D2.1: DIONE stakeholders, personas and co-designed scenarios

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Abstract:	The deliverable provides an overview of the process of identifying DIONE stakeholders and defining the user requirements to serve as the basis for further development of DIONE products and tools. The report presents the description of DIONE stakeholders, analysis of the current CAP policies and the future CAP reform, high-level User Scenarios created around DIONE personas and detailed technical scenarios.

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3	SINERGISE LABORATORIJ ZA GEOGRAFSKE INFORMACIJSKE SISTEME DOO	SINERGISE	SI
4	CORE INNOVATION AND TECHNOLOGY OE	CORE	EL
5	NATIONAL PAYING AGENCY	NMA	LT
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7	GILAB doo Beograd-Palilula	GILAB	RS
8	Cyprus Agricultural Payments Organisation (CAPO)	CAPO	EL

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List of Abbreviations and Acronyms	
CAP	Common Agricultural Policy
EC	European Commission
LC/LU	Land Cover/ Land Use
OTSC	On The Spot Check
RDP	Rural Development Programme
GAEC	Good Agricultural and Environmental Conditions
LPIS	Land Parcel Identification System
IEEP	Institute for European Environmental Policy
SAPS	Single Area Payment Scheme
ADEB	Areas dedicated to the enhancement of biodiversity
EFA	Ecological Focus Area
SMR	Statutory Management Requirements
GHG	Greenhouse Gas

1. Introduction

The report provides an overview of the process of identifying DIONE stakeholders and defining the user requirements as the basis for further development of DIONE products and tools. In Section 2 the methodology that has been adopted and followed in this process is explained, including all the steps and actions conducted. The results and conclusions of the analysis of the current CAP policies and the related critical studies and deliberations on future CAP reform are presented in Section 3. Section 4 summarizes the findings on DIONE stakeholders including how they can benefit from DIONE solutions. The results of co-design process in the form of DIONE personas, archetypes that represent potential DIONE user types, and the high-level User Scenarios created around the personas, are described in Section 5. The detailed technically specific user requirements are presented in Section 6. Section 7 presents the conclusions and DIONE's Minimum Viable Products descriptions.

2. Methodology

To maximize market potential and applicability of DIONE products and tools, a co-design methodology has been adopted. It means that DIONE stakeholders were identified and involved in the beginning of development process. Co-designing of products and services means involving stakeholders fully in the process through a dialog. In this case, they are a partner in the process of developing products and services: a) They provide the information through dialogue; b) They participate in the solution design; c) They participate in solution development; d) They design the experience as they interact with it (proactive).

Besides, a number of the relevant policy documents, surveys and CAP audit reports were studied in order to gain in-depth knowledge of the current context of CAP and its environmental aspects (achievements, challenges and limitations) but also of the spirit of the future CAP reform. The final goal was to shape the DIONE solutions to meet the user requirements and fit into their business processes.

The process of defining user requirements consisted of the following steps:

1. Identification of DIONE stakeholders was done with support of DIONE pilot partners NPA (National Paying Agency of Lithuania) and CAPO (Cyprus Agricultural Payments Organisation). The aim was to define business/operational profile and the area(s) of intervention and interaction with the DIONE toolbox.

2. Analysis of the current CAP and its role in environmental protection and climate change mitigation, the context of CAP reform and how DIONE idea can fit the future CAP concept.

3. Co-design process involved the following activities:

> - Initial questionnaire sent to the pilot partners (NPA and CAPO) aimed at collecting the information on the Paying Agencies practices, challenges and initial perception of DIONE idea.

- <u>Workshop</u> conducted during the kick-off meeting involved DIONE technical partners and the pilot partners. The information collected from the initial questionnaire were further clarified and the user requirements were discussed.

- <u>Online questionnaire</u>[1] aimed at collecting comprehensive feedback from broader range of DIONE stakeholders was launched. Initially, it was planned to organize focus groups in pilot countries (Cyprus and Lithuania) but due to COVID-19 pandemic outbreak, the physical meetings were not an option.

In total, 26 organizations from 14 European countries (Lithuania, Cyprus, Greece, Serbia, Bosnia and Herzegovina, Austria, Malta, Ireland, Latvia, Czech Republic, The Netherlands, Germany, Denmark and Montenegro), representing 7 different user types responded.

- Based on the information collected in various stages of the process, the following outcomes from the user requirements analysis were created:

- <u>DIONE personas</u>: archetypes or characters that represent a potential user types
- <u>High-level User Scenarios</u>: narratives created around personas describing: Persona's needs (context why the user would use DIONE), users' interaction with the platform (tasks and how the user will accomplish the tasks), goals achieved and benefits
- <u>Technical scenarios</u>: more detailed descriptions of the user requirements for each of the DIONE products and tools.

3. DIONE in the context of CAP reform

3.1 Rationale of the current CAP with regard to introducing Greening

The 2013 reform of the common agricultural policy (CAP) introduced a green direct payment ('greening'). It was a substantial addition to the instruments of the CAP, cross-compliance and voluntary rural development measures, dedicated to environmental and climate issues. **The aim was to further improve sustainable management of natural resources linked to farming through payments for practices beneficial to the environment and the climate.**

Farmers receive the green direct payment if they can show that they comply with three obligatory practices which are good for the environment (soil and biodiversity in particular) and for climate. The three greening obligations are:

1. Crop diversification: growing a greater variety of crops helps make soil and ecosystems more resilient. It helps to halt degradation of soils and soil erosion and therefore also helps production capacity. In concrete terms, the rules stipulate that farms with more than 10 ha of arable land have to grow at least two crops, while at least three crops are required on farms

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[1] https://forms.gle/yFf3aRc8ABdSJLbR8

with more than 30 ha of arable land. Furthermore, the main crop may not cover more than 75% of the arable land. Several exemptions to these rules take account of the individual situation of farmers, notably farmers with a large proportion of grassland which in itself is very beneficial for the environment.

2. Maintenance of permanent grassland: Permanent pasture is a very effective means of locking carbon away and thus helps to reduce global warming. Preserving environmentally sensitive grassland conserves soil carbon and protects grassland habitats. A ratio of permanent grassland to agricultural land is set by member states at national or regional level (with a 5% margin of flexibility). Moreover, farmers cannot plough or convert permanent grassland in designated sensitive areas. More than a third of EU farmland is permanent grassland subject to protection aimed in particular at carbon sequestration; a fifth of this grassland is classified as environmentally sensitive with a view to protecting biodiversity and carbon storage.

3. Ecological focus areas (EFAs): Farmers with arable land exceeding 15 ha must ensure that at least 5% of their land is an ecological focus area with a view to safeguarding and improving biodiversity on farms. Ecological focus areas may include, for example, fallow land, landscape features, afforested areas, terraces, hedges/wooded strips or nitrogen fixing crops such as clover and alfalfa which help to improve soil organic matter. Hedges, trees, ponds, ditches, terraces, stone walls and other landscape features are important habitats for birds and other species and help protect biodiversity, including pollinators.

In order to accommodate the diversity of agricultural systems and environmental conditions across Europe, the concept of 'equivalence' was introduced. Member states may allow farmers to meet one or more greening requirements through equivalent (alternative) practices. This means that some practices can replace one or several of the three established greening measures. These practices include agri-environment climate measures or certification schemes that are similar to greening and which yield an equivalent or higher level of benefit for the climate and the environment. The principle behind these greening methods is to remunerate farmers for their efforts to protect the environment and biodiversity, since market prices do not reflect the work involved.

Greening is not an optional scheme. All farmers participating in CAP direct payment schemes (such as the Basic Payment Scheme or the Single Area Payment Scheme[2]) must also apply for the green payment. However, smaller holdings can benefit from support under greening without having to meet all, or even any, of greening requirements. Greening requirements also do not apply to holdings considered 'green by definition': for example, organic farmers benefit from the green payment without having to demonstrate compliance with the three greening practices. Also, Member states must allocate 30% of their direct payment allocation to this greening payment.

Apart from greening, the CAP has two other important instruments for pursuing environmental and climate objectives:

(a) Cross-compliance is a mechanism linking most CAP payments to a set of basic standards to ensure the good agricultural and environmental condition of land (GAECs) and certain obligations, known as statutory management requirements (SMRs). SMRs are defined in the respective EU legislation on the environment, climate change, public, animal and plant health, and animal welfare. Farmers who do not meet these standards and requirements risk incurring a penalty reducing all their direct payments, usually by 1 % to 5 %;

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[2] https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/income-support/basic-payment_en#thebasicpaymentscheme

(b) Environmental measures under rural development (CAP's Pillar II) – such as the agri-environment-climate measure[3] – are like the green payment in that they reward farmers for certain practices that benefit the environment and climate. Unlike greening, however, these measures are contractual, based on voluntary commitments by farmers. The premiums paid to farmers reflect the additional costs and income loss resulting from such commitments.

3.2 CAP green direct payments after 2020

3.2.1 Facts about current greening

An evaluation of the Common Agriculture Policy's Pillar 1 greening measures[4] for the European Commission, led by IEEP on behalf of Alliance Environment, found that overall, the greening measures have led to only small changes in management practices, except in a few specific areas. As a result, their environmental and climate impacts have been limited and locally specific. In addition, the measures have had a negligible effect on production or economic viability of farms and the additional administrative costs associated with them have been relatively low.

The evaluation study focuses on the implementation of the greening measures between 2015 and 2017 in the EU28, with a specific focus in 10 Member States (Austria, Czech Republic, France, Germany, Latvia, Netherlands, Poland, Romania, Spain and the UK). It examines the drivers influencing Member State and farmers' implementation choices; the effects of the measures on farming practices, production, the environment and climate; administrative costs and efficiency; coherence with CAP objectives and measures, as well as broader environmental and climate legislation; their relevance in addressing EU, national and regional needs and their EU added value.

It was also found that the Commission did not develop a complete intervention logic for the green payment whilst also lacking of clear, sufficiently ambitious environmental targets that greening should be expected to achieve. Furthermore, the budget allocation for greening is not justified by the policy's environmental content. The green payment remains, essentially, an income support scheme. Moreover, it was shown that greening is unlikely to provide significant benefits for the environment and climate, mainly because of the significant deadweight which affects the policy. In particular, we estimate that greening led to changes in farming practices on only around 5 % of all EU farmland.

Finally, we found that the policy's likely results do not justify the significant complexity which greening adds to the CAP. Part of this complexity results from overlaps between greening and other environmental instruments of the CAP, including standards on good agricultural and environmental condition of land (GAECs). Greening resembles GAECs in that it is also, essentially, a set of basic environmental conditions applicable to income support. Farmers as well as national and regional administrations complain of the policy's complexity in certain respects and have clearly asked for this load to be lightened.

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[3] https://ec.europa.eu/info/food-farming-fisheries/sustainability-and-natural-resources/agriculture-and-environment/cap-and-environment/agri-environment-measures_en
[4] https://ieep.eu/publications/cap-greening-evaluation-published

3.2.2 New CAP structure after 2020

The EU has committed itself to further deep cuts in greenhouse gas emissions; the key natural resources of soil, air and water are still under pressure in many areas; and the available indicators on farm and forest biodiversity still do not paint a rosy picture. The citizens of the EU expect the CAP to make a stronger contribution to care for the environment and climate. But this is not the only expectation concerning the CAP. Farmers as well as national and regional administrations complain of the policy's complexity in certain respects and have clearly asked for this load to be lightened.

To address CAP objectives, each Member State will draw up a "CAP strategic plan". In its plan, each Member State will analyse the situation on its territory in terms of strengths, weaknesses, opportunities and threats (SWOT) – as well as its related needs – in respect of these objectives. It will set quantified targets against the objectives and design "interventions" (types of action) for achieving them, on the basis of an EU-level menu. The Commission will approve the plan when satisfied with its quality. Year-by-year progress against the targets will be monitored and the plan will be adjusted as necessary. This overall approach will for the first time apply to both "pillars" of the CAP together: not only to support for wider rural development (CAP Pillar II) as at present, but also to direct income support payments to farmers (part of CAP Pillar I), which take the lion's share of CAP funding.

Overall, as the approach will be focused much more on obtaining results than at present, the number and level of detail of rules set out for the CAP in EU legislation will be cut substantially. **This shift will offer Member States increased opportunities to implement the CAP in ways that are well tailored to the particular features of their respective farm sectors and rural areas**.

3.2.3 Conditionality as core aspect of the new CAP

Conditionality is a system of linkage between area- and animal-based CAP payments (in Pillar I or Pillar II) and a range of obligations. When recipients of these payments (mainly farmers, but sometimes other land managers) do not meet the obligations, the payments may be reduced. These obligations originate either in CAP legislation (in the case of "standards for good agricultural and environmental condition" – GAEC) or in non-CAP directives and regulations (in the case of "statutory management requirements" – SMRs2). All the GAEC standards and some of the SMRs are environmental – concerning climate change, water, soil, and biodiversity/landscapes. The new system will effectively merge and streamline two elements in the current CAP – known as "cross-compliance" and "greening". These already provide benefits for the environment and climate but are seen as being open to improvement.

