, M. Zitti (2013). Estimating soil sealing rate at national level - Italy as a case study. *Ecological Indicators* 26/2013:137–140.

4. Salvati L, Munafò M, Gargiulo Morelli V, Sabbi A (2012). Low-density settlements and land use changes in a Mediterranean urban region. *Landscape and Urban Planning*, vol. 105, p. 43-52

5. M. Munafò, C. Norero, A. Sabbi, L. Salvati (2010), Soil Sealing in the Growing City. A Survey in Rome, Italy. *Scottish Geographical Journal*, 126(3), 153-161

5 relevant previous projects, activities

1. SMURBS (Smart Urban Solutions for air quality, disasters and city growth)
2. Era-Planet (The European network for observing our changing planet)
3. Ecopotential (Improving future ecosystem benefits through Earth Observations)
4. LIFE+ SAM4CP (Soil Administration Models 4 Community Profit)
5. LIFE+ IMAGINE (Integrated coastal area Management Application implementing GMES, Inspire and sEis data policies)

Significant infrastructure, major items of technical equipment

ISPRA coordinates and manage the Italian Environmental Information System (SINA), the National federated information system for environmental monitoring and reporting data and indicators. ISPRA in the National Coordinating Structure for the implementation of INSPIRE in Italy.

Paragraph description of the organisation in light of the project content and main tasks

Research spinoff rasdaman GmbH has been established in 2003 for commercializing the rasdaman technology which effectively has pioneered Array Databases and is world technology leader in this domain. In 2008, rasdaman GmbH has disclosed part of its product to establish the open-source rasdaman community version in parallel to the commercial rasdaman enterprise version, adopting a dual-licensing model. More specifically, in 2008/2009, the company has teamed up with Jacobs University for a code split to establish rasdaman community (encompassing a complete Array DBMS) as an open-source project. The original rasdaman code remains as rasdaman enterprise. Both are kept in sync at any time, and both rasdaman GmbH and Jacobs University contribute actively to the open-source project.

Downward compatible rasdaman enterprise comprises highly effective performance boosters, extra functionality, and convenience utilities. For both versions the company offers support, development, and maintenance. Installations of rasdaman enterprise can be found, e.g., with ECMWF, MEE0 (700+ TB), AWI, NCI Australia, etc.

Further, the company is outstandingly active and successful in developing international datacube standards, such as ISO Array SQL and the OGC Big Datacube suite, Coverage Implementation Schema (CIS) and Web Coverage Service (WCS) which is also adopted by INSPIRE and under ad-option by ISO (OGC CIS ŽISO DIS 19123-2). The CEO has been invited to overhaul ISO 19123.

The rasdaman technology has received numerous innovation awards. ESA in 2017 has announced that “The RASDAMAN product is currently the world leading environment in this domain and the standard working horse for OGC standardisation on these innovative data access interfaces.” As such, rasdaman is a critical component for European technology independence.

In LANDSUPPORT, the company will lead WP2; deploy, interface, and support the raster data management component; continue shaping Big Data standards.

CV or description of persons involved

Dr. Peter Baumann (m) is founder and CEO of rasdaman GmbH as well as Professor of Computer Science at Jacobs University teaching Databases, Web services, and Software Engineering. He has authored and co-authored 130+ book chapters and papers on array databases and related fields, holds international patents on array databases, and has effectively pioneered the field with the invention of rasdaman. He has 20+ years experience in international project management, including ESA and EU FP5 through H2020 projects, particularly while leading EU FP7 EarthServer and H2020 EarthServer-2. He is key shaper of international Big Data efforts and strongly tied into the open-source community; selected engagements

Dimitar Misev (m) is Head of Product Development and a substantial code contributor to both rasdaman community and enterprise. He holds an MSc degree in CS from Jacobs University. In parallel to his employment with rasdaman GmbH he is finalizing his PhD in CS at Jacobs University which centers around the ISO Array SQL standard he has written under supervision of Peter Baumann.

Role in LANDSUPPORT: software developer, user support, standardization.

Heike Hoenig (f) is Director, Marketing at rasdaman GmbH. She holds a degree in Germanistics from Oldenburg University and has 20+ years of professional experience in journalism, PR and marketing, e.g., in doing market studies. In EU EarthServer, she has performed all outreach work for rasdaman GmbH, such as trade fairs, newsletters, and social media. Further, she has done the concept of award-winning 1h TV documentary “Big Earth Data”. Based on this success she is leading outreach (reaching currently 468,000 named recipients) in EU H2020 EarthServer-2.

Role in LANDSUPPORT: outreach.

5 relevant publications, products, services, datasets, software, achievements

1. rasdaman: flexible, scalable datacube engine (in operational use on 700+ TB databases; OGC & INSPIRE WCS Reference Implementation)

2. OGC “Big Earth Data” suite, WCS, consisting of over a dozen individual specifications (standards, adopted, implemented by both open-source and proprietary tool implementers; adopted as INSPIRE standard)

3. ISO 9075 SQL Part 15: Multi-Dimensional Arrays (standard, in final adoption stage)

4. P. Baumann: Array Databases and Raster Data Management. In: T. Özsu, L. Liu (eds.): Encyc-lopedia of Database Systems, Springer, 2017

5. P. Baumann, I. Manolescu-Goujot, L. Trani, Y.E. Ioannidis, G.G. Barnaföldi, L. Dobos, E. Bányai (eds.): Proc. 28th International Conference on Scientific and Statistical Database Management, SSDBM 2016, Budapest, Hungary, July 18-20, 2016. ACM 2016

5 relevant previous projects, activities

1. ORBiDANSe (coordinator; running): Orbital big data analytics service, installing rasdaman on an ESA satellite. Funded by German BMVI (Ministry of Transport and Infrastructure)

2. BigPicture (running): Diagnosis in the field: Big-Data-based determination of causes for satellite-image-derived and site-specific variations. Funded by German BMEL (Ministry of Food and Agriculture).

3. EarthServer-2 (coordinator; running): Agile Analytics on Big Data Cubes, with rasdaman as datacube platform

technology. Funded by EU H2020 EINFRA.

 Associated with document Ref. Ares(2018)1548916 - 21/03/2018

4. Testbed-13 (running): Global, hands-on, collaborative prototyping for rapid development and delivery of proven candidate specifications to the OGC Standards Program. Funded by OGC and a consortium including ESA, Airbus, DigitalGlobe, NASA, and others.

5. EVO-ODAS (running): "Evolution of EO Online Data Access Services" analyses relevant scenarios and technologies for EO data publication and access, identifies potential for improvements of standards and their implementations, prototypes and evaluates selected improvements and proposes standard extensions for future releases. Funded by ESA

Other supporting documents relevant to the call

Selected awards:

- o NASA WorldWind Europe Challenge 2014 award
- o Gardels Award 2014 from OGC for Peter Baumann for his "exemplary contributions to the OGC's consensus standards process"
- o Copernicus Masters competition, Big Data Challenge (sole winner) 2014
- o Geospatial World Innovation Award 2013

Paragraph description of the organisation in light of the project content and main tasks

The Joint Research Centre (JRC) is the European Commission's science and knowledge service which employs scientists to carry out research in order to provide independent scientific advice and support to EU policy. Soil data and information play a crucial role in the development and implementation of EU policies and global multilateral agreements. The JRC provides assessments of available soil resources at the global scale and acts as a single focal point for soil data and information linked to climate change, biodiversity and desertification, for use by the Commission and others. The JRC also helps the EU Member States to fulfil their assessment obligations regarding their soil resources by operating the European Soil Data Centre. The European Soil Data Centre (ESDAC) is the thematic centre for soil related data in Europe. Its ambition is to be the single reference point for and to host all relevant soil data and information at European level. It contains a number of resources that are organized and presented in various ways: datasets, services/applications, maps, documents, events, projects and external links.

For the purpose of this project, the project team is affected to the unit JRC.D3. This unit is entirely based in Ispra, a town in Italy, and is part of Directorate D of the JRC. (Remark to avoid confusion: the town of Ispra in Italy has nothing to do with the Italian National Agency for the Environment ISPRA, another partner in this project, that is based in Rome)

CV or description of persons involved

Luca Montanarella, working since 1992 as scientific project manager in the European Commission. Leading the Soil Data and Information Systems activities of the Joint Research Centre in support to the EU Thematic Strategy for Soil Protection and numerous other soil related policies, like the Common Agricultural Policy (CAP), the UNCCD, UNFCCC, CBD, etc... Responsible of the European Soil Data Centre (ESDAC), the European Soil Information System (EUSIS) and the European Soil Bureau Network (ESBN).

Recently in charge of supporting the establishment of the Global Soil Partnership (GSP) at FAO.

Currently chairing the Intergovernmental Technical Panel on Soils (ITPS) and the IPBES thematic assessment on land degradation and restoration (LDR).

More than 200 publications, books and reports.

Numerous awards and memberships.

Panagos Panos has a PhD in soil erosion modelling awarded from University of Basel. He also received a Master in Business Administration (MBA) in University of Patras (2005-2010). He also studied Informatics in the homonymous Department of Athens University of Economics & Business during the period 1989-1993. From 1993 to 1997 he has worked as a software developer in the private sector in Greece and then moved to Brussels, Belgium. During the period 1997-2000 he has been IT consultant for European Commission in relation to the project Euro Info Centres (DG Enterprise), after which he returned to Greece to become the Head of the Information Systems Department at the private company INTRAMET. He joined the European Commission - Joint Research Centre in 2001 with duties in database administration and development of GIS and Web applications. He has participated in the many FP5, FP6 and FP7 projects EUROHARP, PECOMINES, EWCZ-EuWASP, Geoland-2, DIGISOIL, I-Soil, eSoter, SoilTrEC, CASCADE, EcoFinders, RECARE.

Marc Van Liedekerke received an MSc. degree in Elektrotechnical Engineering from the State University of Ghent (B) in 1983 and an MSc. in Informatics from the same university in 1984. He has been an assistant professor at the Catholic University of Leuven (1984-1986) performing research in the fields of medical image enhancement and industrial visual inspection. Marc joined the European Commission Joint Research Centre in 1987. From 1987 to 1993 he has been active in the emerging fields of Distributed Artificial Intelligence and Graphical User Interface programming through participation in the ESPRIT projects Archon and Kwick. Since then he has specialized in data and information management for large environmentally oriented projects, for which he integrates databases and models with Geographical Information Systems and scientific visualization components, which are then made on-line accessible in the Web environment. Through the MANSEV project, he pioneered, in collaboration with EMEA and EU pharmaceutical companies, the web-based submission of medicine applications at EU-level.

5 relevant publications, products, services, datasets, software, achievements

Panagos P., Borrelli P., Meusburger K., Yu B., Klik A., Lim K.J., Yang J.E., Ni J., Miao C., Chattopadhyay N., Sadeghi S.H., Hazbavi Z., Zabihi M., Larionov G.A., Krasnov S.F., Garobets A., Levi Y., Erpul G., Birkel C., Hoyos N., Naipal V., Oliveira P.T.S., Bonilla C.A., Meddi M., Nel W., Dashti H., Boni M., Diodato N., Van Oost K., Nearing M.A., Ballabio C., 2017. Global rainfall erosivity assessment based on high-temporal resolution rainfall records. *Scientific Reports* 7: 4175. DOI: 10.1038/s41598-017-04282-8.

Robinson, David A, Panos Panagos, Pasquale Borrellis, Arwyn Jones, Luca Montanarella, Andrew Tye, Carl G Obst, 'Soil Natural Capital in Europe; A Framework for State and Change Assessment,' *Scientific Reports*, published 27 July 2017. DOI: 10.1038/s41598-017-06819-3

Montanarella, L. (2015). Agricultural policy: Govern our soils. *Nature*, 528(7580), 32–3. <http://doi.org/10.1038/528032a>

Montanarella L., Pennock D., McKenzie, N., Badraoui M., Chude V., Baptista I., Mamo T., Yemefack M., Singh Aulakh M., Yagi K., Young Hong S., Vijamsorn P., Zhang G., Arrouays D., Black H., Krasilnikov P., Sobocka J., Alegre J., Henriquez C., Mendonca Santos L., Taboada M., Espinosa-Victoria D., Alshankiti A., Alavi Panah S., Elsheikh E., Hempel J., Camps Arbertain M., Nachtergaele F., Vargas R.; World's soils are under threat. *SOIL; Copernicus*; 2015. p. 1263-1272.

Montanarella, L., Panagos, 2015. Policy relevance of Critical Zone Science and Land Use Policy, Volume 49, December 2015, Pages 86-91

5 relevant previous projects, activities

" CASCADE - CAstrophic Shifts in drylands: how CAN we prevent Degradation?" - GA 283068 (FP7): Sustainable management of dryland ecosystems in the context of climate change

"RE CARE - Preventing and Remediating degradation of soils in Europe through Land Care" - GA 603498 (FP7): Land and soil restoration in Europe

"SoilTrec - Soil Transformations in European Catchments" - GA 244118 (FP7): Critical Zone monitoring sites and spatial integration into European catchments.

"SoilCare - Soil Care for profitable and sustainable crop production in Europe" - GA 677407 (H2020): Sustainable soil management under various agricultural management systems.

"ENVASSO - Environmental Assessment of Soil for Monitoring" - GA 22713 (FP6): Monitoring and indicators on the status and trends in European soil properties

Paragraph description of the organisation in light of the project content and main tasks

Regione Campania – Directorate General (DG) of the Agricultural Policy, as for similar large public bodies in other parts of EU, is rooted on EU, national and regional legislation.

The task of this sector is specifically devoted to regional agriculture and it basically consists in the practical and efficient application of (i) administration action, (ii) programming action; (iii) coordination action, (iv) management and monitoring of both development and sustaining policies actions. These task aim to the modernization and the improvement of the competition ability of agriculture, forestry and fisheries sectors with respect to protection and improvement of natural resources and biodiversity in the Campania region. The specific task of the agriculture sector includes the following 3 macro-objectives:

1. Support the economic development in the sectors of agriculture, forestry and fisheries of the regional production system;
2. The protection, promotion and management of land and the environment;
3. Promotion, advice, information and training for the benefit of farmers, forestry and fisheries, and consumers through the development of policies fully coherent and harmonic with the common agricultural policy. In Landwebsupport project "Regcam" guarantee competence in country and regional based transferability actions and testing the developed S-DSS system.

CV or description of persons involved

Brunella Mercadante (female), bachelor's degree in Law at University of Naples Federico II. She is currently Executive Director at Directorate-General (DG) of the Agricultural Policy at Regione Campania and director of the Management Unit "Quality assurance, traceability of Agricultural and Zootechnics and Agricultural Development Service" of the Regione Campania. She is an expert in political management of the territory (she was secretary of the municipality for several municipalities in the Campania Region) and is an expert in environmental protection and management policy (she was Executive Director at the ARPAC - Regional Environmental Protection Agency, 2000)

Amedeo D'Antonio (male), bachelor's degree in Agricultural Sciences at University of Naples Federico II, specialized in pedology and soil conservation. He is currently an officier at the Directorate General (DG) of the Agricultural Policy at Regione Campania, with the role of technical co-ordination and referent for policies and the development of actions on soil and water.

He was responsible – for Regione Campania unit - for the following EU LIFE projects listed below and for many regional and national projects .

Its research activity focuses on territorial evaluations, also using GIS tools, of the impact of the european, national and regional rules on environmental matrices, in particular on soil and water. In addition, he currently is involved in agricultural dissemination activities.

Giuseppe Pesapane (male), bachelor's degree in Agricultural Sciences at University of Naples. He is an official (funzionario?) at the Directorate-General (DG) of the Agricultural Policy at Regione Campania, as referent for the development of cross compliance and greening RDP measures.

Agricultural adviser pursuant to Regulation (EEC) n° 270/79 Officer of the Regione Campania since 2000 with various assignments: development of horticulture (four years), plant health regional service (six years), actually: application of rules on cross-compliance and application of discipline of the residues of farms

Assunta Di Mauro (female), bachelor's degree in Agricultural Sciences at University of Naples.

She is an officier at the Directorate-General (DG) of the Agricultural Policy at Regione Campania, as referent for policies and development of biodiversity actions.

She is an expert and scientific responsible for development services for horticulture, cereal crops and industrial crops, support services for agro-biodiversity and technical support for the implementation of the measures of PSR Campania (rural development plan).

Maria Rosaria Ingenito (female), bachelor's degree in Agricultural Sciences at University of Naples, specialized in pedology and soil conservation. She is currently an officier at the Directorate-General (DG) of the Agricultural Policy at Regione Campania, specialist and referent for the implementation of the Nitrate Directive (Dir. CEE 91/676).

She is an expert in National and European legislation on agricultural / environmental issues. She participates in elaboration of regional rules on agricultural / environmental issues.

Alberto Mattia (male), bachelor's degree in Agricultural Sciences at University of Naples. He is an officier at the Directorate-General (DG) of the Agricultural Policy at Regione Campania. His activity is focused on development of forestry actions. He is an expert in GIS and in environmental assessment procedures, and referent for the analysis and elaboration of the data of the Forest Settlement Plans presented by the Municipalities.

He participates in elaboration of regional rules on forestry issues.

<p>Vivien Buonocore (female), bachelor's degree in Foreign languages  Literature. She is employee at the Directorate General (DG) of the Agricultural Policy at Regione Campania. She currently carries out functions of administrative – technical secretary for the development of activities and projects in foreign languages. In particular, she carries out support activities for the knowledge of English in the management of administrative and scientific technical aspects of projects, with particular expertise in dissemination and communication activities on agricultural policy and land management issues</p>	<p>Literature - 21/03/2018</p>
<p>Fabrizio Ferrer (male), is employee at the Directorate-General (DG) of the Agricultural Policy at Regione Campania. His activities is focused on development of Geographical information System and connection with Regional Information System (SIT I.Ter). In the light of the above mentioned competences, he has worked actively in the realization of many research projects, including the EU LIFE projects listed below.</p>	
<p>5 relevant publications, products, services, datasets, software, achievements</p>	
<p>1. Terribile, F., Bonfante, A., D'Antonio, A., De Mascellis, R., De Michele, C., Langella, G., Basile, A. (2017). A geospatial decision support system for supporting quality viticulture at the landscape scale. <i>Computers and Electronics in Agriculture</i>, 140, 88-102.</p>	
<p>2. Terribile, F., Agrillo, A., Bonfante, A., Buscemi, G., Colandrea, M., D'Antonio, A., De Mascellis, R., De Michele, C., Langella, G., Manna P, Marotta L., Mileti, F A., Minieri, L., Orefice N., Valentini S., Vingiani, S. And Basile, A., (2015). A Web-based spatial decision supporting system for land management and soil conservation. <i>Solid Earth</i>, 6(3), 903.</p>	
<p>3. D'Antonio A., Ingenito M.R. (2006). La sostanza organica nei suoli e la caratterizzazione pedologica dei siti di sperimentazione. In Atti del Convegno "Utilizzo del compost da frazione organica dei rifiuti solidi urbani: attualità e prospettive" Napoli, 30 novembre 2006, 39-54</p>	
<p>4. D'Antonio A., Mottola A., Stellato L., Di Meo T., Ingenito M.R., Lubritto C., Onorati G. (2009) Impiego di tecniche analitiche isotopiche per l'individuazione delle fonti di inquinamento da nitrati nelle acque sotterranee in due aree della Campania. <i>EngHydroEnv Geology</i> 2009, 12, 71-77</p>	
<p>5. Amedeo D'Antonio, Alaa Aldin Alromeed, Anna Maria Stellacci, Rosanna Labella, Mariana Amato (2015). Soil bulk electrical resistivity and forage ground cover: nonlinear models in an alfalfa (<i>Medicago sativa</i> L.) case study. <i>Italian Journal of Agronomy</i> 2015; volume 10:647, 215-219</p>	
<p>5 relevant previous projects, activities</p>	
<p>1. Programma di Sviluppo Rurale della Campania 2014-2020 -CCI2014IT06RDRP019- ver. 2.2, D. EU n. C (2017) 1383 22/02/2017</p>	
<p>2. European Commission: LIFE08 ENV/IT/000408 SOILCONSWEB multifunctional soil conservation and land management through the development of a web based spatial decision supporting system - http://www.landconsultingweb.eu/EN_index.html</p>	
<p>3. European Commission: LIFE11 ENV/IT/000275 ECOREMED implementation of eco-compatible protocols for agricultural soil remediation in litorale domicilio-agro aversano nips - http://www.ecoremed.it/</p>	
<p>4. European Commission: LIFE12 ENV/IT/000719 Technologies to stabilize soil organic carbon and farm productivity, promote waste value and climate change mitigation - http://www.carbonfarm.eu/</p>	
<p>5. Programma operativo FEAMP (Fondo per gli Affari Marittimi e la Pesca dell'Unione Europea) D. EU. n. C(2015) 8452 25/11/2015</p>	
<p>Significant infrastructure, major items of technical equipment</p>	
<p>Regione Campania has mapping and GIS laboratories equipped with advanced hardware and software systems. Regione Campania also has several Agricultural Advisory Centers operating across the whole regional territory.</p>	

Paragraph description of the organisation in light of the project content and main tasks

The Georgikon Faculty of the University of Pannonia is the first regular agricultural higher education institution on the Continent of Europe (established in 1797), and it performs extensive international research programs in soil and environmental sciences, land use, plant production as well as agro-informatics. The university has a wide range of graduate and postgraduate courses for international students, as well as established doctoral schools in the different disciplines. The Department of Plant Production and Soil Science has been running several long-term field experiments since the 1960-ies in which the effect of different rates and forms of fertilizers, soil tillage and crop rotation as well as different systems of organic matter and crop residue management can be studied. The department is also in charge of organizing and supervising the National Long-term Field Trial Network. Data base consisted of soil, plant and climatic data from the field experiments and pilot areas are available for research. The Georgikon Faculty of the University of Pannonia carries out basic and applied research and development in the field of agricultural sciences, participates in the dissemination of professional and scientific knowledge, and works in cooperation with organisations involved in agriculture, the food industry, rural development, environment protection and sustainable development, at both national and international levels.

The Georgikon Faculty, with lead role of the DPPSS is the main organizer and host of the global Land Quality conference series, which brings top land scientist to Keszthely every four years. Infrastructural background of the faculty and the wealth of knowledge that the participating scientists possess enables the University of Pannonia to successfully perform WP leadership and research tasks in the LandSupport project.

CV or description of persons involved

Dr. Gergely Tóth (m) is a professor, (H-index: 22, cited by others: 1284 times) has 20 years of experience in applied research in the areas of soil functions, land evaluation, soil threats. He was the coordinator and principal investigator of the Hungarian land evaluation research programme and was project and task leader in a number of other national and international projects. He has background in soil science and agricultural chemistry from the SCAU in China, PhD and DSc degrees in soil quality and land evaluation from the UP and HAS in Hungary. He was the scientific coordinator of the first LUCAS topsoil survey of the EU, responsible for agri-environmental soil quality indicator development at the European Commission and European coordinator of the Sino-European Panel on Land and Soil.

Dr. Brigitta Tóth (f) is an assistant professor. She has over ten year research experience in soil physics and soil hydrology. Her research activities are focused on soil physics; soil database construction, harmonization; prediction of soil properties at local, regional and continental scale; data mining techniques; mapping of soil hydraulic properties. Most important contributions include the construction of the EU-HYDI database; development of pedotransfer functions for Hungarian and European scale applications; collaboration on incorporating the European hydraulic PTFs in 'eupft' R package; preparation of soil hydraulic maps for Europe at 250 m resolution.

Dr. Tamás Hermann (m) is an assistant lecturer, agronomist, soil scientist, GIS expert. He has fifteen years research experience in research on soil fertility, land evaluation, soil quality assessment. He participated in several research project focused on digital soil mapping, development of land evaluation systems. The main field of his research is also focusing on mapping of agro-environmental indicators and soil properties. He is dealing with nutrient management and with the effect of soil physical properties in different types of soil managements.

5 relevant publications, products, services, datasets, software, achievements

1. Tóth, G., Jones, A. & Montanarella, L. 2013. The LUCAS topsoil database and derived information on the regional variability of cropland topsoil properties in the European Union. *Environ. Monit. Assess.* 185: 7409. doi:10.1007/s10661-013-3109-3
2. Tóth G, Gardi C, Bódis K, Ivits É, Aksoy E, Jones A, Jeffrey S, Petursdottir T, Montanarella L 2013. Continental-scale assessment of provisioning soil functions in Europe *ECOLOGICAL PROCESSES* 2:(32) 1-18.
3. Tóth, G., Hermann, T., M R Da Silva, Montanarella, L., 2016. Heavy metals in agricultural soils of the European Union with implications for food safety, *Environment International* 88: PP. 299-309.
4. Tóth, B., Weynants, M., Pásztor, L., Hengl, T. 2017. 3D Soil Hydraulic Database of Europe at 250 m resolution. *Hydrological Processes*. doi: 10.1002/hyp.11203.
5. Hermann, T. and Tóth, G., Evaluating the effect of nutrient levels of major soil types on the productivity of wheatlands in Hungary, *Communications in Soil Science and Plant Analysis*, 42:1497–1509, 2011

5 relevant previous projects, activities

1. Soilcare - "Soil Care for profitable and sustainable crop production in Europe" H2020 project (677407) (2016-2021)
2. iSQAPER - „Interactive Soil Quality Assessment in Europe and China for Agricultural Productivity and Environmental Resilience” H2020 project (635750) (2015-2020)
3. MyWater – Merging Hydrologic models and EO data for reliable information on Water (www.mywater-fp7.eu). EU FP7 (263188) Collaborative Project (FP7, 2011-2014)
4. DIGISOIL - Integrated system of data collection technologies for mapping soil properties. EU FP7 (211523) Collaborative Project (FP7, 2008-2011)

5. D-e-METER – Developing an Internet-based land evaluation and data collection system to integrate environmental resources appraisal and agricultural information management. NKFP 3/004/2001 (2001-2004) 11/03/2018

Significant infrastructure, major items of technical equipment

University of Pannonia hosts various digital soil property and thematic soil maps with different resolutions for Hungary. The university has well equipped laboratories to measure physical, chemical and biological soil properties and supporting GIS department. It has been running long term field experiments since decades.

