THE SUSTAINABLE TRANSFORMATION OF AGRICULTURE THROUGH DIGITALISATION AND SPACE-USE CASES

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1. INTRODUCTION

This document lists the use cases to be used in the context of the Thematic Call for Proposals for Applications Activities called "The sustainable transformation of agriculture through digitalisation and space". The use cases presented result from the cooperation between the European Space Agency (ESA) and key stakeholders of the agri-food sector. It aims at developing space-based services and applications boosting a sustainable transformation of agriculture by taking advantage of data and innovative technologies.

This call asks for proposals that address at least one of the following use cases, or a combination of the use cases. The proposal must explain which is the primary use case and which aspects of (an)other use cases are taken up in addition. The role of space and/or digital technologies must be specified in each proposal.

Regardless of the use cases to which the service belongs, it is required that the service(s) proposed by the bidder shall include an adequate analysis of their environmental impact. Next-generation digital agriculture technologies are intended to limit Greenhouse Gases (GHG) emissions, to stop leaching of nutrients and pesticides and to increase the functional biodiversity. A positive impact is often claimed but rarely demonstrated. The risk of greenwashing, unintentionally or on purpose, is around the corner. Bidders shall propose solutions to measure, report and monitor the environmental impact of the proposed service(s). The starting point shall be a proper methodology to assess the impact in a clear and impartial manner.

2. USE CASE 1: AGRICULTURE OF DATA

The Agriculture of Data aims to support the transition to a sustainable agriculture in Europe as well as to strengthen policy monitoring and evaluation capabilities through the collection, analysis and sharing of electronic data and/or information.

Data and digital technologies have the potential to enable sustainable food production and to demonstrate compliance with relevant policies (e.g. Farm to Fork Strategy[1], Common

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[1] https://food.ec.europa.eu/horizontal-topics/farm-fork-strategy_en#Strategy

Agricultural Policy[2], Green Deal[3], EU Data Act[4], Nature Restoration Law[5]). All types of data can in principle be included in this definition: farm and agronomy data, socio-economic data, space and IoT based data collected from public authorities and agencies, private businesses and farmers. All data, and related information, are essential for efficient Farm Management Information Systems (FMIS). Many FMIS already exist and have proven to be an efficient tool to help the farmers undertaking multiple functions: organising farm tasks and planning, supervising and maintaining machinery, marketing farm products, etc. This has a positive impact on the environment as the resources are used in an efficient manner. At the same time, FMIS are at the basis of new and innovative applications that make use of Agriculture of Data as it allows the farmer to record and access all the farming data in one place. This is an obvious advantage in the context of Agriculture of Data, which relies on the combination of diverse sources of information (and including often sensitive information).

Examples of agricultural data to be used can include (but not only):

- Farm data/data referring to farms and farm operations, including farm management.
- Agronomic data – related to plant production (e.g. yield planning, soil data,).
- Compliance data – data required for control and enforcement in relation to competent authorities.
- Livestock data - related to the herd (e.g. age, sex, performance indicators such as milk yield and live weight, animal welfare and health indicators).
- Socio-economic data

The ingestion of new data, the seamless connectivity, the interoperability among databases, the edge-computing and AI capabilities are only a few examples of innovative technological solutions which can improve the services offered in FMIS.

From the interviews ESA had with representatives of the farmer community, several novel applications have emerged for implementation in a new generation of FMIS:

2https://agriculture.ec.europa.eu/common-agricultural-policy/cap-overview/cap-glance_en
3 https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en
4 https://www.eu-data-act.com/
5 https://environment.ec.europa.eu/topics/nature-and-biodiversity/nature-restoration-law_en

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- Expansion of the use of agricultural machinery automation as a fleet management tool: this service should include the opportunity of exploiting tractors to be used as sensor platform to collect data from the field while on the move.
- Implement real-time applications enabled by machine learning and/or AI techniques such as weed recognition, fruit defect detection and plant diseases detection.

