LandSense

A Citizen Observatory and Innovation Marketplace for Land Use and Land Cover Monitoring

Deliverable 2.1

Assessment of user requirements, barriers and engagement strategies for LandSense Citizen Observatory

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Author(s)/Organisation(s):
André Mascarenhas – ECSA Steffen Fritz - IIASA Linda See - IIASA Inian Moorthy - IIASA
Contributor(s):
All project partners at User Requirements Workshop

Short Description:
This deliverable reports on the work conducted and findings so far regarding the user requirements, stakeholder engagement strategies and barriers in relation to the LandSense Citizen Observatory.
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1 Background

This deliverable focuses on documenting the activities undertaken within Task 2.1 of *WP2-INVOLVE: Stakeholder inclusion and citizen engagement*. The main objectives of this task were to identify: relevant stakeholders in each demonstration case across all proposed locations; their needs in relation to given issues that LandSense could help address, together with their user requirements regarding the LandSense Citizen Observatory; engagement strategies and barriers.

The following sections present the applied methodological approach and the main outcomes. Given the strong connection between this task and the forthcoming work on the implementation of the demonstration cases in WP4, the main results are organized and reported based on each demonstration case. The current themes and the respective demonstration areas within LandSense are:

(i) Monitoring Land Change in the Urban and Rural Landscape

- City of Heidelberg/Rhein-Neckar metropolitan region
- City of Vienna
- Mid-Pyrenees region (city of Toulouse and surrounding areas)

(ii) Monitoring Agricultural Land Use and Provision of Value-added Agricultural Services;

- Select agricultural regions in Serbia
- Select agricultural regions in Slovenia

(iii) Forest and Habitat Monitoring using Innovative Technologies

- Important Bird & Biodiversity Areas (IBAs) and Special Protection Areas (SPAs) in Spain
- Important Bird & Biodiversity Areas (IBAs) and Special Protection Areas (SPAs) in Flores Island, Indonesia

It should be noted that this is an evolving collaborative process of stakeholder mapping and engagement, therefore further developments on the results presented in this deliverable are expected throughout the project, namely within D2.2 and D2.3.

2 Methodological approach

To achieve the goals of Task 2.1, a methodological approach was designed combining several approaches: a) analysis of literature; b) existing guidelines and best practices for stakeholder engagement and identification of user requirements; c) Face-to-Face (F2F) meetings with key stakeholders; d) interviews with LandSense partners involved in demonstration cases, and e) a workshop on stakeholder engagement and user requirements. The strategy was not to conduct an exhaustive literature review on those topics, but rather to gather practical information from key sources to support actionable measures to achieve the goals in T2.1. Therefore guidelines, reference literature and publications from similar projects were primarily targeted as sources of information. These resources are partly supported by the collection of citizen science guidelines and publications, compiled by the European Citizen Science Association (ECSA)[1]. Additionally, the main conclusions from a workshop on "Defining principles of mobile Apps and platform development for best practice in citizen science: Interaction, Interoperability, Innovation", organized by ECSA, also provided relevant insights. The relevant information retrieved from the resources included key questions to ask and/or key issues to consider during the initial planning stages of a Citizen Science (CS) project, for example, related to:

[1] http://ecsa.citizen-science.net/blog/collection-citizen-science-guidelines-and-publications

- **Topic suitability**: who, apart from the research team, would be interested in the topic (Pettibone et al., 2016)?
- **Target audience**: what defines the target participants for the project (Tweddle et al., 2012)?
- **Forms of participation and participant roles**: how should people participate in the project; what roles do participants play (Pettibone et al., 2016)?
- **Motivation**: what's in it for the participant and are we asking too much? Here it is important to acknowledge that individual motivations, interests and concerns differ widely (Tweddle et al., 2012; Durham et al., 2014).

An important recommendation by Tweddle et al. (2012) that is relevant to LandSense is to share ideas with potential stakeholders at an early planning stage to gauge their response and identify local or social relevance. As these authors stress, this process is important, considering that the assumptions we often make concerning what will work with a given group of participants are usually based on our own personal experiences, which are unlikely to be representative. Since the kick-off meeting, key LandSense partners have been consulting with key stakeholders to discuss the potential issues or topics of interest for the LandSense Citizen Observatory. Stakeholders can be defined as actors who have an interest in the issue under consideration, who are affected by the issue, or who have (or could have) an active or passive influence on decision-making and implementation processes (Varvasovvszky and Brugha, 2000; see Figure 1 for an illustration).

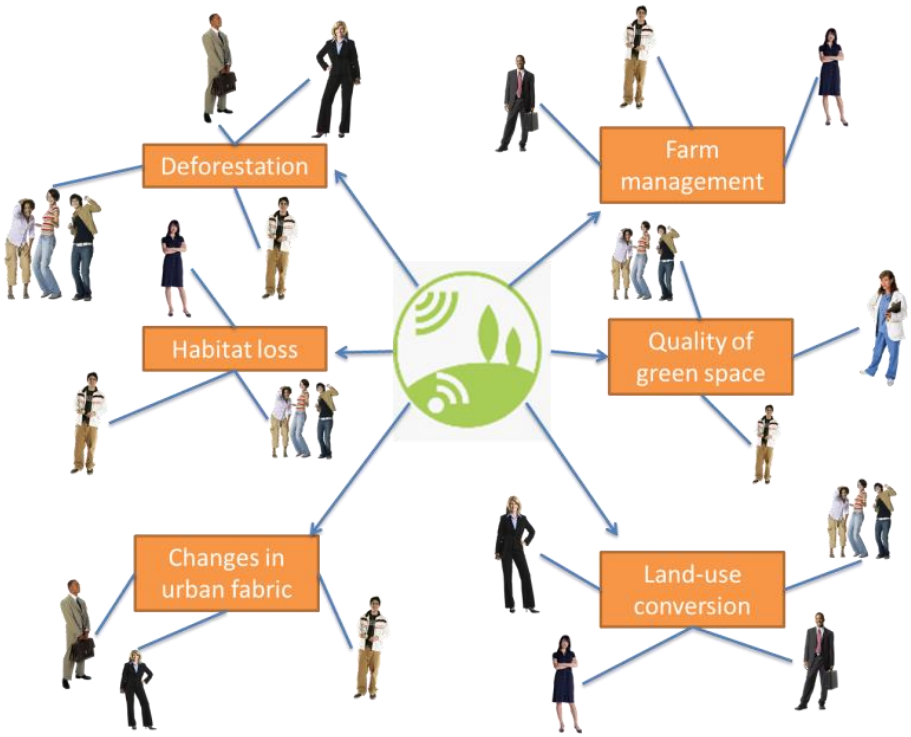

Figure 1: Each potential issue or topic of interest for the LandSense citizen observatory has its own constellation of actors (stakeholders). The issues presented, the typologies of stakeholders and the number of connections are merely illustrating examples.

At the LandSense kick-off meeting that took place at the International Institute for Applied Systems Analysis (IIASA) in Laxenburg, Austria on September 27-28, 2016, a breakout session facilitated by ECSA was dedicated to the "LandSense User Requirements & Demo Case Action Plans". In three groups, the project partners involved in each demonstration case started exchanging ideas about the outcomes of their initial contacts

with key stakeholders, potential issues of interest, initial mapping of actor constellations, engagement strategies and barriers (Figure 2).

Figure 2: Group on "Monitoring Land Change in the Urban and Rural Landscape", one of three groups of the breakout session on "LandSense User Requirements & Demo Case Action Plans" at the LandSense kick-off meeting.

To follow-up on the work with stakeholders being developed by LandSense partners in each demonstration case location, a series of interviews with these partners was conducted. These structured interviews were designed and led by ECSA between December 2016 and January 2017. The interviews mainly covered: a description of the topic(s) of interest and the role of stakeholders in topic definition; descriptions of the stakeholders already identified and their roles in the project's context; preliminary identification of user requirements, barriers of engagement and engagement strategies for the identified stakeholders; and description of planned engagement activities. The interviews served simultaneously as preparation for the LandSense stakeholder workshop described below.

A 2-day "LandSense Stakeholder Workshop on User Requirements and Engagement Strategies" was held at IIASA in Laxenburg, Austria on January 25-26, 2017 (see agenda and participants in Annex 1 and 2). Each day had specific goals and guiding questions, as well as different target audiences. The first day was designed to address public engagement from the perspective of involving potential or fictitious end-users of the LandSense tools. From this perspective, users are individuals who have specific knowledge about a context or the application of a product. Individual end-users are involved because of their practical, contextual or implicit knowledge and their potential expectations towards the improvement of a product or a situation (Hennen and Pfersdorf, 2014). Accordingly, the goals of this day were to showcase existing technology from LandSense partners, which can be used to monitor Land Use and Land Cover (LULC), and to gather feedback on how they (can) address user requirements, considering existing principles for citizen science and citizen science tools. Hence this day contributed to assessing current practices, user requirements and barriers of present LULC technologies. It also follows the recommendation by Tweddle et al. (2012) that CS projects should keep available technologies in mind and what the technological requirements of the projects are. The target audience was composed of LandSense partners, stakeholders from LandSense demonstration cases and members of the international CS community who participated in the ECSA General Assembly that immediately preceded the LandSense workshop. An introduction of LandSense to workshop participants (Figure 3), and a presentation on "Principles for Citizen Science & Development of Mobile apps/platforms"

(Figure 4) provided the overall mental framework for the interactive evaluation of the LandSense tools that would follow. It essentially covered the ten principles for citizen science developed by ECSA (2015), as well as findings from a workshop on "Defining principles of mobile Apps and platforms development for best practice in citizen science: Interaction, Interoperability, Innovation", jointly organized by Naturblick – a project of the Museum für Naturkunde Berlin – and ECSA on the 13th and 14th of December in Berlin, Germany (Naturblick and ECSA, 2016). This was followed by a marketplace event in which existing technologies associated with LandSense were showcased in five different stations (FotoQuest Go, LACO-Wiki, GEOPEDIA, AGROSENSE and BLI Apps for biodiversity monitoring). The workshop participants were split into smaller groups, which then rotated across all stations throughout the period of an afternoon.

Figure 3: Introduction to LandSense project by Steffen Fritz (IIASA).

Figure 4: Principles for citizen science & development of mobile apps/platforms by Soledad Luna (ECSA)

Feedback from participants was gathered in a structured way, by identifying strengths and weaknesses of the tools, as well as opportunities and threats for its use / development. After rotating across all stations, participants re-convened in plenary for a general discussion on the same topics, while addressing the general question "what developments/improvements in LandSense tools are needed for relevant stakeholders and potential users, considering existing principles for citizen science and citizen science tools?" The findings (to be presented in D2.2) from this analysis helped to steer discussions for the second day of the workshop.

The overarching guiding questions for discussion during the second day of the workshop included:

- What are the relevant issues/topics that LandSense can help address in each demo case location?
- Who are the stakeholders/actors related to each of those issues?
- What roles do the different stakeholders play?
- What are their needs/requirements regarding the issues identified?
- How can LandSense support those needs?
- What engagement strategies are needed?
- What engagement barriers need to be overcome?

The participants for the second day included LandSense partners and relevant stakeholders for demonstration case implementation. During this day, the idea of a 'user' followed some common themes, where users have knowledge that can be essential in inventing solutions for already identified problems, or that users can point to existing but generally unknown problems and suggest related solutions (Asaro, 2000; Hennen and Pfersdorf, 2014). In LandSense, this is reflected by the fact that key stakeholders are involved in the identification of the issues or topics of interest (the 'problems' in Asaro's (2000) sense) that LandSense

tools can help to tackle. The relevance of identifying the issues or topics of interest for each LandSense demonstration case is location-specific, which is central to citizen science for defining and solving problems at the local and community levels. The "power of place", defined as the influence of emotional, cultural and material connections to the places where people live, motivates action. Focusing on place enhances the experience for participants in citizen science, and their contributions ultimately have more of an effect on decisions (Newman et al., 2016; NACEPT, 2016). There is evidence that the co-identification of place-specific issues and needs is an effective strategy for many well-established CS projects (Newman et al., 2016).