The new system of conditionality will draw on the content and strengths of the current cross-compliance and greening systems but will make several improvements. Fundamentally, when a Member State explains how it intends to implement conditionality in practice, in future it will do so within its CAP plan – making clear how its planned approach will help achieve the CAP's environmental (and other) objectives, in line with the Member State's SWOT analysis and needs assessment. Furthermore, as conditionality is intended to provide a broad "foundational" level of environmental care, it will cover everyone who receives area- or animal-based CAP payments – and most of the EU's agricultural area. Additionally, certain existing obligations will be adapted to deliver higher environmental benefits – where there is a clear case for doing so. For example, the current

requirement of crop "diversification" (the presence of more than one crop on the arable land of a farm at any one time) will be upgraded to an obligation of crop "rotation". Finally, new (GAEC) standards and links with important directives (i.e. SMRs) will be introduced – again, where it makes clear sense to do so. For example:

- appropriate protection of wetland and peatland will be required, as these are important stores of carbon (which, if released into the atmosphere, would fuel climate change);
- a Farm Sustainability Tool for Nutrients will be made available to farmers – to give them useful recommendations/alerts concerning the application of nutrients on their parcels, thus helping to reduce nutrient leakage and GHG emissions while contributing positively to soil quality (moreover, the recommendations will bring economic benefits by helping to avoid over- or under-fertilisation);
- elements of two important environmental directives will enter the scope of conditionality – the Water Framework Directive and the Directive on the Sustainable Use of Pesticides.

In comparison with the two current systems which it will replace, conditionality will have similarities with the mechanisms of cross-compliance but will be substantially simpler than greening.

The EU rules on greening are relatively long, detailed and prescriptive – because they contain not only the essence of the three basic agricultural practices concerned but also all the detail of how these can be implemented differently in the highly varied circumstances of Member States. This detail includes lists of options, exemptions and numerical values (e.g. in relation to area to be covered by a given practice). The approach was intended to balance the need for common elements with that for a certain flexibility in implementation, but it has nonetheless been criticised for perceived rigidity – and complexity. By contrast: within the system of conditionality, basic standards will likewise be implemented differently in different circumstances, but CAP rules will not set out the full detail of how this can be done - individual Member States will have a much greater say in the process. **This will give them the opportunity to better tailor implementation of the standards to the particular situations of their farmers**.
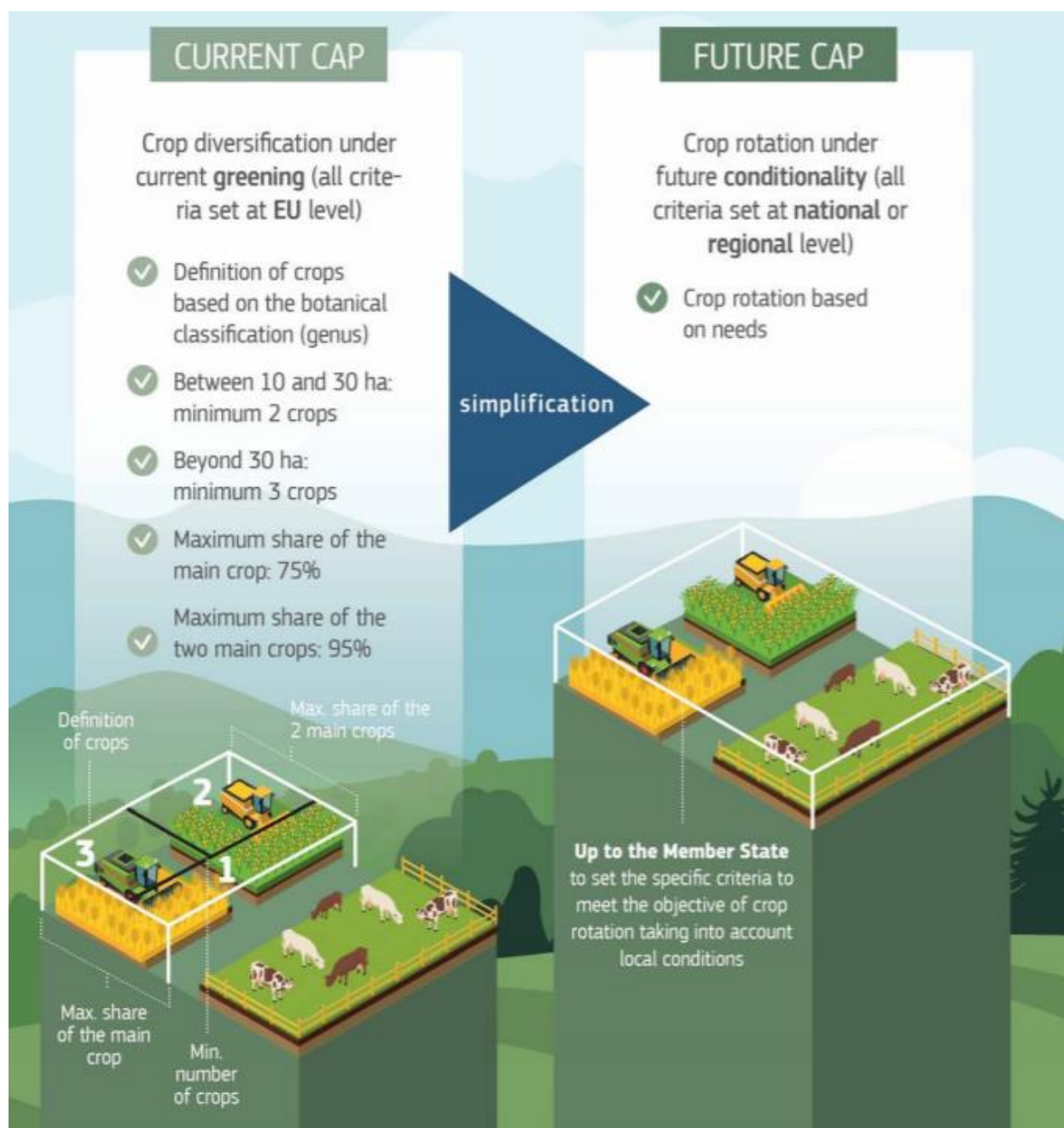
Figure 1: Simplification of crop diversification
Source: The Post-2020 Common Agricultural Policy: Environmental Benefits And Simplification. DG Agriculture and Rural Development, 2019

In the case of GAEC standards, the EU-level rules will set out the essence of each standard in **a very few words** – without lists of options, exemptions etc. Member States will decide on the detail of implementation, setting out at least some of this in their CAP plan. **In principle, every GAEC standard will apply to every farmer for whom the standard is relevant** (e.g. the standard on crop rotation will naturally not apply to farmers with no crops, etc.). However, **Member States may implement a given standard differently for different regions – according to soil, climate, land use, farming structures etc**. Member States may also lay down additional standards to meet the EU's objectives. In the case of most SMRs, Member States have already exercised the power of choice in determining the content of the standards: they did this when deciding how to implement the non-CAP legislation in question. **There will be overall administrative simplification because two separate systems of rules (for cross-**

compliance and greening) – with their own distinct provisions on controls, penalties etc. – will be replaced by one (for conditionality). Finally, strengthened Farm Advisory Services – emphasised by the Commission's proposal – will help farmers follow the rules efficiently.

The nature of the enhanced conditionality proposed by the Commission for the CAP post 2020 is shown in the table below. There are two sets of changes. One is to (re-)incorporate the three greening practices into the conditionality, as GAEC 1 permanent pasture, GAEC 8 crop rotation (to replace crop diversification) and GAEC 9 non-productive areas (to replace Ecological Focus Areas).It is important to underline that, in making this change, all of the exemptions which limit the scope of the greening practices in the current CAP (e.g. organic farms, farms below a certain size or below a certain arable area) have been eliminated. In future, these requirements would apply to all farms in receipt of direct payments, unless Member States are able to reintroduce them in their Strategic Plans – this is not clear.

The other change is the addition of new requirements GAEC 2 to protect carbon-rich soils, GAEC 5 to make compulsory the use of the new Farm Sustainability Tool for Nutrients and GAEC 10 the ban on converting grassland in Natura 2000 sites. GAEC 5 means that the need to have a nutrient management plan is extended to all agricultural land, and not only land in Nitrates Vulnerable Zones as currently.

Table 1: Proposed changes in GAEC standards after 2020. Source: Annex III of Regulation N1306/2013 and Annex II of Draft CAP Strategic Plan Regulation

2014-2020 GAEC standards	Proposed post 2020 GAEC standards
Climate change	*Climate change*
	GAEC 1: Maintenance of permanent pastures
	GAEC 2: Protection of carbon-rich soils through appropriate protection of peatlands and wetlands
GAEC 6: Maintenance of soil organic matter through ban on burning stubble	GAEC 3: Maintenance of soil organic matter through ban on burning stubble
Water	*Water*
GAEC 1: Establishment of buffer strips along water courses	GAEC 4: Establishment of buffer strips along water courses
GAEC 2: Where use of water for irrigation is subject to authorization, compliance with authorization procedures	
GAEC 3: Protection of groundwater against pollution	
	GAEC 5: Use of Farm Sustainability Tool for Nutrients
Soil Protection and Quality	*Soil Protection and Quality*
GAEC 5: Minimum land management reflecting site specific conditions to limit erosion.	GAEC 6: Minimum land management reflecting site specific conditions to limit erosion.
GAEC 4: Minimum soil cover	GAEC 7: No bare soil in most sensitive periods
	GAEC 8: Crop rotation

Biodiversity and Landscape	*Biodiversity and Landscape*
GAEC 7: retention of landscape features, a ban on cutting hedges and trees during the birds breeding and nesting season, and as an option, measures for avoiding invasive plant species.	GAEC 9: Maintenance of non-productive area and features, including a minimum share of agricultural area devoted to non-productive features of areas, retention of landscape features, a ban on cutting hedges and trees during the birds breeding and nesting season, and as an option, measures for avoiding invasive plant species.
	GAEC 10: Ban on converting or ploughing permanent grassland in Natura 2000 sites.

Member States will be required to define, at national or regional level, minimum standards for beneficiaries in line with the main objective of these GAEC standards, taking into account the specific characteristics of the areas concerned, including soil and climatic condition, existing farming systems, land use, crop rotation, farming practices, and farm structures. Member States will also be able to prescribe standards additional to those laid down in the Annex to the proposed Regulation against those main objectives. However, to protect against gold-plating, Member States are not allowed to define minimum standards for main objectives other than the main objectives laid down in the Regulation. This does not prevent Member States from requiring farmers to observe additional standards. It only means that the cross-compliance mechanism, whereby a farmer's direct payments are reduced in the case of infringements, cannot be applied to ensure enforcement in those situations.

The table below summarizes the main differences between the "greening" and the new CAP green regulation after 2020.

Table 2: Proposed changes in greening approach after 2020. Source: Institute For European Environmental Policy, 2018[5]

ISSUE	CURRENT APPROACH	PROPOSED APPROACH
Objectives and targets	CAP is evaluated against its general objectives which cover both Pillar 1 (direct payments and market measures) and Pillar 2 (rural development), but MS not required to actively contribute to these. Instead, MS must comply with detailed spending rules and target their P2 spending at key priority areas. No specific objectives have to be met by MS for P1 expenditure.	MS to draw up single CAP strategic plans covering both P1 and P2 to deliver agreed contributions linked to CAP specific objectives based on a needs assessment, SWOT and MS milestones and targets. Three of the specific objectives are targeted at the environment and climate actions although they are not formulated in a results-orientated way.
Key instruments for the environment and climate	P1 and certain P2 instruments are required to fulfil basic EU requirements for keeping farmland in good agricultural and environmental condition and complying with EU law (cross compliance). Farmers are required to apply basic greening practices to receive 30% of P1 (however many exemptions and loopholes exist). Under P2 more advanced environmental actions can be can voluntarily applied programmed by MS.	Pillar 1 and certain Pillar 2 instruments are required to fulfill an enhanced conditionality effectively merging cross compliance and greening together with some additional requirements. Additional environmental actions can be voluntarily applied through a new eco-scheme under P1 and more advanced environmental actions under P2 programmed by MS.

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[5] https://ieep.eu/news/what-is-the-fate-of-environmental-ambition-in-the-proposed-eu-agricultural-policy

Design of measures	All measures in both pillars are designed in detail at EU level although many offer choices to MS.	The EC will define the range of other acceptable "intervention types" but MS would design and choose the specific measures.
Scope for Member States to select and vary policy instruments	MS choose policy options within P1 (e.g. basic payments calculation, which if any sectors to offer coupled payments to). They both choose and target measure types within P2 with a minimum spend of 30% applying to environmental and climate measures. Some flexibility to shift funds between pillars is allowed.	MS would need to justify their choice of interventions to the EC, but would have a free choice to determine the details of each intervention. While minimum spend for P2 applies to environmental and climate measures, there is no minimum spend for the new eco-scheme in P1. 15% shift between funds between Pillars is allowed.