The faculty bears a wealth of significant infrastructure ranging from racehorse fields to high-tech aquaculture genetics laboratory and conference facilities. The experimental farm, the soil laboratory and the computing center are among those infrastructural elements which are especially important for the LANDSUPPORT project and which are continuously upgraded to keep on the highest international standard. The faculty hosts a number of regional and country biophysical datasets (including soil maps, management inventories, added value spatial datasets etc.) and acts as an information hub for land quality data. This infrastructural capacity together with the professional personnel enabled the DPPSS to play leading role in country and continental scale soil and land use mapping and assessment projects resulting a series of thematic maps with regional to continental coverages, which are also kept at the Faculty and available for the LandSupport project.

Paragraph description of the organisation in light of the project content and main tasks

Research topics: (i) Analysis and modelling of crop growth, soil water dynamics, carbon and nitrogen cycling in the soil-plant-atmosphere system at different scales (sub field, field, catchments, region); (ii) Model based evaluation of climate change impact on field crops yield and definition of adaptation strategies; (iii) Field and model based assessment of land use and management strategies to enhance soil fertility and crop yield while reducing nitrogen leaching and greenhouse emissions. Main activities: (i) Development and improvement of ARMOSA (process-based model of the soil-plant-atmosphere system) that is used to investigate carbon and nitrogen cycling under different cropping systems, pedoclimatic conditions, tillage and climate change scenarios; (ii) Design and management of field experiments on gas emissions (i.e. N₂O and NH₃), nitrate leaching, nitrogen and water use efficiency in field crops and grassland.

CV or description of persons involved

Alessia Perego, Female, Senior Researcher in agroecology since 2011. Since 2007, research activities within 3 national and 4 international projects, including:

LIFE HELPSOIL – (LIFE12 ENV/IT/000578, 2014-2017). Improving soils quality and strengthening the adaptation to climate change through sustainable techniques of Conservation Agriculture

FACCE JPI MACSUR (2013-present). Activities: modelling analysis of winter wheat and grassland productivity, gaseous exchange and carbon dynamics in soils under contrasting scenarios of climate change in Europe.

ARMOSA (Lombardia Region, 2007-2013): Setting up of a monitoring network for the study of the dynamics of nitrogen in the atmosphere and in ground and runoff water in Po valley (northern Italy).

Teaching activity in Agronomy and Statistical methodology for agricultural research.

20 in international journals with IF (Scopus H index= 8, 196 ISI citations).

Marco Acutis, Male, Full Professor in Agronomy at the University of Milano from 2005. Coordinator of the “ValorE” project founded by Lombardy Region (1.4 M€). Main scientific consultant of the World Bank Project climate change and crops in Latin America (250.000 \$). Main scientific consultant of the LIFE+ Project HelpSoil (201-2017). Work package leader of the EU project STAMINA. In charge of the soil water and nitrogen simulation unit of the project SIPEAA (Computer tools for eco-compatible planning of farms) and Aquater (Decision support systems for irrigation in Mediterranean areas) founded by Italian Ministry of Agriculture and task leader in the EU SEAMLESS project. Member of the EFSA panel on Genetically Modified Organisms, task on “statistical considerations in the safety evaluation of GMO’s (2009-2010) and member of the EFSA WG for preparing two scientific Opinion on the FOCUS ground water report. Member of the editorial board of European Journal of Agronomy and of Environmental Modelling and Software. Italian representative for the European Society for Agronomy (2002-2006). Member of the board of Italian Society for Agrometeorology (since 2008) and of the Italian Society for Agronomy (1999-2005).

Teaching activity in agronomy, statistical methodology for agricultural research, and agricultural ecology.

100 in international journals with IF and 2 books chapter edited by Elsevier. (Scopus H index= 21, 1236 ISI citations).

5 relevant publications, products, services, datasets, software, achievements

Perego A., Basile A., Bonfante A., De Mascellis R., Terribile F., Brenna S., Acutis M., 2012. Nitrate leaching under maize cropping systems in Po valley (Italy). *Agriculture Ecosystem and Environment* 147: 57-65.

Perego A., Giussani A., Sanna M., Fumagalli M., Carozzi M., Alfieri L., Brenna S., Acutis M., 2013. The ARMOSA simulation crop model: overall features, calibration and validation results. *Italian Journal of Agrometeorology* 3:23-38.

Acutis M., Alfieri L., Giussani A., Provolo G., Di Guardo A., Colombini S., Bertoncini G., Castelnuovo M., Sali G., Moschini M., Sanna M., Perego A., Carozzi M., Chiodini M.E., Fumagalli M., 2014. ValorE: An integrated and GIS-based decision support system for livestock manure management in the Lombardy region (northern Italy). *Land Use Policy* 41:149-162.

Pirttioja N., Carter T.R., Fronzek S., Bindi M., Hoffmann H., Palosuo T., Ruiz-Ramos M., Tao F., Trnka M., Acutis M., Asseng S., Baranowski P., Basso B., Bodin P., Buis S., Cammarano D., Deligios P., Destain M.F., Dumont B., Ewert F., Ferrise R., François L., Gaiser T., Hlavinka P., Jacquemin I., Kersebaum K.C., Kollas C., Krzyszczak J., Lorite I.J., Minet J., Miguez M.I., Montesino M., Moriondo M., Müller C., Nendel C., Öztürk I., Perego A., Rodríguez A., Ruane A.C., 24, Ruget F., Sanna M., Semenov M.A., Slawinski C., Stratonovitch P., Supit I., Waha K., Wang E., Wu L., Zhao Z., Rötter R.P., 2015. Temperature and precipitation effects on wheat yield across a European transect: A crop model ensemble analysis using impact response surfaces. *Climate Research* 65:87-105.

Sándor R., Acutis M., Barcza Z., Doro L., Hidy D., Köchy M., Minet J., Lellei-Kovács E., Ma S., Perego A., Rolinski S., Ruget F., Sanna M., Seddaiu G., Wu L., Bellocchi G., 2015. Multi-model simulation of soil temperature, soil water content and biomass in Euro-Mediterranean grasslands: uncertainties and ensemble performance. *European Journal of Agronomy*, accepted (DOI: 10.1016/j.eja.2016.06.006).

5 relevant previous projects, activities

1. MACSUR JPI FACCE (2013-present): Modelling analysis to evaluate the response of winter wheat yield and carbon dynamics in grassland to a large range of climate conditions in 16 sites throughout Europe.

2. LIFE+ HELPSOIL (2015-2017): Elaboration of data collected on the field trials of the HelpSoil project; calibration of water, carbon, and nitrogen-related parameters of the process-based model ARMOSA to simulate conservation agriculture practices (minimum tillage and no tillage) under current and future climate scenarios.

3. ValorE - Funded by Lombardy Region (2011-2015): Development of a Decision Support System (DSS) to be applied at both farm and regional scale in Lombardy (Northern Italy) in order to find the best option for minimising the risk of environmental pollution (mainly N) and checking, ante factum, possible impacts of new policies.
4. SEAMLESS (2004-2009) EU Project: System for Agricultural and Environmental Modelling: Linking European Science and Society- Development of Water and Erosion components of the SEAMLESS modelling system.
5. STAMINA (2002-2006), EU Project, Development of a crop simulation model to simulate cereals and oil seed rape growth in hilly landscapes in Europe.
Significant infrastructure, major items of technical equipment
ARMOSA simulation model, version 4.0

Paragraph description of the organisation in light of the project content and main tasks

Zala County Self-Government (ZCG) is a county level public authority in south-western Hungary, based in the county's capital Zalaegerszeg. According to the new territorial planning system in Hungary counties have major role in the planning and implementation of territorial development programmes, defining the key EU funded development projects. As the responsible authority, ZCG plays a key role in the spatial planning as well and among its general tasks ZCG elaborated the Spatial Plan of Zala County (accepted by the General Assembly of Zala County). The purpose of the regulation is to determine the conditions for the useage of the land in certain areas of Zala County, for the coordinated spatial order of the technical infrastructure networks, in the view of sustainable development of the region, and for the preservation of the territorial, landscape, natural, ecological and cultural conditions, furthermore for the potection and the sustainable use of natural resources. Our main task in the Landsupport project is practical testing of the main outputs of the project, like in the framework of the project developed web-based tool which can be connected our existing geographical evaluation systems (e.g. golden crown evaluation).

CV or description of persons involved

Veronika Kárpáti is responsible for regional development in Zala County. She represents of Zala County in the Monitoring Committees (HU-HR, SI-HU, AT-HU, TOP). Her main task is to promote the developments related to Zala county, the implementation of international development ideas of the county. Project experiences: Common values of our past – our living heritage (Slovenia-Hungary CBC Program); Joint planning and cooperation for long-term development in the cross-border region (Hungary – Croatia CBC Program); Geothermal Resource Assessment of the Drava Basin (Hungary – Croatia CBC Program); Labour market promotion (Slovenia – Hungary CBC Program).

Károly Szabó is responsibe for the management of cross-border and domestic projects, including the development of new project ideas, furthermore the planning, the implementation, and the monitoring of these projects. Relevant experiences: LAMAPROM (SI-HU 2007-2013 - lead partner project manager), Tourism4C (HU-HR), ATM for SMEs (INTERREG EUROPE 2014-2020), EUCOMPASS 2 (HU-HR), Furnitu-Re (Central START).

5 relevant publications, products, services, datasets, software, achievements

1. Spatial Plan of Zala County, elaborated by ZCG.

5 relevant previous projects, activities

1. DRAVA GEO project: closed (funded by Hungary-Croatia CBC Program). The aim of the project was to collect more comprehensive information on geothermal systems, particularly those located on the border lands, using surface studies and data of past exploratory drilling sin order to provide the framework for setting long-term energy policy and for strategic decisions made by industry and government.

2. ERRAM project supported by ZCG as strategic partner: closed (funded by Austria-Hungary CBC Program). Main activities: Creation of a cross-border, synchronised database that contains relevant location information; Modelling cross-border accessibility matrices; Programming a common GIS-Tool to calculate regional potentials; evaluate and present achievements in a 'Potentials of the border region' map; Execution of pilot activities in partner regions.

3. RURES project: in progress (funded by Central Europe Program). The main objective of RURES is to exploit the potential of RES and increase energy efficiency in rural regions as they have a great potential to reach energy autonomy.

Significant infrastructure, major items of technical equipment

Our organization has every IT tools (smartpohnes, notebooks, tablets etc.) which is needed for the adoption and testing of the project outputs, like the web-based application. These technical equipment is currenty under useage by the existing evaluation system but the infrastructure has enough capacity to be complemented (and at the same time developed) by the project outputs.

Other supporting documents relevant to the call

Climate Strategy of Zala County and Climate Change Platform (in progress).

Paragraph description of the organisation in light of the project content and main tasks

CMAST bvba (CMAST) - more specifically its Business Unit Strategic Collaborations, with locations in Temse (Belgium) and Munich (Germany, both on the bvba legal entity) - will deliver expertise in WP07 and support the Coordinator UNA in all WP08-related tasks, including project coordination and management, controlling, contractual, communication and research management.

CMAST delivers Project Management, Consulting and Business Solutions services to its life science clients, with >50 experienced project managers and consultants, specialized in 4 business areas. With our Strategic Collaborations business unit / team, services range from facilitating multi-stakeholder collaboration platforms to advisory services on funding opportunities and project management of large multi-stakeholder or consortia projects.

Our recent project engagements summarise as follows:

- 8 IMI projects (ND4BB, Predict TB, EBOVAC, EMIF, RADAR, EPAD, PHAGO)
- 5 large consortium H2020/FP7 projects (MSCA-IAPP, SPIRE, BIOFECTOR, EURenOmics)
- Other funding agencies (BARDA, NIH, BMGF, WHO, BioAster, VLAIO, IWT)

With a thorough understanding of academic as well as industrial Life Sciences research environments, CMAST is able to form a neutral "bridge" between the various stakeholders' needs and facilitate the joint effort towards high-quality project outcomes.

CV or description of persons involved

Kathrin Prebeck (Strategic Collaborations, Munich), with a Masters Degree in European Studies from the University of Passau, is an experienced project manager with about 10 years of various assignments in numerous fields: IMI JU, HEALTH, Food, Security, Infrastructure, BLE, Culture, with a participation in more than 20 projects during all different stages (proposal, negotiation, project management and project finalization). Kathrin Prebeck has acted as a team lead for technical question, and has developed to be an engaged presenter with good communication skills. In the past, Kathrin Prebeck has boosted multi-stakeholder collaboration by lean, but integrative processes and a strong result-oriented focus within any consortium, of any size or scope.

Andre Durudas (Strategic Collaborations, Munich) is an experienced project manager who has since 2010 worked in science project management, including NIH-funded collaboration projects as well as large-scale European-funded research projects in the FP7, Horizon2020 and IMI2 programs. He has been involved in all project stages, including proposals, negotiation, project execution and closure.

Katrien Vanherck (Strategic Collaborations, Temse, Msc and PhD in Bio-Engineering) is a grant consultant, with about 6 years experience in European grant applications as well as project and portfolio management (FP7 and Horizon 2020, LIFE, CEF, COST, Interreg). She is a capable team leader, an experienced presenter and coach and has built up expertise in the organisation of brokerage and dissemination events and workshops.

Caroline Sage (Strategic Collaborations, Temse), with a PhD in Neurosciences from the Catholic University of Leuven, is an experienced project manager and business consultant who has been involved in the set-up and management of multi-stakeholder collaborations since 2010. These include both local (FWO, VLAIO), European (IMI1/2, FP7, H2020, COST, Interreg) and international (Bill & Melinda Gates Foundation, NIH)-funded research projects, in which Caroline has been involved in advising and supporting submission of funding applications, advising on finding appropriate funding opportunities, portfolio management at departmental and campus level of externally funded projects, project planning and resource management in individual projects, setting up partnerships and collaboration schemes, and organizing workshops and meetings for project teams and external stakeholders.

Paragraph description of the organisation in light of the project content and main tasks

Created in 2003 and based in France (Colmar & Grenoble), ACTeon is a human size (20 staff members) research and consultancy specialized in the “soft” dimensions of environmental policy, i.e. social assessment, economics, institutions & governance, facilitation of multi-stakeholder processes, etc. ACTeon’s activities cover a wide range of environmental policy domains, such as water, the link between agriculture & the environment, biodiversity, marine resources, renewable energy, climate change and adaptation. ACTeon is involved in research and consultancy projects at the local, regional, national and European scales. It works for local authorities and environmental/water agencies, national ministries and international organizations such as the European Commission, the European Environment Agency or the OECD. The geographic focus of ACTeon’s activities is the European Union and its neighbouring regions, in particular the Mediterranean Sea region and the Caucasus region.

CV or description of persons involved

Pierre STROSSER is the head of ACTeon and an environmental economist. Combining a dual expertise in water management and environmental economics, Pierre has been involved in the development and implementation of the economic elements of the WFD (economic assessments and economic instruments) for more than 10 years, first as economist at DG Environment where he was in charge inter alia of the economic aspects of the WFD and then as consultant since 2003 with involvement in WFD economics projects and operational applications in around 15 countries and river basins. Pierre is also involved in several studies for assessing the economic value of aquatic ecosystem goods and services, applying a wide range of methods such as avoided cost, travel cost, contingent valuation or choice experiment. In addition, he is leading, or contributing to projects that aim at supporting the development of local catchment plans, these projects mobilizing economic assessments such as cost-effectiveness, costs & benefits or economic valuation. Pierre works in English, French and German.

Gloria DE PAOLI is an environmental economist at ACTeon. She is involved in ResponSEable, a Horizon 2020 research project aimed at understanding and communicating to the public the complex human-ocean relationships and the economic benefits that we derive from marine and coastal ecosystems. She was in charge of ACTeon’s contribution to the DEMOWARE research project, which includes the development of suitable pricing schemes, as well as a cost-benefits analysis tool, for water reuse technologies across Europe. Gloria coordinated a study on managing water demand in Europe for the EEA, which includes a review of price and non-price measures as well as an assessment of price elasticity of water demand. She also coordinated an EU-wide assessment on the potential for growth and job creation through the protection of water resources, where she worked at the interface between EU water policy and macro-economic strategies, analyzing how water policy implementation can promote or constraint economic development and employment in the EU. Gloria works in Italian, English and French.

Anais HANUS - agricultural, food and environmental public policies, stakeholders engagement and participation in territorial development.

5 relevant publications, products, services, datasets, software, achievements

1. De Paoli, G., Mattheiss, V., 2016. Cost, pricing and financing of water reuse against natural water resources. DEMOWARE FP7 Research Project, Deliverable 4.7

2 De Paoli, G., Agenais, A., Strosser, P., Anzaldúa, G., Rouillard, J., Tröltzsh, J., Hinzmann, M., Dige, G., 2016. Managing water demand in Europe: price and non-price approaches to water conservation – Final Report. Service Contract for the EEA No 3415/B2015/EEA.56130. Briefing published at: <https://www.eea.europa.eu/publications/water-management-in-europe-price>

3 Rossi, A., Hanus, A., Arama, Y., 2015. Installations et transmission en agriculture: potentialités et dynamiques à horizon 2035. Etude pour le Ministère de l’Alimentation, de l’Agriculture et de la Forêt. <http://agriculture.gouv.fr/ministere/installations-et-transmission-en-agriculture-potentialites-et-dynamiques-horizon-2035>

4 EEA, 2013. Assessment of cost recovery through pricing of water. Technical report No 16/2013. Main authors of the report: De Paoli, G., Strosser, P., Anzaldúa, G., Ayres, A., Lange, M., Lago, M., Oosterhuis, F., Dige, G. <https://www.eea.europa.eu/publications/assessment-of-full-cost-recovery>

5 Prestor, J., Strosser, P., Bouscasse, H., Neza, E., 2009. Which monetary values for the quality of our environment? The example of pollution in the Krška kotlina alluvial aquifer in Slovenia. *Geologija* 52/1, 113-126

5 relevant previous projects, activities

1. ResponSEable (Supporting the development of cost-effective ocean literacy in Europe) - H2020 research project - 2014/2018

2. DEMOWARE – Innovation & Demonstration for a Competitive and Innovative European Water Reuse Sector - H2020 Research project - 2014/2016

3. Garonne 2050 : perspective study on water needs to the 2050 Horizon in the Garonne river basin - Consultancy project for the Adour-Garonne Water Agency - 2010/2014

4. Development of several Management Plans of French sub-basins, in the context of the River Basin Management Plans - Consultancy projects for several French Water Agencies - 2008/2016

5. Pilot Project - Atmospheric Precipitation -Protection and efficient use of Fresh Water: Integration of Natural Water Retention Measures in River basin management - Consultancy project for DG Environment - 2013/2015

Paragraph description of the organisation in light of the project content and main tasks

The Environment Agency Austria (Umweltbundesamt, EAA) was established in 1985 and is the environmental specialist institution of the Austrian Federal Government. As Austria's largest expert organisation for the environment and one of Europe's leading environmental consultants we are committed to transforming the economy and society in order to ensure sustainable living conditions. With over 500 experts from 55 disciplines we develop an interdisciplinary and cross-cutting knowledge base for decision making on the local, regional, European and international level. EAA undertakes environmental monitoring, assessment and evaluation for the Austrian Minister of the Environment, plays a key role in the implementation of federal environmental laws, EU directives and regulations, provides expert advice to federal and other institutions, designs and operates national environmental databases and is involved in multiple co-operations with national and international institutions. It plays an important role in the EIONET, in that it is the National Focal Point (NFP) for the European Environment Agency (EEA) as well as leader or partner in several European Topic Centres and it is the National Reference Centre of the EEA in several areas. EAA works transparently and independently and engages in dialog with stakeholders in politics, public administration, business, science and civil society.

EAA has in particular expertise in all fields of qualitative and quantitative land and soil protection, such as land cover and land use monitoring, soil sealing and land take, soil and water contamination, ecological impact assessment of agricultural practices, LULUCF reporting and climate change adaptation as well as processing of GIS data. Some years ago awareness raising measures and citizen in-volvement for the protection of soil has been added as a further field of work.

CV or description of persons involved

Sigbert Huber (male), MSc is head of the department for soil and land use management at the Environment Agency Austria since 2010. He has 24 years of experience working in the field of soil protection and environmental reporting. He has been employed at the Environment Agency Austria since 1998 where he provides assessments and interpretation of national and international soil protection issues. Special topics of his work include soil policy, soil indicators, soil monitoring, soil functions and land management at national and international level. He led work packages in several EU projects dealing with soil degradation, soil data and soil management (ENVASSO, GS SOIL, URBAN SMS). Furthermore he was involved in the development of the EU Soil Policy (TWG Soil Contamination). He is National Reference Centre for Soil of the European Information and Observation Network of EEA and member of the European Soil Bureau Network (ESBN). In 2015 he became Secretary of the International Union of Soil Sciences.

Gundula Prokop (female), MSc, MBA is senior expert and project manager at the Austrian Environment Agency (Umweltbundesamt) since 1996. She has 21 years professional experience in soil policy, land take, soil sealing and international project management. She has been mainly providing consultancy to the European Environment Agency and working as co-ordinator or project partner in EU Research and Territorial Co-operation Projects. Furthermore, she has been working under contracts for the European Commission, EUROSTAT, the World Bank and the Joint Research Centre. Gundula has been in charge of developing an indicator for contaminated sites for the EEA (CSI015, LSI003), indicators for land take and soil sealing for the European Commission and land use indicators for regional surveys on behalf of EUROSTAT. Gundula is an active networker and member of several national and international working groups, including the National Reference Centre for Land Use (EEA). Gundula is author and editor of national and international publications related to contaminated land management, brownfield recycling and land take.

Peter Weiss (male) works since 1988 in the Environment Agency Austria, Dept. of Climate Change Mitigation & Emission Inventories. Peter Weiss led 25 international (partly EU-funded) or national projects (participated in more than 100 projects). He leads since 19 years the estimates and reporting for sector land use, use change and forestry (LULUCF) in Austria under the UN-FCCC, Kyoto-Protocol and related EU decisions. In addition, he provided successfully assistance to some EU member states in improving their reporting of LULUCF on basis of national contracts, TWINNING- and TAIEX-Missions and EC MS-assistance projects. He is certified UN-FCCC reviewer for the LULUCF-sector, nominated reviewer and (contributing) author to (IPCC) guideline documents on LULUCF. He participated in several international projects (CARBOINVENT, MASCAREF) and COST Actions (COST E21, COST E43, COST 639) on the LULUCF topic. In addition to his LULUCF-related activities, he has a several years expertise in bioindication and monitoring of heavy metals and organic pollutants and was carrying out several national and international monitoring projects on the load with these pollutants close to sources and in remote areas (e.g. MONARPOP). He is (co-)author of more than 100 publications (book chapters, reports, papers).

Harald Loishandl-Weisz (male) works since 2007 in the Environment Agency Austria, Dept. of Groundwater. He is responsible for data management and administration of the groundwater quality monitoring in Austria. His work covers Quality Assurance, methodology development, status and trend assessment and reporting. In this context he gained experience and knowledge of water related policy and legislation at national and EU level. He gained working experience in multi-disciplinary soil and waste related projects and agricultural land-use with regard to groundwater protection. In order to evaluate the agricultural nitrogen surplus, he carried out the calculation of Nitrogen Balances at the level of groundwater bodies according to the 'Gross Nitrogen Balances'-method of the Eurostat/OECD Handbook 2007. As project leader he coordinated a team of researchers from different academic disciplines. Due to his consultancy work in the ICPDR Groundwater Task Group he is familiar with drafting and presentation of multi-country analytical reports. He was involved in Twinning Projects in Turkey and Kosovo dealing with analyses and development of monitoring networks for groundwater, data validation, data assessment and reporting, and training on groundwater sampling.

Gerhard Zethner (male) is an agricultural expert, working at the department of land use & bio safety in the Umweltbundesamt (Austrian Federal Environment Agency) since 1991. He has 25 years of professional experience in the field of agricultural and environmental aspects of agricultural activities. He elaborates regular contributions to the evaluation of the Austrian environmental program as part of the EU rural development program. Focuses are on the links between agricultural activity, biodiversity, greenhouse gas emissions and abatement and soil protection. In this context the development of agri-environmental indicators are of concern at grass root level. As a member of the Austrian delegation at the OECD Joint Working Party he stipulated the process of developing agri-environmental indicators and IRENA indicators. He is in the team which prepares the yearly Austrian national inventory report to the IPCC - chapter agriculture and the chapter land use, land use change and forestry (LULUCF). Beside these major activities he works in cooperation the STATISTIC AUSTRIA on a regional agricultural nitrogen and phosphorus balance. Agricultural sources of emissions of non-greenhouse gas and particle mater (PM) are of concern too.