Prior to the LandSense user requirements workshop, the partners involved in the different demo cases approached stakeholders in different ways and hence are in different stages of maturity. Thus their approaches to the user requirements have varied and are reflected in different emphases and presentation (Section 3). At the workshop participants interacted mainly in three breakout groups corresponding to each LandSense demonstration case, convening in plenary in the middle and end of the day to report back and discuss on group findings. Similarly to the first day, the outputs of the discussions were gathered in a structured way using a common template. The template included tables to support stakeholder analysis, covering the following fields for each stakeholder identified:

Current status	• What role(s) does the stakeholder play regarding the issue(s)/topic(s) of interest? • What are stakeholders' needs in relation to the issue(s)? • How are these needs currently addressed (if at all)?
LandSense value-added	• How can LandSense help address stakeholders' needs better than in the current situation? • What role can the stakeholder play in LandSense? • What are the users' motivations for participating? And what campaigns and tasks can be created that appeal to different motivations?

Among other items, the template also prompted participants to fill-in stakeholder interest-influence matrices, develop user scenarios and consider key stages in their engagement strategies. Interest-influence matrices are commonly used as a stakeholder mapping tool and they can support the development of engagement strategies that are tailored to different stakeholder groups (Reed, 2016). In the LandSense context, they were designed for each issue or topic of interest, to map stakeholders in terms of their level of influence (or power) on the issue and in terms of their level of interest in LandSense. User scenarios are an explicit and consistent picture of how each stakeholder community would utilize new infrastructure and software tools. It is useful to have a "picture" of the "typical" LandSense user in each stakeholder group including individual behaviours, attitudes and skills. These representations, or personas, can help developers visualize how different stakeholders would use the system and can provide a tool for strategic thinking regarding serving user communities (Michener et al., 2012). Regarding key stages to consider in engagement strategies, the three sections of a participant's journey identified by West and Pateman (2016) were taken into account: Awareness, Initial Participation, Sustained Participation.

In combination, the two days of the workshop have addressed what Nedopil et al. (2013) call the understanding phase in their guidelines for user integration (developed in the context of ambient assistant living, but applicable in the LandSense context). In that phase, project developers or designers need to learn about the needs of the end-user groups and to what extent these go beyond the state-of-the-art of technology. The key initial findings from the interviews, workshop and discussions are outlined below and will directly influence the project activities for subsequent tasks, activities and deliverables in WP2.

3 Main findings

3.1 Demo Case 1 – Monitoring land change in the urban and rural landscape

3.1.1 City of Heidelberg / Rhein-Neckar metropolitan region

A. Description of the issue(s) of interest

Discussions were held with stakeholders regarding different types of citizen observatory applications of volunteered geographic information (VGI) that would be interest to them, which represents a very broad set of ideas. Among others, improvements in the thematic and temporal detail of official land use data in Germany and a citizen platform for urban planning processes were identified as the most relevant user cases for the area of Heidelberg. These discussions are summarized here and will form the basis of where the main focus will eventually be placed.

Stakeholder VGI usage ideas

The area of Heidelberg is represented by three main stakeholders: the Metropolitan region of Rhein-Neckar (MRN); the Rhein-Neckar county (KRN) and the city of Heidelberg (CHEI), which includes the subgroups Vermessungsamt (Survey Department) and Konversion Heidelberg (land conversion planning). Key persons were consulted for their citizen observatory ideas during bilateral talks, a workshop and an excursion. Three themes were identified:

- **Improve land information**: dealing with update cycles of existing OpenStreetMap (OSM) data and their potential extension and fusion with other products;
- **Active land monitoring**: the surveillance of phenomena of concern; and
- **Citizen engagement:** applications essentially driven by citizens.

The format of the user applications was separated into products, services and add-on services. Products serve a specific aim that feeds directly into management and decision making, where participants are indirectly connected to the added value of these products. Services directly involve participants and are subject to direct feedback from them. Add-ons extend existing services or products by functionality aimed at improving them or their data streams. These domains and services are summarized in **Error! Reference source not found.** but eventually will lead to one or two areas of engagement.

Stakeholder VGI usage ideas: Improve land information

Current VGI information is often incomplete in both spatial and temporal detail but excels in thematic detail (Capineri et al., 2016). The ideas listed here aim at closing existing gaps in both detail and quality. For example, by increasing the quality of VGI, there may be considerable uptake of VGI in the future. The different products, services and add-ons in Annex 3 are described in more detail below.

Open Street Map (OSM) Land Use (LU) – product

A temporally and thematically accurate land use product found the highest consensus of usability among stakeholders. The German land use product (ATKIS) and the land property product (ALK) currently lack thematic detail. The OSM LU Beta http://osmlanduse.org/ application, where classes are based on tags (Estima and Painho, 2013), addresses this but does not yet satisfy requirements stated by the stakeholders. Currently the product is incomplete, contains topological errors and there is no estimate of temporal or thematic accuracy provided. To deal with these issues, topological and other types of inconsistencies in OSM data are addressed by extrapolating known OSM LU information to areas where no current classes exist using machine learning and wall-to-wall background data such as remote sensing time series (TS), very high remote sensing (VHR) data and OSM tags (Gislaison et al., 2006; Breiman, 2001; Figure 5). Estimates of accuracy will

be calculated using known standard techniques for land use accuracy assessment (Olofsson et al., 2014) and compared to other existing products such as CORINE. If satisfactory accuracies can be achieved through this proposed LU product, it can then be fused with ATKIS and ALK. Figure 66 depicts a generic concept in which OSM data and remote sensing time series are combined, verified and validated, and eventually connected to official data.

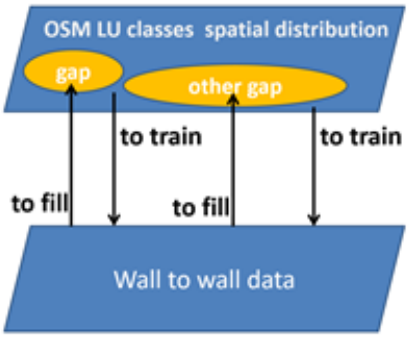

Figure 5 – Concept to establish spatial exhaustive OSM LU product, machine learning is used to describe a model for gap filling.

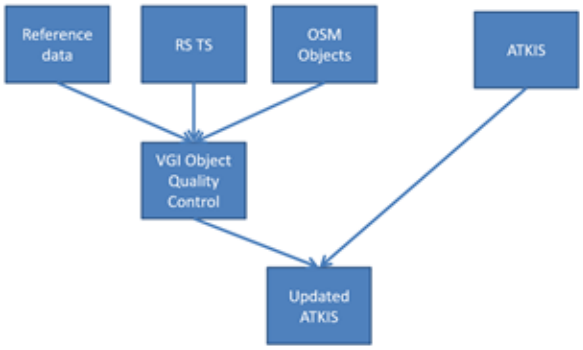

Figure 6 – Products concept of combining OSM, remote sensing (RS) time series (TS) and official German land use product (ATKIS).

OSM roaming updater – Add-on

OSM content can be kept up to date by questioning users at targeted locations. Users with OSM services installed and activated could be asked if a specific feature in their proximity still exists or has changed, e.g. is this place you are at a restaurant? If two or more users agree, then the tag for this location will be validated.

OSM cyclic update – Add-on

Trustworthiness of OSM data is questioned if sensitive information is out of date since such information must be updated frequently. For instance, one-way roads or locations of high public interest must be re-validated in cycles. The OSM cyclical update can be gamified in mapping-missions to increase the attractiveness of these mapping tasks among users and may be offered to anyone who starts a new OSM editing session. Hot-spot driven mapping efforts (http://hotosm.org) exist that have been gamified (e.g. http://mapswipe.org) and could be adopted.

Stakeholder VGI usage ideas: Monitoring features of the landscape

Stakeholders at the city and county level expressed interest in monitoring features of emerging interest for management, evaluation and decision making. Such phenomena are currently blind spots due to the lack of reliable systematic monitoring but are characterized by their profound impact on society and the environment. The monitoring systems proposed here are facilitated by RS TS fused with OSM/ATKIS layers (Figure). RS TS signals for the features of interest can be extracted from Landsat and Sentinel RS TS by band rationing or spectral mixture analysis (SMA).

Urban concentration monitoring – product

Due to intensified usage and increasing population numbers, urban concentration has occurred in Heidelberg, which was outlined by stakeholders based on their experiences of current urban development. Knowledge of the spatially explicit evolution of impervious areas can support decision makers in gaining a better understanding of this phenomenon.

Corn monitoring – product

The demand for corn has increased compared to other crops due to economic stimuli. Governmental institutions have raised concerns about this pattern due to the increased land degradation connected with this crop, which affects the hydrology and soil of the area. A cost benefit analysis of corn production and environmental degradation is required for decision making. However, there is currently no Corn monitor or other statistics reported. A combination of RS TS calibrated by in-situ measurements gathered through mobile devices (i.e. GPS, geo-tagged photographs, textual tags) could help to establish a better understanding of the spatial-temporal distribution of this crop.

Forest monitoring – product
Monitoring in the forest domain similar to that described above for urban concentration and forests could benefit decision making on forest management.

Stakeholder VGI usage ideas: Citizen engagement
Within this domain, citizens drive the content and direction of the application directly, while the previous domains have more indirect benefits for citizen.

Conversion platform
In 2013, about 180 ha of five partially developed areas were made available for the city of Heidelberg. The value, purpose and future usage of such areas is currently being determined. Historically, the areas were used for military accommodation and logistics. From the most prominent to the least, the Mark Twain Village and the Campbell Barracks (MTV) were acquired by the City of Heidelberg on 01.01.2016, the Patrick Henry Village (PHV) is currently being negotiated while the Patton Barracks (PB), Hospital and the Airfield (AF) have experienced little to no planning as yet.

Planning for MTV is almost completed and the interaction of citizens and decision makers has been facilitated through regular face-to-face meetings while online platforms have not been used for promoting any spatial dialog. The planning process has been characterized by a strong interconnections between architects, citizens, law makers and decision makers.

The current planning focus on the future usage of PHV is undecided and potential visions have been formulated and hosted by the international building exhibition (IBA). A platform accommodating spatial planning ideas by citizens for the Patrick-Henry-Village (PHV) is potentially envisaged. Such an effort can be shared with other stakeholders, enabling map-based discussion on potential land uses supporting both citizen and stakeholder visions. Currently this process is performed in quarter yearly discussion forums conducted by the IBA and limited to thematic content as spatial planning is currently within the domain of architects only.
Paper-based and web-based map and map-editing solutions provide capacity for inclusive citizen participation regardless of technical skills while ensuring that protocols and formats for data collection are followed (Klonner et al., 2016). The major disadvantage of a web-based solution is exclusion of social groups while paper-based solutions suffer from increased costs when transferring the mapping results to a computer. Since QR codes can be employed for paper-based solutions, such paper-to-computer harmonization costs can be reduced to a minimum; hence combined usage is favourable. Figure 77 outlines such a spatial planning platform. Geo papers with QR codes can be handed to participants, edited by them, collected and merged with entries directly entered in the system. The results can be discussed during quarterly meetings.

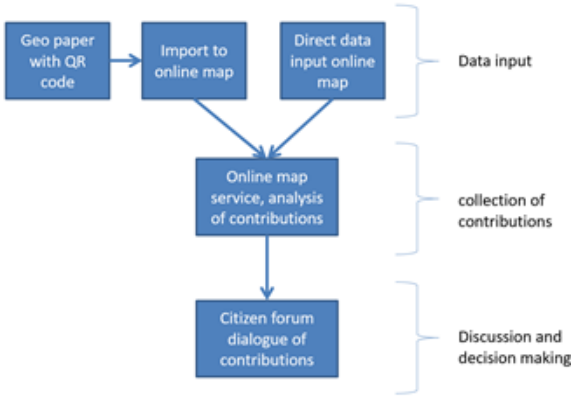

Figure 7 – Components of conversion platform.

Nature conservation and OSM tourist planner

The improvement of tourist features and targeted environmental protection using smartphones to consume, collect and share data and RS TS is proposed here. Similar apps to 'My Seasons', 'Meine Umwelt App' or 'Earth observation monitor' could be developed. Stakeholders have raised concerns regarding the misuse of such apps as similar efforts such as the 'Heidelberg App' have been frequently misused by users. Applications run by governmental institutions cannot reject any user's comment/contributions and must respond, even if the contribution is of little value or creates additional work.

At the LandSense requirements workshop, attempts were made to map out the needs of the main stakeholders with respect to LandSense, which are summarized in Table 1.