3.3 How DIONE support tools conform to the foreseen post 2020 CAP regulations

New regulations boost the potential for knowledge, innovation and digitisation to support simpler implementation of the CAP. Earth Observations and associated technology which help a farmer to optimise his day-to-day business can also warn him when the deadline is approaching for carrying out an activity under a given CAP scheme (e.g. mowing the grass), replace on-the-spot checks and pre-fill a large part of his application form for CAP funding.

DIONE moves to address the lack of evaluation of the CAP environmental measures by providing the paying agencies with a toolbox that will enable them to evaluate the performance of the "greening" factors. A paradigm of the aforementioned technologies is the exploitation of smart sensors for recording the soil quality of agricultural fields. These data are then transmitted securely into a single focal point (central data base) which further processes them to develop spatially explicit maps of key indicators for land degradation

DIONE tool for automated checking of farmers' compliance to the green direct payment scheme rules that already consist of several highly modular components (data collection and management component, rule-based engine component, reporting component, web interface component) will be adopted to better fit the new regulations.

Meanwhile, DIONE methodological framework with data-driven metrics that provides a dynamic Environmental Performance tool for public, policymakers and environmental actors to gain frequently updated insights and actionable information about the environmental performance of the current direct payments scheme will be updated to conform to the future payment schemes.

4. DIONE stakeholders

In this section, general DIONE stakeholders are identified and the assessed benefits from DIONE services are summarized.

Stakeholder	Benefits from DIONE services
Paying agencies (PAs)	PAs are accredited national or regional public organisations that cover (i) all direct payment support schemes together with some of rural development measures, and (ii) monitoring process which has to ensure that the requirements and standards under the cross-compliance provisions are respected. PAs recognize the enhancement of existing monitoring tools and processes – which includes field visits and visual assessment of farmer parcels – as a key area of interest to simplify and lower their monitoring and administrative costs and, but also to perform more accurate, frequent, and wider-sample compliance checks. DIONE integrated EO-based toolbox delivers multiple direct benefits and clear economic value to PAs which is estimated to be at the level of 30% of the current administrative and operational costs of the CAP area-based compliance checks and assessment of respective environmental impacts. Among the main benefits, DIONE will allow: (i) precise monitoring of CAP compliance for small farm parcels (up to 0.1ha, even in more cloudy regions)reducing the needs for expensive VHR data; (ii) reducing needs of on-site inspections by using the DIONE farmers geo-tagged photos framework; (iii) reduction of operational costs as data collection and management component allows faster and automated collection of data from different sources; the rule-based engine allows automated decisions on the farmers' compliance; the Reporting component produces automated standardised reports according to user requirements; the Web interface component provides easy access to the spatial information generated via the DIONE tools; (iv) enriching the portfolio of monitoring/evaluating services as result of AI enabled tool that provides feedback to professionals from PAs about land condition and land use.
Certification bodies (CCBs)	Public and private certification bodies in charge of the control system for specific food production (e.g. organic food production). Their activities include regular and frequent monitoring of a farmer compliances to strict rules as well as obligatory on-site farm inspection. DIONE toolbox has clear value to significantly lower inspection cost and improve overall monitoring of farmers. In specific, low-cost sensors for evaluating land-degradation is a low-cost, handheld, and easy to use tool to assist CCBs for recording the soil's quality and carbon sequestration, result in better farm management (>70%). Collected data, which are transmitted securely into a central data base and further processed, allow development of spatially explicit maps of key indicators for land degradation, resulting in improved delivery reliability (>90%) towards "On Time Full Delivery".
EO industry	The European EO industry is characterized by a large number of SMEs, providing services for a large spectrum of downstream sectors, among which agriculture is of great importance. DIONE EO-based cutting edge services can serve as blue print to lead other European EO SMEs to design and develop similar, more-advanced solutions that can serve the monitoring

	and assessment of compliances for specific areas of CAP or other regulatory systems, within and beyond agriculture.
European and international EO initiatives	European and international EO initiatives such as DIAS, GEOGLAM, and EUROGEOSS will be able to obtain indirect benefit from DIONE success stories. The implementation of innovative EO services for monitoring CAP related compliances will raise new opportunities that can be promoted by the mentioned initiatives. Likewise, these initiatives will support DIONE consortium to promote the developed solutions, to reach a broader audience, thus to maximize the reach and the impact of the project.
Policy makers	Policy makers need large quantities of up to date and precise information to maximize the effectiveness of current and future policies. CAP greening regulations were criticized for lack of differentiation among European farming regions and regulatory overall complexity. DIONE toolbox will allow to record large quantities of farming related data that will assist policy makers in shaping future CAP regulations, enabling, among others, maximized regional differentiation. This will ensure greater policy impact, thus a more sustainable European agriculture.
Farmers	EU producers are highly dependent on public support (e.g. direct payments, rural development). The EU average share of direct payments in agricultural factor income in 2011-2015 stood at 27%. Therefore, it is crucial to ensure that the compliances rules to obtain CAP funding are easily understandable by farmers and monitoring processes are automated, standardized, and time efficient. Satellites and associated technology already help a farmer to optimise his day-to-day business. But DIONE EO based solutions step forward and will support farmers to manage their agricultural processes to meet CAP compliances, further replacing on-the-spot checks with high resolution imageries and automating the application process for CAP funding according to the paying agency requirements (DIONE farmers geo-tagged photos framework). This will also result in less stressful situation for farmers during on-site visits.
Scientific community	The scientific research community is eager to use data to study and analysed the efficacy of CAP regulations and subsidy programmes. DIONE services will provide scientists with large quantities of EO based data about European agriculture, soil quality and farm management, enabling them to research new patterns of the European agriculture sector and to provide evidence-based advices to improve future CAP regulations.
General public	DIONE integrated toolbox is not designed to be used directly by the general public. Nonetheless, many indirect benefits can be derived through cascade effects from the correct adoption of DIONE services by the primary target users. Among them, the most important are: (i) less polluting agriculture sector, resulting in a reduction of green-house gasses in the atmosphere, thus a cutback of climate change phenomena, and safer water streams; (ii) safer food production, ensuring reduced levels of pesticides and herbicides usage; (iii)long term sustainability of the rural regions, granting futureresponsible and high quality food production, as well as natural resources protection.

5. DIONE personas and high-level scenarios

A user persona is an archetype or character that represents a potential user of application. They are formed using characteristics of people who present similar goals, motivations and behaviours. A persona summarizes the target user's background, goals, and needs related to the product. They have a supportive role in order to describe and highlight differences between goals and behaviours[6]. The persona helps to better understand target users by enhancing realism and increasing engagement in a design team with end user representations[7] (Marshall et al., 2015), so developers can design a solution to meet their expectations.

A persona is based on user research data collected from multiple users through observations, interviews, surveys, etc. However, the persona is presented as a description of an individual person, even though the persona actually represents a group of users with similar characteristics.

For the purpose of defining DIONE user requirements, seven different personas were developed, based on the research as well as on the information and knowledge collected during the workshop and the survey.

User Scenarios are high-level narrative describing: **Persona's needs** (context why the user would use DIONE), user's **interaction with the platform** (tasks and how the user will accomplish the tasks), **goals achieved and benefits.** User scenarios help designers understand what motivates users when they interact with a design – a useful consideration for ideation and usability testing.[8]

5.1   Inspector at Paying Agency

Persona
Maria is an inspector at Paying Agency. She visits a couple of times per year at least 5% of farms which receive CAP direct payments for On The Spot Check (OTSC) of compliance. There are a number of eligibility rules to be checked: Single Area Payment Scheme (SAPS)

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compliance, Greening, Cross Compliance, Rural Development Obligations (mechanical weeding, etc).

Since 2018 the regulations allow modern technologies to perform checks on compliance so Maria also performs On The Sport Checks with Remote Sensing by visualizing EO imagery provided by JRC (VHR-HR-Sentinel) for compliance check. She also checks geo-tagged photos with the related information submitted by farmers using a mobile application.

However, she is facing a number of difficulties. For example, it is very challenging to perform the planned OTSC in a short time window (e.g. the Greening and grass mowing checks are performed during July 1 - August 30, which is only 40 working days). She is aware that due to the lack of resources and high execution costs, the control farms are only a small subset of the whole population. Even by using EO data, the photo interpretation is done mainly by humans so the process is still time consuming and variations in interpretation as well as wrong photo interpretations might exist.

Scenarios

(1) Maria receives the automatically imported the following DIONE products for the area she is in charge of into the software that she uses for control of CAP direct payments:
- Crop type map- She needs the dataset to be updated several times throughout the vegetation season. She uses the data to verify the crop type claimed on agricultural parcel level as well as the area of the corresponding crop type which is a part of eligibility checking.
- Mowing/harvest/ploughing marker map - The data is generated through the vegetation season. When the map is imported, Maria can check at parcel level the compliance when agricultural activity is a criterion, for example ploughing is mandatory in case of land lying fallow or when mowing should happen before a certain date.
- Biophysical crop parameters (NDVI, FAPAR, Leaf Chlorophyll Content and others) - Maria receives the data regularly analyses the data to monitor the crop growth and determine the activities and crop growth stages.
- Non-productive EFA types map and permanent pastures map- Maria needs the maps to be produced annually for most of the EFA types except for fallow land in which case monthly data is required. She uses the data to check farmers' compliance with cross-compliance GAECs and greening rules.
- Land Cover/Land Use maps from drones - Maria uses these very high resolution images to check and measure land parcel boundaries and as additional data for cross-compliance and greening check. This significantly reduces the need for OTSC.

(2) Maria receives geo-tagged photos recorded by farmers imported to the software that she uses for control of CAP direct payments. The photos are accompanied with time and location stamp and additional information provided by farmers (e.g. parcel number, crop type, measures claimed, slope and elevation, etc.). She checks the photos and the accompanied information which replace the physical On The Spot Checks.

(3) When conducting OTSCs, Maria collects data on soil characteristics using a miniaturized spectrometer which is remotely connected to DIONE mobile application installed on her smartphone. While the spectrometer scans spectral signature of the soil, the application collects the location and time stamp. Maria also takes a photo and types in some additional information

within the application. The data is automatically sent to DIONE platform which translates the soil spectra into useful parameters (e.g. soil organic carbon) and send the results to the central database of the PA system.

(4) Maria logs in to DIONE farmer's compliance monitoring tool. A dashboard is opened with the list of farmers that applied for direct payments. For each, there is information about the current greening compliance status automatically generated by the DIONE. She searches in the dashboard to find a farmer she wants to check further by using filtering options. She clicks on the farmer's name and the farmer's page opens with his parcels visualised on the map. A table is also provided with the statistical data (e.g. total area, list of parcels with current crop types, area under permanent pastures, area under EFAs, etc.). Current farmer's compliance situation is displayed. She clicks on a particular field in the map and gets the information about the current crop type. From a spatial data list, Maria chooses DIONE products (e.g. crop types, EFAs, pastures, very high resolution orthoimagery, etc.) to be superimposed in the map section for further study. She also choses geo-tagged photos locations to be displayed on the map. She clicks on a location and gets the geo-tagged photo with attributes displayed so she can get in depth information. Maria needs additional information on a certain location where the situation is not clear from the available data so she sends a request to the farmer to take geo-tagged photos there. Having an overview of the spatial distribution of incomliances, Maria can estimate which type of farmers is likely to be incompliant. This analysis helps her to figure out what will be the best way to make farmers to comply the next year or to find out why this type of farmers is likely not to comply.

5.2 Official at Paying Agency

Persona
Paul is an official at the Paying Agency. He is working in the control department. His job is to control the correct subsidy payments and provide consultations to farmers and access to their support related data. Paul also manages the maintenance of LPIS. Since recently, he has been managing projects aimed at developing an innovative monitoring process and a system that produces the indexes for the impact of agriculture in the Climate Change mitigation efforts. He experiences slow adoption of novel ICT tools by the departments doing operations.

Scenarios
(1) Paul receives the automatically imported DIONE products: Crop types, EFAs, Permanent

pastures, Biophysical parameters of crops and Soil data from spectrometers into the PA software. He opens that data to be provided to the farmers through the PA portal.

(2) Paul receives the automatically imported DIONE very high ortho-imagery generated from drones into the PA software where he checks and updates the LPIS.

(3) Paul receives the automatically imported DIONE geo-tagged photos recorded by farmers, soil data from miniaturized spectrometers and continuous soil properties maps into the PA software. He uses the data as in-situ to train the models and produce agro-environmental and climate change mitigation indices.

