D6.2 Market and Business opportunities analysis

Dissemination level: Public
Submission date: 30 April 2021

Contents

This document is issued within the frame and for the purpose of the DEMETER project. This project has received funding from the European Union's Horizon2020 research and innovation programme under Grant Agreement No. 857202. The opinions expressed and arguments employed herein do not necessarily reflect the official views of the European Commission.

List of Tables

List of Figures

1 Executive Summary

D6.2 is one of the initial documents produced by DEMETER in relation to the future use and exploitation of the project results. The first phase of the project has a strong focus on the technical development, since it aims at creating a framework whose value has to be demonstrated. However, we all know that acceptance of a platform or any other technology development once it is fully developed is hard to happen. In the last years we have learned a lot about the benefits of user engagement and co-creation and as such, DEMETER is using a Multi-Actor Approach perspective to ensure that all players are represented and directly engaged in the process. So, in parallel to the technical development, but in coordination with it, DEMETER is running a series of activities aiming at understanding and involving different actors and ensuring that the usage, business, legal and policy aspects associated to DEMETER are considered as input for technical and implementation decisions.

In this respect T6.1, in charge of leading the exploitation, market, business strategies and activities in the project, is working very closely with other tasks in the WP and in particular those of policy and regulation, marketing and dissemination and standardization, but also supports and is supported by WP5 (Pilots) and WP7 (Multi-actor approach). D6.2, as mentioned, triggers the initial discussions on the value associated to DEMETER. The document is structured around two main contents: the definition and analysis of the Value proposition (so, a work that looks into DEMETER) and the analysis of the Smart Agriculture Market.

For the value proposition DEMETER carries out the exercise of segmenting the target actors in order to better identify their needs and requirements. This is done for both the supply (solution providers, consultancy services…) and demand side (farmers of different kinds). The answer to such needs comes with the description of the main innovations brought by DEMETER around the Agricultural Interoperability Space (AIS), the framework for Security, privacy and trust or the Knowledge Creation, Data Sharing & Decision Support Systems.

The analysis of the Smart Agriculture Market includes estimations in terms of size, segmentation of the market including a classification of farmers, a description of current dynamics, a competitor's analysis in order to understand the positioning of the project and a useful SWOT analysis.

Additional content such as a summary of main discussions around the concept of Common Agricultural Data Spaces or initial discussions on the sustainability model of DEMETER provide a nice hook to D6.3, which describes the intermediate -yet preliminary- exploitation plan for the overall project and its contributing partners.

Readers interested in the overall context of the Agri-food sector with respect to digital transformation are also encouraged to read D6.4, focused on the analysis of the Regulatory and Policy Framework. All these three deliverables could be considered the initial steps towards the DEMETER Strategy to maximize Impact.

2 Acronyms

AI	Artificial Intelligence
AIS	Agricultural Interoperability Space
AKIS	Agricultural knowledge information System
CAGR	Compound Annual Growth Rate
CAP	Common Agriculture Policy
DEP	Digital Europe Program
DoA	Description of Action
DSM	Design Structure Matrix
EC	European Commission
EU	Europe
GNNS	Global Navigation Satellite System
HW	Hardware
IoT	Internet of Things
IT	Information Technologies
ICT	Information and Communication Technologies
M	Month
MAA	Multi-actor approach
ML	Machine Learning
OEM	Original Equipment Manufacturer
PEMS	Portable emission measurement system
RFID	Radio-frequency Identification
R&D	Research & Development
SCM	Supply chain management
SME	Small and Medium enterprise
SOCS	Stakeholders Open Collaboration Space
SW	Software
TRL	Technological Readiness Level
UAV	Unmanned aerial vehicle
WP	Workpackage

3 List of Authors

Company	Author
IFA	Ethan Cleary
GFA	Natia Gelashvili
WIT	Christiane O'Meara
ATOS	Nuria de Lama
ATOS	Ana Belén González

4 Document History

Version	Author	Description
0.1	Ana Belén González (ATOS)	First version of ToC shared with WP6 partners
0.2	Ana Belén González (ATOS)	Assignment of ToC sections to partners for contribution
0.3	Ethan Cleary (IFA)	Contribution to Section 8.5, Farmer Segmentation and Annex B
0.4	Natia Gelashvili (GFA)	Contribution to Annex C
0.5	Ana Belén González (ATOS)	Contribution to Section 5, 6, and SWOT analysis 8.4.2
0.6	Christina O'Meara (WIT)	Contribution to Section 7
0.7	Ana Belén González (ATOS)	Improved versions of Section 7 and 8.5. First internal review (section 7, Section 8.4.2, Section 8.5)
0.8	Ana Belén González (ATOS)	Contribution to section 6
0.9	Ana Belén González (ATOS)	Contribution to section 8 and 10
0.10	Ana Belén González (ATOS)	Contribution to Annex A
0.11	Nuria de Lama (ATOS)	Corrections, revision and section on EU context (data spaces), summary and conclusions
1.0	Nuria de Lama, Diego Esteban (ATOS)	Final version for submitting

5 Introduction

This document is the first of a series of three business-related deliverables of the DEMETER project. The series of Deliverables will be the result of the activities carried out by Task 6.1 Exploitation, market, business strategies and activities, framed within WP6 Business Modelling, Innovation Management, Exploitation and Standardisation.

Task 6.1 aims at providing context knowledge on platforms for Agriculture, value chain, actors, etc. to help to establish the best-suited business model for DEMETER, fostering market uptake and ensuring sustainability of project results.

This deliverable provides the following information:

- **Section 6 Methodology for Exploitation** defines the methodology followed during the project within Task 6.1, the exploitation activities and the content of the deliverables resulting from this task
- **Section 7 DEMETER Value Proposition** proposes an initial internal analysis of the DEMETER project, identifying the value proposition, innovations, stakeholders, needs addressed, and value chain
- **Section 8 Smart Agriculture Market Analysis** provides a better understanding of the DEMETER market context, market dynamics and competitors. It also carries out a classification of farmers
- **Section 9 EU Context** offers a brief analysis of current discussions happening at EU level in the context of Digital Transformation for the Agrifood sector in particular in the field of use of data (so, an innovation focus in comparison to D6.4, which focuses on policy and regulation)
- **Section 11 DEMETER Exploitation and sustainability strategy** outlines the strategy to exploit DEMETER outcomes and ensure sustainability after the project ends, which represents an introduction to the contents further developed in D6.3 and the subsequent deliverable D6.8

5.1 Relation to other activities and deliverables

This content of this deliverable is related to the next project deliverables:

- ***D6.1*** *Initial DEMETER Communication and Dissemination Plan*. The exploitation methodology must be aligned with Dissemination and Communication activities
- ***D3.1****. DEMETER Reference Architecture*. In order to better understand the different services to be provided by the DEMETER platform and the stakeholders involved in the foreseen reference architecture. This knowledge was useful for the definition of DEMETER value proposition and value chain
- ***D5.2*** *Revised* Stakeholders Requirements, Pilots Design, and Specification. For a better understanding of the DEMETER pilots and exploitable assets

6 Methodology for Exploitation

ATOS, as leader of the DEMETER's exploitation, will apply the "Innovation Hub Methodology". This proven methodology has been designed and proved successfully by the Innovation Hub of Atos Research and Innovation within Research and Developments (R&D) projects. This methodology aims at carrying out an outstanding exploitation to bring projects' exploitable assets to the market.