5 relevant publications, products, services, datasets, software, achievements

1. Anderl M., Friedrich A., Haider S., Kriech M., Lampert C., Moosmann L., Pazdernik K., Pfaff G., Pinterits M., Poupa S., Purzner M., Schmid C., Schmidt G., Schodl B., Stranner G., Schwaiger E., Schwarzl B., Titz M., Weiss P., Zechmeister A. (2017): Austria's National Inventory Report 2017 - Submission under the United Nations Framework Convention on Climate Change and under the Kyoto Protocol. Umweltbundesamt Wien, Report-0608, 733 pp., download: <http://www.umweltbundesamt.at/fileadmin/site/publikationen/REP0608.pdf>
2. Weiss P., Freibauer A., Gensior A., Hart K., Korder N., Moosmann L., Schmid C., Schwaiger E., Schwarzl B. (2015): Guidance on reporting and accounting for cropland and grassland management in accordance with Article 3(2) of EU Decision 529/2013/EU, Task 3 of a study for DG Climate Action: 'LULUCF implementation guidelines and policy options', Contract No CLIMA.A2/2013/AF3338, Institute for European Environmental Policy, London, download: http://forest.jrc.ec.europa.eu/media/cms_page_media/232/LULUCF_Guidance_on_CM_and_GM.pdf
3. Salata, S., Prokop, G. (2017): Limitation, Mitigation and Compensation in Urban Expansion, Land Cover and Soil Ecosystem Services, Routledge, ISBN: 9781138885097
4. Huber, S. & Prokop, G. (2015): Soil Sealing In: Task Force: Soil Matters - Solutions Under Foot - Stephen Nortcliff (Editor), CATENA VERLAG – GeoEcology Essays, ISBN 978-3-923381-63-0, p. 55-60.
5. H. Loishandl-Weisz, G. Zethner, U. Wemhöner, I. Zieritz, J. Grath (2013): Nitrogen balances - calculations for groundwater bodies, 31 pp., download: <https://www.bmlfuw.gv.at/wasser/wasserqualitaet/grundwasser/Stickstoffbilanzen.html>

5 relevant previous projects, activities

1. The European Topic Centre on Urban, Land, and Soil Systems (ETC-ULS) supports EEA, the European Commission, and Member States (through EIONET) in their environmental decision support tools towards a more integrated approach to environmental issues, including societal challenges mirrored on the inclusion of urban areas, ecosystems, land, and the soil as the biophysical basis for ecosystems, and for human activities, 2015 - 2018, <http://uls.eionet.europa.eu/>
2. RECARE Preventing and Remediating degradation of soils in Europe through Land Care: The main aim of RECARE is to develop effective prevention, remediation and restoration measures using an innovative trans-disciplinary approach, actively integrating and advancing knowledge of stakeholders and scientists in 17 Case Studies, covering a range of soil threats in different bio-physical and socio-economic environments across Europe, 2014 - 2019, <http://www.recare-project.eu/>
3. INSPIRATION - INtegrated Spatial Planning, land use and soil management Research ActiON: INSPIRATION is a coordination and support action funded by the European Commission in order to develop a Strategic Research Agenda (SRA) for Europe on soil, land use and land management, 2015 - 2018, <http://www.inspiration-h2020.eu/>
4. LULUCF implementation guidelines and policy options funded by DG Climate action (CLIMA.A2/2013/AF3338) provided guidance for Member States on reporting and accounting for cropland and grassland management in accordance with Article 3(2) of EU Decision 529/2013/EU, 2014, http://forest.jrc.ec.europa.eu/media/cms_page_media/232/LULUCF_Guidance_on_CM_and_GM.pdf
5. Status analysis of nitrate balances of Austrian groundwater bodies as part of the Status analysis 2013 used as basis for the preparation of the 2nd national water management plan 2015 (national implementation of EU Water Framework Directive), <https://www.bmlfuw.gv.at/wasser/wasserqualitaet/grundwasser/Stickstoffbilanzen.html>

Significant infrastructure, major items of technical equipment  Associated with document Ref. Ares(2018)1548916 - 21/03/2018

Austrian Inventory of riparian zones 2011, Austrian MAES habitat map 2013, Corine LC 1990 - 2012, HRL Copernicus 2012, Austrian Sentinel 2 Land cover map 2017, Austrian Soil Carbon Calculator 2015, Member of National Inspire Coordination Network, ArcGIS licences and IT service unit available

Paragraph description of the organisation in light of the project content and main tasks

The Slovenian Forestry Institute is a public research institute of national importance, which conducts basic and applied research on forests and forest landscapes, forest ecosystems, wildlife ecology, hunting, forest management, and other uses of the resources and services forests provide. The scientific knowledge from these fields helps further the research on forest biodiversity and its management in relation to climate change.

As part of its research programme and related studies, the Institute also provides forestry and environmental services in the public interest.

Another of the Institute's functions is to provide scientific knowledge on all aspects of sustainable development, with the purpose of increasing knowledge and awareness of the importance of forests within the environment and the importance of forest management. In short, the Institute is a scientific, professional, and cultural storehouse for Slovenia's relationship with its forests and the resources and services they provide.

Research Program

The Institute's research programme is organized into six departments, all of which study forests from the standpoint of the sustainable development of society, in balance with the environment, and of which three are involved in this project:

- **Department of Forest Ecology** encloses research into the status of forest ecosystems and processes taking place within them.
- **Department of Forest and Landscape Planning and Monitoring** concentrates on guidance of sustainable development of forests.
- **Department of Forest Yield and Silviculture** focuses on research of growth and yield of forests and studying trees and ecosystems' response to the environmental and climate changes.
- **Department of Forest Physiology and Genetics** combines research and professional guidance in forest physiology and genetics, biodiversity and belowground complexity, conservation of forest genetic resources and forest reproductive material.
- **Department for Forest engineering and economics:** The main priorities are studies and implementation of the innovative approaches for sustainable acquisition and use of renewable forest resources.

- **Department of Forest Protection.** The main priorities are to determine harmful biotic and abiotic factors, predict their occurrence with application of ecological modelling

Public Forestry Service

The Slovenian Forestry Institute intensively monitors forests as part of the public forestry service. This includes surveying and recording forest degradation and damage, providing a diagnostic reporting service, developing an information system for research purposes, and monitoring forestry seeding and nursery activities.

The Institute is also committed to sustainable forest management and the conservation of its biological diversity, as well as to the further development and organization of the Slovenian forestry system and forestry policy.

Public Environmental Service

The Slovenian Forestry Institute's public environmental service monitors emissions and sinks of greenhouse gases resulting from land use, land use change, and forestry. As a signatory of the United Nations Framework Convention on Climate Change, Slovenia is required to submit an annual report on greenhouse gas emissions and sinks. Slovenia is also a signatory of the Kyoto Protocol, which requires countries to reduce greenhouse gas emissions to 1990 levels (for Slovenia to 1986 levels). The Kyoto Protocol allows for flexibility in the manner of cutting emissions. Countries may, for example, partially offset their greenhouse gas emissions with their forests, which remove carbon dioxide from the atmosphere.

The Slovenian Forestry Institute successfully collaborates with Slovenian forestry, timber, and nature conservation organizations, as well as with other educational and research organizations both in Slovenia and abroad.

CV or description of persons involved

dr. Primož Simončič, male works as a senior researcher at the Slovenian Forestry Institute (SFI). He worked as a researcher at the **Department of Forest Ecology** at the SFI and Head of the Department between 1996 and 2013.

The scope of his work includes forest soil quality, forest soil nutrients and tree nutrition, and carbon pools and fluxes in forest ecosystems. He has specifically focused his work on intensive monitoring of forest ecosystems, carbon sequestration, and greenhouse gas reporting.

Member of societies, commissions, project boards: P. Simončič was/is a national coordinator (n.c.) and member of project boards, he was involved as national expert in ICP Forest experts groups (FSCC, FFCC, EPD) within Forest Focus programme (EU/MKGP/MOP: 2004-06, n.c.), ICP Forest/MKGP (2007-2008), -2008 LIFE+ project FutMon (EU/MKGP, n.c.); co-worker and national coordinator of EU projects RECOGNITION (FAIR, n.c.), NAT-MAN (V. EU FP), SUSTMAN (V. EU FP, n.c.), MONARAPOP (Interreg III b; n.c.), »pilot project BioSoil – module Soil« (n.c.), CarbonPro (CADSES; n.c.), COST BurnOut, ManFor CB D (n.c.), EMonFUr Life+ (n.c.), Regiopower (n.c.), Euforinno (co-worker) and national coordinator of several national projects

<p>prof. dr. Tom Levanič, male, senior researcher at SFI (Department of Forest Yield and Silviculture) with scientific background in forest growth, dendroclimatology, intra-annual growth and measurement of tree growth with dendrometers. Principal investigator on a number of EU projects under FP 6 and FP 7 scheme, leader or co-worker on national basic and applied research projects; specialised for tree growth in space and time, as well as on intra-annual level in combination with physiological measurements. Expert for light stable isotopes in tree-rings and other plant-based material. TL is also a Slovenian member in the programme coordinating group of ICP Forest and chair of the expert panel for Growth. He is a professor of forest management at the Biotechnical Faculty, University of Ljubljana.</p>
<p>dr. Andrej Kobler, male, research fellow at SFI (Department of Forest and Landscape Planning and Monitoring). BSc forestry, MSc spatial planning, PhD remote sensing. Involved in national and EU projects as GIS & remote sensing expert, work-package leader and project leader. Since 1994 working on machine-learning-based modelling and model-based forecasting and mapping of forest stand attributes, forest fire danger, climate change related forest alteration, species habitats; remote sensing in lidar, aerial photo-, satellite multispectral domains; remote sensing-based based modelling of forest stand attributes and relief under the forest canopy; pixel based- and image pattern-based forest mapping using mid-resolution and high resolution satellite imagery.</p>
<p>dr. Lado Kutnar, male, senior researcher at SFI (Department of Forest Ecology), with scientific background in Forest Biodiversity and Forest Ecology; PhD in Systematic and Ecology (Biology at Biotechnical Faculty) . Fields of research work: Biodiversity of plant species/ecosystems; Phytosociology, forest communities and habitat types (Natura 2000); Typology of forest sites and site mapping; Plant ecology; Evaluation of environmental factors and bioindication; Climate change impacts to forests; Nature-conservation topics (invasive plant species, conservation of plant and habitats of Natura 2000 area); Forest ground vegetation and forest regeneration; Forest management and planning aspects; Monitoring of forest biodiversity and site conditions. Participation in various international projects, e.g. NAT-MAN, SUSTMAN, BioSoil-Biodiversity, EUMON , ALPFIRS and Life projects FutMon, ManFor C.BD, EMoNFUr as an expert in ecosystem ecology, vegetation, and forest biodiversity. Member of Expert group EC-ICP Forests-Expert Panel Biodiversity and Ground Vegetation - a representative of Slovenia.</p>
<p>dr. Anže Japelj, male, PhD researcher in the Department of forest and Landscape Planning and Monitoring working in the area of environmental economics, focusing on assessment of forest ecosystem services. He is a part of several national and international (StarTree, AlpFFirs, Informed, FireParadox, RegioPower) research projects and COST (CA15206 (Payments for Ecosystem Services - Forests for Water) actions. He is consistently attending the IUFRO 4.05.00 - MANAGERIAL ECONOMICS AND ACCOUNTING meetings.</p>
<p>dr. Andrej Verlič, male, BSc in Forestry and PhD in Environmental Protection from the University of Ljubljana. He works as a research assistant at the Department for Forest Ecology at the Slovenian Forestry Institute. He focuses his research on the governance of forest recreation, perception of forest environment and evaluation of the tourist and recreational use of forests. He worked on object-based classification of forest tree species with Worldview - 2 and lidar.</p>
<p>5 relevant publications, products, services, datasets, software, achievements</p>
<p>1. ELER, Klemen, PLESTENJAK, Gregor, FERLAN, Mitja, ČATER, Matjaž, SIMONČIČ, Primož, VODNIK, Dominik. Soil respiration of karst grasslands subjected to woody-plant encroachment. European journal of soil science, ISSN 1351-0754. [Print ed.], 2013, vol. 64, issue 2, p. 210-218, ilustr. http://dx.doi.org/10.1111/ejss.12020, doi: 10.1111/ejss.12020.</p>
<p>2. KOBLEK, Andrej, PFEIFER, Norbert, OGRINC, Peter, TODOROVSKI, Ljupčo, OŠTIR, Krištof, DŽEROSKI, Sašo. Repetitive interpolation : a robust algorithm for DTM generation from Aerial Laser Scanner Data in forested terrain. Remote sensing of environment, ISSN 0034-4257. [Print ed.], 2007, vol. 108, iss. 1, str. 9-23, ilustr. http://dx.doi.org/10.1016/j.rse.2006.10.013.</p>
<p>3. Kutnar L., Eler K., Marinšek A. (2016) Effects of different silvicultural measures on plant diversity - the case of the Illyrian <i>Fagus sylvatica</i> habitat type (Natura 2000). iForest, 9: 318-324.</p>
<p>4. Mavsar, R., Japelj, A., & Kovač, M. (2013). Trade-offs between fire prevention and provision of ecosystem services in Slovenia. Forest Policy and Economics, 29(0), 62-69. doi:http://dx.doi.org/10.1016/j.forpol.2012.10.011</p>
<p>5. Verlič A., Đurić N., Kokalj Ž., Marsetič A., Simončič P., Oštir K. 2014. Tree Species Classification using WorldView-2 Satellite Images and Laser Scanning Data in a natural Urban Forest. Šumarski list, 9-10: 477-488</p>
<p>5 relevant previous projects, activities</p>
<p>1. LIFE ManFor C.BD (Managing forests for multiple purposes: carbon, biodiversity and socio-economic wellbeing)</p>
<p>2. INFORMED - "INtegrated research on FOrest Resilience and Management in the mEDiterranean"</p>
<p>3. RegioPower (EraNet) – A regional IT-based platform for bringing resource needs and landbased resource production together</p>
<p>4. Site, forest-management, and political aspects of forest response to the expected climate change (V4-0347), Ministry of Agriculture, Forestry, and Food</p>
<p>5. EUFORINNO – European Forest Research and Innovation (RegPot No. 315982)</p>
<p>Significant infrastructure, major items of technical equipment</p>

Dron + software, leica tachymeter, differential Trimble GPS

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Software: ArcGIS, Idrisi raster GIS, GIS server, ...

Own lidar data:

- Point cloud 2-10 returns/m² for the whole Slovenia + derived DEM & CHM , both 1 m horizontal resolution
- 3 ManforCBD sites scanned in 2011 (before thinning) and 2013 (after), each site approx. 70 ha, up to 300 returns/m², DEM, CHM, ...
- forest management unit Slivnica & Menišija (cca 10.000 ha), scanned in 2007, 20 returns/m², + lots of lidar-derived info
- forest management unit Kras 1 (cca 20.000 ha), scanned in 2005, 20 returns/m², + lots of lidar-derived info
- urban forest in Ljubljana
- Snežnik mountain

4.2. Third parties involved in the project (including use of third party resources)

Only one Third Party is involved, namely Università della Basilicata (UNIBAS) which is linked to CNR Beneficiary.

Does the participant plan to subcontract certain tasks (please note that core tasks of the project should not be sub-contracted)	NO
<i>If yes, please describe and justify the tasks to be subcontracted</i>	
Does the participant envisage that part of its work is performed by linked third parties ²	NO
<i>If yes, please describe the third party, the link of the participant to the third party, and describe and justify the foreseen tasks to be performed by the third party</i>	
Does the participant envisage the use of contributions in kind provided by third parties (Articles 11 and 12 of the General Model Grant Agreement)	YES
<p>Contract for 50,000 € with University of Basilicata (UNIBAS) falling under the in-kind contribution against payment (Art.11 of the MGA). These costs will be declared as personnel costs in the person of Prof. Antonio Coppola.</p> <p><i>The contract CNR-UNIBAS will be formalized - via a secondment agreement – taking into account that the seconded person will work at UNIBAS premise. The contribution of the seconded person - namely prof. Antonio Coppola - to the project, will be limited to the only intellectual activities. Then no other costs are required. He will collaborate with CNR in writing and testing numerical procedures for modelling of diffuses solutes and pollutants to the soil toward the groundwater (Task 3.3), for propagation of uncertainty of model inputs into uncertainty of model output (Task 3.1) and for data assimilation techniques (Task 4.3)</i></p> <p>Prof. Coppola has an international well-recognized expertise in hydrology and specifically in process and modelling issues (see curriculum vitae in 4.1 section under CNR partner)</p>	
Does the participant envisage that part of the work is performed by International Partners ³ (Article 14a of the General Model Grant Agreement)?	NO
<i>If yes, please describe the International Partner(s) and their contributions</i>	

5. Ethics and Security

5.1. Ethics

The planned research in LANDSUPPORT will not involve any research on human embryos, human foetal tissues or cells, Human Embryonic Stem Cells (hESCs) as well as humans and animals at all.

The proposal was assessed by independent ethics experts and the outcome from this assessment is reflected in the ethics requirements (*see italics below*).

The consortium confirms that the LANDSUPPORT project will comply with the General Data Protection Regulation (EU 2016/679). More specifically, the consortium will address the ethics requirement and connected deliverables as follows:

Requirement H (research involve human participants) connected to D9.1 (due in M3):

The consortium will produce and provide the following information as a deliverable D9.1:

- (i) *The informed consent procedures that will be implemented for the participation of humans,*
- (ii) *Templates of the informed consent/assent forms and information sheets (in language and terms intelligible to the participants).* More specifically the informed consent will be provided to each LANDSUPPORT participant before the beginning of the related activity and before the participants will be asked to complete the questionnaire. The informed consent procedures and templates will follow the standard practices/protocols within the research organisations in each country in which questionnaires will be carried out and will be compatible with European standards. The information sheet will have the following items: project content, number of expected participants, locations of the project activities, data collection method (paper, digital), data description, description of methods for data use, conservation, and possible cancellation, revoking consent procedure, risks to persons. In any case data privacy will be respected, data will not be transferred to third parties, nor will be used for purposes other than those of the research project. The data will be published anonymously and aggregated and will not be kept further at the end of the project.
- (iii) *Copies of opinions/approvals by ethics committees and/or competent authorities for the research with humans.* In LANDSUPPORT project the Ethics Authority delivering the opinion (within D9.1) will be the “CNR Research Ethics and Bioethics Committee” (<https://www.cnr.it/it/ethics>) who is an independent body of the Italian largest research organization which has already delivered a large number of clearances for H2020 projects. CNR-ISAFOM (Institute for Mediterranean Agricultural and Forestry Systems) is beneficiary in LANDSUPPORT and has a very important role in the project: CNR leads WP3 on developing high performance models and herewith is involved in data collection and developing procedures to evaluate several models; CNR is also strongly involved in other data processing tasks within WP2 (Integrated Databases for the LANDSUPPORT Decision Support System) and within WP4 (Monitor/ assess/ validate LANDSUPPORT technical and scientific results). Therefore, from the technical point of view CNR is competent to hold the responsibility for the ethics opinions. The CNR's National Research Ethics and Bioethics Committee will support and deliver the required opinions about data protection issues and it will issue ethical opinions with authorization value (Ethical Clearance);

In LANDSUPPORT a Stakeholder Group (SHG) - acting as advisors for scientific partners - will be established to maximize project impact (see WP 7). The SHG will be composed of experts from science, institutions involved in land policy implementation, farming and urban planning association, agro-tourism associations, citizen representatives beyond the project partners. SHG will mainly deliver opinions, feedback, ideas and suggestions for/on the functionalities of the platform, testing the usability for the end user.

Requirement NEC (Non-EU Countries) - connected to two deliverables D9.2 and D.9.4

Within the Deliverable 9.2 the following two requirements will be addressed:

- In case activities undertaken in non-EU countries raise ethics issues, the applicants must confirm that the research conducted outside the EU is legal in at least one EU Member State.

In NEC LANDSUPPORT will conduct the same activities (without field work) as those activities conducted in EU countries, Those activities are legal in all EU countries.

LANDSUPPORT does not require that personal data will be exported from a third country into the EU. Moreover in non-EU countries there are no surveys of individuals planned, no individual data will be collected or other similar activities conducted that could raise ethics issues in the field of data protection. The respective confirmations and any updates will be provided within D9.2. In any case and for any unexpected criticalities the CNR's National Research Ethics and Bioethics Committee will provide the ethical mentoring for the whole project.

- Details on the materials which will be imported to/exported from the EU.

LANDSUPPORT does not require that both personal data and samples will be exported from a third country into the EU. Moreover, the partners from Tunisia and Malaysia will share with the project only the data that they are authorized to share.

In exceptional circumstances, if the sharing of personal data will be considered deemed necessary to achieve the objectives of the project, all partners will ensure that they have the required authorizations to share such data, e.g. through informed consent forms or other formal approvals. Further details will be delivered within D.9.2.

If any partner wants to share data that is relevant for LANDSUPPORT that has been collected through previous projects, they will obtain the necessary approval(s) of the related authorities, if any are required to share this data. The above details will be included in D9.2.

Within the Deliverable 9.4 the following requirement will be addressed:

- *Detailed information to demonstrate that fair benefit-sharing arrangements with stakeholders from low and lower-middle income countries are ensured.*

The first test of the system by local Tunisia stakeholders will happen at month 24. A deliverable reporting on the fair benefit-sharing arrangements will be provided at M24.

In general terms the project objective has an intrinsic high benefit sharing value since the system to be developed will strongly support and ameliorate sustainability of agriculture in low and lower-middle income countries (the system is freely available through the web). Moreover, teaching material and webinar will be available to allow local scientists and stakeholder to further benefit from the project. The strict connection with ICARDA will guarantee research collaboration with Lebanon (ICARDA headquarter and Tunisia).

Requirement M (Misuse) connected to D 9.3

- *Risk assessment and details on measures to prevent misuse of research findings must be submitted as a deliverable before the commencement of relevant work or month 6, whichever comes first.*

Deliverable 9.3 due in M6 will include a report addressing among others the following issues:

- (i) Financial data on farms. In any case and for any future circumstances LANDSUPPORT will always anonymise data: LANDSUPPORT does not directly collect financial data from farms. Instead the consortium shall use and process already existing EU database (especially FADN). This database will be provided to the consortium in spatially aggregated way, therefore ensuring that no personal data will be given to LANDSUPPORT and hence it would not be possible to identify the respondents for the project consortium. Only for very few selected farms in Italy, Austria and Hungary (in task 6.3) the consortium should receive farm financial data (most probably from DG Agriculture and Rural Development – Directorate C. Strategy, simplification and Policy Analysis C.3. Farm economics). These data will be delivered under the Commission's specific data privacy condition that the consortium cannot diffuse and distributed those data.
In task 6.3 there are no data from third countries that will be delivered to LANDSUPPORT.
- (ii) Misuse Risk: LANDSUPPORT contains very low misuse risk - similarly to other DSS tools. LANDSUPPORT provides only an informed support to decision-makers and it shall be used as a tool on top of other means (e.g. local needs, social or economic problems, local plant disease etc.) available for decisions on land use. The measures that will be undertaken to mitigate the misuse risks are (i) the proper training (see WP7) of the end users providing very clear instructions for the correct use of the tool, (ii) continuous monitoring of LANDSUPPORT results in the field by the coordinator and respective WP leaders, and (iii) continuous improvement of the models based on real world evidence.

5.2. Security

Please indicate if your project will involve:

- activities or results raising security issues: No.
- 'EU-classified information' as background or results: No.

Annex I: Letters from Stakeholder Group

Here it is provided the list of letters. Original letters can be found in the original proposal Proposal SEP-210443424

SHG member (ranked by scale)	Role, area of expertise	SHG component	Role in LANDSUPPORT
1 - GSP- Global Soil Partnership (FAO- United Nations)	Global Partnership	YES	Test LANDSUPPORT scaling up of appropriate solutions to soil degradation problems
2 - FAO-RNE (Regional Office for Near East and North Africa)	FAO office		In WP3, 6, collaboration to test LANDSUPPORT system with respect to agriculture and
3 - ECTP-CEU European Council of Spatial Planners	European Association of urban planners		Test spatial and urban planning tool for Europe and Italy
4 - ELSA European Land and Soil Alliance	largest European city network dedicated to soil protection		test evaluation land take impacts and land degradation on some ecosystem services
5 - Hungarian Chamber of Agriculture (HU)	National Public body for agriculture, rural development.		Test Agriculture DSS tools for Hungary
6 - AGRYA-HU Agricultural and Rural Youth Association (HU)	National Association of young farmers		Test land planning and management agriculture practices
7 - ILWM-AU Institute for Land and Water Management research	Federal Agency		Test evaluation of land management effect on soil and water quality at local scale
AGES-AU Austrian Agency for Health and Food Safety (their involvement is given in BOKU participant description)	Federal Agency		Test evaluation of environmental tools
9 - ALR-AU Authority Land Reform Lower Austria	Regional Authority on Land		Test evaluation land take impacts on the environment
10 - Confagricoltura (Italy)	National farmer association		Collaboration to WP6 and test land planning and management over agriculture practices
11 - INU – National Institute for Urban Planning (Italy)	The largest Italian Association of urban planners		Collaboration WP6, test spatial and urban planning and SEA and EIA for the Italian territory
12 - General Directorate of planning and Conservation of agricultural lands (Ministry of Agriculture - TUNISIA)	Land Use & Conservation Agricultural Land management, National scale		Test land planning DSS tools at local scale including impacts on ecosystem services under land use/management and climate change scenarios
13 - Institut National de Recherches en Genie Rural, Eaux et Forets, Tunisia	Research body		Test integrated management of Rmel study site
14 - BM-AU Betriebsgesellschaft Marchfeldkanal (AU)	National Company in land and water management		Test of soil sealing impacts and agricultural activities on ecosystem services at Marchfeld
15 - Agritourist - Campania (Italy)	Regional Association of agritourist farms		Collaboration within WP6 and WP7. Test for ecotourism activities at local and regional scales
16 - Telese Municipality (Italy)	Municipality		Local test impact of soil sealing over agricultural activities and ecosystem services
17 - Keszthely Municipality	Municipality		Local Test impact of soil sealing over agriculture
18 - Telesia Multifunctional High school (Italy)	Education Institution		Collaboration and contribution to landscape awareness activities planned in WP7 and implementation of DSS tool “o”.
19 - Local vine-winemaking associations (Vita Salernum, Sannio DOP, Consorzio Tutela Vini Vesuvio)	Winemakers Consortium		Test best vineyard management practices from local to landscape scale, including soil water stress monitoring, irrigation, viticulture zonation valorisation of productions
20 – MidA Foundation	Public Foundation. Permanent Soil Museum	NO	Support LANDSUPPORT project by hosting a permanent exhibit to be placed in the Soil Museum in the section dealing with landscape.