Table 1 – Stakeholder analysis: City of Heidelberg and surrounding areas

Stakeholder	Role	Needs	How are needs addressed	How can LandSense help	Role in LandSense	Motivations for participating
City of Heidelberg	Spatial planning/ Surveying	Improved thematic detail of land use Impervious surface monitor Corn monitoring Cyclical updating of OSM features	Provide land use via osmlanduse.org - facilitates OSM for land use applications Provide land change indicators - decomposition of surface signals by analysis of remote sensing time series	Geoportal, sentinel science hub and USGS host abundance of remote sensing data providing rich data source OSM data provides increasing amount of data on land with a high amount of thematic detail Possibly use FotoQuest for collecting the data	Definition of user requirements and data provision	Students for accuracy assessment within mapathon Administrative bodies are provided with additional sources of information for decision making

Stakeholder	Role	Needs	How are needs addressed	How can LandSense help	Role in LandSense	Motivations for participating
Management of military conversion areas	Management of citizen participation urban planning	VGI based web platform to mimic e-participation Spatial planning and collaborative contribution of citizens for urban planning	Multi-stakeholder (planners, decision makers and citizen) communication tool for collaborative future spatial planning of urban area augmenting existing quarterly annual citizen forums	Currently limited capacities VU has experiences in similar activities Establishment of web platform and spatial communication tool	Citizen to decision maker dialog Data provision and planning	Collaborative planning of future living conditions shifting responsibility towards citizens
Rhein-Neckar-Kreis (rural areas surrounding Heidelberg)	Spatial planning/ Surveying – rural area decision making	Improved thematic detail of land use Monitoring of land change (forests)	Similar as for the city of Heidelberg above	Geoportal, sentinel science hub and USGS host an abundance of remote sensing data, providing a rich data source OSM data provides ever growing data about land with high thematic detail	Data provision	Support of rural land management practices

C. User scenarios

To be defined.

D. Engagement strategies

Table 1 – Engagement strategies for the topic of feeding LandSense OSMLandUse data and linked to soil sealing and detecting hotspots of change.

Stakeholder	Stage 1: Awareness	Stage 2: Initial participation	Stage 3: Sustained participation
CHEI	Bi-lateral meetings (already started)	Demonstration of product value	Temporal consistency of OSMLandUse data
General public	Media Social media	Incorporating links to an app Update of tags to improve maps	Temporal consistency of OSMLandUse data
OSM community	OSM forum	Via HOT - humanitarian OSM (e.g. through link) Mapathon Update of tags to improve maps	Temporal consistency of OSMLandUse data
Students	GIScience blog Social media	Mapathon (validation exercise) Map update Identification of weak spots Update of tags to improve maps	Temporal consistency of OSMLandUse data Mapathon

3.1.2 City of Vienna

A. Description of the issue(s) of interest

Upon consultation with local stakeholders, we defined three potential applications for LandSense tools and services. Two of the applications involve spatial planning and one involves green corridors, and each application is linked to a different municipal department within the city of Vienna:

(i) Municipal Department *MA18: Urban Development and Planning* has a vision and a plan for green infrastructure (STEP 2025)[2] and a typology of green urban open space. They need to monitor the implementation of the green infrastructure and the quality of that green space in the city. They have defined linear transects of green corridors but require *in-situ* data for proper planning and development.

(ii) Municipal Department *MA21: District Planning and Land Use* have an urgent need to know exactly when building and urban infrastructure begins on empty land parcels. This information could be provided by citizens.

[2] https://www.wien.gv.at/stadtentwicklung/studien/pdf/b008394b.pdf

(iii) Municipal Department *MA41: City Survey* wants to know how the city develops in the third dimension (building height). They have a 3D map of buildings, but they only update it occasionally. The interest here would be to know which houses (blocks of houses) in the Mehrzweckkarte, are doing construction on the roofs.

B. Stakeholder analysis

Table 3 provides an overview of the initial stakeholder analysis for the City of Vienna demonstration case.

Table 2 – Stakeholder analysis: City of Vienna

Stakeholder	Role	Needs	How are needs addressed	How can LandSense help	Role in LandSense	Motivations for participating
Municipal Department (MA18)	Urban Development and Planning Responsible for green infrastructure in the city of Vienna	Open data as mission In-situ photos and data of linear green infrastructure in the city of Vienna	Currently authority officials go outside to take pictures but this is done ad-hoc, often not geo-referenced and not directly linked with GIS delineated features	Mobile app for citizens to take photos of green corridors Link with remote sensing for mapping and district planning efforts Obtain feedback from citizens about perceptions of green space Issues reporting (i.e. downed trees) from citizens	Definition of user requirements Data provision	LandSense would be directly addressing their needs and offering a sustainable and scalable solution

Stakeholder	Role	Needs	How are needs addressed	How can LandSense help	Role in LandSense	Motivations for participating
Municipal Department (MA21)	District Planning and Land Use	Open data as mission Need to know when exactly building construction begins on empty city parcels	Currently the information is not available in a timely manner Communication is via e-mail and inefficient	City to provide map of empty parcels for ingestion into Landsense mobile app Mobilize volunteers to report construction in a timely manner Gather citizen feedback about construction zones Hotspot alert maps and time series analysis for district planning	Definition of user requirements	People want to be involved in spatial planning decisions and they can get some information back about what will be built in that location. They can also be asked to give feedback on how happy they are with the new development they are documenting
Municipal Department (MA41)	City Surveying	Open data as mission Need to know what are the activities taking place in renovations and alterations to roofs	Significant data gap as to when and where roof construction is taking place	Citizens report activity in terms of roof renovations and alterations 3D mapping and time series analysis	Data provision	Citizens are interested in what is going on in their neighbourhood

C. User scenarios

To be defined and delivered in D2.2.

D. Engagement strategies

Some initial discussions were helpful in outlining potential types of engagement strategies for different types of stakeholders, organized by the three stages of participation.

Table 3 – Engagement strategies: City of Vienna

Stakeholder	Stage 1: Awareness	Stage 2: Initial participation	Stage 3: Sustained participation
MA18, MA21 and MA41	Bi-lateral meetings (already started)	Provision of data and selecting data from OGD portal Mobility agency[3] for scaling up participation	Demonstration of success in combining their aims with our aims
General public	Use of established communication channels of the city Social media (also from UBA)	Mobility agency[4] for scaling up participation Activation of wider networks via other Austrian organizations (GLOBAL 2000)	tbd
UBA	Existing networks with other associations Students from BOKU[5] Students from TUWien[6] Climate alliance Austria[7] European Land and Soil Association	Existing communication channels (e-mail links to apps and platforms) Social media Students (support from teachers who want to introduce this in their curricula of regional planning and landscape architecture)	tbd

[3] http://www.mobilitaetsagentur.at/
[4] http://www.mobilitaetsagentur.at/
[5] https://www.boku.ac.at/en/
[6] https://www.tuwien.ac.at/en/
[7] http://www.klimabuendnis.at/english

3.1.3 Mid-Pyrenees region (city of Toulouse and surrounding areas)

A. Description of the issue(s) of interest

The role of IGN France (Institut National de l'Information Géographique et Forestière), among others, is to produce and maintain spatial data at country level. At the same time spatial data produced by IGN needs to satisfy as much as possible the needs of different stakeholders who make decisions at local, regional, departmental or country level. Thus, two types of needs are identified: a) IGN needs (to improve and update its spatial data products) and b) stakeholders needs (to compute LULC indicators allowing for LULC monitoring that is in compliance with European and national directives).
In this context three use cases are identified:

- Improve IGN spatial data by identifying positional and thematic errors, adding new attributes (e.g. number of floors for a building) or classes of objects (section A.1);
- Improve actuality of spatial data products by reducing time between two consecutive releases of the same product (section A.1);
- Assist/help IGN spatial data users and partners to produce derived spatial data that fit perfectly to each data end user needs (section A.2).

In the Midi-Pyrenées demo case, IGN will focus on two types of spatial data: Building Theme from BDUni database and LULC database (OCS-GE).

A.1 Improve and update authoritative LULC database and topographic building themes (produced by IGN)

LULC database (OCS-GE ©IGN)

LULC database (OCS-GE © IGN	
Description	• is produced at regional level; at this stage only on Midi-Pyrenées region • is produced by using different IGN products and photo-interpretation • is cyclical updated every 3-6 years, which means that it is outdated (e.g the actual version of LULC is dated 2013) • contains both land use and land cover classes: 17 land use classes and 14 land cover classes. The combination of 17*14 is not always possible.
Needs that can be addressed by LandSense	• distinction between residential land-use, industrial land-use and administrative land-use, which are all included in the same class in the current database • modification of cover classes (geometry) and usage classes (attribute). Some land use classes such as quarries in operation/inactive quarries or agricultural building/non-agricultural building are hard to determinate using photo-interpretation. Hence asking contributors to focus on these land use classes is important • Update 'in transition' land use classes. Some areas under construction (e.g. construction of a new industrial area) were initially mapped as 'in transition'. Hence, we can ask contributors to validate if the construction is finished and to fill in the date of the end of construction, if known; • Considering that the LULC database is outdated, it is critical to differentiate between updates (modification is due to a change of use between 2 LULC database releases) and improvements (modification is due to an error in the previous database).

Building Theme (BDTopo © IGN)	
Description	• is produced at the country level and has less than 1m precision • continuous updates • the buildings will be used during the Landsense campaign because some classes of the LULC database are generated by taking into account data at feature scales such as buildings •
Needs that can be addressed by LandSense	• volunteers to fill in the nature and the function of the building; • volunteers to modify a feature if needed: i.e. geometry and attributes.

A.2 Better fit to stakeholders needs by helping them to produce derived LULC data by using IGN products such as a reference

Some of IGN's partners are also interested in having "on demand" data (it could be additional data such as data with another classification). Their specific demands and needs will need to be considered on a case by case basis. NB: At this stage, IGN needs to focus the pilot down and choose some needs from the list of expressed needs.

B. Stakeholder analysis

For the French campaign, five types of stakeholders were identified (see below) and three roles: data producer, citizen and data end user. Some users can be also data producers but they are using IGN data as a reference and they derive their own data afterwards. In Figure 88, ellipses correspond to needs expressed by stakeholders with respect to LULC data and building data. Green ellipses correspond to needs to which LandSense can contribute.

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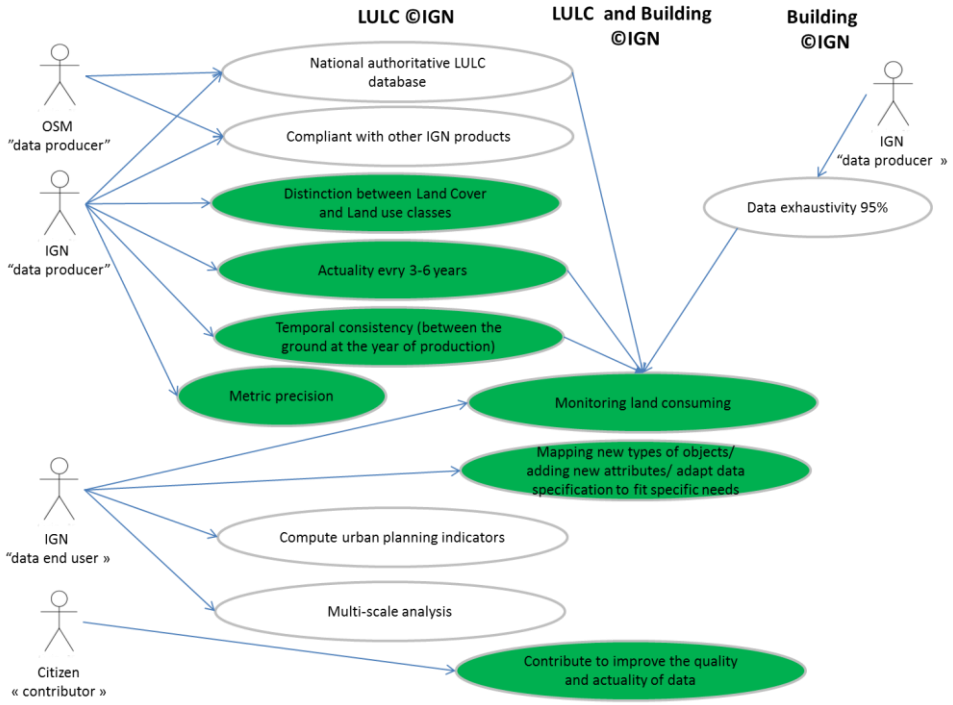

Figure 8 – Schematic of stakeholders in French demonstration case location.

B.1. Identification of stakeholders

- IGN is a stakeholder/final user of LandSense products themselves
- CEREMA[8] is the national study center for risk, environment, mobility and planning
- Local authorities and public bodies (e.g. firefighting services), city administrations, regional governance authorities (e.g. environmental governance), chambers of agriculture
- OSM community as their interest lies in the improvement of the OSM LULC data
- Citizen are stakeholders as part of the OSM community

B.2. What role(s) do stakeholders play regarding the issue(s) of interest?