This methodology is adapted to each project, based on the duration, deliverables, sector, and exploitation specific goals of the project.

For DEMETER exploitation, the methodology proposed is depicted below:

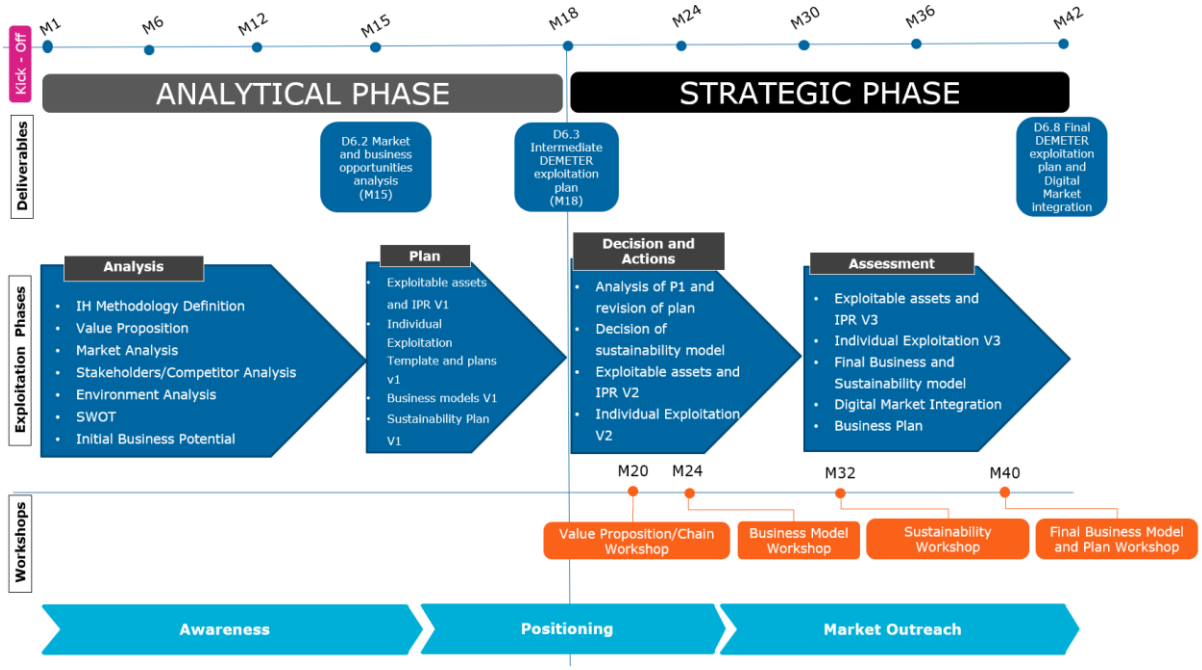

Figure 1. ATOS exploitation methodology for DEMETER project

The methodology is split into two phases:

Analytical Phase: During the initial phase all the activities focus on gathering information about the market context of DEMETER and the identification of the exploitable assets of DEMETER project, both stand-alone SW components and the DEMETER platform as a whole.

Two deliverables will be delivered within this phase, D6.2 *Market and business opportunities analysis* and D6.3 *Intermediate DEMETER exploitation plan*.

Strategic Phase: Once the analytical phase have been carried out and all the information regarding market context and exploitable assets have been gathered, the strategic phase is focused on the definition of the exploitation plans for SW components and the sustainability and business plan for DEMETER platform.

One deliverable will be delivered at the end of this phase, D6.*8 Final DEMETER Exploitation plan and Digital Market integration*.

Along the project lifetime, different workshops among partners and stakeholders will be conducted within task 6.1. During the analytical phase, task 6.1 has worked alongside task 7.2 *Multi-actor approach animation* in different workshops among partners to identify and classifY stakeholders and

for the definition of the value proposition. Both workshops outcomes will be included in deliverables from WP7, although we have considered them to develop several sections of this document.

For the Strategic phase, four workshops are proposed, which will be worked together with task 7.2:

- **Value proposition/Value Chain Workshop**: Workshop among partners to validate and refine the value proposition and Value chain for DEMETER.
- **Business Model Workshop**: Activity to discuss the business models proposed for DEMETER Platform as well as identifying new ones.
- **Sustainability Workshop**: Workshop to discuss the Sustainability plan for DEMETER Platform, in which partners' roles within the plan will be defined.
- **Final Business Model and Plan Workshop**: Final activity to set up the definitive business model for DEMETER platform and outline the Business Plan.

Besides the workshops proposed, questionnaires and surveys have been and will be circulated among partners (foreseen within Task 7.2), including business-related questions to gather feedback from partners and stakeholders.

7 DEMETER Value Proposition

From the outset and as articulated in the proposal, DEMETER's stated intention is to empower farmers through digitisation, in particular enabling them to derive benefits from the data that they produce.

"DEMETER's ambition is to facilitate and speed-up the deployment of interoperable data driven smart farming solution providing decision support and control systems for the agricultural sector that empower farmers to take better decisions, allowing them to harness the full value of their own data and knowledge as well as those shared with others, therefore improving the functioning of the agricultural knowledge and innovation systems and fostering the DSM based on innovation in the sector"[1]

The data space is complicated with data being generated by a multitude of sensors, farm equipment, production systems, reporting mechanisms and further publicly available data. Any consideration of a DEMETER value proposition must consider not just farmers but a multitude of stakeholders as DEMETER is a multi-sided platform which must see adoption by stakeholders on all sides in order to be successful. Led by Daniel Wolferts at Fraunhofer a tiered approach has been outlined engaging with project participants and other stakeholders in an iterative manner in order to advance a common and validated DEMETER value proposition (see below).