  The main problem of adopting machine learning and/or AI techniques for agricultural purposes is the processing of large amount of data collected by heterogenous sources (e.g. drones, satellite, robots). The variety of data is an important challenge as all machine learning and/or AI models need to be trained by data sets that, when taken from the fields, present biological variability (no two leaves are the same) and unstructured environments (e.g. object occlusion, variable lighting conditions, cluttered scenes). Synthetic training data based on simulated/animated environments can help to generate sufficient amounts of training data[6]

The outlined applications are interlinked, meaning that, for example, weed detection could use as AI dataset also data collected by autonomous tractors.

Data is the cornerstone of any agricultural service that is aimed at improving the work life of farmers and the health of our planet. The exploitation of data, especially in agriculture, comes with some challenges for which the community is asking for solutions e.g. issues dealing with personal data protection, data governance contract and competition law, among others. Therefore, any new services proposed in the frame of this Thematic Call for Proposals shall duly consider the issue of data transparency and privacy. In the agricultural market, a specific element to be considered is the sovereignty of data from the farmer's point of view, as the farmer is the principal data originator, and she/he shall consent. It is envisaged that the farmer has visibility of the applications which access and use the data and maintains control of it. These conditions are not only ethically required but are well outlined in the EU Code of Conduct on Agricultural data sharing[7]and are also necessary to ensure a business continuity of the proposed service.

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[6]https://arxiv.org/pdf/1612.03019.pdf

[7]https://fefac.eu/wp-content/uploads/2020/07/eu_code_of_conduct_on_agricultural_data_sharing-1.pdf

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The emphasis on the farmer's point of view and the benefits that the new services will bring also to her/him, has been especially underlined by Copa-Cogeca.

3. USE CASE 2: CLIMATE-SMART AGRICULTURE (CSA)

Climate-smart agriculture (CSA) aims to support actions for transforming agri-food systems towards green and climate resilient practices.

Agriculture is affected in several ways by climate change and, according to many is the sector, is the most vulnerable to the consequences of it. Negative impacts are seen in terms of reduction of crop yields, worsening of nutritional content of the major cereals, lowering of livestock productivity, new pests and diseases derived from climate change effects etc. Substantial investments and innovative solutions are required to maintain the current crop yields and to achieve the food quality and production which will meet the increasing demand of the global population. Various paths are possible within CSA: choosing drought-resistant crops, returning to autochthone crops which ease pressure on the environment especially on water resources, improving the use of water resources and repurposing wastewater as much as possible. CSA measures often includes a combination of practices and technologies. It is in the purpose of this Thematic Call for Proposals to analyse services which support CSA and help to achieve its three main objectives: 1) increase productivity (produce more and better food), 2) enhance resilience (reduce vulnerability to climate related disasters e.g. drought, hail, heatwave, erosion, flooding, storm) and 3) reduce GHG emissions (lower the emissions which are generated for each kilogram of food produced, meaning to help farmers to transit towards less carbon-intensive agriculture). The service(s) proposed by the bidders for this topic shall clearly explain how the solution allows agriculture to adapt to or to mitigate the impact of the climate change and what is the expected outcome. It is also asked to specify which category of CSA the proposed service(s) is (are) dealing with, for example, crop production, land-use change, animal production.

4. USE CASE 3: SERVICES FOR UPSCALING AND/OR PREVIOUS NATIONAL AND/OR INTERNATIONAL INITIATIVES

The majority of countries in Europe, and elsewhere, have undertaken initiatives with the objective of exploiting data and technology to make the agricultural sector environmentally,

socially and economically sustainable. In some cases, the results have been promising and paved the way for potential new activities and initiatives.

In this context, bidders are invited to propose innovative service(s) that leverage and complement such initiatives aimed to promote agricultural innovation. The opportunity is twofold: on the technical side companies will have the advantage of developing sustainable services building on existing technical elements; on the business side they can elaborate their service concept in close coordination with the local user's communities and specifically addressing the issues of their territory, leading to development of a concrete commercial opportunity. The Bidder(s) can complement the existing elements/solutions by adding space capabilities. They can also integrate in their service concept novel digital solutions such as 5G connectivity, digital twins, drone-based services or robots-based applications.

Proposals targeting this use case shall be clear in stating what the starting point is (meaning reporting the outcome of the precedent activity(ies)) both for the technical feasibility and the potential commercial viability. The bidder should also specify if -and to what extent-they have been involved in the previous initiatives.