Annex II: List and Support Letters of Scientific Advisory Board

Here it is provided the list of AB members. Original letters can be found in the original proposal Proposal SEP-210443424

AB member	Main role/expertise
1 - Em. Professor Johan Bouma	Em. Professor of soil science, Wageningen University, the Netherlands
2 - Phd. Helena Gomez Macpherson	Tenure Researcher / CSIC / Instituto de Agricultura Sostenible, Córdoba, Spain
3 - Ms. Monika Ruzztecka	Head of the GIS Unit - UNEP/GRID-Warsaw Centre
4 - Phd. Kris van looy	Scientific Coordinator at ISMC - International Soil Modeling Consortium

Annex III: Detailed description of Case Studies Associated with Document Ref. Ares(2018)1548916 - 21/03/2018

European Union, Italy, Austria and Hungary: for the sake of this proposal it is not necessary to describe these well-known sites.

Campania region (Italy)

Campania is in Southern Italy. It has an area of 13,590 km² divided into 5 provinces (Napoli, Caserta, Avellino, Benevento, Salerno) and a coastline of 350 km on the Tyrrhenian Sea. The region has a population of around 5,900,000 people, making it the third-most-populous region of Italy and the most densely populated in the country. The mountainous interior is fragmented into several massifs, rarely reaching 2,000 m, whereas close to the coast there are volcanic massifs: Vesuvio (1,277 m) and Campi Flegrei. The climate is typically Mediterranean along the coast, whereas in the inner zones it is more continental, with low temperatures in winter. The 51% of the total area is hilly, 34% mountainous and the remaining 15% is made up of plains. Campania mainly produces fruit and vegetables; it is the leader in Italy in the production of tomatoes and nuts. Olive trees cover a good portion of the agricultural land and wine production has increased, together with the quality of the wine. It can be stated that the agro-food industry is one of the main pillars of industry of Campania. A weak point, however, for the region's agriculture is the very reduced size of farms, equal to 3.53 hectares, that makes it more complicated for local governments to apply rural policies and development plans and to follow their evolutions and tangible effects over the territories. This is a very important issue which is exacerbated if we consider that in Campania several territories are affected by land degradation phenomena such as i) soil erosion (e.g. intensely cultivated slopes, mountainous areas once cultivated and now abandoned); ii) landslides and mudslides, mainly affecting volcanic soils which represent a big portion of regional soils; soil pollution (e.g. nitrates and heavy pollution) especially in lowland territories and alluvial plains where the agriculture is very intensive (maize and vegetables); land take/soil sealing which in Campania has still a rate of 80 hectares per month and affects mainly the agricultural lands, causing an intense fragmentation of the rural territories and undermining the ecosystem functions.

Valle Telesina (Campania region, Italy)

Valle Telesina is an area located in South of Italy in the Campania region (province of Benevento), with an extension of 20.000 hectares and lies between 14°26' E and 14°43' E, 41° 18' N and 41° 7' N. The landscape has a complex geomorphology and is characterised by an E-W elongated graben where the Calore river flows. The area is also characterised by five different landscape systems: (i) the hills; (ii) the mountains (limestone relieves); (iii) the alluvial plain; (iv) the pediment plain (slope fan of the limestone relieves) and finally (v) the ancient fluvial terraces.

This area has a high soil and climate spatial variability and it represents a traditional setting for the cultivation of vineyards producing high quality wines - including three DOC wines – and olive trees.

Moreover, the area is characterized by having important soil threats such as the soil sealing caused by the recent urbanization plan over agricultural areas (mainly viticulture).

The main problem is to preserve, as much as possible, the integrity of the vineyard landscape and also to avoid urbanization affecting the best soils and best *terroirs*, especially for vineyards.

Other threats are: soil erosion, decline in soil organic matter and biodiversity, soil compaction - induced by intensive agriculture and soil landslide (mudflow) -, heavy contamination by pesticides - mainly due to intensive vineyard management. These types of problems are specifically addressed by COM 2006/231 Soil Thematic Strategy and NAP for Italy, by the RDPs (Pillar I and II); CAP; Reg. 1698/05 1974/06 (rural development) Reg. 1306/2013 (cross-compliance).

Zala County Region (Western Transdanubia, Hungary)

Zala county is situated in the southwestern corner of Hungary, between the Mura River and Lake Balaton. The total area of the Zala County is 3.784 km². It is a land of varied surface with hills and plenty of brook valleys. Within the formation of its natural landscape, the effects of Alpokalja (literally the foothills of the Alps). This is a fertile region with a dense network of rivers and a high percentage of woodland. According to the statistical data of land use in 2017 the forestry level (32,8%) in Zala County is the second highest in the country and the grasslands with 8,68% is also higher than the national average. The arable lands with 31.2% is considerably lower than the national average. Also below the national average is the proportion of fruits (1%), grapes (0,6%), reeds (0,05%) and fishponds (0,03%). The soils of the county's territory are characterized by the varied spread of soil types. The soil quality is suitable mainly for the forestry, good fertile soils for agricultural production is located in the Northeast regions of the county. Typical soil type is the Ramann-type brown forest soil with good fertility and favorable water management. The climate of the county is more balanced in terms of both temperature and precipitation than the other regions in Hungary.

Keszthely site (Hungary)

The city of Keszthely (46°45'56.4"N 17°14'34.4"E) is located in the south western end of Lake Balaton, on the shore of one of the biggest lakes in Central Europe. Lake Balaton, it is a very important natural (ecological, water and landscape) resources and one of the major target areas of water related recreational tourism in Europe. The city is surrounded by forests and rolling hills to the north, plains to the south east and the lake (about 200 km²). South from the city lies Kis-Balaton (Little Balaton), a swamp which is a part of the Zala river delta and which acts as a natural water purifier for Lake Balaton. The swamp is particularly known as a water fowl habitat and enjoys international recognition and protection as a natural reserve. The climate of site is characterized by an average annual rainfall of 700-800 mm, with a moderate sunlight (1900-1950 annual hours) and an average temperature lower than national one.

Marchfeld-Region (Niederösterreich, Lower Austria)

The Marchfeld-Region (Lat. 48.20°N, Long. 16.72°E) is a semi-arid agricultural production area in Lower Austria with more than 60,000 ha (20,000 ha regularly irrigated during the summer) of agricultural land cropped with vegetables, sugarbeet, potatoes and (winter & summer) cereals.

The farm structures are large and economically viable compared to other areas in Austria. There are 884 farms with more than two-thirds (72%) professional farms where farming is the only source of income. The average size of a farm is around 55ha and there is an upward tendency towards less farms with larger areas and an increasing number of organic farms.

The average annual precipitation in the area is 500–550 mm that can drop to 300 mm making it the driest region of Austria.

Groundwater is used for irrigation and also as a major source of drinking water. In the last few decades nitrate concentration in groundwater has increased dramatically as a result of climate conditions, soil structure and management practices and agriculture is reported to be the main source of groundwater contamination by nitrate. Moreover, due to the dry climate and a high carbonate content in the soil, chemical weathering is low which leads to a lack of nutrients (e.g. potassium).

Crops For the Future - Field research centre (Malaysia)

The CFF field research area lies (lat 2.92°N; long 101.87°E) within Balau Estate (Semenyih district of Selangor province in Malaysia and covers around 50 ha of land. It has a typical lowland tropical climate without a regular dry season. Three main parent materials comprising of granite, colluvium and alluvium Predominantly Flat to Undulating with two soil types: (i) Soil develop over granite (Igneous Rock): Rengam series (fine) and (ii) Soil developed over alluvial: Recent Alluvium T1B Alluvial and Local lluvium/Colluvium.

The mean annual rainfall is about of 2000 mm (years 2001-2011). Rainfall distribution is bimodal with highest monthly rainfall occurring generally from March to April and from October to November. Lower rainfall months may be experienced from January to February and between May and July.

The soil in this areas are subjected to weathering, soil erosion during the rainy seasons and pressure due to extensive use with minimum or little replenishment of nutrients.

CFF area is devoted to research crops including underutilized crops that can have an impact in global food security issues now and in the future. Many of field experiments are available for testing LANDSUPPORT farm system under tropical conditions.

Rmel watershed, Zaghuan Governorate (North-eastern Tunisia)

The Pilot site is located in northeastern Tunisia and coincides with the watershed of the Oued Rmel river, which outlet section is defined by a dam built in 1996 that created a 5 Km²-wide artificial lake. The area (67000 ha) lays between 36°15' and 36°35' latitude N, and 10°05' and 10°25' longitude E, and is almost completely included in the Zaghuan Governorate. Climate is typically Mediterranean with hot summers, mild winters and precipitations (average annual rainfall around 450 mm) concentrated in late autumn and winter.

The watershed is characterized by a wide agricultural plain surrounded by hills and mountains. Agriculture is mainly rainfed and spans over the lowlands and the hillslopes, covering 66% of the watershed. Irrigation is available in limited areas thanks to the water provided by the artificial lake and localized around several minor hill lakes. Dominant rainfed crops are barley, cultivated for grain and fodder, often mixed with oat when grown for fodder, and wheat. Tree crops, mainly olive, cover a wide surface.

Tomatoes, potatoes, cucumbers and watermelons are common irrigated crops. Extensive grazing by small ruminants is present in all the area, involving both rangelands and croplands (fallow and stubble grazing).

In 70% of the area the elevation is below 250 m a.s.l., ranging between 50 and 1,293 m a.s.l. On average slope is gentle.

However, it is above 10% in more than 40% of the pilot site, including in a considerable portion of the cropland. Soil erosion, water conservation and sustainable water management are the main issues in terms of natural resource management. Aging of resident

Annex IV: List of Databases

The complete list can be found in the original proposal Proposal SEP-210443424

Annex V: Additional Methodologies

The complete methodologies can be found in the original proposal Proposal SEP-210443424. Here is given the list of content

Introduction to the overall methodology

Methods

Analysis of requirements

Evaluation of potential socio-economic impacts

Data Collection and Integration

Raster data management

Data pre-processing

Modelling Engines and Output

More Insights about the GCI (Geospatial Cyber-Infrastructure)

The Landsupport Architecture

DSS Tools Dashboard (mapping reporting and accounting etc.)

Test of the System for Level Policy Needs

Annex VI with Figures for Doa-A

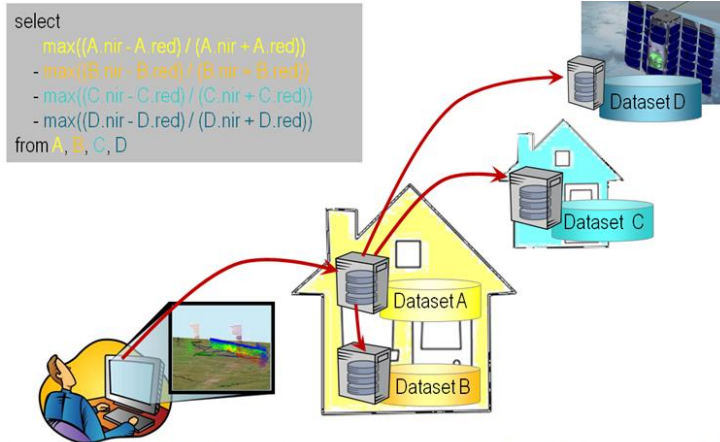


Fig. wp2.2 - Parallel, distributed query processing in clouds and federations based on the rasdaman query splitting method

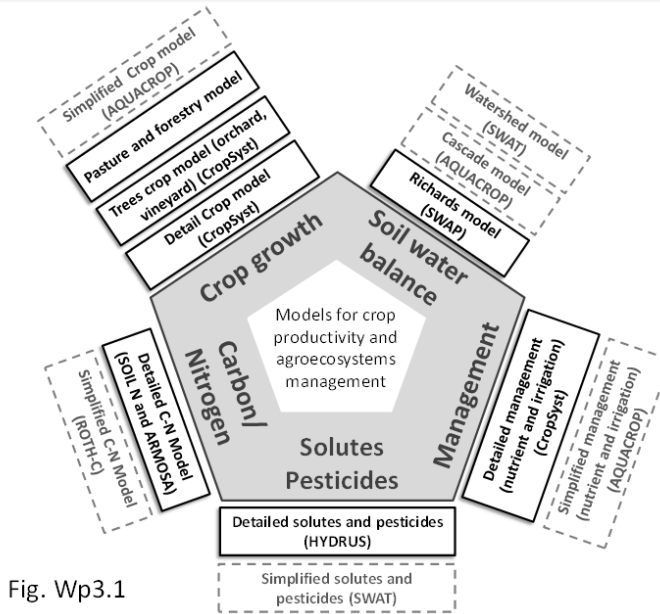
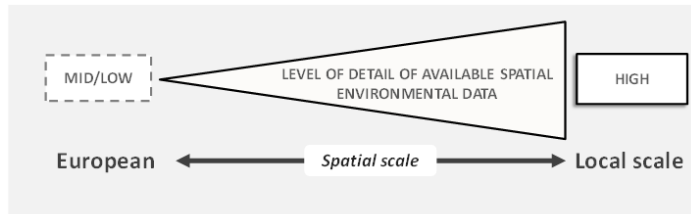


Fig. Wp3.1

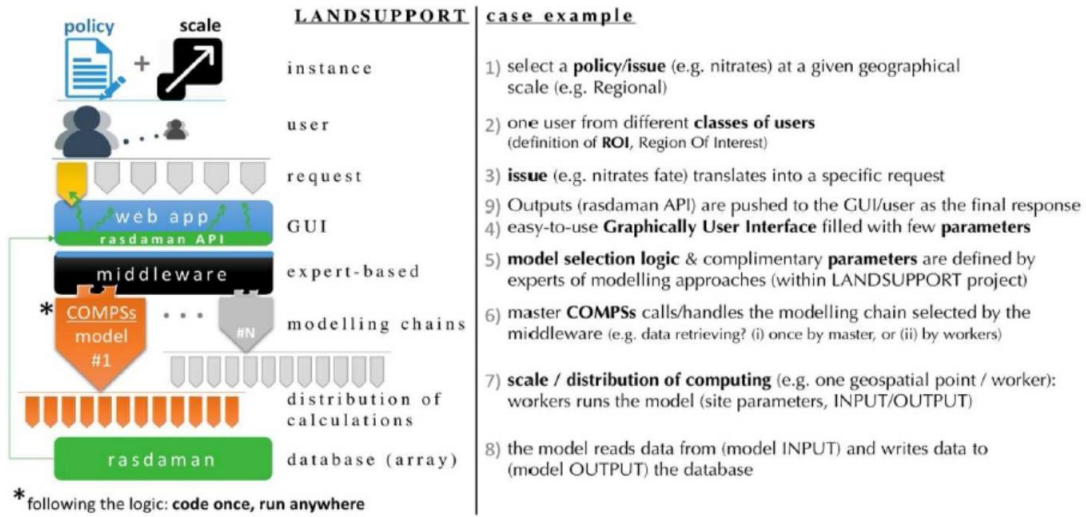
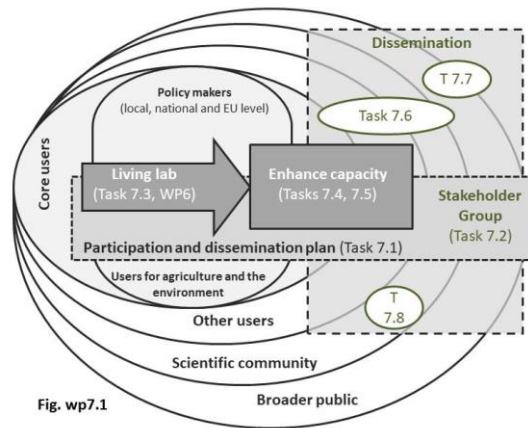


Fig. WP5.1. Overview of the LANDSUPPORT GCI with detailed steps and connection.



ESTIMATED BUDGET FOR THE ACTION (page 1 of 2)

Estimated eligible ¹ costs (per budget category)									EU contribution			Additional information		
A. Direct personnel costs		B. Direct costs of subcontracting	C. Direct costs of fin. support	D. Other direct costs	E. Indirect costs ²	Total costs	Reimbursement rate %	Maximum EU contribution ³	Maximum grant amount ⁴	Information for indirect costs	Information for auditors	Other information:		
A.1 Employees (or equivalent) A.2 Natural persons under direct contract A.3 Seconded persons [A.6 Personnel for providing access to research infrastructure]		A.4 SME owners without salary A.5 Beneficiaries that are natural persons without salary		D.1 Travel D.2 Equipment D.3 Other goods and services D.4 Costs of large research infrastructure						Estimated costs of in-kind contributions not used on premises	Declaration of costs under Point D.4	Estimated costs of beneficiaries/ linked third parties not receiving EU funding		
Form of costs ⁶	Actual	Unit ⁷	Unit ⁸		Actual	Actual	Actual	Flat-rate ⁹						
	(a)	Total (b)	No hours	Total (c)	(d)	(e)	(f)	(g)=0,25x ((a)+(b)+ (c)+(f) +[(h1)+(h2)]- (m))	(i)= (a)+(b)+(c)+ (d)+(e)+(f)+ (g)+(h1)+(h2)+(h3)	(j)	(k)	(l)	(m)	Yes/No
1. UNA	727800.00	0.00	0	0.00	0.00	0.00	167000.00	223700.00	1118500.00	100.00	1118500.00	1118500.00	0.00	No
2. ARIES	146985.00	0.00	2450	85015.00	0.00	0.00	17000.00	62250.00	311250.00	100.00	311250.00	311250.00	0.00	No
3. BSC	235600.00	0.00	0	0.00	0.00	0.00	68000.00	75900.00	379500.00	100.00	379500.00	379500.00	0.00	No
4. BOKU	378122.00	0.00	0	0.00	0.00	0.00	84376.00	115624.50	578122.50	100.00	578122.50	578122.50	0.00	No
5. CNR	576400.00	0.00	0	0.00	0.00	0.00	66550.00	148237.50	791187.50	100.00	791187.50	791187.50	50000.00	No
6. CFF	162150.00	0.00	0	0.00	0.00	0.00	70400.00	58137.50	290687.50	100.00	290687.50	290687.50	0.00	No
7. ICARDA	198691.00	0.00	0	0.00	0.00	0.00	41309.00	60000.00	300000.00	100.00	300000.00	300000.00	0.00	No
8. iASK	20992.00	0.00	0	0.00	0.00	0.00	106900.00	31973.00	159865.00	100.00	159865.00	159865.00	0.00	No
9. ISPRA	97541.00	0.00	0	0.00	0.00	0.00	47000.00	36135.25	180676.25	100.00	180676.25	180676.00	0.00	No
10. RASDAMAN	119340.00	0.00	0	0.00	0.00	0.00	85000.00	51085.00	255425.00	100.00	255425.00	255425.00	0.00	No
11. JRC	0.00	214000.00	0	0.00	0.00	0.00	26000.00	60000.00	300000.00	100.00	300000.00	300000.00	0.00	No
12. REGCAM	33624.00	0.00	0	0.00	0.00	0.00	67800.00	25356.00	126780.00	100.00	126780.00	126780.00	0.00	No
13. UPA	245000.00	0.00	0	0.00	0.00	0.00	101400.00	86600.00	433000.00	100.00	433000.00	433000.00	0.00	No
14. UMI	265072.00	0.00	0	0.00	0.00	0.00	53800.00	79718.00	398590.00	100.00	398590.00	398590.00	0.00	No
15. ZALA	116300.00	0.00	0	0.00	0.00	0.00	10000.00	31575.00	157875.00	100.00	157875.00	157875.00	0.00	No
16. CMAST	353000.00	0.00	0	0.00	0.00	0.00	11800.00	91200.00	456000.00	100.00	456000.00	456000.00	0.00	No
17. ACTEON	215000.00	0.00	0	0.00	0.00	0.00	24600.00	59900.00	299500.00	100.00	299500.00	299500.00	0.00	No
18. EAA	167900.00	0.00	0	0.00	0.00	0.00	22500.00	47600.00	238000.00	100.00	238000.00	238000.00	0.00	No
19. SFI	158850.00	0.00	0	0.00	0.00	0.00	21000.00	44962.50	224812.50	100.00	224812.50	224812.50	0.00	No
Total consortium	4218367.00	214000.00		85015.00	0.00	0.00	1092435.00	1389954.25	6999771.25		6999771.25	6999771.00	50000.00	

ESTIMATED BUDGET FOR THE ACTION (page 2 of 2)

- (1) See Article 6 for the eligibility conditions
- (2) The indirect costs covered by the operating grant (received under any EU or Euratom funding programme; see Article 6.5.(b)) are ineligible under the GA. Therefore, a beneficiary that receives an operating grant during the action's duration cannot declare indirect costs for the year(s)/reporting period(s) covered by the operating grant (see Article 6.2.E).
- (3) This is the theoretical amount of EU contribution that the system calculates automatically (by multiplying all the budgeted costs by the reimbursement rate). This theoretical amount is capped by the 'maximum grant amount' (that the Commission/Agency decided to grant for the action) (see Article 5.1).
- (4) The 'maximum grant amount' is the maximum grant amount decided by the Commission/Agency. It normally corresponds to the requested grant, but may be lower.
- (5) Depending on its type, this specific cost category will or will not cover indirect costs. Specific unit costs that include indirect costs are: costs for energy efficiency measures in buildings, access costs for providing trans-national access to research infrastructure and costs for clinical studies.
- (6) See Article 5 for the forms of costs
- (7) Unit : hours worked on the action; costs per unit (hourly rate) : calculated according to beneficiary's usual accounting practice
- (8) See Annex 2a 'Additional information on the estimated budget' for the details (costs per hour (hourly rate)).
- (9) Flat rate : 25% of eligible direct costs, from which are excluded: direct costs of subcontracting, costs of in-kind contributions not used on premises, direct costs of financial support, and unit costs declared under budget category F if they include indirect costs
- (10) See Annex 2a 'Additional information on the estimated budget' for the details (units, costs per unit).
- (11) See Annex 2a 'Additional information on the estimated budget' for the details (units, costs per unit, estimated number of units, etc)
- (12) Only specific unit costs that do not include indirect costs
- (13) See Article 9 for beneficiaries not receiving EU funding
- (14) Only for linked third parties that receive EU funding

ANNEX 2a

ADDITIONAL INFORMATION ON THE ESTIMATED BUDGET

Unit cost for SME owners/natural beneficiaries without salary

1. Costs for SME owner not receiving a salary

Units: hours worked on the action

Amount per unit ('hourly rate'): calculated according the following formula

[EUR 4650 /143 hours] multiplied by [country-specific correction coefficient of the country where the beneficiary is established]

Country-specific correction coefficient (in force at the time of the call):

country	coefficient	country	coefficient	country	coefficient	country	coefficient	country	coefficient
AT	104.8%	DK	135.3%	HR	97.5%	LV	75.9%	SE	111.7%
BE	100.0%	EE	78.3%	HU	76.2%	MT	89.6%	SI	86.1%
BG	71.5%	EL	92.7%	IE	113.5%	NL	104.3%	SK	82.6%
CY	91.8%	ES	97.6%	IT	106.7%	PL	76.4%	UK	120.3%
CZ	83.8%	FI	116.6%	LT	73.1%	PT	89.1%		
DE	98.8%	FR	111.0%	LU	100.0%	RO	68.3%		

- Beneficiary no. 2, ARIESPACE

Country-specific correction coefficient (ITALY) = 106.7%

Amount per unit ('hourly rate') for Beneficiary no.2 = $4650/143 * 106.7\% = \text{EUR } 34.70$

Estimated number of units for Beneficiary no.2 = **2450** (see Annex 2)

ACCESSION FORM FOR BENEFICIARIES

ARIESPACE SRL (ARIES), established in Centro Direzionale IS.A3, NAPOLI 80143, Italy, VAT number: IT05291901212, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('2')

in Grant Agreement No 774234 ('the Agreement')

between UNIVERSITA DEGLI STUDI DI NAPOLI FEDERICO II. **and** the Research Executive Agency (REA) ('the Agency'), under the powers delegated by the European Commission ('the Commission'),

for the action entitled 'Development of Integrated Web-Based Land Decision Support System Aiming Towards the Implementation of Policies for Agriculture and Environment (LANDSUPPORT)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ACCESSION FORM FOR BENEFICIARIES