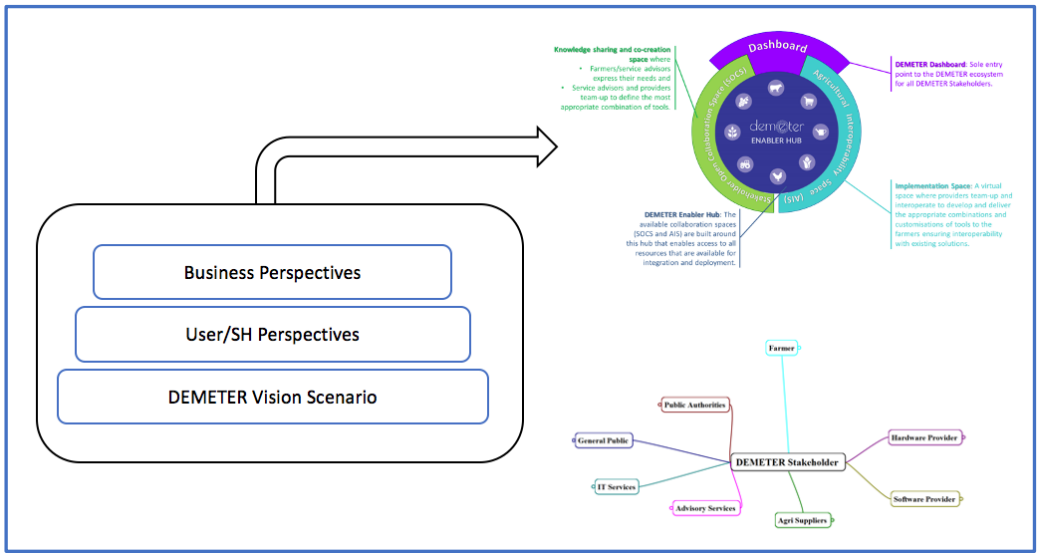

Figure 2. DEMETER Value proposition process identification

In the first step of this process, The DEMETER Vision scenario was elaborated by soliciting input from participants in each of the 20 pilots through a questionnaire. The questionnaire asked respondents (1) to state their key expected achievements within DEMETER, (2) to briefly describe the DEMETER platform, (3) to identify who would benefit from DEMETER and finally (4) to articulate the benefits that would be experienced by those beneficiaries. These questionnaires were used to identify a common vision for the value of DEMETER. The DEMETER Vision Scenario report succinctly describes this value proposition.

"DEMETER enables better decision making in agriculture"

Enhanced decision-making benefits not just farmers but service providers, technology providers and other stakeholders. Based on input from the questionnaires the DEMETER Vision Scenario goes on to

[1] DEMETER Grant Agreement, DEMETER Consortium, 2019

identify specific platform benefits that might be valued by users of the DEMETER platform, in particular farmers, the general public, advisory services, software and hardware providers, Agri-suppliers, final users and public authorities. A summary of some of these benefits is provided in the table below.

Stakeholders	Benefits provided by DEMETER
Farmers	Resource efficiency Improved product quality Data capability and access / vendor independence Interoperability among different solutions Better decisions Regulatory certainty
General Public	Knowledge access
Advisor and Services	Connect to many farmers and Agri-sector
Hardware/Software Providers	New markets/ networks/ knowledge Better understanding of farmers and needs/ requirements Better algorithms/ more holistic solutions Shared development Common framework to develop new solutions
Agri-Suppliers	New Marketplace and customers to sell services Leverage new technical solutions Improved/ optimised processes due to data
Public Authorities	Supply chain info/ transparency More info on products they use
Final Users	Data on nation's agricultural activity

Table 1. DEMETER benefits envisioned by stakeholders

The overriding theme connecting all of these stakeholders is data – data access, data frameworks, data analytics, insights & knowledge, transparency. Data enables enhanced decision making that can benefit all players or stakeholders across the value chain informing production processes, product development, market strategies, governmental policies, etc.

These initial assumptions related to value and benefits will be continuously validated and revised/ updated during the project through questionnaires and workshops, building on the already completed pilot interviews and stakeholder analysis workshops, carried out by WP7. Deeper market engagement activities and business testing will help refine these assumptions in the next phase of DEMETER exploitation methodology.

7.1 Description of the problems and needs

Market analysis, to be discussed in section 8, confirms there is a clear and growing demand for smart agriculture technologies, but that certain restraints and challenges are hindering adoption of these technologies and further evolution of the sector. These hurdles include lack of standards/ interoperability, data security and privacy issues, low level of technical knowledge among certain farmer groups, availability of adequate systems for large scale data management lack of proof of cost effectiveness. Through a stakeholder workshop which involved 60 participants from across Europe and led by WP5 and WP7 the problems and needs of the specific stakeholders were explored and those needs clearly resonate with the aforementioned hurdles and restraints. The findings of these stakeholder workshops are discussed below, classified by stakeholders.

7.1.1 Farmers and Farmer Organisation

This group is segmented according to farm size and supporting groups. The key outputs for this group are summarised in the table below.

Farmers' Needs, Interests and Concerns and why they need DEMETER	
Larger Scale Farms	Frequent frustration recording, retrieving and accessing farm-level data and information due to lack of interoperability and data silos. Preparing for an inspection or audit is a complex activity data and records spread across multiple systems and data formats. Not being able to project, plan, model or budget optimally due to limited or multiple different analytical and reporting systems. Merchants have access to analytics and are able to run reports easily which makes price negotiations an unequal scenario in particular when settling payment.
Smaller Scale Farmers	Currently, no access or limited access farm-level data and information due to lack of interoperability and data silos. The stress of preparing for an inspection or audit is compounded by lost records and ad-hoc record keeping across multiple systems and data formats. The opportunity cost of not being able to project, plan, model or budget effectively due no data, flat files and data stored in siloed locations. Merchants have access to analytics and are able to run reports easily which makes price negotiations an unequal scenario in particular when settling payment.
Smaller/Local Farmer Purchasing & Producer Groups	Frustration aggregating data across group members. Better data sharing and governance capabilities. Not being able to project, plan, model or budget for group purchasing or marketing and sales activities due to limited or multiple different analytical and reporting systems. Merchants have access to analytics and are able to run reports easily which makes price negotiations an unequal scenario in particular when settling payment.
Farmer Co-operatives	More targeted and timely support to co-op members due to better access to member data. Better data sharing and governance capabilities. Procurement foresight and budgeting moving towards Lean/JIT procurement through access to aggregated data via DEMETER.