(4) Paul logs in to DIONE environmental performance tool. He is provided with the menu of generated environmental performance indicators and other relevant datasets for the area of interest. He chooses the data layer to be displayed on the map and the geographic region. He picks on the map and the temporal changes of the parameter is displayed on the graph. Paul then picks on the other location and the related temporal changes are superimposed on the graph so he can compare the two locations. By setting the parameters of relevance, Paul triggers calculation of statistical data (e.g. environmental impact in comparison to certain crops). He exports the generated information to be used for the regular reporting he conducts.

5.3 Agronomist - consultant

Persona
Grigoris is an agronomist working at a company that provides consultancy in agriculture and environmental issues. He works on monitoring and implementation of protocols concerning good agricultural practices: AGRO2, ECOLABEL, GLOBALGAP, TNC, QS, IFA, SQF 1000. He is also an expert in CAP measures dedicated to environmental and climate resilient strategies such as cross-compliance and greening. He often visits clients' farms and evaluates its compliance to statutory management, good agricultural practice requirements, providing information and advisory service on how to manage farm and its technology (e.g. crop monitoring, fertilization plans, evaluation of documentation etc.).   The tools he has tried that were supposed to simplify the procedures seemed to be too complex and not so user-friendly as farmers/advisers would have liked. For him, it is crucial to have the access to the right databases (state and private), data integration with the farm management software and a tool to get the satellite images with national coverage without the need to search and buy it from commercial suppliers.

Scenarios
(1) Grigoris logs in to DIONE farmer's compliance monitoring tool. The dashboard opens with the list of the farmers who are his clients. Searching capabilities allow him to easily find a particular client. He opens the client's page and inspects the data for the particular farm, including: current greening compliance status, crop type per parcel, EFAs, permanent pastures, geo-tagged photos recorded by the farmer, very high resolution drone imagery, soil characteristics from spectrometers and biophysical parameters of crops. On the timescale, he chooses timeframe for the data to be displayed and he takes a look at the historical data. By picking a location on the map section, Grigoris retrieves graph presentation of the parameters' changes through the time. By picking two locations, he can make comparison of parameters' behaviour. He imports data on pests and diseases that occurred on the farm so he can analyse it in the context of other data. Based on the inspected information, Grigoris: 1) provides advice to his client regarding compliance to CAP direct payments rules, 2) develops crops management plan and provides advice on using precise farming, 3) inspects crops' health and decides what actions should be taken during the growing season. He generates an automatic report on his client's compliance with regulations and crop's health.

5.4 Farmer

Persona
Joao is a small farmer managing 20 ha of cereal crops and 10 ha of olive trees. Every year he submits the application in order to receive direct payments. Therefore, he has to check if he respects the rules imposed for CAP direct payments such as cross-compliance GAECs and greening. Additionally, his olives trees are an organic grove. Every year an inspector from the organic inspection company visits the farm for evaluating the compliance.   Monitoring of the farm activities and the compliance with a number of rules is expensive and time consuming for Joao. He is aware that there are various applications and data sources, but he faces the lack of consultants who could interpret the data.

Scenarios
(1) Joao wants to check if he is compliant with greening rules. He logs in to DIONE farmer's compliance monitoring tool. Now he can see his parcels and the current greening compliance status. He notices that pasture data is missing in one part of his farm which influences his compliance status. He decides to go to the field and take several geo-tagged photos to provide additional proof.   (2) Joao goes to the field to take new geo-tagged photos with his smartphone. He starts DIONE

mobile application which guides him to the locations where the inspector is requesting new geo-tagged photos. It also guides him to the ideal image capture and quality. On the screen Joao sees agricultural parcel boundaries superimposed. When Joao sets the right position and orientation of his smartphone, he takes the photos and types in the additional information.

5.5 Researcher -scientist

Persona
Mariana holds a PhD and works as a principal investigator/researcher at the Scientific Institute. Her project is in the field of the complete crops' irrigation and nutrition cycle as well as of the reduction of carbon footprint and water consumption. These topics are being considered in the context of the CAP modernisation so she needs to address the related aspects such as farmers' profiles, precision agriculture technologies, EU and national policies and Land Use management. To do the research, Mariana primarily needs access to a quantity of reliable data, some of it preferable in near-real time.

Scenarios
(1) Mariana receives the automatically imported DIONE products: Crop types, EFAs, Permanent pastures, Biophysical parameters of crops and Soil data from spectrometers into the GIS software she uses for her research project. (2) Mariana logs in to DIONE environmental performance tool. From the menu of generated environmental performance indicators and other relevant datasets for the area of interest, she selects soil organic carbon to be displayed on the map. She triggers calculation of the indicator changes between two dates and correlation of the indicator changes with scheme measures applied. She inspects the results visualised on the map and as summary statistics. Mariana then exports the results for the further use in her research environment.

5.6 Organic inspector

Persona
Julia is an organic inspector at the Organic Certification Organization. As the experienced expert, she reviews farmers' applications to verify that practices comply with the organic regulations, and then she conducts an on-site inspection. For certified operations, she visits once a year a selected farm for compliance check. It generally consists of looking for things like buffer zones from neighbouring farms to ensure that the organic integrity of crops is maintained and requesting additional data from the farmer for evaluating compliance like pest management, soil fertility, and other factors. If there are issues, she follows up on corrective actions. Due to the number of operations she has to inspect every year, she often experiences difficulties to visit all plots or all parts of plots. Furthermore, one or two visits could not cover all stages of production (phenophases).

Scenarios
(1) Julia logs in to DIONE farmer's compliance monitoring tool. The dashboard opens with the list of the farmers who are certified for organic production. The dashboard enables filtering by region, crop type and harvest time. She opens a selected farmers' page and inspects the available data: ● Crop type map- She needs the dataset to be updated at the beginning and at the end of the vegetation period. She needs to see the crop type on adjacent plots, to assess critical time for inspection (according to a specific time for treatment of crops on adjacent plots). ● Mowing/harvest/ploughing marker map - Julia expects to receive the information shortly after the event happened. She will use it to update certified quantities. In case the crop is left on plot (not harvested) would issue only confirmation of status of the plots, instead of certificate for products. ● Biophysical crop parameters (NDVI, FAPAR, Leaf Chlorophyll Content and others) - Maria wants to get information if plants are under stress, this information is necessary for scheduling inspection in the most critical time for use of inputs in crop production. ● Non-productive EFA types map and permanent pastures map- Julia needs the maps to be produced annually. She wants to see EFA elements belonging to a selected farm. She picks an element and retrieves the information on the type of the EFA element and the area to assess size of area involved into organic production. ● Permanent pastures - Julia needs the data to be updated several times a year in cases there are frequent rotations during the year (for e.g. vegetables). She selects a pasture field and retrieves the information on the area, because she wants to assess the average areas used per animal. ● Farmers' geo-tagged photos - Julia sees on the map the locations of the photos taken. She

reviews the data submitted and evaluates if there is a need for additional inspection and what would be the focus of that inspection.
- Aerial imagery from drones - Julia uses these very high-resolution images to check distant parts of the plots, buffer zones and neighbouring plots.
- Soil data and maps from spectrometers - Julia wants to see on the map all sample points for a certain region filtered for a certain soil property and she wants to click on a sampling point to retrieve the associated metadata. She uses it to cross-check data provided by the farmer.

Julia can see for each farmer the total harvested quantity of each crop type per farmer and the total area per producer.

By setting the dates on the timescale or on calendar, Julia can visualise historical data from previous seasons in order to check if crop rotations occurred. She triggers automatic generation of a report. She imports additional data that can facilitate inspection.

(2) Julia logs in to DIONE environmental performance tool. From the menu of generated environmental performance indicators and other relevant datasets for the area of interest, she selects EFA types as a proxy for biodiversity to be displayed on the map. She triggers calculation of the percentage of areas dedicated for environmental sustainability related to total agricultural area per producer.

5.7   Official at the Ministry

Persona
Antonio is an official at the Ministry of agriculture. He works on commissioning and management of all evaluation activities before, during and after the Rural Development Programme (RDP) lifecycle. Every year, a part of his job is drafting and submission of the Annual Implementation reports. For his work, he needs farm level microdata, especially regarding environmental characteristics of the farms, both for the beneficiaries and the non-beneficiaries of the Programme. However, the data is of a very limited availability. This creates major difficulties in constructing a counterfactual analysis or calibrating computational models that would allow a sound assessment of the net effects of the RDP.

Scenarios

(1) Antonio receives automatically imported the following DIONE products into his software:
- Crop type map- He needs the data of crop types at the end of the year to compare beneficiaries and non-beneficiaries with similar characteristics and assess the net effect of interventions. He uses the information to feed computational models for water use and water quality.
- Mowing/harvest/ploughing marker map - He needs the data at the end of the year to compare beneficiaries and non-beneficiaries with similar characteristics and assess the net effect of interventions. He uses the information to feed computational models estimating erosion and/or organic content.
- Non-productive EFA types map - Antonio needs the data to be produced annually. He expects that EFAs will be incorporated in the Good Agricultural and Environmental Conditions (GAEC) after the new CAP is in effect.
- Permanent pastures map - Antonio needs the data to be produced annually.
- Continuous soil property maps - He will use it as the basis for computational models assessing erosion and/or organic content.

(2) Antonio logs in to DIONE environmental performance tool. In the dashboard, he filters the farmers who are beneficiaries of RDP. He triggers computation of statistics to compare environmental performance indicators of the farms-beneficiaries of RDP with non-beneficiaries to access the net effects of RDP interventions.

6. Technical scenarios

Technical scenarios are created to provide more technical details on the user requirements. They are created for each of the DIONE products and tools and provide the systematized review of the user requirements through common and specific user requirements, usage of the product/tool and additional requirements.

Common user requirements are those shared across all or most of the user types.

User specific requirements are the ones expressed by a specific user type.

Usage of a product/tool describes the way and motivation of a product or tool.

Additional requirements refer to the requirements expressed by the user that are not directly connected to the DIONE objectives, but are considered to be an added value.

Prioritization of the user requirements distinguished two categories: higher and lower priority, with higher priority requirements being the ones that are either common across different user groups or specific for a certain user group, but of higher importance (e.g. essential for the business process, highly useful, common within the user group, etc..). **Higher priority requirements** are marked with green letters while for the **lower priority requirements** yellow letters are used.

DIONE PRODUCT: CROP TYPE MAPS			
User types: Agronomist – consultant, Farmer, Inspector at PA, Organic inspector, Official at ministry, Official at PA, Researcher			
Requirements	**Relevant crop types**	**Timeframe**	**Access (Import/Dione UI)**

Common	**Relevant crop types (the current CAP legislations requires three crop types groups):**
	    - Permanent crops (olive, cherry, peach, kiwi, etc.);
	    - Annual crops (wheat, corn, oats, buckwheat, rye, barley, etc.);
	    - Permanent pastures;
	Useful related information:
	    - Area under a crop type;
	    - Irrigation data (water source, irrigation technology);
	    - Fertilizer data (type, quantity);
	
	Achieve crop classification by categorizing main permanent crops (indicative: vineyards, citrus trees, stone fruits). Crop type related information: classification of the previous eligibility criteria per parcel.
		- **During the whole (cultivation/sowing/ growing/vegetation) season;**
		- **Continuously (every week, monthly, several times during the season (for each crop probably 2-3 times));**
		- **Before September/October;**
			- **Web application UI;**
			- **Import (download, WFS, REST API).**

Specific	Relevant crop type:
	    Agronomist – consultant:
	      - **Cotton, asparagus, vineyard;**
	      - **Winter, spring cereals, rape seed, leguminous;**
	      - **Vegetables;**
	    Inspector at PA:
	      - **Peas, rapeseed, beans, triticale, clover, sugar beet.**
	      - **Catch crops;**
	    Researcher:
	      - **Cereals, potatoes, grape;**
	    Official at PA:
		Farmer:
		    - **Prior to yield and before the start of cultivation period;**
		Inspector at PA:
		    - **From 04-01 to 09-01;**
		    - **As early as possible;**
		    - **For permanent crops in July and October (Montenegro);**
		
		Organic inspector:	

- Distinction/classification between arable land and permanent crops (two categories of land cover);
- Main arable crops (indicative: cotton, wheat, rice, maize, sunflower, alfalfa, barley;

Farmer:

- Olive trees and grapes (Greece);

Useful related information:

Agronomist – consultant:

- Useful information: areas under special status (nitrate pollution), variety of cultivation;
- Variety, growing stage (BBCH), vegetation index, drilling date…;
- Share of arable crops/ permanent cultures/ permanent pasture per defined geographic or administrative unit (NUTS/LAU level);

- I want to import this type of info (i.e. the dates of the phenological stages) into algorithms that we have developed that define management practices (i.e, irrigation, fertilization practices);

Farmer:

- Vegetation indices, soil parameters, qualitative data upon fruits;

Inspector at PA:

- Actual crop conformity to the declared one, agricultural activity timestamps;

- Depending on crop type, from April till October, at the beginning and at the end of vegetation;

Official at ministry:

- After the end of each financial year (October 15th);

Researcher:

- In some cases at the duration of the crop, and in some other cases at the end of the agricultural period. Also it can be monthly. It depends on where the information shall be utilised;

Official at PA:

- During declaration: March to June and after the end of the season;

	- **Classification results should be at least at 90% accuracy (per crop type);** - **Information on: level of certainty concluding the crop type, the period for which information has been taken into account to define the crop type, the used data for concluding on the crop type;** **Official at ministry:** - **Phytosanitary data (type, quantity);** **Researcher:** - **Information regarding and the use of plant residues of all the crop types;** **Official at PA:** - **Achieve crop classification by categorizing main permanent crops (indicative: vineyards, citrus trees, stone fruits). Crop Type related information: classification of the previous eligibility criteria per parcel.**	
Usage	**Agronomist – consultant:** - **By checking a field on the map we would like to get information about the type of soil, the type of irrigation, environmental area issues (e.g. Natura), the crop type, the crop varieties (e.g.in cotton), the time sequence in annual crops.** - **We would use for crop mapping, for planning of the use of the fertilizers, pesticides for the certain crops in the certain fields; For the crop development analysis and decisions for the actions to be taken to the field during the vegetation; Adoption of precision farming technologies; For the yield analysis etc.** **Inspector at PA:** - **To verify if some parcels are applied with a wrong crop;** - **To verify the crop type area of the corresponding crop type;** - **The compliance to the greening rules.** - **To detect the crop type so that the farmer no longer has to specify the crop**	

	Official at ministry:
	
	   - Use the information to compare beneficiaries and non-beneficiaries with similar characteristics and assess the net effect of interventions.
	   - Use the information to feed computational models for water use and water quality.
	