- IGN has a goal to produce and provide topographical and LULC data for public authorities and citizens. IGN leads existing production and validation processes for geographical databases.
- CEREMA is a stakeholder as they need data for achieving their studies
- The local authorities use the IGN databases for specific tasks such as district planning, and legislature for development, agriculture, and the environment.
- Part of the local authorities (e.g. firefighting services) contribute to databases as a result of reports made while in the field

B.3. What are their needs relative to the issue(s) of interest?

There is a need for increasing the accuracy of the data around building use (housing, services, and commercial areas). Information may be used for local development planning and for assessing land use changes over time. The number of floors is required for urban planning as it is often used for deciding on planning permission of buildings related to vertical extensions and for limiting urban sprawl. Information about the

[8] http://www.cerema.fr/

accessibility of public buildings for disabled people is needed for identifying where adaptations are to be made.

Regarding the LULC dataset, a specific need is to be able to distinguish residential land use from industrial land use and from land use dedicated to the tertiary sector. This aspect is linked to the difficulty in distinguishing buildings (and small land plots) that are for residential use and the ones that are for agricultural use. The need for local authorities is to have LULC databases corresponding to one and in the future several specific years in order to be able to calculate LULC changes. One city wants maps from 2005 until now, to be able to assess the temporal LULC changes. If IGN produces the map with older aerial photography, then local knowledge on the ground could also be integrated - an interesting topic for LandSense. For the people (citizens or public bodies) holding local knowledge, it is important for them to be able to contribute this to LULC databases.

B.4. How are those needs currently addressed?

Currently information about buildings is collected from aerial photography and field work. Building use and height are investigated by linking sources of information from IGN databases and from written forms held by the tax authority. How can we *validate the data that authorities have, e.g. taxes might be a sensitive topic.* We will focus on asking citizens to document building use and the number of floors for urban planning.

Currently LULC information is collected and merged from existing data. Thus, some land uses (residential, industrial, services) are gathered in the same class. Map validation is made from ground-based sampling of targeted sites and comparing it with remote sensing methods. The accuracy assessment follows official guidelines for LULC databases.

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B.5. How can LandSense help them address those needs?

IGN data will work on the adaptation of OSM tools that will be integrated into the platform by the OSM WG3 team. The tool will be cross platform (mobile application, desktop) and should allow reports to be made with comments, mapping by using aerial images and import in GPX format. A discussion took place on if and how existing LandSense related technology, such as the FotoQuest-GO mobile application can contribute to this. It would be interesting to possibly use the Fotoquest-GO mobile app to send volunteers to specific locations. Fotoquest-GO could also be adapted so that only one picture of the target needs to be taken. The importance of creating win-win situations between projects/platforms (e.g. between OSM and the wiki foundation where they “give” something to each other) was highlighted.

B.6. What role can they play in LandSense?

All stakeholders will participate in the field campaign, covering different aspects: providing data, developing the mobile app, communicating within the field campaign, leading the campaign, etc.

B.7. What can be their motivations for participating?

- For LULC, contributing local knowledge to databases
- Access to updated or more accurate databases
- Gamification to add an element of competition

Table 5 summarizes the stakeholder analysis undertaken during the LandSense User Requirements workshop while Figure 9 places these stakeholders in an influence-interest matrix. From the figure, it is clear that authorities at the city and regional level have both high influence and high interest so should be the stakeholders where engagement is a top priority. At the same time, IGN also has a strong interest and reasonable influence so having them drive this demo case is a very positive element.

Table 4 – Stakeholder analysis: Mid-Pyrenees region, France.

Stakeholder	Role	Needs	How are needs addressed	How can LandSense help	Role in LandSense	Motivations for participating
IGN	Responsible for LULC databases	Update their spatial database and integrating citizen science based data into the workflow	Aerial photography and field work	Existing LandSense services to create a trigger for the field campaign (e.g. Change detection service)	Field Campaign	Increase accuracy in mapping products Engagement with citizens
CEREMA	Risk, environment, mobility and planning and is a stakeholder Responsible for studies based on LULC databases	Updated and improved databases	-	Provide citizen feedback and create participatory monitoring methods	Communication about the field campaign	-
Local authorities – including public bodies (firefighting services), city administrations, regional governances (e.g. environmental governance), Chambers of agriculture	Responsible for information to citizens and for local law enforcement	Know the features of the buildings (number of floors) for urban planning Distinguish land use between residential, agricultural, industrial, services sector	-	Provide citizen feedback and create participatory monitoring methods	Communication about the field campaign	-

Stakeholder	Role	Needs	How are needs addressed	How can LandSense help	Role in LandSense	Motivations for participating
OSM community	Supporting LandSense and partnering with IGN	Increasing accuracy in LULC theme	-	-	Bridge to the OSM community Assistance in volunteer recruitment	Sharing local knowledge
Students	-	Educational needs	-	-	Involving them in campaigns	Sharing local knowledge

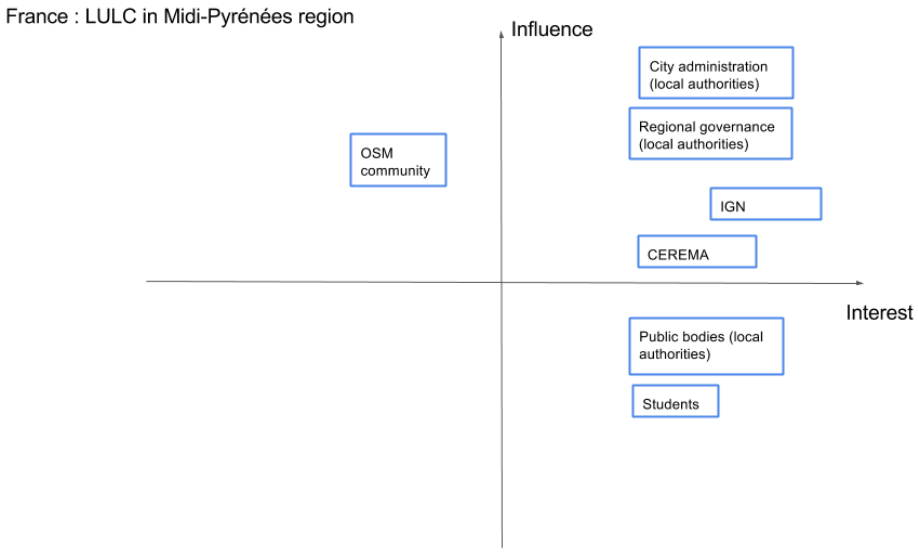

Figure 9 – Interest-Influence matrix: Mid-Pyrenees region, France.

C. User scenarios

The scenario is summarized in Figure 50. Two types of campaigns are identified:

- a passive campaign where contributors can contribute for improving or updating data, and
- an active campaign generated by the LandSense Change Detection Service and QA control where needed and consists mainly of *in-situ* validation.

As mentioned earlier, two types of data will be used during the campaign: Building Theme (noted Building Theme © IGN) and LULC (noted LULC © IGN year 1) datasets. Year 1 represents the year where the LULC database is released. The datasets will be available from the LandSense platform in an OSM data format.

First, for the Building Theme only, the QA Control service can be used as a trigger for an active campaign due to the resolution of Sentinel data and because building function information will be asked during the campaign. As we mentioned earlier, this theme will be updated continuously, which implies that no specific distinction between improvement and verification needs to be made in the database. Thus, LandSense will help IGN in improving and making reports for updating their building themes. This theme is then used to update LULC data (a new release: year1+n) by re-computing land cover classes in urban and peri-urban areas and then assign the LU classes.

Second, for LULC data, both QA control and Change detection services can be used as triggers to activate a campaign. Knowing that LULC data are released every 3-6 years, it is very important to distinguish between contributions made to improve LULC data and to update LULC data because a change occurred in the field. Thus, Landsense can help to improve IGN data in a continuous way, to update LULC data and indirectly to reduce time between two consecutive data releases.

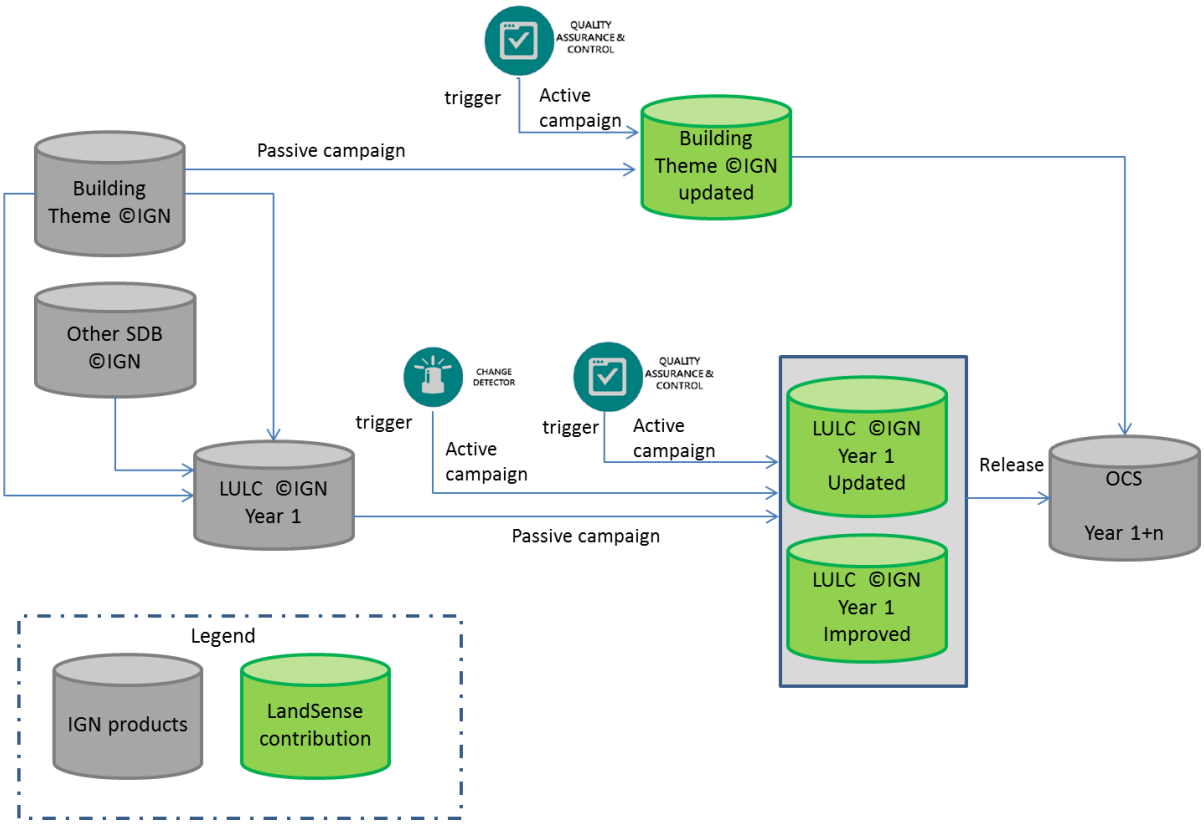

Figure 5 – General workflow for IGN demo case 1 in Midi-Pyrénées.

Through the passive and active campaigns, three types of contributions are considered:

- **Reports:** they are seen as triggers and consist of making an alert (a point geometry) for inconsistencies, errors or differences between mapped data and ground truth. To be efficient, this contributor has to be able to choose the location easily, to take photos and choose the types of report from a list of choices (positional error, attribute error, new features, etc.).
- **Mapping:** the second type of contribution is mapping (i.e. draw new features or modify existing features in the database. Both attributes and geometry can be modified. To do that, supplementary information can be used such as: his local knowledge, reports made by other contributors. He/She can accept or reject the reports made by other people.
- **Validation:** it concerns the validation of specific tasks triggered by LandSense Services or to ensure the data quality assessment from a statistical point of view (one of most important constraints for national mapping agencies in map production).

The stakeholders/contributors can have different roles during LandSense campaigns such as making reports, mapping, and validating/rejecting reports. They will be trained with respect with their role. The validation of data can be done by stakeholders/contributors considered as experts (e.g. firefighters, city hall employees, etc.). The validation is optional and depends on data: the validation of some attributes is mandatory while for others it will be optional.

All types of contributions (reports, mapping and validation) can be done “in situ” or “from desk” (especially to determinate if this modification is an update or an upgrade to the LULC database).