Farmers' Needs, Interests and Concerns and why they need DEMETER	
	Better marketing due to greater insights into production levels and activities, seasonal sensitivities etc.
Farmers' Organisations & Associations	DEMETER will cater for farmers of all sizes, income levels, production systems and digital capabilities for the betterment of the industry as a whole. Macro and sectoral analysis of data trends for more effective lobbying and policy formation. Development of digital skills programmes based on farming data.

Table 2. Farmers' Needs, Interests and Concerns

Data is a key underlying theme among all of the sub-segments in this group. The problems related to data could be broadly grouped into 'access' and 'analytics/action'.

A clear need exists to improve access across all segments whether to gain leverage for group purchases through local farmer purchasing/ producer groups or to gain an improved view of all farm level data generated through non connected systems at larger farms. Pilot 1.4 IoT Corn Management & Decision Support System is an example of this problem. This pilot has been developed in partnership with the Romanian Maize Growers Association. Weather related data is critical to optimising farm operations and predicting & maximising yield. Corn growers in the region use a variety of related data sources that vary from basic weather station data to mobile sensors on farm machinery. Data from different sources is generally not correlated. In brief, data remains in silos and extent of data access can vary greatly from site to site. The need for greater data access underscores specific problems related to, for example, retrieving and accessing data, lack of interoperability and aggregating data from different members of a group. This challenge is highlighted by the OECD[2];

"While the agribusiness production chain grows more complex, its users are becoming more specialised. Because of this increasing specialisation, farmers do not always have an integrated solution where all the technologies and innovations are compatible with each other."

Another problem relates to data sharing and governance. Sensitivities exist around sharing data and even data ownership.

The value of data lies in the insights and actions that it supports. Another common need identified by the various subsegments was the need to be able to model, project, budget or do other data analysis to support their business. One of the underlying problems identified is the different analytical and reporting systems.

7.1.2 Software Providers, Hardware Providers & Advisory Services

Output from the stakeholder workshops for Software Providers, Hardware Providers and Advisory Service is summarised in the table below.

[2] https://www.oecd-forum.org/posts/53345-the-future-of-farming-4-0-the-digitalisation-of-agriculture

SW & HW providers, and Advisory services Needs, Interests and Concerns and why DEMETER is needed	
Software Providers	Opens up new markets – the total addressable market (TAM) is 11 million farmers. Unparallel access to a currently lowly digitalized sector. DEMETER will allow for new levels of interoperability allowing for quicker development, testing and deployment of software solutions. Access to key players within the agricultural ecosystem including farmers, farming organisations, large machinery and equipment organisations and research organisations. Development and R&I can be more directed through access to emerging farmer requirements and feedback. Abundance of data to develop, test and build Artificial Intelligence (AI)/Machine Learning (ML) solutions.
Hardware Providers	DEMETER offers a new route to market, not traditionally available. DEMETER offers all types of farming systems, farming conditions, farming topologies to trial, refine and deploy hardware. Access to key players and insights within the agricultural ecosystem including farmers, farming organisations, large machinery and equipment organisations and research organisations. DEMETER will allow for new levels of interoperability allowing for better situational testing and development, of hardware. Ability to access different networks (Narrow Band IoT, LoRa Wan[3] etc.) and communication protocols expanding the reach of hardware solutions. Development and R&I can be more directed through access to emerging farmer requirements and feedback
Advisory Services	More targeted and timely support to co-op members due to better access to member data. Better data sharing and governance capabilities. Better collaboration between advisory services (regional and inter-regional) DEMETER combines advisor knowledge and new data-insights to achieve better results for farmers.

[3] https://lora-alliance.org/

SW & HW providers, and Advisory services Needs, Interests and Concerns and why DEMETER is needed	
	Advisors can reference DEMETER pilots to illustrate the value of digital ag across different farming systems to their farmer clients. Abundance of data (aggregated and anonymised) for benchmarking and conducting research projects. Access to key players within the agricultural ecosystem including farmers, farming organisations, large machinery and equipment organisations and research organisations.

Table 3. SW & HW, and Advisory services' needs, interests and concerns

The Agri Sector at farming level offers many opportunities for software and hardware providers given the, on average, current low levels of digitalisation in agriculture and rural areas. The total addressable market is large, but it is a market that is widely dispersed and therefore not always easy to access. Sector needs are complex varying by agricultural activity type and region. In theory, Farm Management Information Systems, sensors and related technologies should be functionally relevant for a wide variety of crops, however in practise there is a fragmentation of available solutions. This is in part due to a lack of holistic view of the sector as a whole. The process of securing share of market among olive orchards, orange groves and potato farmers require a meaningful understanding of these respective sub segments. The markets are characterised by a large number of farmers and accessing these markets efficiently can be challenging. The process of reaching, understanding needs and engaging the various farmers and farming organisations from related but distinct segments is a resource intensive pursuit. While automated fly traps used in the olive orchards should be fit for purpose in orange groves (Pilot Cluster 3) transference of technologies between the different crop sub segments is not typical due to market fragmentation.

There are some critical success factors that underpin successful software and hardware businesses. The context of the Agri sector poses some particular challenges in this regard. For example, software and hardware relies on supporting infrastructure such as effective communication protocols including GSM, LoRA and Narrowband IoT. The availability of a choice of communication protocols to suit a given context is patchy at best with rural infrastructure often lacking. Another key need is an efficient mechanism by which to gather farmer requirements and feedback to inform product development. Given rural context and dispersed locations this also poses a problem for these stakeholders. Key software such as decision support systems or robotics that may be underpinned by AI/ ML require large trainings sets to develop, test, validate and improve the underlying data models and the previously mentioned data silos and lack of interoperability and access can hinder innovation in this regard.

7.2 Innovations, benefits and added value of DEMETER

7.2.1 Agricultural Interoperability Space (AIS)

One of the central components and a key innovation of the DEMETER platform is the AIS. The AIS facilitates the integration of diverse systems and technologies that are currently operating in silos today. **This is achieved through a reference architecture that prioritises interoperability and a standardized approach**, thereby leveraging existing technologies and allowing for the use of new ones. Existing smart farming applications and services tend to be targeted at very specific problems and are often based on proprietary technologies. While open source IoT solutions could add value,

there hasn't been widespread adoption to date. A PROVIDER/ CONSUMER model determines whether a platform, thing, service or application is consumed or provided. A number of underlying enablers facilitate service PROVISION & CONSUMPTION with key functionality related to, for example, networking & data security. This novel approach facilitates a move towards a democratic and open technology market with no single master system.