	Official at PA:
	
	   - Inform the farmer about irregularities and pay subsidies at the end of season.
	   - I want to pick a field on the map and to get the information on the current crop type.
	
	Researcher:
	
	   - Need versatile queries. For example, we would like to select (spatially) a part of the crop field and be able to receive information about this specific crop (including temporal details).
	
	Organic inspector:
	
	   - We want to pick a field on the map and to get the information on the current crop type and area under that crop to assess yield.

Additional requirements	**Agronomist – consultant:**
	
	   - The reporting of the existence of any meteorological stations or/and entomological traps in nearby areas. Reports which contain soil characteristics, plant health;
	
	Inspector at PA:
	
	   - The level of certainty concluding the crop type. The period for which information has been taken into account to define the crop type;
	   - Regarding the Crop Type Maps, they consider that it is an important and central instrument towards satisfying the requirements of the Monitoring Requirements;
	   - Important is a statistical analysis of the type I (alpha) and type II (beta) errors to assess the quality of an automated system. (Technical Guide DS/CDP/2018/17, Chapter 5)
	
	Organic inspector
	
	  - Crop type on adjacent plots, to assess critical time for inspection (according to a specific time for treatment of crops on adjacent plots).
	
	Official at PA:

	- Distinction of the Southern countries' pastures would be very useful.

DIONE PRODUCT: MOWING / HARVEST / PLOUGHING MARKER MAPS		
User types: Agronomist – consultant, Farmer, Inspector at PA, Organic inspector, Official at ministry, Official at PA, Researcher		
Requirements	**Timeframe**	**Access (Import/DIONE UI)**
Common	- **Shortly after the mowing/harvest/ploughing happened;** - **End of season;** - **Throughout the season;** - **Markers should contain time (period) of the event**	- **Web application UI;** - **Import (download, WFS, REST API).**
Specific	**Agronomist – consultant:** - **During the growing season as often as possible.** **Farmer:** - **Prior to harvest or early February before the start of the cultivation period.** **Inspector at PA:** - **From 06-01 to 11-01 (Lithuania).**	

	- **Monthly data by the end of October (Montenegro);** **Official at ministry:** - **After the end of the financial year.** **Researcher:** - For irrigation, during and at the end of the agricultural period. We also need information about the performance/efficiency of the crop at the end of the agricultural period. **Official at PA:** - **During declaration: March to June and after the end of the season.**
Usage	**Agronomist – consultant:** - In annual crops we would like to know the time of sowing and also what type of crop was cultivated in the previous years. We want to pick a field on the map and to get the information if/when the mowing took place. We want to have an all-farms map with the crops, all measures taken in the field and evaluation of yield. - We would use for crop mapping, for planning of the use of the fertilizers, pesticides for the certain crops in the certain fields; For the crop development analysis and decisions for the actions to be taken to the field during the vegetation; Adoption of precision farming technologies; For the yield analysis etc. - To import the info in a decision support system in regard with the practices (i.e fertilization) **Inspector at PA:** - **In some cases the agricultural activity is an eligibility criterion, ie: For Land lying Fallow the need of ploughing is a must; For Citrus the harvest period is a parameter to control other agricultural**

practices; mowing of grassland is mandatory until 15th November; ploughing of (permanent) grassland is prohibited.

- We would like to see at parcel's level at that time period activity has happened.

- To assess the compliance to support eligibility rules under different support schemes (for example, mowing should happen before certain data. We need the information (near) real time, so we can inform farmers (near) real time about the activities we as the PA see in the fields. We want to use it helping farmers to comply with the regulation criteria

- We want to use it in order to collect data to be able to make a good risk analysis: e.g.: in which areas are a lot of incompliances, which type of farmer is likely to be incompliant. This analysis makes us to be able to figure out what will be the best way to make farmers comply the next year or to find out why this type of farmers are likely not to comply.

- To assess some risk factors for Risk analysis for OTSC.

Official at ministry:

- Use the information to compare beneficiaries and non-beneficiaries with similar characteristics and assess the net effect of interventions. Use the information to feed computational models estimating erosion and/or organic content.

Official at PA:

- We want to get the information of the realistic state on the picked field in real time. The information will be used to control payments (type and area of crops, the use of agro-technical measures, GAEC, environmental and other conditions). During the season to inform the farmer. I want to pick a field on the map and to get the information if/when the mowing took place.

Researcher:

- We usually utilise this information in the context of research and development projects for the improvement of agricultural practices, mainly in crop irrigation and nutrition. Versatile queries for research.

Additional requirements	**Agronomist – consultant:** - **The reporting of the existence of any meteorological stations or/and entomological traps in nearby areas. Reports which contain soil characteristics, plant health.** **Inspector at PA:** - The approximate period the respective agricultural activity has taken place. The grazing activity for Permanent Grassland areas is of interest since it is an eligibility criterion. Overgrazing activity for Permanent Grassland areas is of interest since it is an eligibility criterion (it is prohibited). Mowing time periods if more one once per parcel. Detectable grazing plots from parcel's by animals. - **Distinction: Is the activity ploughing or another non-turning tillage.** **Organic inspector:** - **If crop is left on plot (not harvested) we would like to get information on that, because in that case we issue only confirmation of status of plots, instead of certificate for products.** **Official at ministry:** - **Tillage data (method, tool, tractor power). These data would be useful as parameters for computational models estimating erosion and/or organic content.** -

DIONE PRODUCT: BIOPHYSICAL PARAMETERS OF CROPS
User types: Agronomist – consultant, Farmer, Inspector at PA, Organic inspector, Official at PA, Researcher

Requirements	Access (Import/Dione UI)

Common	- **Web application UI;** - **Import (download, WFS, REST API).**
Usage	**Agronomist – consultant:** - **Inspecting data through map** - **For documentation of farming practices, documentation of environmental indicators, certification of production systems. Check crop performance.** - **To make decisions about what actions should be taken in the fields during the growing season.** - **I want to import this type of info into algorithms that we have developed that define management practices (i.e, irrigation, fertilization practices)** **Farmer:** - **Per pixel based biophysical maps will be used to optimize fertilization.** **Inspector at PA:** - **For monitoring the crop growth of the agricultural parcels and to verify their claimed crop and their eligibility. Furthermore we will use these parameters to allocate the non-eligible features and parcels in order to proceed with further investigation and checks. Finally, these parameters will help us identify possible distinction or land use changes and confirm crop existence which is critical for parcel eligibility and the LPIS update.** - **These parameters can be used for detecting several activities that are eligible or not. We would use these parameters for improving mowing detection as we are not sure yet what is the exact distinction in these signals and what activity can best be detected by which parameter.** - **We will use these parameters to allocate the non-eligible features and parcels in order to proceed with further investigation and checks.**

	- These parameters will help us identify possible distinction or land use changes and confirm crop existence which is critical for parcel eligibility and the LPIS update. **Organic inspector:** - We would like to have option to crop data - We would like to get information if plants are under stress, this information is necessary for scheduling inspection in the most critical time for use of inputs in crop production. **Official at PA:** - We will use this information to see if the picked field is the type of crop that farmer was applied for in application. - Definition of crop types. - For crop classifications and for the production agro-environmental indexes. **Researcher:** - The use mainly of data on crop evolution, LAI etc is taking place in order to compare fields where specific agricultural caring practises occur. Also, this data can be used in teaching and Research. - For recommendation for field operations.
Additional requirements	**Inspector at PA:** - Additionally, we can use biophysical parameters of crops in order to have a representation of spatial information on different types (classes) of physical coverage of Cyprus, e.g. forests, grasslands, croplands, lakes. It would be useful to include transitions of land cover classes over time and hence captures land cover changes.

DIONE PRODUCT: NON-PRODUCTIVE EFA MAP OF HIGH QUALITY DETAIL (1M OR LESS)		
User types: Agronomist – consultant, Farmer, Inspector at PA, Organic inspector, Official at ministry, Official at PA, Researcher		
Requirements	**Timeframe**	**Access (Import/Dione UI)**
Common	- **Annually;**	- **Web application UI;** - **Import (download, WFS, REST API);**

Specific	**Agronomist - consultant:**
	  - **At least one per week;**
	Inspector at PA:
	  - **From 06-01 to 11-01 every month for agricultural practice (for example, fallow land), for others once a year until 07-01. (We only need the ones which could be done every month).**
	Researcher:
	  - **Many times per year;**
	Official at PA:
	  - **Every 3 years;**	

Usage	**Inspector at PA:** - **We want to see EFA elements on a map (not necessarily belonging to a specific farm) and I want to pick an element and retrieve the information on the type of the EFA element and the area;**	

	- To help farmers find the eligible elements on the map, making it clear what this element contributes to biodiversity or the environment. This looks like the EFA-layer that the PA has to implement, but adding data on the contribution to the environment and biodiversity is an important addition; - A list of all EFA elements belonging to a certain farm; **Official at PA:** - We want to see EFA elements belonging to a selected farm on a map and I want to pick an element and retrieve the information on the type of the EFA element and the area to cross comply with my data; **Agronomist – consultant:** - I want to see relevant information and to retrieve them as a hard copy; **Organic inspector:** - We want to see EFA elements belonging to a selected farm on a map and we want to pick an element and retrieve the information on the type of the EFA element and the area to assess size of area involved into organic production; **Researcher:** - We would like to be able to select both a specific crop field as well as a larger area and receive the requested data;
Additional requirements	**Agronomist – consultant:** - We want to see the data everywhere in every app, program, that our eyes would recognize the information as usual, as daily news; **Official at ministry:** - EFAs will be incorporated in the Good Agricultural and Environmental Conditions (GAEC) after the new CAP is in effect. So the corresponding GAEC will be required; **Inspector at PA:**

	- For some non-permanent area like swamps or other water area it will be good that we have a date (in October) with minimum and maximum area for that year;

DIONE PRODUCT: PERMANENT PASTURES MAP		
User types: Agronomist – consultant, Farmer, Inspector at PA, Organic inspector, Official at ministry, Official at PA, Researcher		
Requirements	**Timeframe**	**Access (Import/Dione UI)**
Common	- **Annually;**	- **Web application UI;** - **Import (download, WFS, REST API);**
Specific	**Agronomist – consultant:** - **Every week. Because from the data you can generate other recommendations for farming. Some institutions required 1 per 5 years.** **Farmer:** - **Once a year until 07-01.** **Official at ministry:** - **Every year, during the grazing season.** **Official at PA:** - **Maps can be updated every 2-3 years.**	