It is evident that contributors can change their role during the project. Additonal important considerations include:

- The registration on the LandSense engagement platform is mandatory and contributors need to sign agreements that are compliant with French legislation. IGN France will prepare the 'Terms and conditions'.
- Identifier federation: The LandSense engagement platform needs to consider OSM accounts within their single signon. This way an OSM contributor can contribute without registering for another account.

D. Engagement strategies

Table 5 – Engagement strategies: Mid-Pyrenees region, France.

Stakeholder	Stage 1: Awareness	Stage 2: Initial participation	Stage 3: Sustained participation
IGN	Done via e-mail	-	-
Local authorities	Already aware, existing communication channels, shared work	Shared work	-
General public	Email Social media Events	Through the events in the previous column Link to app in the social media and e-mails	Nurturing your users community - via continuous updates social media for example
OSM community	Forum of OSM community Special event from OSM OSM annual meeting OSM-related platforms with specific tasks (e.g. focused on a given area)	Forum of OSM community Special event from OSM OSM annual meeting OSM-related platforms with specific tasks (e.g. focused on a given area)	OSM community (nurturing your community - via continuous updates social media for example) OSM-related platforms with specific tasks (e.g. focused on a given area) - communities around OSM

3.2 Demo Case 2 – Monitoring Agricultural Land Use and Provision of Value-added Agricultural Services

A. Description of the issue(s) of interest

The LandSense services will be demonstrated in the monitoring of agricultural land use. Innovative tools will provide farmers with information on the vegetation health status from remotely sensed Earth Observation (EO) data as an incentive to share data on crops grown, crop phenological information (e.g. emergence and flowering), management information (e.g. dates of planting and harvest as well as nutrient use and application), occurrence of pests and diseases and impact of extreme weather. Its main objective will be to help establishing an open and collaborative framework needed to create the desired synergies between EO systems and crowdsourcing as the data sources i.e. "farmers as sensors". This two-way communication has considerable value for a variety of end users of the data and also for the farming community, which will have access to Copernicus products and the sharing of collective knowledge across the community. The European-wide crop yield forecasting of the JRC will be used as a test bed to investigate whether (guided) ground-based and crowdsourced information can be of added value in operational activities.

The agricultural demonstration case will integrate LandSense LULC results into complimentary existing commercial solutions for support in agriculture (ArgoSens[9], SentinelHub[10], Geopedia[11]) to leverage the power of EO systems and advanced crowdsourcing techniques to deliver value added services to European farmers and public authorities involved in the agricultural sector. However, farmers are specific in their use and uptake of new technology compared to actors from other economic sectors. For this reason, attention has been given to understanding the specific nature of the tech-IT nexus. An appreciation of the specific circumstances under which farmers adopt and use technology will be an integral part to the approach applied in the demonstration cases.

According to a 2014 report by IBM, "today, the sector of the economy with the lowest ITintensity is farming, where IT accounts for just 1 percent of all capital spending." The lack of IT uptake in agriculture can best be explained through the interplay between agriculture and risk, and farmers` interpretation of the IT-agriculture nexus. Risk is a well-researched aspect of agriculture (OECD, 2016; FAO, 2016; USDA, 2016). And, the consensus is that farmers overwhelmingly avoid risk. This risk aversion can be tied to the intrinsically risky nature of agriculture– with or without risky behaviour, farmers are always exposed to the risk of uncertain natural phenomenon, and this makes agriculture an intrinsically riskier means of securing a livelihood than other economic activities. Amongst the risk farmers are keen to avoid is *technological uncertainty* (Vani, 2015). Technological uncertainty is associated with the creation of innovative applications that make quasi-fixed past investments obsolete. For a farmer, the innovation processes that leads to IT innovations may be viewed as random and disconnected. IT innovations can be products of research and design carried out away from the farm. Farmers often feel that they are confined to this process and unable to influence it.

Demonstration cases, however, do have a proven track record. The advantages for learning associated with the interactive nature of demonstration cases is well understood and is considered an integral part of agricultural development (FAO, 2014a; FAO, 2014b;FAO, 2012). *Learning by doing* is an excellent way to promote the use of the AgroSense app, showing that they are well functioning, and presenting their benefits

[9] http://app.inosens.rs/AgrosensePortal/#/app-h/welcome
[10] http://www.sentinel-hub.com/
[11] http://www.geopedia.si/#T105_x499072_y112072_s9_b4

in a real-life setting. However, drawing on research on *risk* and *technological uncertainty* in agriculture, LandSense demonstration cases will not neglect the following characteristics of the agriculture-IT nexus:

- **LandSense will take into account the complex cost-benefit analysis of farmers**. This cost-benefit analysis also takes into account losses that can be incurred as a result of rendering past quasi-fixed investments obsolete. Keeping this in mind, the AgroSense and CleverFarm apps will demonstrate the full range of benefits farmers can expect from the apps. Farmers will understand that the apps offer far reaching benefits– a chance to spend less time working and more time the family, a chance to reduce the exposure of family labor to harmful pesticides, etc. Only such a far reaching explanation of the benefits of the AgroSense app can address the complexity of the farmer`s cost-benefit analysis.
- **LandSense will also be used as an opportunity to allow farmers to take part in the dissemination process of a technical innovation.** By providing farmers a chance, free-of-charge, to see firsthand the benefits of the AgroSense app, farmers will be brought in closer to the process of innovation and dissemination. The goal of the demonstration cases will be to empower farmers in their decision to adopt the apps in their everyday farming practices.

Furthermore, the LandSense project has built-in co-creation mechanisms. For example, co-creation workshops will ensure that feedback from end users is constantly fed into the LandSense management process. This will be further translated into the demonstration cases where through a greater understand and appreciation for the farmers` needs.

Target areas include: a) Autonomous Province of Vojvodina (Serbia) and b) select areas in Slovenia

Autonomous Province of Vojvodina (Serbia)

Vojvodina is an autonomous province of Serbia, located in the northern part of the country in the Pannonian Plain. Due to its geographical positioning, Vojvodina has highly convenient natural conditions for agricultural production (in terms of soil, climate and hydrology), and agriculture has always been a significant part of the local economy. Another specific advantage of the region is that 77 % of total land – 1.65 million ha – is cultivable agricultural land. Almost half of the employed population is active in agriculture which means there is a high development potential within agricultural production. The share of agribusiness in the total industrial production is 40%, or 30% of the total exports of Vojvodina. In the region there are 147.588 agricultural holdings, prevalently family farms – 146,290 and 1,298 holdings of legal entitles and unincorporated enterprises. The average acreage of the farm in Vojvodina is around 8.0 hectare with average economic size of the farm 12,032€. (Agricultural census 2012, Statistical Office of the Republic of Serbia).

LandSense partner INOSENS is active in and has close collaboration with PA4ALL, a Living Lab for Precision Agriculture based in Vojvodina, which has access to more than 3500 users from the entire farming value chain of the region, including farmers, vendors of equipment and agrochemicals and agronomists/ consultants. This community is already involved in a number of EC funded activities (e.g. the Future Internet accelerator FRACTALS) and will be the starting point to engage users in the Serbian pilot.

Select areas in Slovenia

The areas of interest within the context of this demonstration case are still under discussion. The regions will be specified within D2.2.

B. Stakeholder analysis

Table 6 – Stakeholder analysis: Demo Case 2 – Monitoring Agricultural Land Use and Provision of Value-added Agricultural Services.

Stakeholder	Role	Needs	How are needs addressed	How can LandSense help	Role in LandSense	Motivations for participating
Farmers Focus on younger farmers and perhaps more digital savvy farmers	In-situ photo acquisition Translating the maps into management decision	Getting pre-visual indicators of stress Selling it as eye in the sky Learning about neighbouring productivity	Showing NDVI map that is translated into usable information Showing anomaly map	Step wise progression from Agrosense basic to Agrosense+ Alert of next satellite pass with Sentinel (10 days and down to 5 days in the future) In-situ data	Integrating AgroSense mobile app with Sentinel Hub and Geopedia Overcoming digital barriers/divide Determining benchmarking information from farmers	Farmers are traditional and what is the farmers incentive to change? Need to show initial value and build trust sequentially How are motivations changing over time
Public bodies that engage in monitoring activities	Use of results to enforce regulations including CAP	More accurate maps to support enforcement / monitoring efforts, improve existing workflows	Validate crop maps and improve algorithms overtime	Better crop maps In-situ data for validation	End-user feedback to tailor solution to meet their needs and fit into existing work processes	Having a better geo-info solution to support their work
Agricultural Schools	Train young farmers to use AgroSense application results (e.g. NDVI maps) to translate into economic value on farm (higher yields, less inputs)	Updated archive of RS data	A new tool for agricultural support	Provide a tool and training support to use satellite-data based indices to support agricultural production	Point of entry to reach farmers that have high chance to adopt tech	Improve curriculum with modern tools

C. User scenarios

The AgroSense app combines satellite data, crop classification algorithms and a crowd sourcing app. The current solution focuses on a data fusion method that is successfully utilized in combination with state-of-the-art machine learning algorithms to improve the overall classification performance, as well as in enabling application of satellite imagery with a coarser spatial resolution in the given specific cropland classification task. An essential part in training of recognition systems is high quality reference data set. In order to collect as much data as possible, crowdsourcing is facilitated by an extensive specially designed user application, implemented on a smartphone platform. Users send geo-tagged images of crop in their field via the Android application AgroSense.apk, where each image contains the label designating the crop type selected by the user (Figure 61). Images are automatically synchronized with the server, where after verification and parcel plotting, corresponding pixels are added to a reference dataset. The ground-truth data collected are then consolidated and used for the extraction and labelling of multispectral measurements corresponding to individual pixels. In this way, the final labelled dataset used for training and testing of classifiers in different classification scenarios has been produced.

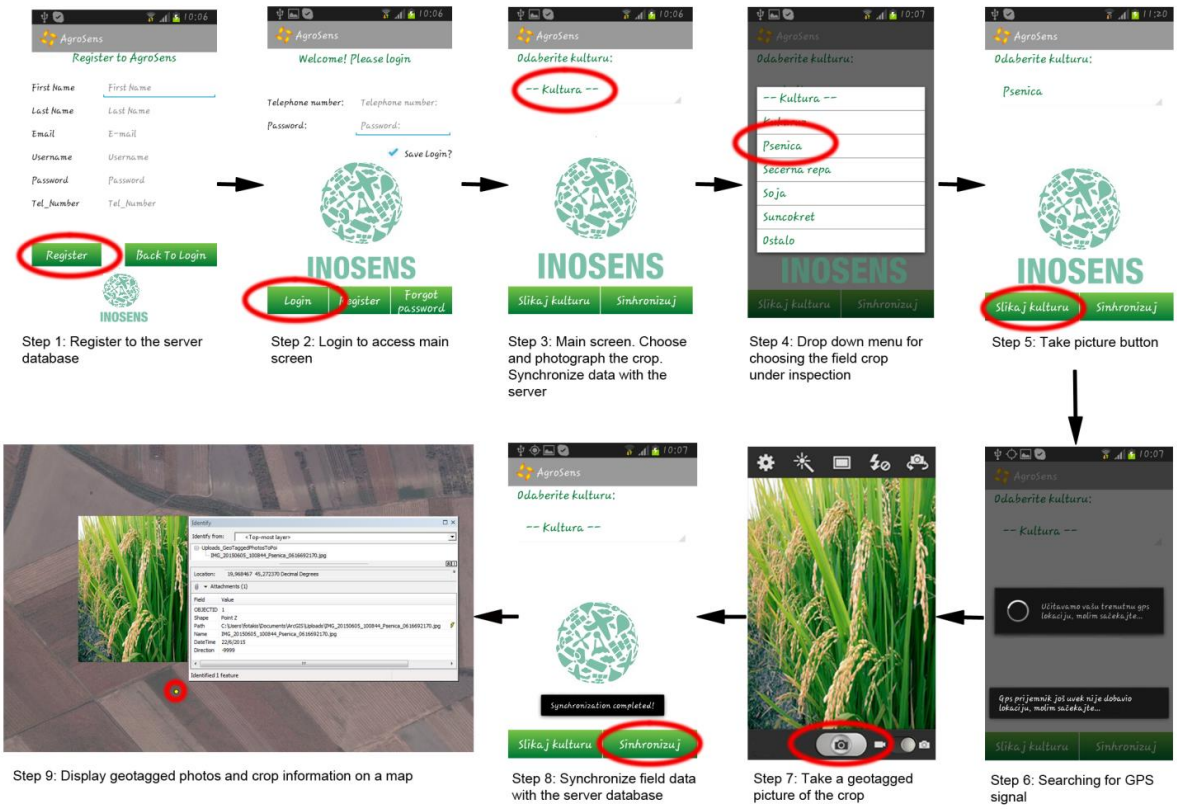

Figure 6 – Screenshots of the AgroSense application showing the user process.