The benefits of this approach include:

- Access to a wider range of technologies and capabilities. In the current context farmers may be 'locked in' to a single dominant supplier, confined to a predefined feature set. The market dynamics do not make customised solution accessible or affordable for many at production level. Furthermore, choice and 'discoverability' of innovations is not straightforward
- New uses for existing technologies. The availability of open and interoperable components will pave the way for the configuration of customised solutions, new uses for existing generic ICT technologies and transferability of tech across different agri domains.
- Emergence of new technologies. The reference architecture supports open innovation, thereby opening opportunities for SMEs including software and hardware developers to develop new technologies

Pilot 2.1 (In-Service Condition Monitoring of Agricultural Machinery) demonstrates some of the above benefits enabled by DEMETER. It is seeking to trial a less expensive alternative to monitoring gaseous pollutant emissions (a mandatory requirement since 2019 per non-road emission standards) at two sites in Germany. Currently the responsibility falls with engine manufacturers and the Portable Emission Measurement Systems (PEMS) used are expensive and require trained personnel. Underpinned by the AIS, this pilot will test the use of existing onboard sensors and will gather, store, analyse and share data as appropriate to satisfy technical and regulatory stakeholders.

7.2.2 Security, Privacy & Trust

The lack of a common approach in IoT to security, privacy and trust management as well as the absence of a full lifecycle perspective concerning smart objects acts as an inhibitor to adoption and frustrates effective adoption of cross-technology solutions. DEMTER tackles this issue through a Lightweight Authentication, Authorization and Access control solution for Smart Agriculture. Interoperability will be enabled through bridge solutions to third party elements like the increasingly adopted FIWARE Service Enablers. The solution will be flexible and scalable.

Key benefits include:

- Privacy preservation through fine-grained access control
- Framework for regulation compliance including privacy by design and minimization
- Access to pre-existing proven, secure, privacy-preserving tools
- Secure access to new datasets allowing for 'full picture' farming and enhanced decision support.

Pilot 2.4 (Benchmarking at Farm Level Decision Support Systems) will demonstrate these innovations in action through the provision of a simple to use benchmarking system that would allow the use of ICT and IoT technologies in practical management and decision support, with a focus on data integration. This will be done by adopting Linked Data as a federated layer, complemented with security mechanisms, and implementing computational benchmarking models with interfaces that reuse/extend existing decision support and farm management systems (as an added value feature).

7.2.3 Knowledge Creation, Data Sharing & Decision Support Systems

DEMETER's open platform for ***knowledge creation & data sharing*** is predicated on cost and power-effective IoT data acquisition through enablers for a combination of LWAN and %G networks and IP communication standards. The platform will be constructed with common data models and ontologies. Interoperability is assured through the use of a semantic data model and translation/ management and inference mechanisms. Data security and privacy components will ensure safe data sharing. DEMETER's Data & knowledge enablers are responsible for data stewardship and user preferences are recognised through Data Management & Data Sharing components. The platform will be integrated to existing knowledge and information systems such as the Open Interoperable Agriculture Knowledge Information Systems (AKIS). The data approach paves the way for cooperating AKIS to offer data and to consume data from their counterparts.

Specific innovation implementations of this improved data sharing & knowledge creation are manifested in DEMETER in multiple ways including through, for example, (1) farm enabler dashboards that will collect/ present data from multiple heterogenous data sources including farm machinery, sensors, weather sources and (2) data integration across the entire dairy supply chain.

Pilot 4.1 (Dairy Farmers Dashboard for the entire Milk/ Meat Production Value Chain) leverages the data sharing possibilities opened up by DEMETER to deliver a farmer dashboard that overcomes the challenges of disparate apps/ ICT systems to provide a full picture at animal, herd and farm level encompassing aspects including health, milk quality, milk performance, feeding and genetics. The dashboard will also encompass tools to data collection, modelling and analysis related to greenhouse emissions. This dashboard delivers a holistic, single viewpoint for dairy herd performance. This increased data access ultimately enables more advanced modelling and predictions, for example, related to milk yields and helps improve critical operational support.

Decision Support in precision agriculture is increasingly important to help famers consider the large number of variables that can impact crop yields. Many of the existing solutions have relatively narrow focus, for example fertiliser use optimisation or crop cycle planning. The ***Decision Support Systems*** in DEMETER will benefit from access to a greater range of data from diverse sources and the application of advanced AI-based techniques that are domain specific. This will result in highly accurate and reliable decision support. The modular approach enables customisation depending on specific needs.

The benefits of DEMETER's data sharing/knowledge creation and Decision Support Systems innovations include;

- Farmers
    - Huge operational impact with the ability to lower administrative burden, save time and costs and improve yields and profitability
    - Easy access to wide variety of data and useful decision support systems that enable strategic precision farming
    - Tangible means of measuring and ultimately lowering environmental impact
    - Access to existing and new technologies
- Farmer purchasing / producer groups
    - Data to support collective bargaining
    - Integration with new and existing technologies across group members
    - Access to greater intelligence and insight
    - Operational efficiencies/ cost savings
- Farmer Cooperatives

  - Purchasing foresight moving towards lean / JIT procurement
  - Better marketing due to greater insights into seasonal sensitivities etc.
  - Enhanced collaboration and relationship management with members
  - Enhanced support and advice targeting management
  - Enhanced sales targeting
- Farm Organisations & Associations
  - Ensuring access to digital capabilities for farmers of all digital experience levels
  - Drive awareness and adoption of digital technologies for betterment of the industry.
  - Potential to remove sole reliance on extension agents.
- Software/ hardware providers
  - Access to components that can strengthen existing product proposition
  - Access to insights including directly from users that can guide product development
  - Availability of data that can be used to train data models

7.2.4 Food Safety

The deployment of IoT in farms and farming facilities can play a key role in ensuring food safety and the related technologies underpin the emerging digital food traceability systems. DEMETER's innovation lies in the integration of environmental monitoring of food products across the chain with existing traceability information to provide in-depth visibility regarding safety, quality and freshness of a food product right through to the point of delivery to consumer. This will result in a very granular level of information. An example of this in action is Pilot 4.2 (Consumer Awareness, Milk Quality, Animal Welfare Tracking). This will result in improved information across four different strands:

- Breeding and milking with a focus on animal welfare and optimization of farm activities;
- Transportation of milk, with a focus on product safety;
- Processing, with a focus on quality of the final product;
- Labelling, with a focus on information to consumers.