BARCELONA SUPERCOMPUTING CENTER - CENTRO NACIONAL DE SUPERCOMPUTACION (BSC), established in Calle Jordi Girona 31, BARCELONA 08034, Spain, VAT number: ESS0800099D, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('3')

in Grant Agreement No 774234 ('the Agreement')

between UNIVERSITA DEGLI STUDI DI NAPOLI FEDERICO II. **and** the Research Executive Agency (REA) ('the Agency'), under the powers delegated by the European Commission ('the Commission'),

for the action entitled 'Development of Integrated Web-Based Land Decision Support System Aiming Towards the Implementation of Policies for Agriculture and Environment (LANDSUPPORT)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ACCESSION FORM FOR BENEFICIARIES

UNIVERSITAET FUER BODENKULTUR WIEN (BOKU), established in GREGOR MENDEL STRASSE 33, WIEN 1180, Austria, VAT number: ATU16285008, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('4')

in Grant Agreement No 774234 ('the Agreement')

between UNIVERSITA DEGLI STUDI DI NAPOLI FEDERICO II. **and** the Research Executive Agency (REA) ('the Agency'), under the powers delegated by the European Commission ('the Commission'),

for the action entitled 'Development of Integrated Web-Based Land Decision Support System Aiming Towards the Implementation of Policies for Agriculture and Environment (LANDSUPPORT)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ACCESSION FORM FOR BENEFICIARIES

CONSIGLIO NAZIONALE DELLE RICERCHE (CNR), established in PIAZZALE ALDO MORO 7, ROMA 00185, Italy, VAT number: IT02118311006, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('5')

in Grant Agreement No 774234 ('the Agreement')

between UNIVERSITA DEGLI STUDI DI NAPOLI FEDERICO II. **and** the Research Executive Agency (REA) ('the Agency'), under the powers delegated by the European Commission ('the Commission'),

for the action entitled 'Development of Integrated Web-Based Land Decision Support System Aiming Towards the Implementation of Policies for Agriculture and Environment (LANDSUPPORT)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ACCESSION FORM FOR BENEFICIARIES

CROPS FOR THE FUTURE RESEARCH CENTRE (CFF), established in JALAN BROGA, SELANGOR 43500, Malaysia, VAT number: not applicable, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('6')

in Grant Agreement No 774234 ('the Agreement')

between UNIVERSITA DEGLI STUDI DI NAPOLI FEDERICO II. **and** the Research Executive Agency (REA) ('the Agency'), under the powers delegated by the European Commission ('the Commission'),

for the action entitled 'Development of Integrated Web-Based Land Decision Support System Aiming Towards the Implementation of Policies for Agriculture and Environment (LANDSUPPORT)'.
'

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ACCESSION FORM FOR BENEFICIARIES

INTERNATIONAL CENTRE FOR AGRICULTURAL RESEARCH IN THE DRY AREAS (ICARDA), established in BECHIR AL KASSAR DALIA BUILDING 2ND FLOOR AREA VERDUN, BEIRUT, Lebanon, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('7')

in Grant Agreement No 774234 ('the Agreement')

between UNIVERSITA DEGLI STUDI DI NAPOLI FEDERICO II. **and** the Research Executive Agency (REA) ('the Agency'), under the powers delegated by the European Commission ('the Commission'),

for the action entitled 'Development of Integrated Web-Based Land Decision Support System Aiming Towards the Implementation of Policies for Agriculture and Environment (LANDSUPPORT)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ACCESSION FORM FOR BENEFICIARIES

FELSOBBFOKU TANULMANYOK INTEZETE (iASK), established in CHERNEL U. 14, KOSZEG 9730, Hungary, VAT number: HU15833239, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('8')

in Grant Agreement No 774234 ('the Agreement')

between UNIVERSITA DEGLI STUDI DI NAPOLI FEDERICO II. **and** the Research Executive Agency (REA) ('the Agency'), under the powers delegated by the European Commission ('the Commission'),

for the action entitled 'Development of Integrated Web-Based Land Decision Support System Aiming Towards the Implementation of Policies for Agriculture and Environment (LANDSUPPORT)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ACCESSION FORM FOR BENEFICIARIES

Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA), established in Via Vitaliano Brancati 48, Rome 00144, Italy, VAT number: IT10125211002, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('9')

in Grant Agreement No 774234 ('the Agreement')

between UNIVERSITA DEGLI STUDI DI NAPOLI FEDERICO II. **and** the Research Executive Agency (REA) ('the Agency'), under the powers delegated by the European Commission ('the Commission'),

for the action entitled 'Development of Integrated Web-Based Land Decision Support System Aiming Towards the Implementation of Policies for Agriculture and Environment (LANDSUPPORT)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ACCESSION FORM FOR BENEFICIARIES

RASDAMAN GMBH (RASDAMAN), established in HANS HERMANN SIELING STRASSE 17, BREMEN 28759, Germany, VAT number: DE274855819, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('10')

in Grant Agreement No 774234 ('the Agreement')

between UNIVERSITA DEGLI STUDI DI NAPOLI FEDERICO II. **and** the Research Executive Agency (REA) ('the Agency'), under the powers delegated by the European Commission ('the Commission'),

for the action entitled 'Development of Integrated Web-Based Land Decision Support System Aiming Towards the Implementation of Policies for Agriculture and Environment (LANDSUPPORT)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ACCESSION FORM FOR BENEFICIARIES

REGIONE CAMPANIA (REGCAM), established in VIA S. LUCIA 81, NAPOLI 80132, Italy, VAT number: IT80011990639, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('12')

in Grant Agreement No 774234 ('the Agreement')

between UNIVERSITA DEGLI STUDI DI NAPOLI FEDERICO II. **and** the Research Executive Agency (REA) ('the Agency'), under the powers delegated by the European Commission ('the Commission'),

for the action entitled 'Development of Integrated Web-Based Land Decision Support System Aiming Towards the Implementation of Policies for Agriculture and Environment (LANDSUPPORT)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ACCESSION FORM FOR BENEFICIARIES

PANNON EGYETEM (UPA), established in EGYETEM U 10, VESZPREM 8200, Hungary, VAT number: HU15308816, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('13')

in Grant Agreement No 774234 ('the Agreement')

between UNIVERSITA DEGLI STUDI DI NAPOLI FEDERICO II. **and** the Research Executive Agency (REA) ('the Agency'), under the powers delegated by the European Commission ('the Commission'),

for the action entitled 'Development of Integrated Web-Based Land Decision Support System Aiming Towards the Implementation of Policies for Agriculture and Environment (LANDSUPPORT)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ACCESSION FORM FOR BENEFICIARIES

UNIVERSITA DEGLI STUDI DI MILANO (UMI), established in Via Festa Del Perdono 7, MILANO 20122, Italy, VAT number: IT03064870151, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('14')

in Grant Agreement No 774234 ('the Agreement')

between UNIVERSITA DEGLI STUDI DI NAPOLI FEDERICO II. **and** the Research Executive Agency (REA) ('the Agency'), under the powers delegated by the European Commission ('the Commission'),

for the action entitled 'Development of Integrated Web-Based Land Decision Support System Aiming Towards the Implementation of Policies for Agriculture and Environment (LANDSUPPORT)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ACCESSION FORM FOR BENEFICIARIES

ZALA MEGYEI ONKORMANYZATA (ZALA), established in KOSZTOLANYI DEZSO UTCA 10, ZALAEGERSZEG 8900, Hungary, VAT number: HU15734305, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('15')

in Grant Agreement No 774234 ('the Agreement')

between UNIVERSITA DEGLI STUDI DI NAPOLI FEDERICO II. **and** the Research Executive Agency (REA) ('the Agency'), under the powers delegated by the European Commission ('the Commission'),

for the action entitled 'Development of Integrated Web-Based Land Decision Support System Aiming Towards the Implementation of Policies for Agriculture and Environment (LANDSUPPORT)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ACCESSION FORM FOR BENEFICIARIES

CMAST (CMAST), established in GEORGES VAN DAMMEPLEIN 57, TEMSE 9140, Belgium, VAT number: BE0807942001, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('16')

in Grant Agreement No 774234 ('the Agreement')

between UNIVERSITA DEGLI STUDI DI NAPOLI FEDERICO II. **and** the Research Executive Agency (REA) ('the Agency'), under the powers delegated by the European Commission ('the Commission'),

for the action entitled 'Development of Integrated Web-Based Land Decision Support System Aiming Towards the Implementation of Policies for Agriculture and Environment (LANDSUPPORT)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ACCESSION FORM FOR BENEFICIARIES

ACTEON SARL (ACTEON), established in BP FERME DU PRE DU BOIS LE CHALIMONT, ORBEY 68370, France, VAT number: FR57481460194, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('17')

in Grant Agreement No 774234 ('the Agreement')

between UNIVERSITA DEGLI STUDI DI NAPOLI FEDERICO II. **and** the Research Executive Agency (REA) ('the Agency'), under the powers delegated by the European Commission ('the Commission'),

for the action entitled 'Development of Integrated Web-Based Land Decision Support System Aiming Towards the Implementation of Policies for Agriculture and Environment (LANDSUPPORT)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ACCESSION FORM FOR BENEFICIARIES

UMWELTBUNDESAMT GESELLSCHAFT MIT BESCHRANKTER HAFTUNG (UBA GMBH) (EAA), established in SPITTELAUER LANDE 5, WIEN 1090, Austria, VAT number: ATU45908200, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('18')

in Grant Agreement No 774234 ('the Agreement')

between UNIVERSITA DEGLI STUDI DI NAPOLI FEDERICO II. **and** the Research Executive Agency (REA) ('the Agency'), under the powers delegated by the European Commission ('the Commission'),

for the action entitled 'Development of Integrated Web-Based Land Decision Support System Aiming Towards the Implementation of Policies for Agriculture and Environment (LANDSUPPORT)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ACCESSION FORM FOR BENEFICIARIES

GOZDARSKI INSTITUT SLOVENIJE (SFI), established in VECNA POT 2, LJUBLJANA 1000, Slovenia, VAT number: SI37808052, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('19')

in Grant Agreement No 774234 ('the Agreement')

between UNIVERSITA DEGLI STUDI DI NAPOLI FEDERICO II. **and** the Research Executive Agency (REA) ('the Agency'), under the powers delegated by the European Commission ('the Commission'),

for the action entitled 'Development of Integrated Web-Based Land Decision Support System Aiming Towards the Implementation of Policies for Agriculture and Environment (LANDSUPPORT)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary



EUROPEAN COMMISSION
Joint Research Centre (JRC)

Director



ANNEX 3b

ADMINISTRATIVE ARRANGEMENT WITH THE JOINT RESEARCH CENTRE (JRC) FOR A HORIZON 2020 GRANT

This **Administrative Arrangement** is **between** the following parties:

on the one part,

the Research Executive Agency ('the Agency'), under the powers delegated by the European Commission ('the Commission'), represented by Deputy Head of Unit, Research Executive Agency Sustainable Resources for Food Security and Growth, Tereza BUDNAKOVA,

and

on the other part,

the **Joint Research Centre (JRC)**, represented by the *Director of the Sustainable Resources*.

With this Administrative Arrangement, the **parties agree to consider the JRC as beneficiary in Grant Agreement No 774234** ('the Grant Agreement') **between UNIVERSITA DEGLI STUDI DI NAPOLI FEDERICO II. (UNA) and the Research Executive Agency (REA) ('the Agency')**, under the powers delegated by the European Commission ('the Commission'), **for the action "Development of Integrated Web-Based Land Decision Support System Aiming Towards the Implementation of Policies for Agriculture and Environment (LANDSUPPORT)"**

The **JRC accepts the grant and agrees to implement the action**, as specified in Annex 1 to the Grant Agreement, under its own responsibility and in accordance with the Grant Agreement, with all the obligations and conditions it sets out.

The **parties agree** to the following **specific provisions** for the JRC:

- the JRC becomes part of the Grant Agreement not via an accession form but via an administrative arrangement (preamble);
- the JRC is considered a 'beneficiary' (preamble);
- *the periodic financial report must contain information on the amount of each interim payment and payment of the balance to be paid by the Agency to the JRC (Article 20.3);*
- the part of the pre-financing payment(s) related to the JRC is not paid to the coordinator, but kept by the Commission or Agency for the JRC (Article 21.2).

In addition to these specificities, the **parties agree**:

1. Start of participation

The JRC will assume rights and obligations under the Grant Agreement with effect from *the date of entry into force of the Grant Agreement*.

2. Payments

Payments will be transferred according to the Commission's accounting rules on internal invoicing and will be made from the operational budget line of the *Agency* to the Legal Entity File (LEF) number of the JRC, mentioning the Recovery Order (RO) number. The JRC will submit a debit note for each payment (including the pre-financing).

The *Agency* will make the following payments (see Article 21 of the Grant Agreement) to the JRC:

- a **pre-financing payment** of EUR **160,000.00** (*one hundred and sixty thousand EURO*), within 30 days from the submission of a debit note by the JRC after the signature of the Administrative Arrangement.

The JRC agrees that the amount of EUR **15,000.00** (*fifteen thousand EURO*), representing its contribution to the Guarantee Fund (see Article 21.2 of the Grant Agreement), is transferred in its name by the *Agency* to the Guarantee Fund;

- *one or more interim payments* (see Article 21.3 of the Grant Agreement)
- a **payment of the balance** (see Article 21.4 of the Grant Agreement).

3. Late-payment interest

No interest will be paid on delayed payments between the JRC and the *Agency*.

4. Certificate on the financial statements and certificate on the methodology

The JRC Quality assurance and risk management unit will act as the competent public officer for providing the certificates pursuant to Articles 20.4 and 18.1.2 of the Grant Agreement.

5. Amendments

Any amendment to the Administrative Arrangement will be signed in the electronic exchange system (see Articles 52 and 55 of the Grant Agreement).

6. Interpretation

If the Grant Agreement conflicts with any provision of the Administrative Arrangement with regard to relations between the *Agency* and the JRC, the latter will prevail.

7. Termination

If the Grant Agreement is terminated (see Article 50.1 or 50.3 of the Grant Agreement), this Administrative Arrangement will terminate automatically in parallel.

If the participation of the JRC is terminated (see Article 50.2 or 50.3 of the Grant Agreement), the Administrative Arrangement will be terminated under the conditions set out in the Grant Agreement — *mutatis mutandis*.

8. Entry into force

The Administrative Arrangement will enter into force on the day of signature by the JRC.

SIGNATURE

For the JRC

print
format A4
landscape

MODEL ANNEX 4 FOR H2020 GENERAL MGA — MULTI

FINANCIAL STATEMENT FOR [BENEFICIARY [name]/ LINKED THIRD PARTY [name]] FOR REPORTING PERIOD [reporting period]

Eligible ¹ costs (per budget category)													Receipts	EU contribution			Additional information	
A. Direct personnel costs		B. Direct costs of subcontracting		[C. Direct costs of fin. support]		D. Other direct costs		E. Indirect costs ²		[F. Costs of ...]		Total costs	Receipts	Reimbursement rate %	Maximum EU contribution ³	Requested EU contribution		
A.1 Employees (or equivalent)		A.4 SME owners without salary		[C.1 Financial support]		D.1 Travel		[D.4 Costs of large research infrastructure]		[F.1 Costs of ...]		Receipts of the action, to be reported in the last reporting period, according to Article 5.3.3						
A.2 Natural persons under direct contract		A.5 Beneficiaries that are natural persons without salary		[C.2 Prizes]		D.2 Equipment												
A.3 Seconded persons [A.6 Personnel for providing access]						D.3 Other goods and												
Form of costs ⁴	Actual	Unit		Actual	Actual	Actual	Actual	Flat-rate ⁵	[Unit][Lump sum]	Unit								
	a	Total b	No hours	Total c	d	[e]	f	[g]	h=0,25 x (a+b+c+f+g)	No units	Total [i1]	Total [i2]	j=a+b+c+d+h+e+f+g	k	l	m	n	
[short name beneficiary /linked third party]																		o

The beneficiary/linked third party hereby confirms that:
 The information provided is complete, reliable and true.
 The costs declared are eligible (see Article 6).
 The costs can be substantiated by adequate records and supporting documentation that will be produced upon request or in the context of checks, reviews, audits and investigations (see Articles 17, 18 and 22).
 For the last reporting period: that all the receipts have been declared (see Article 5.3.3).

ⓘ Please declare all eligible costs, even if they exceed the amounts indicated in the estimated budget (see Annex 2). Only amounts that were declared in your individual financial statements can be taken into account later on, in order to replace other costs that are found to be ineligible.

¹ See Article 6 for the eligibility conditions

² The indirect costs claimed must be free of any amounts covered by an operating grant (received under any EU or Euratom funding programme; see Article 6.2.E). If you have received an operating grant during this reporting period, you cannot claim any indirect costs.

³ This is the *theoretical* amount of EU contribution that the system calculates automatically (by multiplying the reimbursement rate by the total costs declared). The amount you request (in the column 'requested EU contribution') may be less

⁴ See Article 5 for the form of costs

⁵ Flat rate : 25% of eligible direct costs, from which are excluded: direct costs of subcontracting, costs of in-kind contributions not used on premises, direct costs of financial support, and unit costs declared under budget category F if they include indirect costs (see Article 6.2.E)

⁶ Only specific unit costs that do not include indirect costs

ANNEX 5

MODEL FOR THE CERTIFICATE ON THE FINANCIAL STATEMENTS

- For options [*in italics in square brackets*]: choose the applicable option. Options not chosen should be deleted.
- For fields in [grey in square brackets]: enter the appropriate data

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TERMS OF REFERENCE FOR AN INDEPENDENT REPORT OF FACTUAL FINDINGS ON COSTS DECLARED UNDER A GRANT AGREEMENT FINANCED UNDER THE HORIZON 2020 RESEARCH FRAMEWORK PROGRAMME

INDEPENDENT REPORT OF FACTUAL FINDINGS ON COSTS DECLARED UNDER A GRANT AGREEMENT FINANCED UNDER THE HORIZON 2020 RESEARCH FRAMEWORK PROGRAMME

Terms of Reference for an Independent Report of Factual Findings on costs declared under a Grant Agreement financed under the Horizon 2020 Research and Innovation Framework Programme

This document sets out the ‘**Terms of Reference (ToR)**’ under which

[*OPTION 1: [insert name of the beneficiary] (‘the Beneficiary’) [OPTION 2: [insert name of the linked third party] (‘the Linked Third Party’), third party linked to the Beneficiary [insert name of the beneficiary] (‘the Beneficiary’)]*

agrees to engage

[insert legal name of the auditor] (‘the Auditor’)

to produce an independent report of factual findings (‘the Report’) concerning the Financial Statement(s)¹ drawn up by the [Beneficiary] [Linked Third Party] for the Horizon 2020 grant agreement [insert number of the grant agreement, title of the action, acronym and duration from/to] (‘the Agreement’), and

to issue a Certificate on the Financial Statements’ (‘CFS’) referred to in Article 20.4 of the Agreement based on the compulsory reporting template stipulated by the Commission.

The Agreement has been concluded under the Horizon 2020 Research and Innovation Framework Programme (H2020) between the Beneficiary and [*OPTION 1: the European Union, represented by the European Commission (‘the Commission’)*][*OPTION 2: the European Atomic Energy Community (Euratom,) represented by the European Commission (‘the Commission’)*][*OPTION 3: the [Research Executive Agency (REA)] [European Research Council Executive Agency (ERCEA)] [Innovation and Networks Executive Agency (INEA)] [Executive Agency for Small and Medium-sized Enterprises (EASME)] (‘the Agency’), under the powers delegated by the European Commission (‘the Commission’).*]

The [Commission] [Agency] is mentioned as a signatory of the Agreement with the Beneficiary only. The [European Union][Euratom][Agency] is not a party to this engagement.

1.1 Subject of the engagement

The coordinator must submit to the [Commission][Agency] the final report within 60 days following the end of the last reporting period which should include, amongst other documents, a CFS for each beneficiary and for each linked third party that requests a total contribution of EUR 325 000 or more, as reimbursement of actual costs and unit costs calculated on the basis of its usual cost accounting practices (see Article 20.4 of the Agreement). The CFS must cover all reporting periods of the beneficiary or linked third party indicated above.

The Beneficiary must submit to the coordinator the CFS for itself and for its linked third party(ies), if the CFS must be included in the final report according to Article 20.4 of the Agreement..

The CFS is composed of two separate documents:

- The Terms of Reference (‘the ToR’) to be signed by the [Beneficiary] [Linked Third Party] and the Auditor;

¹ By which costs under the Agreement are declared (see template ‘Model Financial Statements’ in Annex 4 to the Grant Agreement).

- The Auditor's Independent Report of Factual Findings ('the Report') to be issued on the Auditor's letterhead, dated, stamped and signed by the Auditor (or the competent public officer) which includes the agreed-upon procedures ('the Procedures') to be performed by the Auditor, and the standard factual findings ('the Findings') to be confirmed by the Auditor.

If the CFS must be included in the final report according to Article 20.4 of the Agreement, the request for payment of the balance relating to the Agreement cannot be made without the CFS. However, the payment for reimbursement of costs covered by the CFS does not preclude the [Commission,] [Agency,] the European Anti-Fraud Office and the European Court of Auditors from carrying out checks, reviews, audits and investigations in accordance with Article 22 of the Agreement.

1.2 Responsibilities

The [Beneficiary] [Linked Third Party]:

- must draw up the Financial Statement(s) for the action financed by the Agreement in compliance with the obligations under the Agreement. The Financial Statement(s) must be drawn up according to the [Beneficiary's] [Linked Third Party's] accounting and book-keeping system and the underlying accounts and records;
- must send the Financial Statement(s) to the Auditor;
- is responsible and liable for the accuracy of the Financial Statement(s);
- is responsible for the completeness and accuracy of the information provided to enable the Auditor to carry out the Procedures. It must provide the Auditor with a written representation letter supporting these statements. The written representation letter must state the period covered by the statements and must be dated;
- accepts that the Auditor cannot carry out the Procedures unless it is given full access to the [Beneficiary's] [Linked Third Party's] staff and accounting as well as any other relevant records and documentation.

The Auditor:

- [Option 1 by default: is qualified to carry out statutory audits of accounting documents in accordance with Directive 2006/43/EC of the European Parliament and of the Council of 17 May 2006 on statutory audits of annual accounts and consolidated accounts, amending Council Directives 78/660/EEC and 83/349/EEC and repealing Council Directive 84/253/EEC or similar national regulations].
- [Option 2 if the Beneficiary or Linked Third Party has an independent Public Officer: is a competent and independent Public Officer for which the relevant national authorities have established the legal capacity to audit the Beneficiary].
- [Option 3 if the Beneficiary or Linked Third Party is an international organisation: is an [internal] [external] auditor in accordance with the internal financial regulations and procedures of the international organisation].

The Auditor:

- must be independent from the Beneficiary [and the Linked Third Party], in particular, it must not have been involved in preparing the [Beneficiary's] [Linked Third Party's] Financial Statement(s);
- must plan work so that the Procedures may be carried out and the Findings may be assessed;
- must adhere to the Procedures laid down and the compulsory report format;
- must carry out the engagement in accordance with this ToR;
- must document matters which are important to support the Report;
- must base its Report on the evidence gathered;
- must submit the Report to the [Beneficiary] [Linked Third Party].

The Commission sets out the Procedures to be carried out by the Auditor. The Auditor is not responsible for their suitability or pertinence. As this engagement is not an assurance engagement, the Auditor does not provide an audit opinion or a statement of assurance.

1.3 Applicable Standards

The Auditor must comply with these Terms of Reference and with²:

- the International Standard on Related Services ('ISRS') 4400 *Engagements to perform Agreed-upon Procedures regarding Financial Information* as issued by the International Auditing and Assurance Standards Board (IAASB);
- the *Code of Ethics for Professional Accountants* issued by the International Ethics Standards Board for Accountants (IESBA). Although ISRS 4400 states that independence is not a requirement for engagements to carry out agreed-upon procedures, the [Commission][Agency] requires that the Auditor also complies with the Code's independence requirements.

The Auditor's Report must state that there is no conflict of interests in establishing this Report between the Auditor and the Beneficiary [and the Linked Third Party], and must specify - if the service is invoiced - the total fee paid to the Auditor for providing the Report.

1.4 Reporting

The Report must be written in the language of the Agreement (see Article 20.7).

Under Article 22 of the Agreement, the Commission[, the Agency], the European Anti-Fraud Office and the Court of Auditors have the right to audit any work that is carried out under the action and for which costs are declared from [the European Union] [Euratom] budget. This includes work related to this engagement. The Auditor must provide access to all working papers (e.g. recalculation of hourly rates, verification of the time declared for the action) related to this assignment if the Commission [, the Agency], the European Anti-Fraud Office or the European Court of Auditors requests them.

1.5 Timing

The Report must be provided by [dd Month yyyy].

1.6 Other terms

[The [Beneficiary] [Linked Third Party] and the Auditor can use this section to agree other specific terms, such as the Auditor's fees, liability, applicable law, etc. Those specific terms must not contradict the terms specified above.]

[legal name of the Auditor]	[legal name of the [Beneficiary][Linked Third Party]]
[name & function of authorised representative]	[name & function of authorised representative]
[dd Month yyyy]	[dd Month yyyy]
Signature of the Auditor	Signature of the [Beneficiary][Linked Third Party]

² Supreme Audit Institutions applying INTOSAI-standards may carry out the Procedures according to the corresponding International Standards of Supreme Audit Institutions and code of ethics issued by INTOSAI instead of the International Standard on Related Services ('ISRS') 4400 and the Code of Ethics for Professional Accountants issued by the IAASB and the IESBA.