Scenario #1

Djordje is a dairy farmer in the northern Serbian village of Susek. He has 20 heads of Holstein Friesian cattle, which are fed on a variety of pastures around the village. However, the Holstein Friesian breed can be sensitive to the quality of grazed lands. One day spent on a pasture that is of poorer quality lowers Djordje`s cow`s productivity, and for a small farmer like Djordje, this lowered productivity has far reaching consequences. Furthermore, Djordje has no way of knowing the quality of the pasture beforehand, given

that the pastures are closely located but spread around a rugged peak of the Fruska Gora mountain range. A similar situation applies for other dairy farmers in the village.
Djordje does not apply any tech in his farming, but he is tech savvy in his private life, owning a smartphone and PC. One night he reads an article about AgroSense on a local ag-news website. He finds out that there is a way for him and his fellow farmers to come together and solve the problem of not knowing which pasture to take their cattle to feed on. Farmers download the AgroSense app and snap geo-referenced shots of their pastures. They upload the pictures and in return receive a multitude of NDIV data (in an understandable manner) which allows them to understand the types of grass, their quality and quantity at each pasture. This allows the local dairy farmers to let their cattle graze at the best pastures, while allowing other pastures to regenerate.
This leads to an efficient cycle for using the pastures who`s functioning is constantly monitored. The local municipality learns about the effects AgroSense has had on effective pasture use in the area. Other farmers are encouraged to use AgroSense during regular municipal meetings. Very soon, almost all cattle farmers in Susek are using AgroSense to organize and coordinate grazing.

Scenario #2
Jelena leads a fruit farmers` co-op in Serbia along the border with Hungary. The small co-op grows peaches and apricots which are sold to local juice producers. Peaches and apricots are particularly susceptible to infections and pests. Although not every tree is always affected, every tree is treated with pesticides. Jelena and her partners find it more expensive to individually check each tree for infections and pests instead of simply treating all of the trees.
One night Jelena is contacted by a large juice producer who wishes to sign a contract with her. However, he has one condition: Jelena must lower the use of pesticides. One way of doing so would be to treat only trees that are affected by infections and pests, instead of all the trees. She tells the juice producer that she simply cannot afford to check each tree for infections and pests and act in a targeted manner to reduce the overall use of pesticides. The fruit producer informs her about AgroSense; he`s heard of it through subscribing to InoSens` newsletter ever since he took part in one of their agro-accelerator programs. Next week Jelena tells her colleague farmers to take pictures of their orchards and upload them through the AgroSense app. In return they receive easy to understand information (based on optical indicies) on which parts of their orchards may need pesticide treatment. This allows them to save on pesticide costs while fulfilling an important part of a very lucrative contract.

Scenario #3
Steva is a wine producer in the Serbian village of Banostor. The village has a long tradition of wine production and Steva works closely with other wine producers in the area. Recently, the government has started making more funds available for wine production. Government subsidies come in the form of direct payment per grapevine. This means that wine producers need to consider the optimal distance between each plant in regards to yield and grape quality, but also in regards to the subsidy– the closer the plants are to one another, the more grapevines per unit area of land, the higher the total received subsidy. Steva knows that there must be an optimal distance between grapes that takes into account production needs and the benefits of the subsidies.
Steva and his fellow wine producers look at historic yields of vineyards in the area, trying to find the optimal spacing between vines. However, they soon realize that yields do not tell the full picture. Plant health, resistance to pests, resilience, are not fully captured by yields, yet are vital to the quality of wine and long term business success of any wine producer. One of Steva`s fellow producers informs him about the AgroSense app. Steva learns that the AgroSense app can provide him NDVI related information about grapevines. So, Steva and his colleagues snap pictures of their vineyards, making sure that they capture as a high variety as possible in regards to spacing between plants. Once they receive the NDVI related data in

return for their pictures, the wine producers are comfortably able to conclude which spacing will work best for them, considering their production interests, and interests towards the government subsidies.

D. Engagement strategies

During the LandSense user requirements workshop, participants within the agricultural demonstration case discussed some inital ideas regarding engagment strategies. Additional details on the action plans that integrate some of these ideas will be delivered within D2.2. The inital ideas are listed below:

Stage 1: Awareness
• Exploit access to PA4ALL living lab (network of 3500 users within agricultural value chain) • Build connections with young farmers, technology savvy farmers • Interviews to identify early adopters within PA4ALL living lab • Leverage exploitation events and networks organized by INOSENS via other H2020 projects • Build list of all potential networks, associations, companies, etc. • Connect with GEOGLAM community • Critical to show economic and social value to the users from the beginning • Integrate farmers within the co-development process • Engage agricultural schools – highlight education value • Make a promotional video that highlights value that the solution will deliver • Need to tailor awareness campaigns based on location (i.e. Serbia or Slovenia)
Stage 2: Initial participation
• Methods to match user expectation with user capabilities • Capacity development evetns to help overcome digital barriers • Continual monitoring and evaluation of user motivations and values • Create champion users and communities • Overcoming limitations of optical satellite data (i.e. cloud cover)
Stage 3: Sustained participation
• Aligning app with changing motivations • Building a trust with users to make them superusers • Challenging users with different tasks, increasing interaction and engagement • Outreach to other interested sectors (i.e. insurance, etc.) • Timely and insightful feedback to the users

3.3 Demo Case 3 – Forest and Habitat Monitoring using Innovative Technologies

3.3.1 Monitoring of Threats in Spain and in Indonesia

A. Description of the issue(s) of interest

Land use change activity that threatens the forest, grassland and farmland areas in Indonesia (IBA in Flores Island) and Spain (select IBAs and SPAs).

An Important Bird and Biodiversity Area (IBA) is a site identified using an internationally agreed set of criteria as being globally important for the conservation of bird populations. BirdLife International developed the program and identifies the sites. Currently there are over 12,000 IBAs worldwide.

A special protection area (SPA) is a designation under the European Union Directive on the Conservation of Wild Birds. Under the Directive, Member States of the EU have a duty to safeguard the habitats of migratory birds and certain particularly threatened birds. Together with Special Areas of Conservation (SACs), the SPAs form a network of protected sites across the EU, called Natura 2000.

B. Stakeholder analysis

Table 8 – Stakeholder analysis: Spain.

Stakeholder	Role	Needs	How are needs addressed	How can LandSense help	Role in LandSense	Motivations for participating
Birdlife International	Facilitate communication with and engagement of volunteers; determine user requirements for Spain; annual reporting on IBAs including threats	Long term engagement of volunteers to contribute to BL's goals; recruitment of new volunteers; Information on threats needed for the WBDB; an alert system of where change is happening based on automated processing of remote sensing	Currently collect data on change but have not yet analyzed it; threats currently not being collected	Provide the linkage between the data collection and the WBDB, provide a hotspot alert system for change	Obtaining user requirements through SEO/BirdLife in Spain, input concepts and ideas to the app development (by IIASA), developing verification system for alerts, helping to develop link between LandSense and WBDB	Grow their community of volunteers, adds a new source of information on threats needed for reporting, improves the WBDB, can ultimately lead to improved conservation of bird species
BirdLife Spain (local partners)	Facilitate the communication with and engagement of volunteers	Easy comprehension of the project by volunteers	Through coordination and communications meetings	Help to gather additional threat information via new app	Work with IIASA to build app, advertise the app to current volunteers, be part of an ongoing dialogue between volunteers	Grow their community of volunteers, adds a new source of information on threats

Stakeholder	Role	Needs	How are needs addressed	How can LandSense help	Role in LandSense	Motivations for participating
				Satellite images Reassess their existing engagement strategies for volunteers Improve their channels of communication with volunteers	and experts to feedback to the volunteers (can be via tools in the LandSense engagement platform)	Increase the participation in the Environmental Impact Assessment (EIA) sending letters, suggestions and allegations. Numbers of responses will increase widely Capacity to react to respond to the threats so an automatically system have to be enable Capacity to keep inform the volunteers

Stakeholder	Role	Needs	How are needs addressed	How can LandSense help	Role in LandSense	Motivations for participating
				Improve and expand their training system for volunteers(bird ID, bird counting methodology)		A priority system have to be agreed and carried out in the app
National government	Management of national parks	Inputs of threats to management plans	Receive alerts of threats	Provide information on projects which can be considered as threats for management and decision making	Be better informed of ongoing threats through LandSense	Better information for decision making
Regional authorities	Manage both national parks, Natura 2000 sites	Inputs of threats to management plans	Receive alerts of threats	Provide information on on projects which can be considered as threats for management and decision making	Be better informed of ongoing threats through LandSense	Better information for decision making

Stakeholder	Role	Needs	How are needs addressed	How can LandSense help	Role in LandSense	Motivations for participating
Local authorities	Initiates these local monitoring exercises, capacity building, education and awareness raising in schools	Better and timely information about threats	Currently receive threat information in conventional ways, e.g. calls to the police	Provide information on threats so they can be acted upon	Could receive threats through an alert system (first vetted by BirdLife), e.g. the police, who would be the first authority to deal with complaints	Ability to receive timely and reliable information on threats through an alert system
IBA Caretakers (Encargados de Area)	Monitor threats (similar to volunteers)	To improve communication with SEO Explicit way to record threats	Record habitat change and threats in the LandSense apps	Provide an easy to use app to monitor threats Motivate them and be more active	Based on the alert system, help to direct volunteers to identify and locate the threat	Obtain improved information on threats Involve them in the EIA procedure
Volunteers	Monitor birds in spring and winter as well as habitats and habitat change	Explicit way to record habitat changes and threats	Record habitat change but nothing is currently done with the data	Provide an easy to use app to monitor threats, raise awareness about threats, view maps of threats across Spain	Will monitor threats via the app but should also receive back information about the threats, other ideas to come out of workshop in Spain	By reporting threats, these can be acted upon by the local authorities, ability to see action taken from threat reports

Table 9 – Stakeholder analysis: Flores, Indonesia.

Stakeholder	Role	Needs	How are needs addressed	How can LandSense help	Role in LandSense	Motivations for participating
BirdLife International	Facilitate communication with and engagement of volunteers Determine user requirements for Indonesia Annual reporting on IBAs including threats	Long term engagement of volunteers to contribute to BL's goals; recruitment of new volunteers Information on threats needed for the WBDB (World Biodiversity Database) An alert system of where change is happening based on automated processing of remote sensing	Some volunteers and caretakers already in place but no threat information being collected; automatic link to the WBDB is not there; alert system is not in place	Increase numbers of volunteers monitoring threats, build a mobile app for threat monitoring; make direct links between threats from app, a verification procedure and a direct link to the WBDB	Obtaining user requirements through a workshop in Indonesia, input concepts and ideas to the app development (by IIASA), developing verification system for alerts, helping to develop link between LandSense and WBDB	Grow their community of volunteers, adds a new source of information on threats needed for reporting, improves the WBDB, can ultimately lead to improved conservation of bird species
Friends of the Earth Indonesia	Help the communities in land use conflicts Facilitate communication with WALHI in Indonesia	Help in work on land use conflicts	Mostly a facilitation role in LandSense so needs hinge mainly on helping local communities	Can make links to other activities involving land rights. Can indirectly lead to some of the broader goals of conservation and protection of forests.	Will work on the ground with communities, different levels of government and other NGOs to help monitor threats. Could also help in	Can indirectly lead to some of the broader goals of conservation and protection of forests.