Food Safety innovations in DEMETER deliver a number of key benefits;

- Producers have access to more data and can track/ demonstrate quality of product thereby open the possibility of improved prices
- Access to data will drive improved quality
- Animal welfare is easier to track and linked to end product
- Processing companies have more transparent information and supply chain can benefit in terms of tweaking process/ improving supply chain dynamics
- Consumers are more informed about all aspects of the product they consume/ full transparency
- New technology solutions will emerge as access to data and insights from across the supply chain emerges.

7.2.5 New Business Models & Value Chains

A user-led approach is central to DEMETER innovation & development approach ensuring that all stakeholders derive value. This is underpinned by both the methodological approach and available tools. The DEMETER ***Stakeholders Open Collaboration Space (SOCS)*** facilitates digital co-creation involving farmers, advisors and providers and the availability of a range of technologies, components and data. A structured and extensive ***Multi-Actor Approach*** is being employed, enlisting all stakeholders including farmers, end users and service providers throughout the DEMETER effort - guiding design and development both at platform and pilot level, simultaneously ensuring outcomes

that are needed and valued in the sector and also creating a sense of shared 'ownership' for outcomes. The Multi-actor approach (MAA) process is also critical to understanding critical success factors, including key drivers and deterrents that would influence stakeholder's attitudes and behaviours, ultimately identifying what supports and mechanisms need to be put in place to ensure innovation adoption. The key benefits that derive from business model and value chain innovations include;

- User generated agricultural data becomes substantial and accessible and farmers are given the tools to own, leverage and derive value from own data.
- Connected, Collaborative Agriculture enables full value chain data sets, i.e. from source to consumption opening the possibility not just improved products, processes and impacts but also new business models.
- A ground up, user-centred approach delivers useful, needed solutions that will improve outcomes for all stakeholders

An example of this ecosystem development in action can found in the data brokerage platform being tested through Pilot 2.3 Data Brokerage Platform and Decision Support Services. The outcome will be that farmers will have access to a complete set of data regardless of source and their roles in the value chain will evolve form partial consumer to a full prosumer. They can also be data providers as the platform will enable a trust-based data market supporting service provision and growth by Agri-tech companies and advisors.

7.3 DEMETER Value Chain

The DEMETER platform enables the discovery, development, provision and consumption of a host of Agri-tech related services. Actors in the value chain can be both service providers and service consumers. For example, farmers can provide data to the platform but can also consume data and a variety of data related services. A service can be simply data provision or can extend to sophisticated decision support systems. Services can be 'core', in other words related to directly optimising agricultural production activities or services can play 'supporting' roles, for example data security protection technologies.

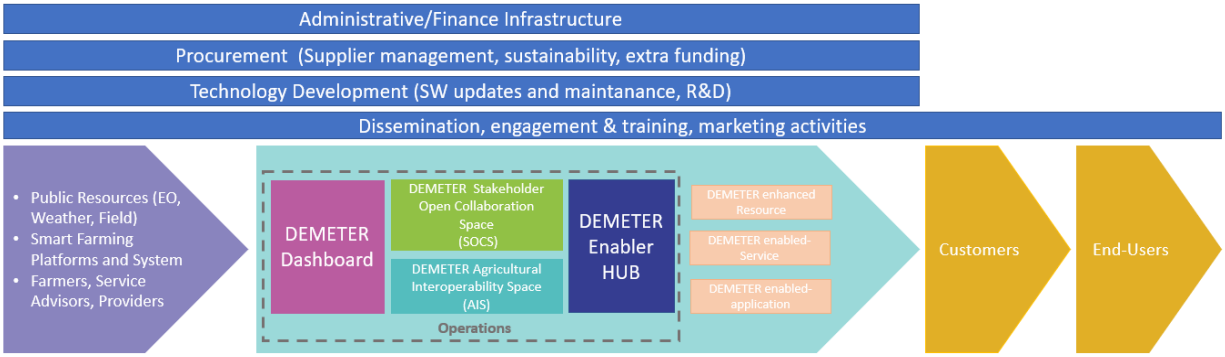

Figure 3. DEMETER Value Chain

7.3.1 Stakeholders' roles in DEMETER value chain

The Pilot Clusters provide a useful representation of the value chain in action. It is worth noting that not all value chain participants are identified at this stage. As pilot actions progress technology or knowledge gaps may be identified and other participants may be recruited. The participants below are a good representation of value chain possibilities for DEMETER and not necessarily a comprehensive list of actors.

7.3.1.1 Pilot Cluster 1 & 2 [Arable Crops]

This cluster focuses on an efficient, integrated management of water and energy.

Pilots Cluster 1	Value Chain Participant	Value Chain role
P1.1 & 1.2 Water and energy savings in irrigated crops	Community of Irrigators (Cartagena)	Data provider, Decision support services consumer. *CORE*
	Odins	Software provider – irrigation operations control and decision support. *CORE*
	Tragsa	Operating standard for systems interoperability *SUPPORT*
	Government of Spain	Service Provider (Geographic Information Services). *CORE*
	Farmers	Data Provider, Service Consumer. *CORE*
	Consumers	Services consumer *INDIRECT* (e.g. environmental impact)
	DEMETER enabled DSS	Data consumer, service consumer, service provider. *CORE*
	DEMETER AIS	Interoperability Services *SUPPORT*
P1.3 Smart Irrigation Service in Rice and Maize Cultivation	ELGO/ICCS	HW/SW providers. *CORE*
	Farmers	Data providers/ Service consumers (Smart Irrigation Service, Decision Support). *CORE*
	Weather monitoring Service	Data Provider. *CORE*
	VRA Machinery	Data provider/ Service consumer. *CORE*
	DEMETER Enabled DSS	Data consumer, service consumer, service provider. *CORE*
Pilot 1.4 IoT Corn Management & Decision Support Platform	Romanian Maize Growers Association	Data providers/ Service Consumers. *CORE*
	Farmers	Data Providers/ Service Consumers. *CORE*
	Various weather sources (mobile sensors, Weather stations)	Data Providers. *CORE*
	DEMETER Enabled DSS	Data consumer, service consumer, service provider. *CORE*
	Inovagria	HW/SW provider. *CORE*
	DEMETER data gateway	Service enabler. *SUPPORT*