**Independent Report of Factual Findings on costs declared
under Horizon 2020 Research and Innovation Framework Programme**

(To be printed on the Auditor's letterhead)

To
[name of contact person(s)], [Position]
[[Beneficiary's] [Linked Third Party's] name]
[Address]
[dd Month yyyy]

Dear [Name of contact person(s)],

As agreed under the terms of reference dated [dd Month yyyy]

with [OPTION 1: [insert name of the beneficiary] ('the Beneficiary')] [OPTION 2: [insert name of the linked third party] ('the Linked Third Party'), third party linked to the Beneficiary [insert name of the beneficiary] ('the Beneficiary')],

we

[name of the auditor] ('the Auditor'),

established at

[full address/city/state/province/country],

represented by

[name and function of an authorised representative],

have carried out the procedures agreed with you regarding the costs declared in the Financial Statement(s)³ of the [Beneficiary] [Linked Third Party] concerning the grant agreement [insert grant agreement reference: number, title of the action and acronym] ('the Agreement'),

with a total cost declared of
[total amount] EUR,

and a total of actual costs and 'direct personnel costs declared as unit costs calculated in accordance with the [Beneficiary's] [Linked Third Party's] usual cost accounting practices' declared of

[sum of total actual costs and total direct personnel costs declared as unit costs calculated in accordance with the [Beneficiary's] [Linked Third Party's] usual cost accounting practices] EUR

and **hereby provide our Independent Report of Factual Findings ('the Report')** using the compulsory report format agreed with you.

The Report

Our engagement was carried out in accordance with the terms of reference ('the ToR') appended to this Report. The Report includes the agreed-upon procedures ('the Procedures') carried out and the standard factual findings ('the Findings') examined.

³ By which the Beneficiary declares costs under the Agreement (see template 'Model Financial Statement' in Annex 4 to the Agreement).

The Procedures were carried out solely to assist the [Commission] [Agency] in evaluating whether the [Beneficiary's] [Linked Third Party's] costs in the accompanying Financial Statement(s) were declared in accordance with the Agreement. The [Commission] [Agency] draws its own conclusions from the Report and any additional information it may require.

The scope of the Procedures was defined by the Commission. Therefore, the Auditor is not responsible for their suitability or pertinence. Since the Procedures carried out constitute neither an audit nor a review made in accordance with International Standards on Auditing or International Standards on Review Engagements, the Auditor does not give a statement of assurance on the Financial Statements.

Had the Auditor carried out additional procedures or an audit of the [Beneficiary's] [Linked Third Party's] Financial Statements in accordance with International Standards on Auditing or International Standards on Review Engagements, other matters might have come to its attention and would have been included in the Report.

Not applicable Findings

We examined the Financial Statement(s) stated above and considered the following Findings not applicable:

Explanation (to be removed from the Report):

If a Finding was not applicable, it must be marked as 'N.A.' ('Not applicable') in the corresponding row on the right-hand column of the table and means that the Finding did not have to be corroborated by the Auditor and the related Procedure(s) did not have to be carried out.

The reasons of the non-application of a certain Finding must be obvious i.e.

- i) if no cost was declared under a certain category then the related Finding(s) and Procedure(s) are not applicable;*
- ii) if the condition set to apply certain Procedure(s) are not met the related Finding(s) and those Procedure(s) are not applicable. For instance, for 'beneficiaries with accounts established in a currency other than euro' the Procedure and Finding related to 'beneficiaries with accounts established in euro' are not applicable. Similarly, if no additional remuneration is paid, the related Finding(s) and Procedure(s) for additional remuneration are not applicable.*

List here all Findings considered not applicable for the present engagement and explain the reasons of the non-applicability.

....

Exceptions

Apart from the exceptions listed below, the [Beneficiary] [Linked Third Party] provided the Auditor all the documentation and accounting information needed by the Auditor to carry out the requested Procedures and evaluate the Findings.

Explanation (to be removed from the Report):

- If the Auditor was not able to successfully complete a procedure requested, it must be marked as 'E' ('Exception') in the corresponding row on the right-hand column of the table. The reason such as the inability to reconcile key information or the unavailability of data that prevents the Auditor from carrying out the Procedure must be indicated below.*
- If the Auditor cannot corroborate a standard finding after having carried out the corresponding procedure, it must also be marked as 'E' ('Exception') and, where possible, the reasons why the Finding was not fulfilled and its possible impact must be explained here below.*

List here any exceptions and add any information on the cause and possible consequences of each exception, if known. If the exception is quantifiable, include the corresponding amount.

....

Example (to be removed from the Report):

1. *The Beneficiary was unable to substantiate the Finding number 1 on ... because*
2. *Finding number 30 was not fulfilled because the methodology used by the Beneficiary to calculate unit costs was different from the one approved by the Commission. The differences were as follows: ...*
3. *After carrying out the agreed procedures to confirm the Finding number 31, the Auditor found a difference of _____ EUR. The difference can be explained by ...*

Further Remarks

In addition to reporting on the results of the specific procedures carried out, the Auditor would like to make the following general remarks:

Example (to be removed from the Report):

1. *Regarding Finding number 8 the conditions for additional remuneration were considered as fulfilled because ...*
2. *In order to be able to confirm the Finding number 15 we carried out the following additional procedures:*

Use of this Report

This Report may be used only for the purpose described in the above objective. It was prepared solely for the confidential use of the [Beneficiary] [Linked Third Party] and the [Commission] [Agency], and only to be submitted to the [Commission] [Agency] in connection with the requirements set out in Article 20.4 of the Agreement. The Report may not be used by the [Beneficiary] [Linked Third Party] or by the [Commission] [Agency] for any other purpose, nor may it be distributed to any other parties. The [Commission] [Agency] may only disclose the Report to authorised parties, in particular to the European Anti-Fraud Office (OLAF) and the European Court of Auditors.

This Report relates only to the Financial Statement(s) submitted to the [Commission] [Agency] by the [Beneficiary] [Linked Third Party] for the Agreement. Therefore, it does not extend to any other of the [Beneficiary's] [Linked Third Party's] Financial Statement(s).

There was no conflict of interest⁴ between the Auditor and the Beneficiary [and Linked Third Party] in establishing this Report. The total fee paid to the Auditor for providing the Report was EUR _____ (including EUR _____ of deductible VAT).

We look forward to discussing our Report with you and would be pleased to provide any further information or assistance.

[legal name of the Auditor]

[name and function of an authorised representative]

[dd Month yyyy]

Signature of the Auditor

⁴ A conflict of interest arises when the Auditor's objectivity to establish the certificate is compromised in fact or in appearance when the Auditor for instance:

- was involved in the preparation of the Financial Statements;
- stands to benefit directly should the certificate be accepted;
- has a close relationship with any person representing the beneficiary;
- is a director, trustee or partner of the beneficiary; or
- is in any other situation that compromises his or her independence or ability to establish the certificate impartially.

Agreed-upon procedures to be performed and standard factual findings to be confirmed by the Auditor

The European Commission reserves the right to i) provide the auditor with additional guidance regarding the procedures to be followed or the facts to be ascertained and the way in which to present them (this may include sample coverage and findings) or to ii) change the procedures, by notifying the Beneficiary in writing. The procedures carried out by the auditor to confirm the standard factual finding are listed in the table below.

If this certificate relates to a Linked Third Party, any reference here below to ‘the Beneficiary’ is to be considered as a reference to ‘the Linked Third Party’.

The ‘result’ column has three different options: ‘C’, ‘E’ and ‘N.A.’:

- ‘C’ stands for ‘confirmed’ and means that the auditor can confirm the ‘standard factual finding’ and, therefore, there is no exception to be reported.
- ‘E’ stands for ‘exception’ and means that the Auditor carried out the procedures but cannot confirm the ‘standard factual finding’, or that the Auditor was not able to carry out a specific procedure (e.g. because it was impossible to reconcile key information or data were unavailable),
- ‘N.A.’ stands for ‘not applicable’ and means that the Finding did not have to be examined by the Auditor and the related Procedure(s) did not have to be carried out. The reasons of the non-application of a certain Finding must be obvious i.e. i) if no cost was declared under a certain category then the related Finding(s) and Procedure(s) are not applicable; ii) if the condition set to apply certain Procedure(s) are not met then the related Finding(s) and Procedure(s) are not applicable. For instance, for ‘beneficiaries with accounts established in a currency other than the euro’ the Procedure related to ‘beneficiaries with accounts established in euro’ is not applicable. Similarly, if no additional remuneration is paid, the related Finding(s) and Procedure(s) for additional remuneration are not applicable.

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
A	ACTUAL PERSONNEL COSTS AND UNIT COSTS CALCULATED BY THE BENEFICIARY IN ACCORDANCE WITH ITS USUAL COST ACCOUNTING PRACTICE		
	<p>The Auditor draws a sample of persons whose costs were declared in the Financial Statement(s) to carry out the procedures indicated in the consecutive points of this section A.</p> <p><i>(The sample should be selected randomly so that it is representative. Full coverage is required if there are fewer than 10 people (including employees, natural persons working under a direct contract and personnel seconded by a third party), otherwise the sample should have a minimum of 10 people, or 10% of the total, whichever number is the highest)</i></p> <p>The Auditor sampled [] people out of the total of [] people.</p>		

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
A.1	<p>PERSONNEL COSTS</p> <p><u>For the persons included in the sample and working under an employment contract or equivalent act (general procedures for individual actual personnel costs and personnel costs declared as unit costs)</u></p> <p>To confirm standard factual findings 1-5 listed in the next column, the Auditor reviewed following information/documents provided by the Beneficiary:</p> <ul style="list-style-type: none"> ○ a list of the persons included in the sample indicating the period(s) during which they worked for the action, their position (classification or category) and type of contract; ○ the payslips of the employees included in the sample; ○ reconciliation of the personnel costs declared in the Financial Statement(s) with the accounting system (project accounting and general ledger) and payroll system; ○ information concerning the employment status and employment conditions of personnel included in the sample, in particular their employment contracts or equivalent; ○ the Beneficiary’s usual policy regarding payroll matters (e.g. salary policy, overtime policy, variable pay); ○ applicable national law on taxes, labour and social security and ○ any other document that supports the personnel costs declared. <p>The Auditor also verified the eligibility of all components of the retribution (see Article 6 GA) and recalculated the personnel costs for employees included in the sample.</p>	<p>1) The employees were i) directly hired by the Beneficiary in accordance with its national legislation, ii) under the Beneficiary’s sole technical supervision and responsibility and iii) remunerated in accordance with the Beneficiary’s usual practices.</p> <p>2) Personnel costs were recorded in the Beneficiary's accounts/payroll system.</p> <p>3) Costs were adequately supported and reconciled with the accounts and payroll records.</p> <p>4) Personnel costs did not contain any ineligible elements.</p> <p>5) There were no discrepancies between the personnel costs charged to the action and the costs recalculated by the Auditor.</p>	
	<p><i>Further procedures if ‘additional remuneration’ is paid</i></p> <p>To confirm standard factual findings 6-9 listed in the next column, the Auditor:</p> <ul style="list-style-type: none"> ○ reviewed relevant documents provided by the Beneficiary (legal form, legal/statutory 	<p>6) The Beneficiary paying “additional remuneration” was a non-profit legal entity.</p>	

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	<p>obligations, the Beneficiary’s usual policy on additional remuneration, criteria used for its calculation...);</p> <ul style="list-style-type: none"> ○ recalculated the amount of additional remuneration eligible for the action based on the supporting documents received (full-time or part-time work, exclusive or non-exclusive dedication to the action, etc.) to arrive at the applicable FTE/year and pro-rata rate (see data collected in the course of carrying out the procedures under A.2 ‘Productive hours’ and A.4 ‘Time recording system’). <p><i>IF ANY PART OF THE REMUNERATION PAID TO THE EMPLOYEE IS NOT MANDATORY ACCORDING TO THE NATIONAL LAW OR THE EMPLOYMENT CONTRACT ("ADDITIONAL REMUNERATION") AND IS ELIGIBLE UNDER THE PROVISIONS OF ARTICLE 6.2.A.1, THIS CAN BE CHARGED AS ELIGIBLE COST TO THE ACTION UP TO THE FOLLOWING AMOUNT:</i></p> <p>(A) <i>IF THE PERSON WORKS FULL TIME AND EXCLUSIVELY ON THE ACTION DURING THE FULL YEAR: UP TO EUR 8 000/YEAR;</i></p> <p>(B) <i>IF THE PERSON WORKS EXCLUSIVELY ON THE ACTION BUT NOT FULL-TIME OR NOT FOR THE FULL YEAR: UP TO THE CORRESPONDING PRO-RATA AMOUNT OF EUR 8 000, OR</i></p> <p>(C) <i>IF THE PERSON DOES NOT WORK EXCLUSIVELY ON THE ACTION: UP TO A PRO-RATA AMOUNT CALCULATED IN ACCORDANCE TO ARTICLE 6.2.A.1.</i></p>	<p>7) The amount of additional remuneration paid corresponded to the Beneficiary’s usual remuneration practices and was consistently paid whenever the same kind of work or expertise was required.</p>	
		<p>8) The criteria used to calculate the additional remuneration were objective and generally applied by the Beneficiary regardless of the source of funding used.</p>	
		<p>9) The amount of additional remuneration included in the personnel costs charged to the action was capped at EUR 8,000 per FTE/year (up to the equivalent pro-rata amount if the person did not work on the action full-time during the year or did not work exclusively on the action).</p>	
	<p><i>Additional procedures in case “unit costs calculated by the Beneficiary in accordance with its usual cost accounting practices” is applied:</i></p> <p>Apart from carrying out the procedures indicated above to confirm standard factual findings 1-5 and, if applicable, also 6-9, the Auditor carried out following procedures to confirm standard</p>	<p>10) The personnel costs included in the Financial Statement were calculated in accordance with the Beneficiary's usual cost accounting practice. This methodology was consistently</p>	

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	<p>factual findings 10-13 listed in the next column:</p> <ul style="list-style-type: none"> ○ obtained a description of the Beneficiary's usual cost accounting practice to calculate unit costs; ○ reviewed whether the Beneficiary's usual cost accounting practice was applied for the Financial Statements subject of the present CFS; ○ verified the employees included in the sample were charged under the correct category (in accordance with the criteria used by the Beneficiary to establish personnel categories) by reviewing the contract/HR-record or analytical accounting records; ○ verified that there is no difference between the total amount of personnel costs used in calculating the cost per unit and the total amount of personnel costs recorded in the statutory accounts; ○ verified whether actual personnel costs were adjusted on the basis of budgeted or estimated elements and, if so, verified whether those elements used are actually relevant for the calculation, objective and supported by documents. 	<p>used in all H2020 actions.</p> <p>11) The employees were charged under the correct category.</p> <p>12) Total personnel costs used in calculating the unit costs were consistent with the expenses recorded in the statutory accounts.</p> <p>13) Any estimated or budgeted element used by the Beneficiary in its unit-cost calculation were relevant for calculating personnel costs and corresponded to objective and verifiable information.</p>	
	<p><u>For natural persons included in the sample and working with the Beneficiary under a direct contract other than an employment contract, such as consultants (no subcontractors).</u></p> <p>To confirm standard factual findings 14-18 listed in the next column the Auditor reviewed following information/documents provided by the Beneficiary:</p> <ul style="list-style-type: none"> ○ the contracts, especially the cost, contract duration, work description, place of work, ownership of the results and reporting obligations to the Beneficiary; ○ the employment conditions of staff in the same category to compare costs and; ○ any other document that supports the costs declared and its registration (e.g. invoices, 	<p>14) The natural persons reported to the Beneficiary (worked under the Beneficiary's instructions).</p> <p>15) They worked on the Beneficiary's premises (unless otherwise agreed with the Beneficiary).</p> <p>16) The results of work carried out belong to the Beneficiary.</p>	

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	accounting records, etc.).	17) Their costs were not significantly different from those for staff who performed similar tasks under an employment contract with the Beneficiary.	
		18) The costs were supported by audit evidence and registered in the accounts.	
	<p><u>For personnel seconded by a third party and included in the sample (not subcontractors)</u></p> <p>To confirm standard factual findings 19-22 listed in the next column, the Auditor reviewed following information/documents provided by the Beneficiary:</p> <ul style="list-style-type: none"> ○ their secondment contract(s) notably regarding costs, duration, work description, place of work and ownership of the results; ○ if there is reimbursement by the Beneficiary to the third party for the resource made available (in-kind contribution against payment): any documentation that supports the costs declared (e.g. contract, invoice, bank payment, and proof of registration in its accounting/payroll, etc.) and reconciliation of the Financial Statement(s) with the accounting system (project accounting and general ledger) as well as any proof that the amount invoiced by the third party did not include any profit; ○ if there is no reimbursement by the Beneficiary to the third party for the resource made available (in-kind contribution free of charge): a proof of the actual cost borne by the Third Party for the resource made available free of charge to the Beneficiary such as a statement of costs incurred by the Third Party and proof of the registration in the Third Party's accounting/payroll; ○ any other document that supports the costs declared (e.g. invoices, etc.). 	19) Seconded personnel reported to the Beneficiary and worked on the Beneficiary's premises (unless otherwise agreed with the Beneficiary).	
		20) The results of work carried out belong to the Beneficiary.	
		<p><i>If personnel is seconded against payment:</i></p> <p>21) The costs declared were supported with documentation and recorded in the Beneficiary's accounts. The third party did not include any profit.</p>	
		<p><i>If personnel is seconded free of charge:</i></p> <p>22) The costs declared did not exceed the third party's cost as</p>	

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
		recorded in the accounts of the third party and were supported with documentation.	
A.2	<p>PRODUCTIVE HOURS</p> <p>To confirm standard factual findings 23-28 listed in the next column, the Auditor reviewed relevant documents, especially national legislation, labour agreements and contracts and time records of the persons included in the sample, to verify that:</p> <ul style="list-style-type: none"> ○ the annual productive hours applied were calculated in accordance with one of the methods described below, ○ the full-time equivalent (FTEs) ratios for employees not working full-time were correctly calculated. <p>If the Beneficiary applied method B, the auditor verified that the correctness in which the total number of hours worked was calculated and that the contracts specified the annual workable hours.</p> <p>If the Beneficiary applied method C, the auditor verified that the ‘annual productive hours’ applied when calculating the hourly rate were equivalent to at least 90 % of the ‘standard annual workable hours’. The Auditor can only do this if the calculation of the standard annual workable hours can be supported by records, such as national legislation, labour agreements, and contracts.</p> <p><i>BENEFICIARY'S PRODUCTIVE HOURS' FOR PERSONS WORKING FULL TIME SHALL BE ONE OF THE FOLLOWING METHODS:</i></p> <p><i>A. 1720 ANNUAL PRODUCTIVE HOURS (PRO-RATA FOR PERSONS NOT WORKING FULL-TIME)</i></p> <p><i>B. THE TOTAL NUMBER OF HOURS WORKED BY THE PERSON FOR THE BENEFICIARY IN THE YEAR (THIS METHOD IS ALSO REFERRED TO AS ‘TOTAL NUMBER OF HOURS WORKED’ IN THE NEXT COLUMN). THE CALCULATION OF THE TOTAL NUMBER OF HOURS WORKED WAS DONE AS FOLLOWS: ANNUAL WORKABLE HOURS OF THE PERSON ACCORDING TO THE EMPLOYMENT</i></p>	<p>23) The Beneficiary applied method [<i>choose one option and delete the others</i>] [A: 1720 hours] [B: the ‘total number of hours worked’] [C: ‘standard annual productive hours’ used correspond to usual accounting practices]</p> <p>24) Productive hours were calculated annually.</p> <p>25) For employees not working full-time the full-time equivalent (FTE) ratio was correctly applied.</p> <p><i>If the Beneficiary applied method B.</i></p> <p>26) The calculation of the number of ‘annual workable hours’, overtime and absences was verifiable based on the documents provided by the Beneficiary.</p>	

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	<p><i>CONTRACT, APPLICABLE LABOUR AGREEMENT OR NATIONAL LAW PLUS OVERTIME WORKED MINUS ABSENCES (SUCH AS SICK LEAVE OR SPECIAL LEAVE).</i></p> <p><i>C. THE STANDARD NUMBER OF ANNUAL HOURS GENERALLY APPLIED BY THE BENEFICIARY FOR ITS PERSONNEL IN ACCORDANCE WITH ITS USUAL COST ACCOUNTING PRACTICES (THIS METHOD IS ALSO REFERRED TO AS 'STANDARD ANNUAL PRODUCTIVE HOURS' IN THE NEXT COLUMN). THIS NUMBER MUST BE AT LEAST 90% OF THE STANDARD ANNUAL WORKABLE HOURS.</i></p> <p><i>'ANNUAL WORKABLE HOURS' MEANS THE PERIOD DURING WHICH THE PERSONNEL MUST BE WORKING, AT THE EMPLOYER'S DISPOSAL AND CARRYING OUT HIS/HER ACTIVITY OR DUTIES UNDER THE EMPLOYMENT CONTRACT, APPLICABLE COLLECTIVE LABOUR AGREEMENT OR NATIONAL WORKING TIME LEGISLATION.</i></p>	<p>26.1) The Beneficiary calculates the hourly rates per full financial year following procedure A.3 (method B is not allowed for beneficiaries calculating hourly rates per month).</p> <p><i>If the Beneficiary applied method C.</i></p> <p>27) The calculation of the number of 'standard annual workable hours' was verifiable based on the documents provided by the Beneficiary.</p> <p>28) The 'annual productive hours' used for calculating the hourly rate were consistent with the usual cost accounting practices of the Beneficiary and were equivalent to at least 90 % of the 'annual workable hours'.</p>	
A.3	<p>HOURLY PERSONNEL RATES</p> <p><u>D) For unit costs calculated in accordance to the Beneficiary's usual cost accounting practice (unit costs):</u></p> <p>If the Beneficiary has a "Certificate on Methodology to calculate unit costs " (CoMUC) approved by the Commission, the Beneficiary provides the Auditor with a description of the approved methodology and the Commission's letter of acceptance. The Auditor verified that the</p>	<p>29) The Beneficiary applied [<i>choose one option and delete the other</i>]:</p> <p>[Option I: "Unit costs (hourly rates) were calculated in accordance with the Beneficiary's usual cost</p>	

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	<p>Beneficiary has indeed used the methodology approved. If so, no further verification is necessary.</p> <p>If the Beneficiary does not have a "Certificate on Methodology" (CoMUC) approved by the Commission, or if the methodology approved was not applied, then the Auditor:</p> <ul style="list-style-type: none"> ○ reviewed the documentation provided by the Beneficiary, including manuals and internal guidelines that explain how to calculate hourly rates; ○ recalculated the unit costs (hourly rates) of staff included in the sample following the results of the procedures carried out in A.1 and A.2. <p><u>II) For individual hourly rates:</u></p> <p>The Auditor:</p> <ul style="list-style-type: none"> ○ reviewed the documentation provided by the Beneficiary, including manuals and internal guidelines that explain how to calculate hourly rates; ○ recalculated the hourly rates of staff included in the sample (recalculation of all hourly rates if the Beneficiary uses annual rates, recalculation of three months selected randomly for every year and person if the Beneficiary uses monthly rates) following the results of the procedures carried out in A.1 and A.2; ○ (only in case of monthly rates) confirmed that the time spent on parental leave is not deducted, and that, if parts of the basic remuneration are generated over a period longer than a month, the Beneficiary has included only the share which is generated in the month. <p><u>“UNIT COSTS CALCULATED BY THE BENEFICIARY IN ACCORDANCE WITH ITS USUAL COST ACCOUNTING PRACTICES”:</u></p> <p><i>IT IS CALCULATED BY DIVIDING THE TOTAL AMOUNT OF PERSONNEL COSTS OF THE CATEGORY TO WHICH THE EMPLOYEE BELONGS VERIFIED IN LINE WITH PROCEDURE A.1 BY THE NUMBER OF FTE AND THE ANNUAL TOTAL PRODUCTIVE HOURS OF THE SAME CATEGORY CALCULATED BY THE BENEFICIARY IN ACCORDANCE WITH PROCEDURE A.2.</i></p>	<p>accounting practices”]</p> <p>[Option II: Individual hourly rates were applied]</p> <p><i>For option I concerning unit costs and if the Beneficiary applies the methodology approved by the Commission (CoMUC):</i></p> <p>30) The Beneficiary used the Commission-approved methodology to calculate hourly rates. It corresponded to the organisation's usual cost accounting practices and was applied consistently for all activities irrespective of the source of funding.</p> <p><i>For option I concerning unit costs and if the Beneficiary applies a methodology not approved by the Commission:</i></p> <p>31) The unit costs re-calculated by the Auditor were the same as the rates applied by the Beneficiary.</p> <p><i>For option II concerning individual hourly rates:</i></p> <p>32) The individual rates re-</p>	