Stakeholder	Role	Needs	How are needs addressed	How can LandSense help	Role in LandSense	Motivations for participating
					cases where conflicts arise.	
National Government, e.g. Ministry of Forestry	Mapping, e.g. of concessions, and management of forests at the national level	Information on threats identified (nature of threats, map of location)	Unclear where they currently get this information	Provide information on threats (nature of threats, map of location) via smartphone-based alerts or LandSense engagement platform	Be better informed of ongoing threats through LandSense	Better information for decision making
District level government	Responsible for land management and land use decisions, where there may be possible conflicts at the village level, in e.g. granting of concessions	Information on threats (nature of threats, map of location)	Unclear where they currently get this information	Provide information on threats (nature of threats, map of location) via smartphone-based alerts or LandSense engagement platform	Be better informed of ongoing threats through LandSense	Better information for decision making
Local Forestry Agency	Management, conservation and policy implementation regarding use of the forest - will be a beneficiary of the information	Information on threats (nature of threats, map of location)	Unclear where they currently get this information	Provide information on threats (nature of threats, map of location) via smartphone-based alerts or LandSense engagement platform	Be better informed of ongoing threats through LandSense	Better information for decision making

Stakeholder	Role	Needs	How are needs addressed	How can LandSense help	Role in LandSense	Motivations for participating
Village Government	Will be a beneficiary of the information in order to directly act on the threats - need to receive information about threats in a simple, timely way (as a hook to get them involved so they act on these threats)	Need alerts about the threats (possibly anonymized) and to generally improve the communication between different levels of government and the communities	Get reports through conventional channels (if threats are even reported)	Some kind of communication (smart-phone based) to receive alerts	Be better informed of ongoing threats and implement actions	Better information for decision making, can act on threats as they appear
Local Conservation Group in Mbeliling	IBA caretakers reporting on the threats and could train the local community	See actions taken at the government level	Get reports through conventional channels (if threats are even reported)	App to collect information on threats: fires, illegal logging, others to be identified	Will work with communities to monitor threat including training	By reporting threats, these can be acted upon by different levels of government, ability to see action taken from threat reports
Local community	Providing the information and benefiting from it	Land rights See actions taken at the government level	Make reports through conventional channels (if even reported)	App to collect information on threats: fires, illegal logging, others to be identified	Will monitor threats via the app but should also receive back information about the threats, other ideas to come out of workshop in Indonesia	By reporting threats, these can be acted upon by different levels of government, ability to see action taken from threat reports

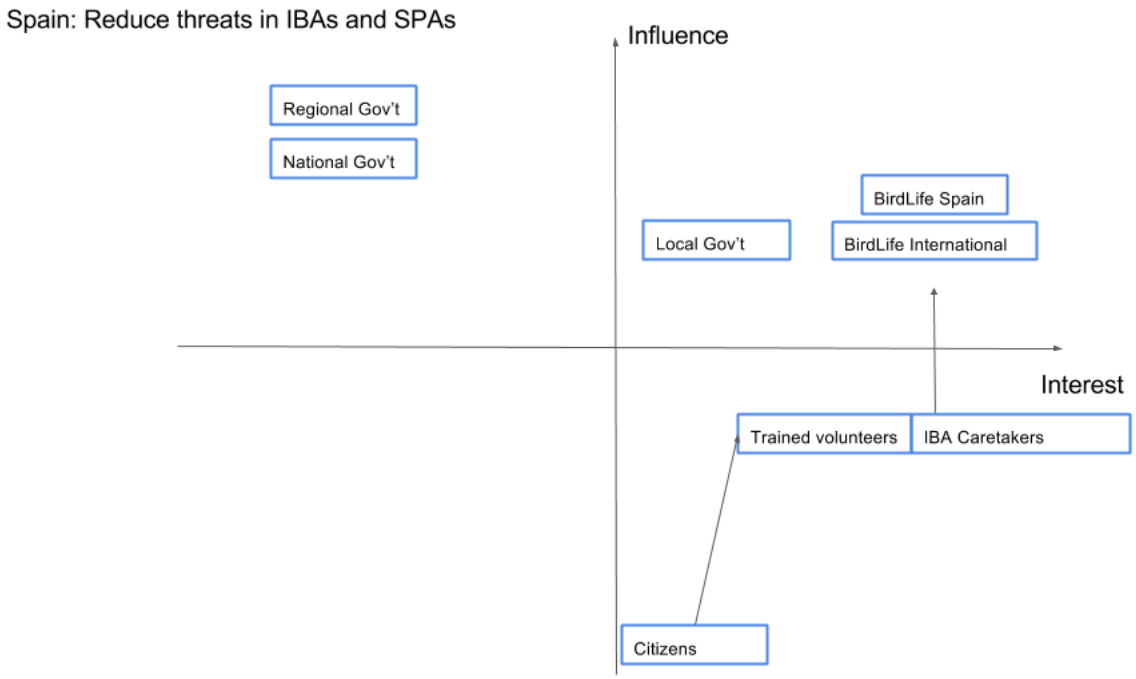

Figure 72 – Interest-Influence matrix: Spain.

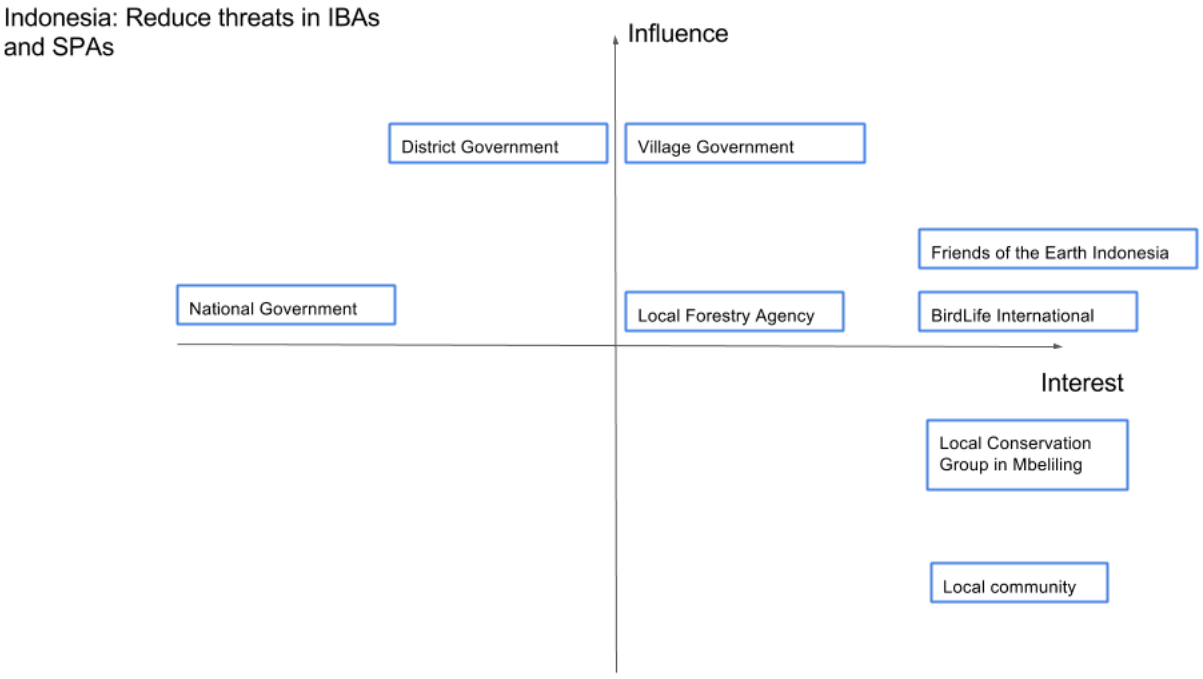

Figure 8 – Interest-Influence matrix: Indonesia.

C. User scenarios

The interactions with LandSense for different types of users are envisaged as follows (same for Spain and Indonesia).

User: volunteer from the monitoring department (who is already recruited).

1. The volunteer downloads the app (web and mobile linked with WBDB) for monitoring threats from LandSense, which must be a completely new app (to be determined still) compatible with WBDB (the Form is already available).
2. Volunteers in birds monitoring programs currently survey an area (10 km sq).
3. Step 1: The volunteer records the regular information (species, number of individuals, habitat info, gps location) and the threats.
4. Step 2: A volunteer looks at a map (on the app or on some visualization platform linked to LandSense) and sees the alerts for where change has happened. They can then choose to go to any of these area to verify the change.
5. Step 3: An alert is sent from the app to a database that should be checked by the responsible person in SEO (TBD).
6. Once a threat is reported by a volunteer, it would automatically go to the BirdLife partner on the ground (across the app.). It would then be verified. Once verified, it would be automatically fed to the WBDB (to be confirmed by Information Management) and depending upon the nature of the threat, be reported to the relevant authority, who will act on the threat.
7. The volunteer will receive feedback regarding the threat report, i.e. what happened to the information and if was acted upon.
8. Volunteers will continue to get the annual bulletin produced by the local BirdLife volunteer but there will be new channels of communication facilitated by the LandSense platform, e.g. discussion boards.
9. Volunteers can also go to LandSense engagement platform and view the map of threats identified.

User: volunteer (new recruit / regular citizen).

The following interaction with LandSense is envisaged:

1. The volunteer goes to the LandSense platform and views a map of alerts that indicate where change is happening. They see that an alert is highlighted near them. This picks their interest.
2. They download the app focussed on threat identification from LandSense.
3. They monitor the threat.
4. Items 6 to 10 above are identical for this user.

User: IBA Caretaker

1. IBA coordinator informs about the existing LandSense app to the IBAs caretakers.
2. IBA caretaker downloads the app.
3. IBA caretaker reports threats by going to the field/ receiving information from different channels (eg official Bulletins, newspapers...), using the app. It is important to note here that IBA Caretakers will report threats that are expected to happen in the future even if sometimes they will never happen, so in these cases images will never register any changes.
4. Items 6 to 10 above are identical for this user.

User: Birdlife Spain/Indonesia

1. BirdLife Spain/Indonesia receives alerts through the app and “Change detection system/database” (e.g. change detection map created by a LandSense partner).
2. BirdLife Spain/Indonesia mobilize volunteers to investigate the change.
3. BirdLife Spain/Indonesia verify threat information coming back from volunteers.

4. Once change is verified as a real threat in the app by BirdLife Spain/Indonesia, the new app sends this information to BirdLife International.

User: BirdLife International and BirdLife Spain/Indonesia (local partner)

1. Once a year, BirdLife International must prepare a 'State of the IBA' report. This report outlines how well IBAs are doing at the global level. From the list of IBAs, the ones that are endangered are highlighted. BirdLife will directly access the WBDB for this information so LandSense will ensure that the data collected can be first verified (tool needed) and then automatically written to the WBDB.
2. At the national level, local partners should take action regarding IBAs where problems have been identified.
3. The national partners will report back on these IBAs/actions on the LandSense platform.

D. Engagement strategies

Table 10 – Identification of potential engagement barriers: Spain

Stakeholder	Potential engagement barriers
Birdlife International	Amount of time taken to verify alerts may be large (are resources available?); how well does the automated alert system work still unproven.
Birdlife Spain (local partners)	Amount of time taken to verify alerts may be large (are resources available?), how well does the automated alert system work still unproven. Capacity to react to respond to the threats so an automatically system has to be enabled. Capacity to keep the volunteers informed. A priority system have to be agreed and carried out in the app.
National government	It is difficult to get in touch with the National Government in this issue to improve this project based on previous experience. Lack of interest. LandSense could be too technologically focussed so need to determine the real information needs of the national government.
Regional authorities	It is difficult to get in touch with the Regional Authorities in this issue to improve this project based on previous experience. LandSense could be too technologically focussed so need to determine the real information needs of the national government.
Local authorities	It is difficult to get in touch with the Local Authorities in this issue to improve this project based on previous experience. Alert system must be easy to use and provide reliable information.
IBA Caretakers	Cannot monitor in some areas because landowners do not allow IBA caretakers to go onto their land. Potential conflicts with hunters (e.g. reporting threats that cannot be seen by Earth Observation). Do not use smartphones.

	Some of them not enough motivated to go to the field. Many of them remain anonymous and do not want to be known. Difficult to meet because they are widely distributed in the whole of Spain. Many resources have to be used to organize a workshop.
Volunteers	Potential conflicts with hunters (e.g. reporting threats that cannot be seen by Earth Observation). Do not use smartphones and prefer to use a paper-based method. Most of the volunteers are overburden because they participate in most of the monitoring programs and censuses and do not want to do more.

Table 11 – Identification of potential engagement barriers: Indonesia

Stakeholder	Potential engagement barriers
BirdLife International	Same as for Spain.
Friends of the Earth Indonesia	Need to get behind the cause in order to promote it.
National Government, e.g. Ministry of Forestry	Lack of interest, need to understand benefits.
District level government	Lack of interest, need to understand benefits.
Local Forestry Agency	Lack of interest, need to understand benefits.
Village Government	LandSense could be too technologically focussed so need to determine the real information needs of the village government.
Local Conservation Group in Mbeliling	Cannot monitor in some area due to the rough terrain, remoteness of the location and only some people accustomed to use smartphone.
Local community	Land use conflicts as no land rights and concessions issued. Conflicts due to reporting activities that the local community does but does not want reported. Do not use smartphones and lack of capacity on documenting. Do not want to share information.