Table 4. Pilots Cluster 1 Stakeholders' roles in DEMETER value chain

Pilots Cluster 2	Value Chain Participant	Value Chain role
Pilot 2.1 In Service Condition Monitoring of Agricultural Machinery	Legal Institution	Service/ Data Consumer
	Farmer	Data Providers. *CORE*
	Software Provider	Service provider (Analysis & Modelling). *CORE*
	Advisory Services	Service provider & service consumer. *CORE*
	DEMETER Enabler HUB	Service Provider. *SUPPORT*
	DEMETER Agricultural Interoperability Space (AIS)	Service enabler. *SUPPORT*
Pilot 2.2 Automated Documentation of Pilot Crop Processes	John Deere	Data provider, Software (DSS) provider. *CORE*
	M2Xpert	Software provider (operational management/DSS). *CORE*
	Fraunhofer IESE	Software provider (quality assessment). *SUPPORT*
	DEMETER Enabler HUB	Service provider. SUPPORT
	DEMETER Agricultural Interoperability Space (AIS)	Service enabler. *SUPPORT*
	Farmers	Data provider/ Service consumer. *CORE*
Pilot 2.3 Data Brokerage Service & decision Support System	DEMETER Enabler HUB	Service provider. *CORE*
	DEMETER Agricultural Interoperability Space (AIS)	Service enabler. *SUPPORT*
	Farmers	Data provider/ service consumer. *CORE*
	FMIS	Data provider. *CORE*
	Advisory Services	Data/ service consumers. *CORE*
	Various (LPIS, Satellite, Water bodies)	Data providers. *CORE*
P2.4 Benchmarking at farm level decision support	DEMETER Enabler HUB	Service provider (security, user interfaces, etc.). *SUPPORT*
	DEMETER Agricultural Interoperability Space (AIS)	Service provider (data integration). *SUPPORT*
	SW providers	Service providers & consumers. *CORE*
	HW providers	Service providers. *CORE*

Table 5. Pilots Cluster 2 Stakeholders' roles in DEMETER value chain

7.3.1.2 Pilot Cluster 3 Fruits & Vegetables

This cluster focusses on the health and quality of several fruit and vegetable crops in Europe, involving the use of several technologies including existing farming digital platforms IoT sensor networks, mode and DSS, remote Sensing Data and advanced data analysis tools.

Pilots Cluster 3	Value Chain Participant	Value Chain role
P3.1 Decision Support system to support olive growers – integrated pest management, fertilizer use, and irrigation needs	Farmers	Data provider, service consumer. *CORE*
	Consumers	Services consumer *INDIRECT* (e.g. environmental impact)
	DEMETER enabled DSS	Data consumer, service consumer, service provider. *CORE*
	DEMETER AIS	Interoperability Services. *SUPPORT*
	OLIVESS	SW Data & Services provider. *CORE*
	Various	Data/ SW/ HW service providers. *CORE*
P3.2 Precision Farming for Mediterranean Crops -usage of IoT and Ground Robots to enable more efficient usage of inputs (water, energy, pesticides, macronutrients etc)	HW Providers (sensors -e.g. soil parameter, ground robots)	Data/service provider. *CORE*
	SW providers	Data service/provider & consumer. *CORE*
	Farmers Associations (FENADEGAS)	Data provider/service consumer. *CORE*
	Farmers (Vineyards, olive groves, orchards)	Data providers/ service consumers. CORE
	DEMETER Enabled DSS	Data consumer, service consumer, service provider. *CORE*
	DEMETER AIS	Interoperability Services. SUPPORT
D3.3 Pest Management Control on Fruit Fly	DEMETER Enabled DSS	Data consumer, service consumer, service provider. CORE
	DEMETER AIS	Interoperability Services. SUPPORT
	Ministry of Agriculture/ Monitoring Programmes	• Data/ Service provider, Data/ Service Consumer. *CORE*
	HW (e.g. sensors) provider	Data provider. *CORE*
	Device (smart traps) manufacturers	Data provider. *CORE*
	Fruit Farmers	Service consumer (DSS) & Indirect beneficiaries – reduced pest prevalence
D3.4 Open Platform for Improved Crop	Watchitgrow.be (platform provider)	Data & services provider. *CORE*

Pilots Cluster 3	Value Chain Participant	Value Chain role
Monitoring in Potato Farms	AVR Connect (IoT platform – field machinery data)	Data provider & services consumer. *CORE*
	DEMETER enabled DSS	Data consumer, service consumer, service provider. *CORE*
	DEMETER AIS	Interoperability Services. *SUPPORT*
	Farmers	Data provider/ service consumer

Table 6. Pilot Cluster 3 Stakeholders' roles in DEMETER value chain

7.3.1.3 Pilot Cluster 4 Livestock

This cluster focusses on supporting livestock farmers in achieving optimal animal health and high quality in production of animal-based products through advanced data models and decision support.

Pilots Cluster 4	Value Chain Participant	Value Chain role
P4.1 Dairy Farmers Dashboard for the Entire Milk and Meat Production Value Chain	Agricultural DataFlow (SW/ Platform)	Data & services provider. *CORE*
	Mimiro (SW/ platform)	Services provider. *CORE*
	Advisory Services (SINTEF/ TFoU)	Services provider. SUPPORT
	Farmers	Data Provider, Service Consumer. *CORE*
	DEMETER enabled DSS	Data consumer, service consumer, service provider. *CORE*
	DEMETER AIS	Interoperability Services. *SUPPORT*
Pilot 4.2 Consumer Awareness, Milk Quality & Animal Welfare Tracking	Dairy Farmers (Maccarese SpA)	Data providers, service consumers. *CORE*
	Dairy Distributors (incl Latte Sano SpA)	Data Providers, service consumers. *CORE*
	Coldiretti (Agricultural Association)	Data providers, service consumers. CORE
	Engineer SpA (IT Services)	DSS (Animal Welfare, traceability), benchmarking services. *CORE*
	RoTechnology (SW/ HW provider)	Traceability services. CORE
	DEMETER enabled DSS	Data consumer, service consumer, service provider. *CORE*
	DEMETER AIS	Interoperability Services. *SUPPORT*
Pilot 4.3 Proactive Milk Quality Control	HW/ SW providers (e.g. Smartbó, Zoetis)	Data providers. *CORE*

Pilots Cluster 4	Value Chain Participant	Value Chain role
welfare & health scoring framework – indoor herds	R&D (Tyndall – portable diagnostic platform)	Data Providers, service provider (Data Modelling, DSS). *CORE*
	Farmers/Vets	Data consumers, service consumer. *CORE*
	DEMETER enabled DSS	Data consumer, service consumer, service provider. *CORE*
	DEMETER AIS	Interoperability Services. *SUPPORT*
P4.4 Optimal Chicken Farm management	DNET (platform)	Data provider, service provider. *CORE*
	HW providers (IoT)	Data Providers. *CORE*
	Farmers	Data provider & service consumer. *CORE*
	DEMETER enabled DSS	Data consumer, service consumer, service provider. *CORE*
	DEMETER AIS	Interoperability Services. *SUPPORT*

Table 7. Pilots Cluster 4 Stakeholders' roles in DEMETER value chain

7.3.1.4 Pilot Cluster 5 Cross Sectorial Focus

This pilot cluster runs pilots across several sectors and addresses both supply and demand side of the chains.