Usage	**Inspector at PA:** - **We want to see pasture fields(not necessarily belonging to a selected farm) on a map and I want to pick a pasture field and retrieve the information on the area;** - **A list of all permanent pastures belonging to a certain farm;** **Agronomist – consultant:** - **Analysing the map;** - **Checking the compliance.** **Organic inspector:** - **We want to see EFA elements belonging to a selected farm on a map and we want to pick a pasture field and retrieve the information on the area, because we want to assess the surface per animal.** **Inspector at PA:** - **We want to see EFA elements belonging to a selected farm on a map and we want to pick a pasture field and retrieve the information on the area because we want to check the real state of that area.** **Researcher:** - **We would like to able to select both a specific crop field as well as a larger area and receive the available data**
Additional requirements	**Inspector at PA:** - Information on whether the permanent pasture area has been overgrazed and when. - **Type of permanent pasture (natural kept, local practices, seeded, etc) Simone for types.** - **Prorata Coefficient to be compared with the one of the previous year.** **(Explanation: Cyprus-in some cases a permanent pasture area might include sub areas which are not eligible as permanent pasture. In these cases instead of calculating the exact area of the ineligible and cropping it off the eligible area it is possible to define a percentage which is valid for this specific parcel denoting the percentage of the parcel's area which is ineligible. Example: Parcel Abc-123 of 35 decares with Prorata coefficient of 20% means that the eligible area of this parcel is 28 decares. The prorata coefficient is a parameter within the CAPO's LPIS of each year).** - **Agricultural activity time periods.**

	- **Different PP categories would be very helpful (Explanation: Ireland- Permanent Pasture accounts for about 88% of Irish farmer claims. Activity varies greatly from very intensive to extensive)** - **Pasture fields can be very important for biodiversity. In NL we will probably classify degree of herb richness in grassland. Different classes yield more or less income support. Pasture fields can be very important for biodiversity. In NL we will probably classify degree of herb richness in grassland. Different classes yield more or less income support.** **Official at PA:** - **Distinction of southern countries pastures would be very useful.**

DIONE TOOLBOX: FARMERS' GEO-TAGGED PHOTOS

User types: Agronomist – consultant, Farmer, Inspector at PA, Organic inspector, Official at PA, Researcher

MOBILE APPLICATION

Requirements	Characteristics	The most important information to be visualised to the operator	Key functionalities	Helpful guide
Common	- **User friendly;** - **Mobile connectivity;** - **Compatibility;**	- **Declared agricultural parcels, LPIS reference parcels;** - **GPS location;**	- **Show navigation and time stamp;** - **Navigation to the field/points where images must be taken;**	- **Text, audio, video;** - **Hand on training;**

	- **Automatic location and time stamp;** - **Offline mode;**	- **Background imagery to help navigate to the location;** - **The details/characteristics of the claimed parcel (the parcel's Village, code, area, crop, slope, elevation and measures);** - **The type of crop on the field;** - **Display points where images must be taken;**	- **Enter metadata (details)**	
Specific	**Inspector at PA:** - **Location accuracy, augmented reality of reference parcel boundaries;** - **Method that detects and prevents scams/frauds (i.e. GPS Fake Apps or taking pictures of**	**Inspector at PA:** - Different layers of data (NDVI and etc.); - Crop health, estimated yield, suggested fertilization plan; - **The reason of taking a photo in order to make sure the right**	**Inspector at PA:** - **Augmented reality of parcel;** - **Built in validation to ensure adequate data capture;** - **Showing when an image is well taken (warning: not towards the sun etc.);** **Researcher:**	**Inspector at PA:** - **Departments website;** **Agronomist – consultant:** - **On-line interactive and context-sensitive help (like you said display points on the screen, or warn the user if he is going to capture the image incorrectly etc.)**

	pictures). Edits of the EXIF data should not be possible. **Organic inspector:** - **Language option;** **Researcher:** - **Real time upload to cloud for safety. Provide analysis on machinery edge computing;** **Official at PA:** - **On click button, to assure not manipulation of the metadata or the parcel border;**	**photograph is taken;** **Official at PA:** - **Accuracy level of the border delineation;**	- **Import text, import coordinates, display predetermined waypoints and route. Be connected with machinery navigation (e.g. through ISOBUS);**	

DATA				

Requirements	Access (Import/Dione UI)
Common	- **Web application UI;** - **Import (download, WFS, REST API);**

Usage	DIONE UI (access/visualization)
	
	   - **Option to crop data if it is necessary;**
	
	Purpose
	
	  Agronomist – consultant:
	    - **Development of a farmer's management plan;**
	    - **Crop development analysis;**
	    - **To relate this info to info from other sources (e.g. comparing NDVI maps, with the photos of the crop during the same dates of the NDVI maps)**
	
	  Farmer:
	    - **Providing proof to the PA or Organic Certification Organization**
	    - **Collecting metadata from the farm. Analyze the photo and check the growth.**
	
	  Inspector at PA:
	    - **Towards deciding whether an area / agricultural parcel is eligible for aid.**
	    Example1: Measure 10: Agro-environmental obligations, mechanical weeding. Proof that the obligation was fulfilled.
	    Example 2: Greening: EFA shown in pictures.
	    - **Location accuracy, direction.**
	    - **To determine activity, validate a claim and prove performance.**
	    - **Replace the physical OTSC.**
	
	  Organic inspector:
	    - **We would review the data submitted and evaluate if there is a need for additional inspection and what would be the focus of that inspection.**
	
	  Official at PA:
	    - **Checking if the photographed types of crops matched with reported crops.**
	    - **Collection of evidence on the field in cases where imagery, VHR or HHR is not of sufficient quality. Storm damage to crops or structures. Collection of ground truthing for training of algorithms.**
	    - **Facilitate the declaration in order to decrease the declaration mistakes;**

	Researcher: - **Verify fieldwork, archiving.**
Additional key metadata attributes	**Inspector at PA:** - **Sensor used;** **Official at PA:** - **Accuracy level of the border delineation;**

DIONE PRODUCT: ORTHOIMAGERY FROM DRONES	
User types: Agronomist – consultant, Farmer, Inspector at PA, Organic inspector, Official at PA, Researcher	
Requirements	**Access (Import/Dione UI)**
Common	- **Web application UI;** - **Import (download, WFS, REST API);**
Usage	**Agronomist – consultant:**

	- Development of a crop management plan. Consulting on plant health issues or water stress issues. - Precision farming technology application. Preparation for inspection; - To define the management practices. Needed resolution, approx. 5x5 m2 **Farmer:** - This would be important for yield monitoring; **Inspector at PA:** - Resolution Less than 30 cm. - Towards deciding whether an agricultural parcel is eligible for aid. - Towards deciding whether an area contains EFA characteristics or not and their attributes. - Define precise boundaries, if needed. Again, to determine activity, eligible areas but also possibility of using this type of data to train the AMS. Replace the physical OTSC. The land parcels borders could be measured not in the field, but on the high-resolution images, also some crops could be visible on these images. - It may become possible to distinguish (the number of) different herbs in the grassland and it may be possible to recognize mixtures of crops. It might be possible to check a lot more agro environmental measures. - I want to check measures that cannot be checked by other data (apart from geotag photo) **Organic inspector:** - To check distant parts of plots, buffer zones, neighbour plots; - We would like to also have an option to crop data if it is necessary; **Official at PA:** - We would like to see the real position of the photographed field and real state of crops on it; - Drone images to replace the OTSC and for the eligibility and for the LPIS update in the latter stage. Resolution as big as possible; **Researcher:** - For research purposes, too expensive for production;
Additional requirements	**Inspector at PA:**

	- **To lower precision requirements in LPIS QA, because agricultural land could be ploughed any day and in any location of agricultural reference parcel (except, where it is not allowed). It's impossible to have very precise LC/LU boundaries in LPIS, if we have a new orthophoto once in three years.**

DIONE PRODUCT: SOIL DATA AND MAPS FROM SPECTROMETERS			
User types: Agronomist – consultant, Farmer, Inspector at PA, Organic inspector, Official at ministry, Official at PA, Researcher			
APPLICATION			
Requirements	**Key characteristics**	**Metadata**	**Information to provide to the operator**
Common	- **User friendly;** - **Device compatibility;** - **Mobile connectivity;**	- **Location;** - **Timestamp;** - **Geo-tagged photo;** - **Operator;**	- **Location;** - **Base map;**
Specific	**Inspector at PA:** - **Compatibility with Department systems;**	**Agronomist – consultant:** - **Soil properties data;**	**Farmer:** - **Soil properties data;** **Official at PA:** - Realistic state on a field; - **Sophisticated spectral analysis directly leading to the crop type;**

Functionalities	**Researcher:**
	
	   - **Support direct applying fertilizers of pesticides;**
	
	Official at PA:
	
	   - **Sophisticated spectral analysis directly leading to the crop soil type;**	

DATA		
Requirements	**Useful data**	**Access (Import/Dione UI)**

Common	- **Soil organic carbon;**
	
	  - **Soil texture;**
	
	  - **Soil moisture;**
	
	  - **Soil PH;**
	
	  - **Soil nitrate;**
		- **Import (download, WFS, REST API);**

Specific	**Agronomist – consultant:**
	
	  - **soil structure, soil erosion level, mechanical composition, soil compaction, temperature etc.**
	
	Official at PA:
	
	  - **Only digital numbers from spectral bands;**
	
	  - **Residues of pesticides and fertilizers. Till now we don't really have easy ways to check if**
		Inspector at PA:
		
		   - **We would like to provide whatever data will be generated in DIONE, to be available to our farmers though PA Portal;**
		
		Inspector organic cert:
		
		   - **We would use DIONE User Interface, but we would like to also have an option to crop data if it is necessary;**

	pesticides and/or fertilizers are used (while prohibited in certain measures). It would be an opportunity; - **Hummus richness;** **Researcher:** - **Soil granularity;**	

Usage	**Common:**
	   - **Map visualization;**
	   - **Monitoring of soil quality;**
	Agronomist – consultant:
	   - **Filter through selected properties and comparing them in space**
	   - **To check the validity of info (if the distribution of measurements doesn't seem correct). To define the soil variability in the area.**
	Inspector at PA:
	   - **Visualize data per parcel;**
	   - **We want to see on the map all sample points for a certain region filtered for a certain soil property and I want to click on a sampling point to retrieve the associated metadata;**
	Researcher:
	   - **Support direct applying of fertilizers;**

Continuous soil property maps usage	**Agronomist – consultant:**
	   - **For development of crop management plan;**
	   - **To be able to compare them with lab measurements at specific points.**

Inspector at PA:

- Although a continuous property map would have much more interest if this is not cost effective a moment property map is still very useful. Either the moment or the continuous soil property map would be used to identify any legal or administrative infringements on the soil used by the farmers (e.g. overuse of fertilizer, overgrazing).

Organic inspector:

- As indication of usage of substances for soil fertility;

- We want to see which eco-scheme is promising in this area or which activity has to be carried out to improve the soil health or if possible to check if (no) pesticides or fertilizers are used or which kind of fertilizer should be used;

Official at ministry:

- They could form the basis for computational models assessing erosion and/or organic content;

Official at PA:

- Only for in situ control points;

- For the production of Climate Change mitigation indexes;

Researcher:

- In combination with other data;

DIONE PRODUCT: MAPS OF SOIL DEGRADATION INDICATORS		
User types: Agronomist – consultant, Farmer, Inspector at PA, Organic inspector, Official at ministry, Official at PA, Researcher		
Requirements	**Relevant indicators of soil degradation**	**Access (Import/Dione UI)**

Common	- **Loss of organic matter.** - **Changes in soil structure.** - **Soil carbon;** - **Soil salinity;** - **Soil erosion;**	- **Import (download, WFS, REST API);**
Specific	**Agronomist – consultant:** - **Soil fertility, alkalinity, compression, top soil color. Wind, water data, biological activity;** **Researcher:** - **Nitrates, acidity, heavy metals, conductivity, pH, sodium, etc.;**	

Usage	**Official at PA:**
	   - **We want to overlay the maps with the parcel boundaries and derive aggregated results);**
	Agronomist – consultant:
	   - **To see the evolution of degradation (i.e loss of soil organic carbon) in time (for any specific area);**
	   - **Crop management plan;**
	   - **Soil indicator map;**	

DIONE TOOLBOX: COMPLIANCE MONITORING TOOL

	User types: Agronomist – consultant, Farmer, Inspector at PA, Organic inspector, Official at PA				
Requirements	**Dashboard (appearance/filtering)**	**Type of analysis**	**Report**	**Import data**	**Historical data**
Common	**Filtering:** - **Filter by farmer, scheme, crop type, compliance, other requirements such as EFA types**	- **Statistical Data (Average, Max / Min, Rations, etc.)** - **Retrieving data for location selected on the map (in graph or tabular mode)** - **Comparison of a parameter data for two locations selected on the map (in graph or tabular mode)**	- **Overall farmer compliance, scheme compliance stats;**	- **Farmers' parcels borders and relevant parcel data. From LPIS. The data on parcel size, crop declared.** - **Data import through integration with PA infrastructure**	- **Interactive timeline or calendar to set the time frame for the data to be presented in graphical, tabular way or on the map**
Specific	Dashboard appearance: **Organic inspector:** - **To have a list of the claimed parcels per farmer and to navigate to each claimed parcel through a real spatial layer;**	**Inspector at PA:** - **List/request geotagged photos** - **Financial analysis of the parcels not cleared for payment to see the**	**Official at PA:** - **All relevant information for the payment of subsidies;** - **The report must contain all the findings of an inspection along**	**Agronomist – consultant:** - **Pests, diseases found in the crop;** **Inspector at PA:** - **The claimed parcels and the corresponding spatial layer. The**	**Inspector at PA:** - **Up to 5 years. Some parcels participate in measures that have 5- or 6-years duration;**