Stage 1: Awareness

How can we effectively advertise to diverse groups with varying motivations?

- Need a clear message.
- Use various channels: magazines, social media campaigns, working with schools (Indonesia), link to events (e.g. Big Garden Bird Watch events), link to national congresses and World Congress (taking place in Singapore), Doñana bird watching fairs, other bird watching fairs in Spain.
- Could possibly adapt bioblitz concept to this.
- Link with local institutions (e.g. universities Indonesia).
- Indonesia will require a different approach to be determined with local stakeholders.

How can we make the objective of the demo case clear to participants?

- Must meet the needs of the participants (usability of the application).
- Make big picture clear (app clear).
- Raise awareness of the main environmental issues.
- Connect the big picture to something that people can relate to.
- Make effective use of visuals to get the message across.
- Tie it to other existing campaigns (e.g. IBA campaigns).

Stage 2: Initial participation

How can we match participants' expectations of their role with the actual task or role?

It is important that the information provided to participants is very clear, e.g. time investment needed, clear explanation of any protocols to be followed.

What can motivate people to actually join the project? How did they hear about us?

- Modification of bioblitz to get people involved.
- Some basic gamification in apps.
- Idea of investigating alerts could be an appealing motivation.
- Effective use of storytelling to get people involved.
- Empowerment of NGOs such that they take ownership of the issues and then train the community.

Stage 3: Sustained participation

How can we regularly communicate and provide feedback to the participants?

- Feedback to participants is critical, e.g. evidence that threats are acted upon, visuals in the LandSense engagement platform, i.e. map of their contributions, expand upon current situation, which is a paper copy of an annual report (Spain)
- Possibility to query what they are seeing and talk to an expert or possibly peers?
- View their contributions online or report generated, e.g. like a report card
- Two way communication must be enabled, e.g. between participant and automated alert, between participant who sees something and creates an alert and then others act on that and verify it, etc.

How can we see if motivations change over time?

- Analyse number of participants and check their use.
- Check forums and Facebook to look for comments about the app.
- Need to take into account that people migrate / change jobs so this will affect participation numbers.

How can participants interact with one another?

- Currently not implemented but app should have some capabilities for this, e.g. discussion forum, add pictures to Facebook.
- More effective use of social media.
- Competitive element could be added.
- Use Facebook as a way of connecting people but also for advertising.

Would rewarding participants be an option? Which kinds of rewards?

- Use of a badge system?
- Award certificates that participants can add to their portfolios/CVs.
- Assign different levels of responsibility (e.g. could become custodians of the data).
- Provide different levels of incentives as people participate more.
- Being part of a publication (co-author, acknowledgement, policy briefs).
- Explore programs like the Unilever programme (Indonesia).
- Get a printout of the map of your area (Indonesia).
- Get access to other LandSense technologies, ECSA, etc.

4 Concluding remarks

This report shows the amount of work already done by LandSense partners regarding the stakeholder analysis and the assessment of user requirements and engagement strategies. It also provides insights into how some of the LandSense tools perform. Together this allows drawing the broader picture on the links between the human (stakeholders, including users) and technological components of the LandSense citizen observatory. The work developed by the LandSense partners for each demonstration case location is in different stages of development. This was expected, considering that stakeholder engagement and the definition of topics of interest are iterative processes dependent both on the work by LandSense partners and by stakeholders' availability and inputs. Although a considerable amount of information was already gathered, as stressed in Section 1 this is an ongoing co-creation process of issue definition and stakeholder mapping and engagement, therefore further developments on the results presented in this deliverable are expected throughout the project. In this way, current gaps will also be tackled. For example, user scenarios can be further developed once the issues in the demonstration cases locations are better defined and the stakeholder analysis is more mature.

5 Acknowledgements

We sincerely thank all the stakeholders that have offered their insights so far, as support to the development of the LandSense Citizen Observatory.

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Annex 1 – Agenda of the "LandSense Stakeholder Workshop on User Requirements and Engagement Strategies"

AGENDA

January 25, 2017

Target audience: Stakeholders from LandSense Demo Cases, LandSense partners, ECSA members

Guiding questions: What is the *status quo* of available Citizen Science tools that can be used to monitor land-use and land cover? What is the way forward for LandSense tools to address user requirements, considering existing principles for citizen science and citizen science tools?

14:00	→	Welcome and Introduction to Workshop André Mascarenhas (ECSA)
4:10	→	Welcome and Presentation of LandSense Citizen Observatory Steffen Fritz (IIASA)
14:20	→	Principles for Citizen Science & Development of Mobile apps/platforms Soledad Luna (ECSA)
14:30	→	Exchange of experiences and hands-on exercises on citizen science tools for monitoring land cover and land use

Station 1: FotoQuest Go	→	Steffen Fritz (IIASA)
Station 2: Agrosense	→	Igor Milosavljevic (INOSENS)
Station 3: BLI Apps for biodiversity monitoring	→	Sofia Capellan & Blas Molina (BLI)
Station 4: GEOPEDIA	→	Matej Batič (SINERGISE)
Station 5: Laco-Wiki	→	Christoph Perger & Linda See (IIASA)

17:00	→	Plenary Discussion & Synthesis
17:45	→	Closing Remarks André Mascarenhas (ECSA) / Linda See (IIASA)
19:30	→	Dinner

AGENDA

January 26, 2017

Target audience: Stakeholders from LandSense Demo Cases, LandSense partners

Guiding questions: What are the relevant issues/topics that LandSense can help address in each demo case location? Who are the stakeholders/actors related to each of those issues? What roles do the different stakeholders play? What are their needs/requirements regarding the issues identified? How can LandSense support those needs? What engagement strategies are needed? What engagement barriers need to be overcome?

9:00	→	Welcome and Introduction to the Workshop
		Steffen Fritz (IIASA) / André Mascarenhas (ECSA)
9:15	→	Overview of LandSense Demonstration Cases
		Inian Moorthy (IIASA)
9:30	→	Discussion on LandSense User Requirements
		Breakout Groups – LandSense User Requirements
		Demo 1: Monitoring Land Change in the Urban and Rural Landscape
		Demo 2: Monitoring Agricultural Land Use
		Demo 3: Forest and Habitat Monitoring
10:45	→	Coffee Break
11:00	→	Continued Breakout Group Discussions
12:30	→	Working Lunch
1:30	→	Reporting back from Breakout Groups morning session
		Moderators: Steffen Fritz (IIASA) / André Mascarenhas (ECSA)
14:15	→	Continued Breakout Group Discussions
15:15	→	Coffee Break
15:30	→	Plenary Discussion & Synthesis
16:45	→	Closing Remarks
		Inian Moorthy (IIASA) / André Mascarenhas (ECSA)

Annex 2 – List of participants of the "LandSense Stakeholder Workshop on User Requirements and Engagement Streategies"

January 25, 2017

NO.	LAST NAME	FIRST NAME	AFFILIATION
1.	Agnello	Gaia	ECSA; MfN
2.	Albrecht	Franziska	GeoVille
3.	Ansine	Janice	The Open University
4.	Arun	Pratihast	Wageningen University
5.	Banko	Gebhard	Umweltbundesamt Austria
6.	Biesinger	Alexander	Cologne University of Applied Sciences
7.	Birli	Barbara	Umweltbundesamt Austria
8.	Bowser	Anne	Woodrow Wilson International Center for Scholars
9.	Capellan	Sofia	Birdlife International
10.	Demanoff	Vanessa	Museum national d'Histoire naturelle
11.	Fraisl	Dilek	IIASA
12.	Fritz	Steffen	IIASA
13.	Göbel	Claudia	ECSA; MfN
14.	Gotthard	Stefan	City of Tulln
15.	Harlin	John	Leysin American School
16.	Jolivet	Laurence	IGN France
17.	Lakeman Fraser	Poppy	Imperial College London, OPAL Programme
18.	Lipinski	Marc	CNRS
19.	Luna	Soledad	ECSA; MfN
20.	Mascarenhas	André	ECSA; MfN
21.	Matej	Batic	Sinergise
22.	Matheus	Andreas	Secure Dimensions
23.	Milosavljevic	Igor	INOSENS
24.	Mocnik	Franz-Benjamin	University of Heidelberg
25.	Molina	Blas	SEO / Birdlife International
26.	Moorthy	Inian	IIASA
27.	Ochu	Erinma	University of Salford
28.	Paolo	Carletti	University of Padova

NO.	LAST NAME	FIRST NAME	AFFILIATION
29.	Perger	Christoph	IIASA
30.	Ramirez	Iván	Birdlife International
31.	Redolfi De Zan	Lara	CNBF National Centre Forest Biodiversity IT
32.	Sandén	Taru	Austrian Agency for Health and Food Safety
33.	Sara	Aielli	University of Padova
34.	Schultz	Michael	University of Heidelberg
35.	See	Linda	IIASA
36.	Sieber	Andrea	Alps-Adria University Klagenfurt, Austria
37.	Slawson	David	Imperial College London (OPAL)
38.	Sousa	Maria	ISCTE - Lisboa; Biosite CRL, Lisboa
39.	Spinelli	Oliviero	Comunità Ambiente
40.	Tiago	Patricia	BioDiversity4All
41.	Vohland	Katrin	ECSA; MfN
42.	Wildenberg	Martin	GLOBAL 2000

January 26, 2017

NO.	LAST NAME	FIRST NAME	AFFILIATION
1.	Albrecht	Franziska	GeoVille
2.	Arun	Pratihast	Wageningen University
3.	Banko	Gebhard	Umweltbundesamt Austria
4.	Birli	Barbara	Umweltbundesamt Austria
5.	Capellan	Sofia	Birdlife International
6.	Fraisl	Dilek	IIASA
7.	Fritz	Steffen	IIASA
8.	Gotthard	Stefan	City of Tulln
9.	Jolivet	Laurence	IGN France
10.	Luna	Soledad	ECSA; MfN
11.	Mascarenhas	André	ECSA; MfN
12.	Matej	Batic	Sinergise
13.	Matheus	Andreas	Secure Dimensions

NO.	LAST NAME	FIRST NAME	AFFILIATION
14.	Milosavljevic	Igor	INOSENS
15.	Mocnik	Franz-Benjamin	University of Heidelberg
16.	Molina	Blas	SEO / Birdlife International
17.	Moorthy	Inian	IIASA
18.	Ramirez	Iván	Birdlife International
19.	Riffler	Michael	GeoVille
20.	Schultz	Michael	University of Heidelberg
21.	See	Linda	IIASA
22.	Vohland	Katrin	ECSA; MfN
23.	Wildenberg	Martin	GLOBAL 2000

Annex 3 – Summary of stakeholder VGI usage ideas for City of Heidelberg/ Rhein-Neckar metropolitan region demonstration case

Summary of stakeholder VGI usage ideas considered for potential UHEI/CHEI demo case. Abbreviations: Open Street Map (OSM), very high resolution remote sensing data (VHR), remote sensing time series (RS TS), official German land use product (ATKIS), Metropolitan area Rhine Neckar (MRN), City of Heidelberg (CHEI), Rhein Neckar county (KRN); in-situ is equivalent for Smartphone based data capture.

Domain	Service name	Platform	Basic functionality	Data usage	Type of data	Format	Direct user
Improve land information	OSM LU	Web based	land use thematic information	OSM, VHR, RS TS	raster, points, tags	product	MRN, CHEI, KRN
	OSM roaming updater	In-situ	update tags validity	OSM	tags	Add-on	MRN, CHEI, KRN
	OSM cyclic updater	Web based	update tags + points	OSM, VHR	points, tags	Add-on	MRN, CHEI, KRN
Active monitoring	Urban concentration monitoring	Web based	monitor of impervious coverage/vegetation cover	ATKIS, OSM, RS TS	raster, points	product	MRN, CHEI
	Corn monitoring	Web based + in-situ	monitor of corn/non-corn usage	ATKIS, OSM, RS TS	raster, points, photos, tags	product	MRN, CHEI, KRN
	Forest monitoring	Web based + in-situ	monitor of forest changes	ATKIS, OSM, RS TS	raster, points, photos, tags	product	MRN, CHEI, KRN
Citizen engagement	Conversion platform	Web based	citizen dialog	OSM, VHR	raster, points, photos, tags	service	CHEI
	Nature conservation	Web based + in-situ	focused ecosystem monitoring	OSM, VHR, RS TS	raster, points, photos, tags	product	MRN, CHEI, KRN
	OSM tourist updater	In-situ	update tourism features	OSM	points, tags	Add-on	CHEI, KRN