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	<p><u>HOURLY RATE FOR INDIVIDUAL ACTUAL PERSONAL COSTS:</u> <i>IT IS CALCULATED FOLLOWING ONE OF THE TWO OPTIONS BELOW:</i></p> <p>A) [OPTION BY DEFAULT] BY DIVIDING THE ACTUAL ANNUAL AMOUNT OF PERSONNEL COSTS OF AN EMPLOYEE VERIFIED IN LINE WITH PROCEDURE A.1 BY THE NUMBER OF ANNUAL PRODUCTIVE HOURS VERIFIED IN LINE WITH PROCEDURE A.2 (FULL FINANCIAL YEAR HOURLY RATE);</p> <p>B) BY DIVIDING THE ACTUAL MONTHLY AMOUNT OF PERSONNEL COSTS OF AN EMPLOYEE VERIFIED IN LINE WITH PROCEDURE A.1 BY 1/12 OF THE NUMBER OF ANNUAL PRODUCTIVE HOURS VERIFIED IN LINE WITH PROCEDURE A.2.(MONTHLY HOURLY RATE).</p>	<p>calculated by the Auditor were the same as the rates applied by the Beneficiary.</p> <p>32.1) The Beneficiary used only one option (per full financial year or per month) throughout each financial year examined.</p>	
A.4	<p>TIME RECORDING SYSTEM</p> <p>To verify that the time recording system ensures the fulfilment of all minimum requirements and that the hours declared for the action were correct, accurate and properly authorised and supported by documentation, the Auditor made the following checks for the persons included in the sample that declare time as worked for the action on the basis of time records:</p> <ul style="list-style-type: none"> ○ description of the time recording system provided by the Beneficiary (registration, authorisation, processing in the HR-system); ○ its actual implementation; ○ time records were signed at least monthly by the employees (on paper or electronically) and authorised by the project manager or another manager; ○ the hours declared were worked within the project period; ○ there were no hours declared as worked for the action if HR-records showed absence due to holidays or sickness (further cross-checks with travels are carried out in B.1 below) ; ○ the hours charged to the action matched those in the time recording system. 	<p>33) All persons recorded their time dedicated to the action on a daily/ weekly/ monthly basis using a paper/computer-based system. <i>(delete the answers that are not applicable)</i></p> <p>34) Their time-records were authorised at least monthly by the project manager or other superior.</p> <p>35) Hours declared were worked within the project period and were consistent with the presences/absences recorded in HR-records.</p>	

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	<p><i>ONLY THE HOURS WORKED ON THE ACTION CAN BE CHARGED. ALL WORKING TIME TO BE CHARGED SHOULD BE RECORDED THROUGHOUT THE DURATION OF THE PROJECT, ADEQUATELY SUPPORTED BY EVIDENCE OF THEIR REALITY AND RELIABILITY (SEE SPECIFIC PROVISIONS BELOW FOR PERSONS WORKING EXCLUSIVELY FOR THE ACTION WITHOUT TIME RECORDS).</i></p>	36) There were no discrepancies between the number of hours charged to the action and the number of hours recorded.	
	<p><u>If the persons are working exclusively for the action and without time records</u></p> <p>For the persons selected that worked exclusively for the action without time records, the Auditor verified evidence available demonstrating that they were in reality exclusively dedicated to the action and that the Beneficiary signed a declaration confirming that they have worked exclusively for the action.</p>	37) The exclusive dedication is supported by a declaration signed by the Beneficiary's and by any other evidence gathered.	
B	COSTS OF SUBCONTRACTING		
B.1	<p>The Auditor obtained the detail/breakdown of subcontracting costs and sampled cost items selected randomly <i>(full coverage is required if there are fewer than 10 items, otherwise the sample should have a minimum of 10 item, or 10% of the total, whichever number is highest).</i></p> <p>To confirm standard factual findings 38-42 listed in the next column, the Auditor reviewed the following for the items included in the sample:</p> <ul style="list-style-type: none"> ○ the use of subcontractors was foreseen in Annex 1; ○ subcontracting costs were declared in the subcontracting category of the Financial Statement; ○ supporting documents on the selection and award procedure were followed; ○ the Beneficiary ensured best value for money (key elements to appreciate the respect of this principle are the award of the subcontract to the bid offering best price-quality ratio, under conditions of transparency and equal treatment. In case an existing framework contract was used the Beneficiary ensured it was established on the basis of the principle of best value for money under conditions of transparency and equal treatment). 	<p>38) The use of claimed subcontracting costs was foreseen in Annex 1 and costs were declared in the Financial Statements under the subcontracting category.</p> <p>39) There were documents of requests to different providers, different offers and assessment of the offers before selection of the provider in line with internal procedures and procurement rules. Subcontracts were awarded in accordance with the principle of best value for money.</p> <p><i>(When different offers were not collected the Auditor explains</i></p>	

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	<p>In particular,</p> <ul style="list-style-type: none"> i. if the Beneficiary acted as a contracting authority within the meaning of Directive 2004/18/EC (or 2014/24/EU) or of Directive 2004/17/EC (or 2014/25/EU), the Auditor verified that the applicable national law on public procurement was followed and that the subcontracting complied with the Terms and Conditions of the Agreement. ii. if the Beneficiary did not fall under the above-mentioned category the Auditor verified that the Beneficiary followed their usual procurement rules and respected the Terms and Conditions of the Agreement.. <p>For the items included in the sample the Auditor also verified that:</p> <ul style="list-style-type: none"> o the subcontracts were not awarded to other Beneficiaries in the consortium; o there were signed agreements between the Beneficiary and the subcontractor; o there was evidence that the services were provided by subcontractor; 	<p><i>the reasons provided by the Beneficiary under the caption “Exceptions” of the Report. The Commission will analyse this information to evaluate whether these costs might be accepted as eligible)</i></p>	
		40) The subcontracts were not awarded to other Beneficiaries of the consortium.	
		41) All subcontracts were supported by signed agreements between the Beneficiary and the subcontractor.	
		42) There was evidence that the services were provided by the subcontractors.	
C	COSTS OF PROVIDING FINANCIAL SUPPORT TO THIRD PARTIES		
C.1	<p>The Auditor obtained the detail/breakdown of the costs of providing financial support to third parties and sampled [redacted] cost items selected randomly (full coverage is required if there are fewer than 10 items, otherwise the sample should have a minimum of 10 item, or 10% of the total, whichever number is highest).</p> <p>The Auditor verified that the following minimum conditions were met:</p> <ul style="list-style-type: none"> a) the maximum amount of financial support for each third party did not exceed EUR 60 000, unless explicitly mentioned in Annex 1; 	43) All minimum conditions were met	

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	b) the financial support to third parties was agreed in Annex 1 of the Agreement and the other provisions on financial support to third parties included in Annex 1 were respected.		

D	OTHER ACTUAL DIRECT COSTS		
D.1	<p>COSTS OF TRAVEL AND RELATED SUBSISTENCE ALLOWANCES</p> <p>The Auditor sampled [REDACTED] cost items selected randomly (<i>full coverage is required if there are fewer than 10 items, otherwise the sample should have a minimum of 10 item, or 10% of the total, whichever number is the highest</i>).</p> <p>The Auditor inspected the sample and verified that:</p> <ul style="list-style-type: none"> ○ travel and subsistence costs were consistent with the Beneficiary's usual policy for travel. In this context, the Beneficiary provided evidence of its normal policy for travel costs (e.g. use of first class tickets, reimbursement by the Beneficiary on the basis of actual costs, a lump sum or per diem) to enable the Auditor to compare the travel costs charged with this policy; ○ travel costs are correctly identified and allocated to the action (e.g. trips are directly linked to the action) by reviewing relevant supporting documents such as minutes of meetings, workshops or conferences, their registration in the correct project account, their consistency with time records or with the dates/duration of the workshop/conference; ○ no ineligible costs or excessive or reckless expenditure was declared. 	44) Costs were incurred, approved and reimbursed in line with the Beneficiary's usual policy for travels.	
		45) There was a link between the trip and the action.	
		46) The supporting documents were consistent with each other regarding subject of the trip, dates, duration and reconciled with time records and accounting.	
		47) No ineligible costs or excessive or reckless expenditure was declared.	
D.2	<p>DEPRECIATION COSTS FOR EQUIPMENT, INFRASTRUCTURE OR OTHER ASSETS</p> <p>The Auditor sampled [REDACTED] cost items selected randomly (<i>full coverage is required if there are fewer than 10 items, otherwise the sample should have a minimum of 10 item, or 10% of the total, whichever number is the highest</i>).</p> <p>For “equipment, infrastructure or other assets” [from now on called “asset(s)”] selected in the sample the Auditor verified that:</p> <ul style="list-style-type: none"> ○ the assets were acquired in conformity with the Beneficiary's internal guidelines and procedures; ○ they were correctly allocated to the action (with supporting documents such as delivery 	48) Procurement rules, principles and guides were followed.	
		49) There was a link between the grant agreement and the asset charged to the action.	
		50) The asset charged to the action was traceable to the accounting records and the underlying documents.	

	<p>note invoice or any other proof demonstrating the link to the action)</p> <ul style="list-style-type: none"> ○ they were entered in the accounting system; ○ the extent to which the assets were used for the action (as a percentage) was supported by reliable documentation (e.g. usage overview table); <p>The Auditor recalculated the depreciation costs and verified that they were in line with the applicable rules in the Beneficiary's country and with the Beneficiary's usual accounting policy (e.g. depreciation calculated on the acquisition value).</p> <p>The Auditor verified that no ineligible costs such as deductible VAT, exchange rate losses, excessive or reckless expenditure were declared (see Article 6.5 GA).</p>	<p>51) The depreciation method used to charge the asset to the action was in line with the applicable rules of the Beneficiary's country and the Beneficiary's usual accounting policy.</p>	
		<p>52) The amount charged corresponded to the actual usage for the action.</p>	
		<p>53) No ineligible costs or excessive or reckless expenditure were declared.</p>	
<p>D.3</p>	<p>COSTS OF OTHER GOODS AND SERVICES</p> <p>The Auditor sampled [REDACTED] cost items selected randomly (<i>full coverage is required if there are fewer than 10 items, otherwise the sample should have a minimum of 10 item, or 10% of the total, whichever number is highest</i>).</p> <p>For the purchase of goods, works or services included in the sample the Auditor verified that:</p> <ul style="list-style-type: none"> ○ the contracts did not cover tasks described in Annex 1; ○ they were correctly identified, allocated to the proper action, entered in the accounting system (traceable to underlying documents such as purchase orders, invoices and accounting); ○ the goods were not placed in the inventory of durable equipment; ○ the costs charged to the action were accounted in line with the Beneficiary's usual accounting practices; ○ no ineligible costs or excessive or reckless expenditure were declared (see Article 6 GA). <p>In addition, the Auditor verified that these goods and services were acquired in conformity with the Beneficiary's internal guidelines and procedures, in particular:</p> <ul style="list-style-type: none"> ○ if Beneficiary acted as a contracting authority within the meaning of Directive 	<p>54) Contracts for works or services did not cover tasks described in Annex 1.</p>	
		<p>55) Costs were allocated to the correct action and the goods were not placed in the inventory of durable equipment.</p>	
		<p>56) The costs were charged in line with the Beneficiary's accounting policy and were adequately supported.</p>	
		<p>57) No ineligible costs or excessive or reckless expenditure were declared. For internal invoices/charges only the cost element was charged, without any mark-ups.</p>	

	<p>2004/18/EC (or 2014/24/EU) or of Directive 2004/17/EC (or 2014/25/EU), the Auditor verified that the applicable national law on public procurement was followed and that the procurement contract complied with the Terms and Conditions of the Agreement.</p> <ul style="list-style-type: none"> ○ if the Beneficiary did not fall into the category above, the Auditor verified that the Beneficiary followed their usual procurement rules and respected the Terms and Conditions of the Agreement. <p>For the items included in the sample the Auditor also verified that:</p> <ul style="list-style-type: none"> ○ the Beneficiary ensured best value for money (key elements to appreciate the respect of this principle are the award of the contract to the bid offering best price-quality ratio, under conditions of transparency and equal treatment. In case an existing framework contract was used the Auditor also verified that the Beneficiary ensured it was established on the basis of the principle of best value for money under conditions of transparency and equal treatment); <p><i>SUCH GOODS AND SERVICES INCLUDE, FOR INSTANCE, CONSUMABLES AND SUPPLIES, DISSEMINATION (INCLUDING OPEN ACCESS), PROTECTION OF RESULTS, SPECIFIC EVALUATION OF THE ACTION IF IT IS REQUIRED BY THE AGREEMENT, CERTIFICATES ON THE FINANCIAL STATEMENTS IF THEY ARE REQUIRED BY THE AGREEMENT AND CERTIFICATES ON THE METHODOLOGY, TRANSLATIONS, REPRODUCTION.</i></p>	<p>58) Procurement rules, principles and guides were followed. There were documents of requests to different providers, different offers and assessment of the offers before selection of the provider in line with internal procedures and procurement rules. The purchases were made in accordance with the principle of best value for money.</p> <p><i>(When different offers were not collected the Auditor explains the reasons provided by the Beneficiary under the caption “Exceptions” of the Report. The Commission will analyse this information to evaluate whether these costs might be accepted as eligible)</i></p>	
<p>D.4</p>	<p>AGGREGATED CAPITALISED AND OPERATING COSTS OF RESEARCH INFRASTRUCTURE</p> <p>The Auditor ensured the existence of a positive ex-ante assessment (issued by the EC Services) of the cost accounting methodology of the Beneficiary allowing it to apply the guidelines on direct costing for large research infrastructures in Horizon 2020.</p> <p><i>In the cases that a positive ex-ante assessment has been issued (see the standard factual findings 59-60 on the next column),</i></p>	<p>59) The costs declared as direct costs for Large Research Infrastructures (in the appropriate line of the Financial Statement) comply with the methodology described in the positive ex-ante assessment report.</p>	

	<p>The Auditor ensured that the beneficiary has applied consistently the methodology that is explained and approved in the positive ex ante assessment;</p> <p><i>In the cases that a positive ex-ante assessment has NOT been issued (see the standard factual findings 61 on the next column),</i> The Auditor verified that no costs of Large Research Infrastructure have been charged as direct costs in any costs category;</p> <p><i>In the cases that a draft ex-ante assessment report has been issued with recommendation for further changes (see the standard factual findings 61 on the next column),</i></p> <ul style="list-style-type: none"> The Auditor followed the same procedure as above (when a positive ex-ante assessment has NOT yet been issued) and paid particular attention (testing reinforced) to the cost items for which the draft ex-ante assessment either rejected the inclusion as direct costs for Large Research Infrastructures or issued recommendations. 	<p>60) Any difference between the methodology applied and the one positively assessed was extensively described and adjusted accordingly.</p>	
		<p>61) The direct costs declared were free from any indirect costs items related to the Large Research Infrastructure.</p>	
<p>E</p>	<p>USE OF EXCHANGE RATES</p>		
<p>E.1</p>	<p>a) <u>For Beneficiaries with accounts established in a currency other than euros</u></p> <p>The Auditor sampled [REDACTED] cost items selected randomly and verified that the exchange rates used for converting other currencies into euros were in accordance with the following rules established in the Agreement (full coverage is required if there are fewer than 10 items, otherwise the sample should have a minimum of 10 item, or 10% of the total, whichever number is highest):</p> <p><i>COSTS RECORDED IN THE ACCOUNTS IN A CURRENCY OTHER THAN EURO SHALL BE CONVERTED INTO EURO AT THE AVERAGE OF THE DAILY EXCHANGE RATES PUBLISHED IN THE C SERIES OF OFFICIAL JOURNAL OF THE EUROPEAN UNION (https://www.ecb.int/stats/exchange/eurofxref/html/index.en.html), DETERMINED OVER THE CORRESPONDING REPORTING PERIOD.</i></p> <p><i>IF NO DAILY EURO EXCHANGE RATE IS PUBLISHED IN THE OFFICIAL JOURNAL OF THE EUROPEAN UNION FOR THE CURRENCY IN QUESTION, CONVERSION SHALL BE MADE AT THE AVERAGE OF THE MONTHLY ACCOUNTING RATES ESTABLISHED BY THE COMMISSION AND PUBLISHED ON ITS WEBSITE (http://ec.europa.eu/budget/contracts_grants/info_contracts/inforeuro/inforeuro_en.cfm), DETERMINED OVER THE CORRESPONDING REPORTING PERIOD.</i></p>	<p>62) The exchange rates used to convert other currencies into Euros were in accordance with the rules established of the Grant Agreement and there was no difference in the final figures.</p>	

	<p>b) <u>For Beneficiaries with accounts established in euros</u></p> <p>The Auditor sampled [REDACTED] cost items selected randomly and verified that the exchange rates used for converting other currencies into euros were in accordance with the following rules established in the Agreement (full coverage is required if there are fewer than 10 items, otherwise the sample should have a minimum of 10 item, or 10% of the total, whichever number is highest):</p> <p><i>COSTS INCURRED IN ANOTHER CURRENCY SHALL BE CONVERTED INTO EURO BY APPLYING THE BENEFICIARY'S USUAL ACCOUNTING PRACTICES.</i></p>	<p>63) The Beneficiary applied its usual accounting practices.</p>	
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[legal name of the audit firm]

[name and function of an authorised representative]

[dd Month yyyy]

<Signature of the Auditor>

ANNEX 6

MODEL FOR THE CERTIFICATE ON THE METHODOLOGY

- For options [*in italics in square brackets*]: choose the applicable option. Options not chosen should be deleted.
- For fields in [grey in square brackets]: enter the appropriate data.

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INDEPENDENT REPORT OF FACTUAL FINDINGS ON THE METHODOLOGY CONCERNING GRANT AGREEMENTS FINANCED UNDER THE HORIZON 2020 RESEARCH AND INNOVATION FRAMEWORK PROGRAMME

**Terms of reference for an audit engagement for a methodology certificate
in connection with one or more grant agreements financed
under the Horizon 2020 Research and Innovation Framework Programme**

This document sets out the ‘**Terms of Reference (ToR)**’ under which

[OPTION 1: [insert name of the beneficiary] (*‘the Beneficiary’*)] [OPTION 2: [insert name of the linked third party] (*‘the Linked Third Party’*), third party linked to the Beneficiary [insert name of the beneficiary] (*‘the Beneficiary’*)]

agrees to engage

[insert legal name of the auditor] (*‘the Auditor’*)

to produce an independent report of factual findings (*‘the Report’*) concerning the [Beneficiary’s] [Linked Third Party’s] usual accounting practices for calculating and claiming direct personnel costs declared as unit costs (*‘the Methodology’*) in connection with grant agreements financed under the Horizon 2020 Research and Innovation Framework Programme.

The procedures to be carried out for the assessment of the methodology will be based on the grant agreement(s) detailed below:

[title and number of the grant agreement(s)] (*‘the Agreement(s)’*)

The Agreement(s) has(have) been concluded between the Beneficiary and [OPTION 1: *the European Union, represented by the European Commission (‘the Commission’)*][OPTION 2: *the European Atomic Energy Community (Euratom,) represented by the European Commission (‘the Commission’)*][OPTION 3: *the [Research Executive Agency (REA)] [European Research Council Executive Agency (ERCEA)] [Innovation and Networks Executive Agency (INEA)] [Executive Agency for Small and Medium-sized Enterprises (EASME)] (‘the Agency’), under the powers delegated by the European Commission (‘the Commission’).*].

The [Commission] [Agency] is mentioned as a signatory of the Agreement with the Beneficiary only. The [European Union] [Euratom] [Agency] is not a party to this engagement.

1.1 Subject of the engagement

According to Article 18.1.2 of the Agreement, beneficiaries [and linked third parties] that declare direct personnel costs as unit costs calculated in accordance with their usual cost accounting practices may submit to the [Commission] [Agency], for approval, a certificate on the methodology (*‘CoMUC’*) stating that there are adequate records and documentation to prove that their cost accounting practices used comply with the conditions set out in Point A of Article 6.2.

The subject of this engagement is the CoMUC which is composed of two separate documents:

- the Terms of Reference (*‘the ToR’*) to be signed by the [Beneficiary] [Linked Third Party] and the Auditor;
- the Auditor’s Independent Report of Factual Findings (*‘the Report’*) issued on the Auditor’s letterhead, dated, stamped and signed by the Auditor which includes; the standard statements (*‘the Statements’*) evaluated and signed by the [Beneficiary] [Linked Third Party], the agreed-upon procedures (*‘the Procedures’*) performed by the Auditor and the standard factual findings

(‘the Findings’) assessed by the Auditor. The Statements, Procedures and Findings are summarised in the table that forms part of the Report.

The information provided through the Statements, the Procedures and the Findings will enable the Commission to draw conclusions regarding the existence of the *[Beneficiary’s] [Linked Third Party’s]* usual cost accounting practice and its suitability to ensure that direct personnel costs claimed on that basis comply with the provisions of the Agreement. The Commission draws its own conclusions from the Report and any additional information it may require.

1.2 Responsibilities

The parties to this agreement are the *[Beneficiary] [Linked Third Party]* and the Auditor.

The *[Beneficiary] [Linked Third Party]*:

- is responsible for preparing financial statements for the Agreement(s) (‘the Financial Statements’) in compliance with those Agreements;
- is responsible for providing the Financial Statement(s) to the Auditor and enabling the Auditor to reconcile them with the *[Beneficiary’s] [Linked Third Party’s]* accounting and bookkeeping system and the underlying accounts and records. The Financial Statement(s) will be used as a basis for the procedures which the Auditor will carry out under this ToR;
- is responsible for its Methodology and liable for the accuracy of the Financial Statement(s);
- is responsible for endorsing or refuting the Statements indicated under the heading ‘Statements to be made by the Beneficiary/ Linked Third Party’ in the first column of the table that forms part of the Report;
- must provide the Auditor with a signed and dated representation letter;
- accepts that the ability of the Auditor to carry out the Procedures effectively depends upon the *[Beneficiary] [Linked Third Party]* providing full and free access to the *[Beneficiary’s] [Linked Third Party’s]* staff and to its accounting and other relevant records.

The Auditor:

- *[Option 1 by default: is qualified to carry out statutory audits of accounting documents in accordance with Directive 2006/43/EC of the European Parliament and of the Council of 17 May 2006 on statutory audits of annual accounts and consolidated accounts, amending Council Directives 78/660/EEC and 83/349/EEC and repealing Council Directive 84/253/EEC or similar national regulations].*
- *[Option 2 if the Beneficiary or Linked Third Party has an independent Public Officer: is a competent and independent Public Officer for which the relevant national authorities have established the legal capacity to audit the Beneficiary].*
- *[Option 3 if the Beneficiary or Linked Third Party is an international organisation: is an [internal] [external] auditor in accordance with the internal financial regulations and procedures of the international organisation].*

The Auditor:

- must be independent from the Beneficiary *[and the Linked Third Party]*, in particular, it must not have been involved in preparing the Beneficiary’s *[and Linked Third Party’s]* Financial Statement(s);
- must plan work so that the Procedures may be carried out and the Findings may be assessed;
- must adhere to the Procedures laid down and the compulsory report format;
- must carry out the engagement in accordance with these ToR;
- must document matters which are important to support the Report;
- must base its Report on the evidence gathered;
- must submit the Report to the *[Beneficiary] [Linked Third Party]*.

The Commission sets out the Procedures to be carried out and the Findings to be endorsed by the Auditor. The Auditor is not responsible for their suitability or pertinence. As this engagement is not an assurance engagement the Auditor does not provide an audit opinion or a statement of assurance.

1.3 Applicable Standards

The Auditor must comply with these Terms of Reference and with¹:

- the International Standard on Related Services ('ISRS') 4400 *Engagements to perform Agreed-upon Procedures regarding Financial Information* as issued by the International Auditing and Assurance Standards Board (IAASB);
- the *Code of Ethics for Professional Accountants* issued by the International Ethics Standards Board for Accountants (IESBA). Although ISRS 4400 states that independence is not a requirement for engagements to carry out agreed-upon procedures, the Commission requires that the Auditor also complies with the Code's independence requirements.

The Auditor's Report must state that there was no conflict of interests in establishing this Report between the Auditor and the Beneficiary [*and the Linked Third Party*] that could have a bearing on the Report, and must specify – if the service is invoiced - the total fee paid to the Auditor for providing the Report.

1.4 Reporting

The Report must be written in the language of the Agreement (see Article 20.7 of the Agreement).

Under Article 22 of the Agreement, the Commission, [*the Agency*], the European Anti-Fraud Office and the Court of Auditors have the right to audit any work that is carried out under the action and for which costs are declared from [*the European Union*] [*Euratom*] budget. This includes work related to this engagement. The Auditor must provide access to all working papers related to this assignment if the Commission[, *the Agency*], the European Anti-Fraud Office or the European Court of Auditors requests them.

1.5 Timing

The Report must be provided by [dd Month yyyy].

1.6 Other Terms

[The [Beneficiary] [Linked Third Party] and the Auditor can use this section to agree other specific terms, such as the Auditor's fees, liability, applicable law, etc. Those specific terms must not contradict the terms specified above.]

[legal name of the Auditor]

[name & title of authorised representative]

[dd Month yyyy]

Signature of the Auditor Signature

[legal name of the [Beneficiary] [Linked Third Party]]

[name & title of authorised representative]

[dd Month yyyy]

Signature of the [*Beneficiary*] [*Linked Third Party*]

¹ Supreme Audit Institutions applying INTOSAI-standards may carry out the Procedures according to the corresponding International Standards of Supreme Audit Institutions and code of ethics issued by INTOSAI instead of the International Standard on Related Services ('ISRS') 4400 and the Code of Ethics for Professional Accountants issued by the IAASB and the IESBA.

Independent report of factual findings on the methodology concerning grant agreements financed under the Horizon 2020 Research and Innovation Framework Programme

(To be printed on letterhead paper of the auditor)

To
[name of contact person(s)], [Position]
[[Beneficiary's] [Linked Third Party's] name]
[Address]
[dd Month yyyy]

Dear [Name of contact person(s)],

As agreed under the terms of reference dated [dd Month yyyy]

with [OPTION 1: [insert name of the beneficiary] ('the Beneficiary')] [OPTION 2: [insert name of the linked third party] ('the Linked Third Party'), third party linked to the Beneficiary [insert name of the beneficiary] ('the Beneficiary')],

we

[name of the auditor] ('the Auditor'),

established at

[full address/city/state/province/country],

represented by

[name and function of an authorised representative],

have carried out the agreed-upon procedures ('the Procedures') and provide hereby our Independent Report of Factual Findings ('the Report'), concerning the [Beneficiary's] [Linked Third Party's] usual accounting practices for calculating and declaring direct personnel costs declared as unit costs ('the Methodology').