	- **Overall farmer compliance;**
	- **Individual parcel compliance and allow to filter based on parcel compliance;**
	
	Filtering:
	   Organic inspector:
	- **One filter - crop types, another - harvest time, regions;**
	   Official at PA:
	- **Number of cadastral parcel, farm ID;**
	   Inspector at PA:
	- **Irrigated areas;**
		impact at herd / scheme level;
		
		Organic inspector:
		- **Total harvested quantity of each crop per farmer, total area per producer;**
		
		Official at PA:
		- **Types of crops in a certain time period of season;**
		- **Zonal stats for declared area, segmentation of homogeneous areas;**
		- **Statistics of crop types of farmers per area and of parcel and farm size;**
		   Agronomist – consultant:
		- **Compliance to AEC commitments and**
			with the remarks of the inspector and also if possible, the signature of the 2 inspectors (and the farmer's);
			
			Agronomist – consultant:
			- **Compliance to regulations**, crop **health, 2-3 times per year;**
			
			Inspector at PA:
			- **Information per agricultural parcel: eligibility status, participate or not in measures and which measures, geo-tagged photos exists or not, EFA characteristics within the agricultural parcel, on the spot control and type of on the spot control, area claimed, area**
				various GIS layers that PA currently uses. The on the Spot spatial Layer that each year is created by the PA;
				- **Financial data;**
				- **Whether parcel is under ECO scheme;**
				- **All the data that is produced during the year that influences the degree of compliance of the schemes: e.g. (agricultural) machine data, reference layers, data from farm-suppliers, from central government records, from chain partners, from anywhere;**
				- **A layer with borders of sub-parcels due to an eligibility criterion where farmers have to divide their parcel in 1 ha units as areas**	

		environmental cross-compliance;	found, area paid, crop type, etc.;	for specific flowers (2nd pillar measure).	
				Official at PA: - **Agricultural parcels from smart farming tools and reference parcels;**	

Usage	General usage scenario:
	
	 I search in the dashboard to find a farmer I want to check. I click on his name and it takes me to the farmer's page where his parcels are visualized on the map. A table is also provided with the statistical data (e.g. total area, list of parcels with current crop types, area under permanent pastures, area under EFAs, etc.). Current farmer's compliance situation is displayed. From a spatial data list, I chose geo-tagged photos locations to be displayed on the map. I click on a location and get the geo-tagged photo with attributes displayed so I can check more what the farmer did in the field. I also chose the crop type map from the spatial data list to be displayed. I click on a particular field and the map and get the information about the current crop type, etc.
	
	 Import data:
	
	     Inspector at PA:
	
	          - **To allow analysis to determine impact on the herd before requesting additional data or geo-tag photos from the farmer;**
	
	 Historical data:
	
	     Agronomist – consultant:
	
	          - **Crop grown yearly data to check rotation.**
	
	     Inspector at PA:
	
	          - **It could explain next year's situation;**				

	- The AMS allows for payment on certain inconclusive parcels therefore it would be important to have historical data available to the system. - All data should be traceable in time (data from previous years should be accessible all the time). **Inspector organic cert:** - We would like to see historical data, to check crop rotation and previous yield (crop type, yield in previous year). **Official at PA:** - Get the information on what is happening on the specific field in the time (crop rotation). - All data should be traceable in time (data from previous years should be accessible all the time). - We need historical data because we have to check for repeatable non-compliances. - Some parcels participates in measures that have 5 or 6 years duration. It will then be possible to see the improvement.
Additional requirements	**Inspector at PA:** - It would be useful to allow this tool to facilitate interaction with the farmer e.g. allow them to see it, use it and upload data through it. **Official at PA:** - For farmers it is quite important to add the amounts of money they can earn by participating in schemes. It makes it possible to show how participating in (eco)-schemes generates a business/revenue-model. If other businesses want to pay the farmer more for their products if a certain standard of environmental performance of level of biodiversity is reached, they must be able to make use of the same data. In that situation environmental performance or biodiversity becomes even more rewarding for a farmer. Not taking into account the amounts that can be earned is a mistake: a farmer must see the measures in combination with the earnings (which he need to carry out the measures).

DIONE TOOLBOX: ENVIRONMENTAL PERFORMANCE TOOL		
User types: Agronomist – consultant, Inspector at PA, Organic inspector, Official at ministry, Official at PA, Researcher		
Requirements	**Relevant environmental Performance parameters/indicators**	**Other relevant data/maps**
Common	- **CAP context environment indicators[9]** - **Soil organic carbon;** - **Soil texture;** - **Biodiversity;** - **Fertilizer and phytosanitary parameters;** - **Water quality (show agriculture performance is helping to improve water quality);** - **Air quality (ammonia emissions, climate change, carbon sequestration);**	- **Crop types;** - **Parcels with the data on measures applied (GAEC, greening, RDP);** - **Geo-tagged photos;** - **Satellite imagery;** - **Drone imagery;** - **Maps with areas dedicated to environmental sustainability;** - **Intensity of production;**
	Tool functionalities	
	Registration/Login **Dashboard** **Map and graph charts view of the indicators** **Area and time query**	

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[9] https://ec.europa.eu/info/sites/info/files/food-farming-fisheries/farming/documents/cap-indicators-glossary_en.pdf

	Environmental performance score of an AOI	
Specific	**Organic inspector:** - **Areas dedicated to the enhancement of biodiversity (ADEB): Landscape elements regarded as ADEB and Requirements regarding the quality of ADEB** (https://icbag.ch/resources/Merkblaetter/ENG/ENG_Enhancementbiodiversity_2020.pdf) **Agronomist – consultant:** - **Permanent pasture ratio (because of protection of permanent pasture),** - **Percentage of fields affected/ threatened by soil erosion (because of soil degradation and micro flood risk),** - **Average parcel size (lowering the parcel size is in some countries important measure to reduce negative impact of intensive farming),** - **Crop diversification (average number of crops grown on the farms/ in defined areas)**	**Agronomist – consultant:** - **Soil tillage, grazing;** **Official at PA:** - **GAEC, SMRS and Climate Change mitigation of agriculture;**
Usage	**Common:** - **Menu of generated environmental performance indicators and other relevant datasets for the area of interest;** - **Map section for visualization of spatial data layers;** - **Graph showing changes of a selected indicator through time on a selected location;** - **Comparison of an indicator's temporal performance between two selected locations;**	

- Setting parameters for statistic/correlation calculation (e.g. indicator-timeframe-crop type-scheme) and presenting the results;
- Export of the generated results;

Agronomist – consultant:

- Get various statistics (through time on a graph, compare values of parameters in different locations);
- The parameters/indicators should be presented at European/ National/ Regional (NUTS/LAU) levels as both statistics and thematic maps. Time development should be presented in the form of charts;

Organic inspector:

- Calculation of the percentage of areas dedicated to environmental sustainability related to total agricultural area per producer;

Official at ministry:

- Compare beneficiaries of the Rural Development (RDP) with commitments to improve water and air quality with similar non-beneficiaries and assess the net effects of the RDP interventions;

Inspector at PA:

- Ability to illustrate farmer/agri performance over time as a direct result of targeted scheme intervention.

Official at PA:

- Visualisation of changes of a Key indicator through time on a graph, comparison of values of a parameter in two locations, calculation of statistics on the environmental impact in comparison to certain crops;
- To get an idea of what are the possibilities to perform better (and knowing this: for the PA to get an idea: how to encourage farmers to perform better);

7. Conclusion

The results of the process of DIONE users' identification and analysis and co-design of products and tools in the context of CAP reform show the following:

- DIONE products and tools are designed (through defining user requirements and scenarios) to conform to the foreseen reformed CAP regulations (i.e. strategic plans and measures to be designed by each Member State, enhanced conditionality effectively merging cross compliance and greening)

- variety of user requirements across user types brings the need of prioritisation based on criteria of common requirements across user groups and the importance of user specific requirements.

Based on the prioritisation of the user requirements systematized in the section 6, for each of the DIONE products and tools a Minimum Viable Product (MVP) has been defined. A MVP can be defined as the "version of a new product which allows a team to collect the maximum amount of validated learning about customers with the least effort".[10] It means that MVPs included the user requirements that are either common across different user groups or specific for a certain users group, but of higher importance (e.g. essential for the business process, highly useful, common within the user group, etc..). The MVPs are presented in the following section.

7.1   DIONE Minimum Viable Products

CROP TYPE MAPS

COMMON REQUIREMENTS (describe the tool functionalities or product characteristics that are common for all users (not user specific))	
UR_C1 - Identifying relevant crop groups with sufficient accuracy	It is important for the crop type map product that sufficient accuracy (> 90%) is achieved when identifying crop types.
UR_C2 - Continuous updating during the season	Crop type maps are oftentimes required multiple times per year and it needs to be able to update them periodically during the growing season to satisfy the user requirements.

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[10] https://en.wikipedia.org/wiki/Lean_startup#cite_note-16

UR_C3 - Additional metadata	In addition to the crop type, additional information (such as area under the crop type) is displayed to the user.

USER SPECIFIC REQUIREMENTS (describe the tool functionalities or product characteristics that are specific for particular user type)	
Farmer	
UR_S1 - Biophysical indices	In addition to the crop type (which is already known to the farmer) biophysical indices are shown for the parcel.
Paying Agency Inspector	
UR_S2 - Certainty level	The level of certainty concluding the crop type for the used model. (i.e. the confidence of the model of its decision)
UR_S3 - Inference data period	The period for which information has been taken into account to predict the crop type,
Paying Agency Official	
UR_S4 - Distinction between arable land and permanent crops	The system must also be able to classify the land cover type (at least between arable land and permanent crops)
UR_S5 - Previous eligibility criteria	The previous eligibility criteria for the parcel that is viewed needs to be shown.
Agronomy Consultant	

UR_S6 - Biophysical indices	Display various biophysical indices for the parcel.
Organic Inspector	
UR_S7 - Access crop type of adjacent parcel	The organic inspector needs to be quickly able to access crop type information about adjacent plots.

MOWING / HARVEST / PLOUGHING MARKER MAPS

COMMON REQUIREMENTS (describe the tool functionalities or product characteristics that are common for all users (not user specific))	
UR_C4 - Continuous updating during the season	Markers are often times required multiple times per year and need to be calculated multiple times during the growing season.
UR_C5 - Markers display on the map	Users need to be able to visualize the marker results on a map. For example, parcels where no mowing has been detected are colored as red.
UR_C6 - Display the time of event	It is required to show also the time (period) of when the event has taken place on the parcel.

USER SPECIFIC REQUIREMENTS (describe the tool functionalities or product characteristics that are specific for particular user type)	
Farmer	
NA	NA

Paying Agency Inspector	
UR_S8 - Display parcel level at the time period activity has taken	Allow the display of biophysical/vegetation indices for period when activity was detected in addition to the markers.
UR_S9 - Allow for group analysis of considered parcels	Users would like to collect data from multiple parcels to make a good risk analysis - in order to assess what is the best way to make farmers comply
Paying Agency Official	
UR_S10 - Near real-time identification of mowing	Mowing events during the season need to be identified in near real time.
Organic Inspector	
UR_S11 - Detect if plot was not harvested	Organic Inspector would like to detect whether the plot was harvested or not, as if it wasn't the certificate for products is not issued.

BIOPHYSICAL PARAMETERS OF CROPS

COMMON REQUIREMENTS (describe the tool functionalities or product characteristics that are common for all users (not user specific))	
UR_C7 - Continuous updating during the season	Biophysical parameters need to be updated regularly.

UR_C8 - Data export	Data needs to be accessible outside the web application UI (through download or through API)

USER SPECIFIC REQUIREMENTS (describe the tool functionalities or product characteristics that are specific for particular user type)	
Farmer	
UR_S12 - Biophysical parameters on a per-pixel basis	Biophysical indices need to be on a per pixel basis, so different parts of the fields can be assessed for fertilization
Paying Agency Inspector	
UR_S13 - Combine with markers	Display biophysical indicators together with markers in order to assess their validity
Paying Agency Official	
Agronomy Consultant	
UR_S14 - Inspect data through map	Chosen biophysical parameters should be displayed on a map (overlayed over each parcel that is shown on the map)
Organic Inspector	

UR_S15 - Display plants under stress	Organic Inspectors would like to have a visualization option that displays whether plants are under stress.

NON-PRODUCTIVE EFA MAP OF HIGH QUALITY DETAIL

COMMON REQUIREMENTS (describe the tool functionalities or product characteristics that are common for all users (not user specific))	
UR_C9 - EFA elements on a map	Show EFAs on a map, allowing to user to click on a parcel to retrieve more information
UR_C10 – Annual data	EFA maps will be produced at least once a year
UR-C11 - Data export	Data needs to be accessible outside the web application UI (through download or through API)

USER SPECIFIC REQUIREMENTS (describe the tool functionalities or product characteristics that are specific for particular user type)	
Farmer	
NA	NA
Paying Agency Inspector	
UR_S16 - List EFAs of specific farm	List all EFAs belonging to a selected farm.

Paying Agency Official	
UR_S17 - List EFAs of specific farm	List EFAs belonging to a selected farm.
UR_S18 - EFA type information	Retrieve information on the type of the EFA element and the area (to cross comply with internal data)
Agronomy Consultant	
NA	NA
Organic Inspector	
UR_S19 - Display area of the EFA element selected	In order to assess the size of the area involved into organic production, area information for selected EFAs needs to be displayed.

PERMANENT PASTURES MAP

COMMON REQUIREMENTS (describe the tool functionalities or product characteristics that are common for all users (not user specific))	
UR_C12 - Annual update	Permanent pastures maps are updated annually
UR_C13 - Data export	Data needs to be accessible outside the web application UI (through download or through API)

UR_C14 - Pasture fields shown on a map	Permanent pasture parcels are shown on an interactive map, where individuals parcels can be explored further.

USER SPECIFIC REQUIREMENTS (describe the tool functionalities or product characteristics that are specific for particular user type)	
Farmer	
NA	NA
Paying Agency Inspector	
UR_S20 - List of all permanent pastures belonging to a certain farm	List all permanent pastures that belong to a specific farm.
UR_S21 - Overgrazing	Information on whether the permanent pasture area has been overgrazed and when.
UR_S22 - Agricultural activity time periods	Periods of agricultural activity for selected pasture need to be displayed.
Paying Agency Official	
UR_S23 - Pasture distinction	Distinction between the different pastures.
UR_S24 - EFA type information	Retrieve information on the type of the EFA element and the area (to cross comply with internal data)

Agronomy Consultant	
NA	NA
Organic Inspector	
UR_S25 - Pasture area information	Enable picking a pasture fields and retrieving information on the area, to assess the surface per animal.

GEOTAGGED PHOTOS TOOL

COMMON REQUIREMENTS (describe the tool functionalities or product characteristics that are common for all users (not user specific))	
(requirement)	(description)
UR_C15- Mobile application should have the following characteristics: - User friendly; Mobile connectivity; Compatibility; Automatic location and time stamp; Offline mode;	NA

USER SPECIFIC REQUIREMENTS (describe the tool functionalities or product characteristics that are specific for particular user type)

Farmer	
UR_S26 - Navigation	The user is being guided by the application to the parcel location where geotagged photos need to be collected.
UR_S27 - View	The user can view in a user-friendly way information about his parcels and tasks (geotagged photos collection) provided by PA Inspectors
UR_S28 - Data collection	The application guides the user to the ideal image capture and quality. On the screen user can see agricultural parcel boundaries superimposed. When user sets the right position and orientation of his smartphone, he takes the photos.
UR_S29 - Offline mode	The user needs to be able to utilize the application even when internet connection is not available.
Inspector	
UR_S30 - Data integrity and anonymization	The user needs to receive geotagged photos that are not tampered and/or manipulated, whilst their location and time integrity is ensured. View of personal information that may exist in the photos should be also avoided.

ORTHOIMAGERY FROM DRONES

COMMON REQUIREMENTS (describe the tool functionalities or product characteristics that are common for all users (not user specific))

UR_C16 - Drone flights	Conduction of drone flights at different areas of interest so as to support CAP monitoring objectives and crop management parameters.
UR_C17 - Data processing	Processing of raw data collected from flights towards the production of orthoimagery of very high resolution.
UR_C18 - Data export	Data needs to be accessible outside the web application UI (through download or through API)

USER SPECIFIC REQUIREMENTS (describe the tool functionalities or product characteristics that are specific for particular user type)	
Inspector at PA	
UR_S31 – Very high resolution data production	Processing of raw data collected from flights towards the production of orthoimagery of very high resolution.

SOIL DATA FROM SPECTROMETERS

COMMON REQUIREMENTS (describe the tool functionalities or product characteristics that are common for all users (not user specific))	
UR_C19 - User friendly	The device along with the developed mobile application will not require technical training from end users. The Interface will be simple, user friendly with colours easily distinguishable at field conditions (i.e. intense sunlight)

UR_C20 - Device compatibility	The application will be easily installable via direct apk download to mobile devices carrying Android 5 or newer.
UR_C21 - Mobile connectivity	The data to be collected extend from soil reflectance to location, timestamp and soil sample's photo. To this end, the scanning system will be connected to mobile device with Bluetooth, and the device will require to be equipped with built in camera and GPS sensor. The data will be transmitted to the central database system synchronous (through 4G/5G internet connection) or at later stage (asynchronous through WiFi or 4G/5G)
UR_C22 - Metadata	Collected data will be associated with metadata containing Location, Timestamp, Geo-referenced photo and Operator's id. Location and timestamp will be used for fusion with EO data while georeferenced photo and Operator's id will be used for novelty detection.
UR_C23 - Information provided to the operator	The samples exact location will be delivered to the operator prior to their mission. The file format delivered will be able to be projected to a suitable basemap.

USER SPECIFIC REQUIREMENTS (describe the tool functionalities or product characteristics that are specific for particular user type)	
Farmer	
UR_S32 - Soil properties data	Estimations of Soil organic carbon, pH, total N and texture at the specific points measured by the spectrometer
Paying Agency Official	

UR_S33 - Sophisticated spectral analysis directly leading to the soil type	Machine learning algorithms will iterate over large Soil Spectral Libraries and estimate the soil texture of sensed areas at the particular points through the soil scanners.
Agronomy Consultant	
UR_S34 - Soil properties data	Estimations of Soil organic carbon, Soil moisture, pH, total N and texture at specific points

SOIL MAPS

COMMON REQUIREMENTS (describe the tool functionalities or product characteristics that are common for all users (not user specific))	
UR_C24 - Maps of soil organic carbon and soil texture	A map of the content of soil organic carbon and texture (i.e. soil particle size distribution, also known as mechanical composition) at the topsoil with a spatial resolution of 10m will be generated by fusing EO data with the soil point data generated by the spectrometers and other existing soil libraries. The map will be easily served with a REST API, and will be a geo-referenced TIFF file that can be readily imported into any mapping software (including served by browsers).
UR_C25 - Data export	Data needs to be accessible outside the web application UI (through download or through API)

USER SPECIFIC REQUIREMENTS (describe the tool functionalities or product characteristics that are specific for particular user type)	
Farmer	
NA	NA

Paying Agency Inspector	
UR_S35 - Data availability to the farmers through PA platform	The soil maps are open and can be readily ingested into the PA platform so that they can be served to their farmers.
Paying Agency Official	
UR_S36 - Hummus richness	The content of soil organic carbon is directly tied the richness of the humic substances in the soil, and thus this will be provided by the map of soil organic carbon.
Agronomy Consultant	
UR_S37 - Soil mechanical composition	The soil mechanical composition is the soil structure, which will be provided (see general requirements).

COMPLIANCE MONITORING TOOL

COMMON REQUIREMENTS (describe the tool functionalities or product characteristics that are common for all users (not user specific))	
UR_C26 - Registration/Login	User should have an authenticated access to the platform
UR_C27 - Dashboard	**Map view settings** - basemaps selection, layers selection, opacity control, interactive timeline or calendar to set the time frame for the data. This allows seeing parcel changes through history.

- contains all the relevant farm information and controls for browsing through parcels	**List of parcels** with information about crop type, area, cadastral ID and filtering functionality (by crop type, parcel ID etc…) **Reports** relevant to each user **Documents** relevant to each user
UR_C28 - Map view	The map should show the user's parcels overlaid on top of a base map (Bing Maps/OSM or similar). It should support zooming, panning, and overlay of various vegetation indices layers (such as NDVI, Chlorophyll etc.)
UR_C29 - Location query	Query biophysical parameters for specific location. Results will be shown on an interactive graph/table with timeline that shows parameter changes through time.
UR_C30 - Account management	Users should have an ability to manage their personal information in a profile section.
UR_C31 - Filtering	All users need to be provided with functions to filter the data in the platform based on one or more parameters, to ease the usage and speed up finding of relevant information
UR_C32 - PA data integration	Integration with the PA infrastructure is essential, so that Farmer can retrieve his/her application data from the PA.

USER SPECIFIC REQUIREMENTS (describe the tool functionalities or product characteristics that are specific for particular user type)
Farmer

UR_S38 - Tasks (geotagged photos requests)	Farmers should be able to see tasks requested by PA Inspector. For example, a task could be a request for additional information about a farmer's parcel, in which case farmer should provide a geo-tagged photo.
UR_S39 - Consultants management dashboard	Farmers should be able to request consulting services from agronomy consultants and see the list of consultants already assigned. Farmers should be also able to revoke access rights from assigned consultants
UR_S40 - Compliance report	Report showing the compliance status of an application, with all relevant data and statistics (crop types, EFA areas etc.)
UR_S41 - Geotagged photos	Farmers should be able to see the geotagged photos he/she has taken, together with their locations (and orientation) on the map
Paying Agency Inspector	
UR_S42 - List of assigned farmers	Inspector will see the list of farmers that are assigned for inspection. Farmer's compliance status is shown next to each farmer. Inspector can choose which farmer to inspect, upon choosing he/she is presented with the farm profile of the selected farmer. It is also possible to filter the farmers based on some parameters
UR_S43 - List/request geotagged photos	Inspector can see the geotagged photos collected by the farmer, or request new geotagged photos from a specific location
UR_S44 - Inspect parcels (with additional information that supports compliance check)	Inspector will see additional information for each parcel that will support the inspection process. This data will be presented through graphs/numbers that show the probability of an event occurring (for example tillage, mowing...,), or that show some parcel properties

UR_S45 - Compliance report	Report showing the compliance status of an application of the inspected farm, with all relevant data and statistics (crop types, EFA areas etc.)
Paying Agency Official	
UR_S46 - List of assigned farmers/inspectors	PA Official should be able to see the lists of inspectors and farmers/applicants in the paying agency. Also, he/she should be able to assign farmers to inspectors for inspection.
Agronomy Consultant	
UR_S47 - List of farmers/assignment requests	Consultant should be able to see the list of farmers available for consulting/inspecting. Consultant should be able to decide, if he/she accepts to provide consulting services and he/she should be able to cancel consulting services to a specific farmer from the list
UR_S48 - Compliance report	Report showing the compliance status of an application of the inspected farm, with all relevant data and statistics (crop types, EFA areas etc.)
Organic Inspector	
UR_S49 - List of farmers certified for organic production	Organic should be able to see the list of farmers certified for organic production and inspect their farms/parcels.
UR_S50 - Compliance report	Report showing the compliance status of an application of the inspected farm, with all relevant data and statistics (crop types, EFA areas etc.)

Environmental Performance Assessment Tool

COMMON REQUIREMENTS (describe the tool functionalities or product characteristics that are common for all users (not user specific))	
UR_C33 - Registration/Login	New users will be able to register and get access in the tool. Existing users will securely login in the tool. Users will be able to reset password.
UR_C34 - Dashboard	Map view settings: Map mode selection (Satellite, Street, Light and Dark), Agri-Environmental Indicator (AEI) selection according to deliverable D5.1, ability to search and directly navigate to a specific location on the map, opacity control and interactive date-picker or yearly-calendar to set a desired timeframe of interest, ability to choose Area Of Interest (AOI) type of measurement (km2, stremma, ha) Report: The user will be able to see how AOI changes through time in pre-defined timeframe.
UR_C35 - Map view	Some of the map functionalities will include zoom, pan, and overlay visualizations of the selected AEI. Depending on the selected AEI, users will be able to view related information such as graphs/charts, statistics and/or data ranges.
UR_C36 - Management dashboard	User will be able to select an AOI. User will be able to select a timeframe in order to be informed about the AOI through the user-defined time-period.
UR_C37 – Data queries and presentation of the results	Select AOI size unit (km2, stremma and ha). Menu of generated environmental performance AEI for the pre-defined AOI.

	Setting parameters for statistic/correlation calculation (e.g. indicator-timeframe) and presenting the results. Map section for visualization of spatial data layers. Graphs showing changes of the selected AEI through time on a defined AOI. Export of the generated results.
UR_C38 - Environmental performance score	Card showing the environmental performance score of an AOI, with all relevant data and statistics. Supporting export of the results.
UR_C39 - Area query	Users will be able to draw a polygon on the map in order to define the AOI and visualize information about a specific AEI during a user-defined time-period.