You requested certain procedures to be carried out in connection with the grant(s)

[title and number of the grant agreement(s)] ('the Agreement(s)').

The Report

Our engagement was carried out in accordance with the terms of reference ('the ToR') appended to this Report. The Report includes: the standard statements ('the Statements') made by the [Beneficiary] [Linked Third Party], the agreed-upon procedures ('the Procedures') carried out and the standard factual findings ('the Findings') confirmed by us.

The engagement involved carrying out the Procedures and assessing the Findings and the documentation requested appended to this Report, the results of which the Commission uses to draw conclusions regarding the acceptability of the Methodology applied by the [Beneficiary] [Linked Third Party].

H2020 Model Grant Agreements: H2020 General MGA — Multi: v3.0 – dd.mm.2016

The Report covers the methodology used from [dd Month yyyy]. In the event that the [Beneficiary] [Linked Third Party] changes this methodology, the Report will not be applicable to any Financial Statement¹ submitted thereafter.

The scope of the Procedures and the definition of the standard statements and findings were determined solely by the Commission. Therefore, the Auditor is not responsible for their suitability or pertinence.

Since the Procedures carried out constitute neither an audit nor a review made in accordance with International Standards on Auditing or International Standards on Review Engagements, we do not give a statement of assurance on the costs declared on the basis of the [Beneficiary's] [Linked Third Party's] Methodology. Had we carried out additional procedures or had we performed an audit or review in accordance with these standards, other matters might have come to its attention and would have been included in the Report.

Exceptions

Apart from the exceptions listed below, the [Beneficiary] [Linked Third Party] agreed with the standard Statements and provided the Auditor all the documentation and accounting information needed by the Auditor to carry out the requested Procedures and corroborate the standard Findings.

List here any exception and add any information on the cause and possible consequences of each exception, if known. If the exception is quantifiable, also indicate the corresponding amount.

.....

Explanation of possible exceptions in the form of examples (to be removed from the Report):

- i. the [Beneficiary] [Linked Third Party] did not agree with the standard Statement number ... because...;*
- ii. the Auditor could not carry out the procedure ... established because (e.g. due to the inability to reconcile key information or the unavailability or inconsistency of data);*
- iii. the Auditor could not confirm or corroborate the standard Finding number ... because*

Remarks

We would like to add the following remarks relevant for the proper understanding of the Methodology applied by the [Beneficiary] [Linked Third Party] or the results reported:

Example (to be removed from the Report):

Regarding the methodology applied to calculate hourly rates ...

Regarding standard Finding 15 it has to be noted that ...

The [Beneficiary] [Linked Third Party] explained the deviation from the benchmark statement XXIV concerning time recording for personnel with no exclusive dedication to the action in the following manner:

...

Annexes

Please provide the following documents to the auditor and annex them to the report when submitting this CoMUC to the Commission:

¹ Financial Statement in this context refers solely to Annex 4 of the Agreement by which the Beneficiary declares costs under the Agreement.

1. Brief description of the methodology for calculating personnel costs, productive hours and hourly rates;
2. Brief description of the time recording system in place;
3. An example of the time records used by the [Beneficiary] [Linked Third Party];
4. Description of any budgeted or estimated elements applied, together with an explanation as to why they are relevant for calculating the personnel costs and how they are based on objective and verifiable information;
5. A summary sheet with the hourly rate for direct personnel declared by the [Beneficiary] [Linked Third Party] and recalculated by the Auditor for each staff member included in the sample (the names do not need to be reported);
6. A comparative table summarising for each person selected in the sample a) the time claimed by the [Beneficiary] [Linked Third Party] in the Financial Statement(s) and b) the time according to the time record verified by the Auditor;
7. A copy of the letter of representation provided to the Auditor.

Use of this Report

This Report has been drawn up solely for the purpose given under Point 1.1 Reasons for the engagement.

The Report:

- is confidential and is intended to be submitted to the Commission by the [Beneficiary] [Linked Third Party] in connection with Article 18.1.2 of the Agreement;
- may not be used by the [Beneficiary] [Linked Third Party] or by the Commission for any other purpose, nor distributed to any other parties;
- may be disclosed by the Commission only to authorised parties, in particular the European Anti-Fraud Office (OLAF) and the European Court of Auditors.
- relates only to the usual cost accounting practices specified above and does not constitute a report on the Financial Statements of the [Beneficiary] [Linked Third Party].

No conflict of interest² exists between the Auditor and the Beneficiary [and the Linked Third Party] that could have a bearing on the Report. The total fee paid to the Auditor for producing the Report was EUR [] (including EUR [] of deductible VAT).

We look forward to discussing our Report with you and would be pleased to provide any further information or assistance which may be required.

Yours sincerely

[legal name of the Auditor]
[name and title of the authorised representative]
[dd Month yyyy]
Signature of the Auditor

² A conflict of interest arises when the Auditor's objectivity to establish the certificate is compromised in fact or in appearance when the Auditor for instance:

- was involved in the preparation of the Financial Statements;
- stands to benefit directly should the certificate be accepted;
- has a close relationship with any person representing the beneficiary;
- is a director, trustee or partner of the beneficiary; or
- is in any other situation that compromises his or her independence or ability to establish the certificate impartially.

Statements to be made by the Beneficiary/Linked Third Party ('the Statements') and Procedures to be carried out by the Auditor ('the Procedures') and standard factual findings ('the Findings') to be confirmed by the Auditor

The Commission reserves the right to provide the auditor with guidance regarding the Statements to be made, the Procedures to be carried out or the Findings to be ascertained and the way in which to present them. The Commission reserves the right to vary the Statements, Procedures or Findings by written notification to the Beneficiary/Linked Third Party to adapt the procedures to changes in the grant agreement(s) or to any other circumstances.

If this methodology certificate relates to the Linked Third Party's usual accounting practices for calculating and claiming direct personnel costs declared as unit costs any reference here below to 'the Beneficiary' is to be considered as a reference to 'the Linked Third Party'.

<i>Please explain any discrepancies in the body of the Report.</i>	
Statements to be made by Beneficiary	Procedures to be carried out and Findings to be confirmed by the Auditor
<p>A. Use of the Methodology</p> <p>I. The cost accounting practice described below has been in use since /dd Month yyyy/.</p> <p>II. The next planned alteration to the methodology used by the Beneficiary will be from [dd Month yyyy/].</p>	<p>Procedure:</p> <p>✓ The Auditor checked these dates against the documentation the Beneficiary has provided.</p> <p>Factual finding:</p> <p>1. The dates provided by the Beneficiary were consistent with the documentation.</p>
<p>B. Description of the Methodology</p> <p>III. The methodology to calculate unit costs is being used in a consistent manner and is reflected in the relevant procedures.</p> <p><i>[Please describe the methodology your entity uses to calculate <u>personnel costs</u>, productive hours and hourly rates, present your description to the Auditor and annex it to this certificate]</i></p> <p><i>[If the statement of section "B. Description of the methodology" cannot be endorsed by the Beneficiary or there is no written methodology to calculate unit costs it should be listed here below and reported as exception by the Auditor in the main Report of Factual Findings:</i></p> <p>- ...]</p>	<p>Procedure:</p> <p>✓ The Auditor reviewed the description, the relevant manuals and/or internal guidance documents describing the methodology.</p> <p>Factual finding:</p> <p>2. The brief description was consistent with the relevant manuals, internal guidance and/or other documentary evidence the Auditor has reviewed.</p> <p>3. The methodology was generally applied by the Beneficiary as part of its usual costs accounting practices.</p>
<p>C. Personnel costs</p> <p><u>General</u></p>	<p>Procedure:</p> <p><i>The Auditor draws a sample of employees to carry out the procedures indicated in</i></p>

<i>Please explain any discrepancies in the body of the Report.</i>	
Statements to be made by Beneficiary	Procedures to be carried out and Findings to be confirmed by the Auditor
<p>IV. The unit costs (hourly rates) are limited to salaries including during parental leave, social security contributions, taxes and other costs included in the remuneration required under national law and the employment contract or equivalent appointing act;</p> <p>V. Employees are hired directly by the Beneficiary in accordance with national law, and work under its sole supervision and responsibility;</p> <p>VI. The Beneficiary remunerates its employees in accordance with its usual practices. This means that personnel costs are charged in line with the Beneficiary’s usual payroll policy (e.g. salary policy, overtime policy, variable pay) and no special conditions exist for employees assigned to tasks relating to the European Union or Euratom, unless explicitly provided for in the grant agreement(s);</p> <p>VII. The Beneficiary allocates its employees to the relevant group/category/cost centre for the purpose of the unit cost calculation in line with the usual cost accounting practice;</p> <p>VIII. Personnel costs are based on the payroll system and accounting system.</p> <p>IX. Any exceptional adjustments of actual personnel costs resulted from relevant budgeted or estimated elements and were based on objective and verifiable information. <i>[Please describe the ‘budgeted or estimated elements’ and their relevance to personnel costs, and explain how they were reasonable and based on objective and verifiable information, present your explanation to the Auditor and annex it to this certificate].</i></p> <p>X. Personnel costs claimed do not contain any of the following ineligible costs: costs related to return on capital; debt and debt service charges; provisions for future losses or debts; interest owed; doubtful debts; currency exchange losses; bank costs charged by the Beneficiary’s bank for transfers from the Commission/Agency; excessive or reckless expenditure; deductible VAT or costs incurred during suspension of the implementation of the action.</p> <p>XI. Personnel costs were not declared under another EU or Euratom grant (including grants awarded by a Member State and financed by the EU budget and grants awarded by bodies other than the Commission/Agency for the purpose of implementing the EU budget).</p>	<p><i>this section C and the following sections D to F.</i> <i>[The Auditor has drawn a random sample of 10 full-time equivalents made up of employees assigned to the action(s). If fewer than 10 full-time equivalents are assigned to the action(s), the Auditor has selected a sample of 10 full-time equivalents consisting of all employees assigned to the action(s), complemented by other employees irrespective of their assignments.].</i> For this sample:</p> <ul style="list-style-type: none"> ✓ the Auditor reviewed all documents relating to personnel costs such as employment contracts, payslips, payroll policy (e.g. salary policy, overtime policy, variable pay policy), accounting and payroll records, applicable national tax , labour and social security law and any other documents corroborating the personnel costs claimed; ✓ in particular, the Auditor reviewed the employment contracts of the employees in the sample to verify that: <ul style="list-style-type: none"> i. they were employed directly by the Beneficiary in accordance with applicable national legislation; ii. they were working under the sole technical supervision and responsibility of the latter; iii. they were remunerated in accordance with the Beneficiary’s usual practices; iv. they were allocated to the correct group/category/cost centre for the purposes of calculating the unit cost in line with the Beneficiary’s usual cost accounting practices; ✓ the Auditor verified that any ineligible items or any costs claimed under other costs categories or costs covered by other types of grant or by other grants financed from the European Union budget have not been taken into account when calculating the personnel costs; ✓ the Auditor numerically reconciled the total amount of personnel costs used to calculate the unit cost with the total amount of personnel costs recorded in the statutory accounts and the payroll system. ✓ to the extent that actual personnel costs were adjusted on the basis of budgeted or estimated elements, the Auditor carefully examined those elements and checked the information source to confirm that they correspond to objective and verifiable information;

<i>Please explain any discrepancies in the body of the Report.</i>	
Statements to be made by Beneficiary	Procedures to be carried out and Findings to be confirmed by the Auditor
<p><u>If additional remuneration as referred to in the grant agreement(s) is paid</u></p> <p>XII. The Beneficiary is a non-profit legal entity;</p> <p>XIII. The additional remuneration is part of the beneficiary's usual remuneration practices and paid consistently whenever the relevant work or expertise is required;</p> <p>XIV. The criteria used to calculate the additional remuneration are objective and generally applied regardless of the source of funding;</p> <p>XV. The additional remuneration included in the personnel costs used to calculate the hourly rates for the grant agreement(s) is capped at EUR 8 000 per full-time equivalent (reduced proportionately if the employee is not assigned exclusively to the action).</p> <p><i>[If certain statement(s) of section "C. Personnel costs" cannot be endorsed by the Beneficiary they should be listed here below and reported as exception by the Auditor in the main Report of Factual Findings: - ...]</i></p>	<p>✓ if additional remuneration has been claimed, the Auditor verified that the Beneficiary was a non-profit legal entity, that the amount was capped at EUR 8000 per full-time equivalent and that it was reduced proportionately for employees not assigned exclusively to the action(s).</p> <p>✓ the Auditor recalculated the personnel costs for the employees in the sample.</p> <p>Factual finding:</p> <ol style="list-style-type: none"> 4. All the components of the remuneration that have been claimed as personnel costs are supported by underlying documentation. 5. The employees in the sample were employed directly by the Beneficiary in accordance with applicable national law and were working under its sole supervision and responsibility. 6. Their employment contracts were in line with the Beneficiary's usual policy; 7. Personnel costs were duly documented and consisted solely of salaries, social security contributions (pension contributions, health insurance, unemployment fund contributions, etc.), taxes and other statutory costs included in the remuneration (holiday pay, thirteenth month's pay, etc.); 8. The totals used to calculate the personnel unit costs are consistent with those registered in the payroll and accounting records; 9. To the extent that actual personnel costs were adjusted on the basis of budgeted or estimated elements, those elements were relevant for calculating the personnel costs and correspond to objective and verifiable information. The budgeted or estimated elements used are: — (indicate the elements and their values). 10. Personnel costs contained no ineligible elements; 11. Specific conditions for eligibility were fulfilled when additional remuneration was paid: a) the Beneficiary is registered in the grant agreements as a non-profit legal entity; b) it was paid according to objective criteria generally applied regardless of the source of funding used and c) remuneration was capped at EUR 8 000 per full-time equivalent (or up to up to the equivalent pro-rata amount if the person did not work on the action full-time during the year or did not work exclusively on the action).

<i>Please explain any discrepancies in the body of the Report.</i>	
Statements to be made by Beneficiary	Procedures to be carried out and Findings to be confirmed by the Auditor
<p>D. Productive hours</p> <p>XVI. The number of productive hours per full-time employee applied is <i>[delete as appropriate]</i>:</p> <p>A. 1720 productive hours per year for a person working full-time (corresponding pro-rata for persons not working full time).</p> <p>B. the total number of hours worked in the year by a person for the Beneficiary</p> <p>C. the standard number of annual hours generally applied by the beneficiary for its personnel in accordance with its usual cost accounting practices. This number must be at least 90% of the standard annual workable hours.</p> <p><u>If method B is applied</u></p> <p>XVII. The calculation of the total number of hours worked was done as follows: annual workable hours of the person according to the employment contract, applicable labour agreement or national law plus overtime worked minus absences (such as sick leave and special leave).</p> <p>XVIII. ‘Annual workable hours’ are hours during which the personnel must be working, at the employer’s disposal and carrying out his/her activity or duties under the employment contract, applicable collective labour agreement or national working time legislation.</p> <p>XIX. The contract (applicable collective labour agreement or national working time legislation) do specify the working time enabling to calculate the annual workable hours.</p> <p><u>If method C is applied</u></p> <p>XX. The standard number of productive hours per year is that of a full-time equivalent.</p> <p>XXI. The number of productive hours per year on which the hourly rate is based i) corresponds to the Beneficiary’s usual accounting practices; ii) is at least 90% of the standard number of workable (working) hours per year.</p> <p>XXII. Standard workable (working) hours are hours during which personnel are at</p>	<p>Procedure (same sample basis as for Section C: Personnel costs):</p> <ul style="list-style-type: none"> ✓ The Auditor verified that the number of productive hours applied is in accordance with method A, B or C. ✓ The Auditor checked that the number of productive hours per full-time employee is correct. ✓ If method B is applied the Auditor verified i) the manner in which the total number of hours worked was done and ii) that the contract specified the annual workable hours by inspecting all the relevant documents, national legislation, labour agreements and contracts. ✓ If method C is applied the Auditor reviewed the manner in which the standard number of working hours per year has been calculated by inspecting all the relevant documents, national legislation, labour agreements and contracts and verified that the number of productive hours per year used for these calculations was at least 90% of the standard number of working hours per year. <p>Factual finding:</p> <p><u>General</u></p> <p>12. The Beneficiary applied a number of productive hours consistent with method A, B or C detailed in the left-hand column.</p> <p>13. The number of productive hours per year per full-time employee was accurate.</p> <p><u>If method B is applied</u></p> <p>14. The number of ‘annual workable hours’, overtime and absences was verifiable based on the documents provided by the Beneficiary and the calculation of the total number of hours worked was accurate.</p> <p>15. The contract specified the working time enabling to calculate the annual workable hours.</p> <p><u>If method C is applied</u></p> <p>16. The calculation of the number of productive hours per year corresponded to the usual costs accounting practice of the Beneficiary.</p>

<i>Please explain any discrepancies in the body of the Report.</i>	
Statements to be made by Beneficiary	Procedures to be carried out and Findings to be confirmed by the Auditor
<p>the Beneficiary's disposal performing the duties described in the relevant employment contract, collective labour agreement or national labour legislation. The number of standard annual workable (working) hours that the Beneficiary claims is supported by labour contracts, national legislation and other documentary evidence.</p> <p><i>[If certain statement(s) of section "D. Productive hours" cannot be endorsed by the Beneficiary they should be listed here below and reported as exception by the Auditor: - ...]</i></p>	<p>17. The calculation of the standard number of workable (working) hours per year was corroborated by the documents presented by the Beneficiary.</p> <p>18. The number of productive hours per year used for the calculation of the hourly rate was at least 90 % of the number of workable (working) hours per year.</p>
<p>E. Hourly rates</p> <p>The hourly rates are correct because:</p> <p>XXIII. Hourly rates are correctly calculated since they result from dividing annual personnel costs by the productive hours of a given year and group (e.g. staff category or department or cost centre depending on the methodology applied) and they are in line with the statements made in section C. and D. above.</p> <p><i>[If the statement of section 'E. Hourly rates' cannot be endorsed by the Beneficiary they should be listed here below and reported as exception by the Auditor: - ...]</i></p>	<p>Procedure</p> <ul style="list-style-type: none"> ✓ The Auditor has obtained a list of all personnel rates calculated by the Beneficiary in accordance with the methodology used. ✓ The Auditor has obtained a list of all the relevant employees, based on which the personnel rate(s) are calculated. <p>For 10 full-time equivalent employees selected at random (same sample basis as Section C: Personnel costs):</p> <ul style="list-style-type: none"> ✓ The Auditor recalculated the hourly rates. ✓ The Auditor verified that the methodology applied corresponds to the usual accounting practices of the organisation and is applied consistently for all activities of the organisation on the basis of objective criteria irrespective of the source of funding. <p>Factual finding:</p> <p>19. No differences arose from the recalculation of the hourly rate for the employees included in the sample.</p>
<p>F. Time recording</p> <p>XXIV. Time recording is in place for all persons with no exclusive dedication to one Horizon 2020 action. At least all hours worked in connection with the grant agreement(s) are registered on a daily/weekly/monthly basis <i>[delete as appropriate]</i> using a paper/computer-based system <i>[delete as appropriate]</i>;</p> <p>XXV. For persons exclusively assigned to one Horizon 2020 activity the</p>	<p>Procedure</p> <ul style="list-style-type: none"> ✓ The Auditor reviewed the brief description, all relevant manuals and/or internal guidance describing the methodology used to record time. <p>The Auditor reviewed the time records of the random sample of 10 full-time equivalents referred to under Section C: Personnel costs, and verified in particular:</p>

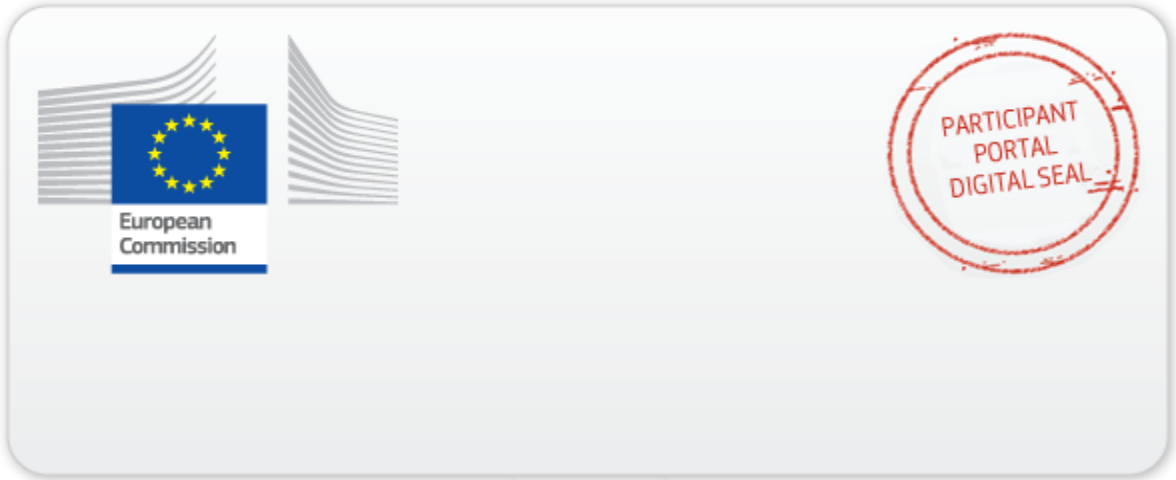
<i>Please explain any discrepancies in the body of the Report.</i>	
Statements to be made by Beneficiary	Procedures to be carried out and Findings to be confirmed by the Auditor
<p>Beneficiary has either signed a declaration to that effect or has put arrangements in place to record their working time;</p> <p>XXVI. Records of time worked have been signed by the person concerned (on paper or electronically) and approved by the action manager or line manager at least monthly;</p> <p>XXVII. Measures are in place to prevent staff from:</p> <ul style="list-style-type: none"> i. recording the same hours twice, ii. recording working hours during absence periods (e.g. holidays, sick leave), iii. recording more than the number of productive hours per year used to calculate the hourly rates, and iv. recording hours worked outside the action period. <p>XXVIII. No working time was recorded outside the action period;</p> <p>XXIX. No more hours were claimed than the productive hours used to calculate the hourly personnel rates.</p> <p><i>[Please provide a brief description of the <u>time recording system</u> in place together with the measures applied to ensure its reliability to the Auditor and annex it to the present certificate¹].</i></p> <p><i>[If certain statement(s) of section “F. Time recording” cannot be endorsed by the Beneficiary they should be listed here below and reported as exception by the</i></p>	<ul style="list-style-type: none"> ✓ that time records were available for all persons with not exclusive assignment to the action; ✓ that time records were available for persons working exclusively for a Horizon 2020 action, or, alternatively, that a declaration signed by the Beneficiary was available for them certifying that they were working exclusively for a Horizon 2020 action; ✓ that time records were signed and approved in due time and that all minimum requirements were fulfilled; ✓ that the persons worked for the action in the periods claimed; ✓ that no more hours were claimed than the productive hours used to calculate the hourly personnel rates; ✓ that internal controls were in place to prevent that time is recorded twice, during absences for holidays or sick leave; that more hours are claimed per person per year for Horizon 2020 actions than the number of productive hours per year used to calculate the hourly rates; that working time is recorded outside the action period; ✓ the Auditor cross-checked the information with human-resources records to verify consistency and to ensure that the internal controls have been effective. In addition, the Auditor has verified that no more hours were charged to Horizon 2020 actions per person per year than the number of productive hours per year used to calculate the hourly rates, and verified that no time worked outside the action period was charged to the action. <p>Factual finding:</p> <p>20. The brief description, manuals and/or internal guidance on time recording provided by the Beneficiary were consistent with management</p>

¹ The description of the time recording system must state among others information on the content of the time records, its coverage (full or action time-recording, for all personnel or only for personnel involved in H2020 actions), its degree of detail (whether there is a reference to the particular tasks accomplished), its form, periodicity of the time registration and authorisation (paper or a computer-based system; on a daily, weekly or monthly basis; signed and countersigned by whom), controls applied to prevent double-charging of time or ensure consistency with HR-records such as absences and travels as well as its information flow up to its use for the preparation of the Financial Statements.

<i>Please explain any discrepancies in the body of the Report.</i>	
Statements to be made by Beneficiary	Procedures to be carried out and Findings to be confirmed by the Auditor
<p><i>Auditor:</i> - ...]</p>	<p>reports/records and other documents reviewed and were generally applied by the Beneficiary to produce the financial statements.</p> <p>21. For the random sample time was recorded or, in the case of employees working exclusively for the action, either a signed declaration or time records were available;</p> <p>22. For the random sample the time records were signed by the employee and the action manager/line manager, at least monthly.</p> <p>23. Working time claimed for the action occurred in the periods claimed;</p> <p>24. No more hours were claimed than the number productive hours used to calculate the hourly personnel rates;</p> <p>25. There is proof that the Beneficiary has checked that working time has not been claimed twice, that it is consistent with absence records and the number of productive hours per year, and that no working time has been claimed outside the action period.</p> <p>26. Working time claimed is consistent with that on record at the human-resources department.</p>

[official name of the [Beneficiary] [Linked Third Party]]
[name and title of authorised representative]
[dd Month yyyy]
 <Signature of the [Beneficiary] [Linked Third Party]>

[official name of the Auditor]
[name and title of authorised representative]
[dd Month yyyy]
 <Signature of the Auditor>



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