Pilots Cluster 5	Value Chain Participant	Value Chain role
P5.1 Disease prediction & Supply Chain Transparency for Orchards & Vineyards	agroNET (DSS pest / disease management)	Data & services provider. *CORE*
	SW/ HW providers (sensors/ traceability etc)	Data & services providers. *CORE*
	DEMETER enabled DSS	Data consumer, service consumer, service provider. *CORE*
	DEMETER AIS	Interoperability Services. *SUPPORT*
	Consumers	Data consumer
P5.2 Farm of Things in Extensive Cattle Holdings	Farmers (Dairy/Dry stock)	Data providers/ service consumer. *CORE*
	SW/ HW providers	Data & services providers. *CORE*
	Processing Sector	Data Providers & Service Consumer. *CORE*
	Consumers	Data providers, data consumers. *CORE*
	DEMETER enabled DSS	Data consumer, service consumer, service provider. *CORE*
	DEMETER AIS	Interoperability Services. *SUPPORT*

Pilots Cluster 5	Value Chain Participant	Value Chain role
	Public/Gov/Animal Welfare bodies	Data consumer
P5.3 Pollination Optimisation in Apiculture	ControlBee (apiary management system)	Data & service provider. *CORE*
	DEMETER enabled Pollination Optimisation Service	Data consumer & services providers. *CORE*
	Farm Management Systems (eDWIN +others)	Data Providers. *CORE*
	Farmers	Data providers. *CORE*
	Beekeeer	Data provider, data & services consumer. *CORE*
	Agricultural Advisors Services	Data providers. *SUPPORT*
	DEMETER enabled DSS	Data consumer, service consumer, service provider. *CORE*
	DEMETER AIS	Interoperability Services. *SUPPORT*
D5.4 Transparent Supply Chain in Poultry Industry	DNET (poultry farm management system)	Data provider. *CORE*
	Fleet Management Systems	Data provider. *CORE*
	DEMETER enabled DSS	Data consumer, service consumer, service provider. *CORE*
	DEMETER AIS	Interoperability Services. *CORE*
	Consumers	Data providers, Data consumers. CORE

Table 8. Pilots Cluster 5 Stakeholders' roles in DEMETER value chain

8 Smart Agriculture Market Analysis

This section analyses the Smart Agriculture Sector, in which DEMETER can be positioned. It provides information on the market size, market dynamics, segmentation, positioning, and competitors as well as a SWOT analysis on DEMETER solution. It also includes a comprehensive study on farmer segmentation, as farmers are a key pillar of the DEMETER solution.

8.1 Smart Agriculture Market Size

The smart agriculture global market was predicted to be worth $13.7B in 2020 and it is projected to reach $22.0 B by 2025, at a CAGR of 9.8% from 2020 to 2025, according to a recent market report by MarketsAndMarkets[4].

The growth of global smart agriculture is supported by increasing demand for automation and advanced agricultural techniques. The integration of advanced technologies in Agriculture industry is contributing to solve the high food supply demand due to the rapidly growing population.

The expected market evolution by geographies is depicted in the next figure:

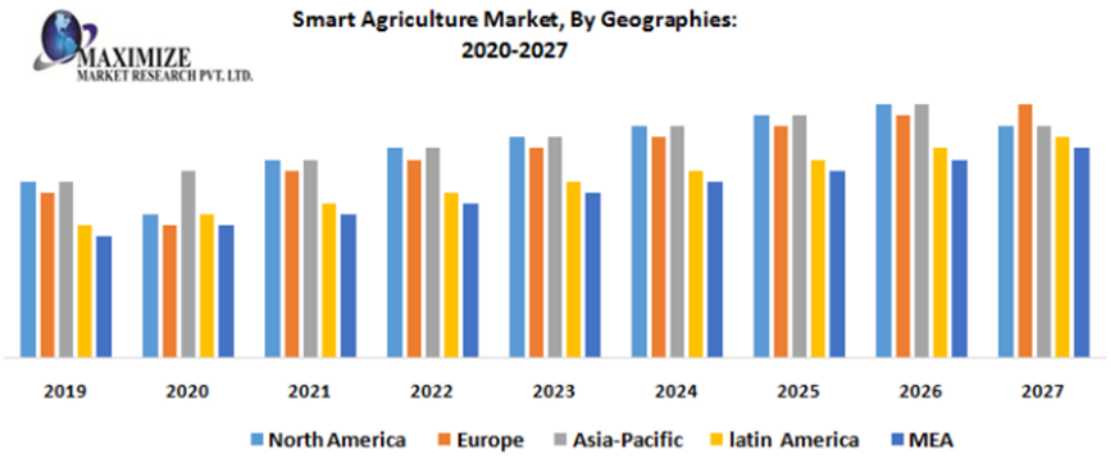

Figure 4. Smart Agriculture Market by Geographies (2020-2027)

(Source: Maximize Market Research PVT.LTD.[5])

Since the last decade, farm productivity across Europe has been considerably growing due to different factors: increasing demanding food due to growth of population, shortening of finite natural resources, shrinking agricultural lands, and need to enhance farm production, among others. Increasing urban population and enhancement of quality of living in countries such as Poland and Czech Republic are fuelling the demand for crop production.

The main European countries with significant market share in the market are Germany, U.K., France, Italy, Spain, Netherlands, Poland and Czech Republic. GermanY leads the market due to the rapid adoption of technologies by farmers to solve existing problems such as decreasing number of farms and the livestock herd sizes.

[4] https://www.marketsandmarkets.com/Market-Reports/smart-agriculture-market-239736790.html
[5] https://www.maximizemarketresearch.com/market-report/smart-agriculture-market/1871/

The European smart farming market is anticipated to reach $7.2B by 2023[6] and the countries with the fastest expected market growth are Netherlands, Czech Republic, Poland and Spain, fuelled by favourable government initiatives, increasing urban population and a greater penetration of internet in farm management[7].

8.2 Smart Agriculture Market Segmentation

Some consultancy firms such as MarketsAndMarkets[8], Goldstein Market Intelligent[9], and Market Research Intelligent[10], have segmented the Smart Agriculture Market in a similar way, by offering and application. We have collected all the information, resulting in the following market categorization:

By Offering	Hardware	Drones
		Sensors
		RFID Tags
		Others (Transmitters, Sprinklers, etc.)
	Software	System integration and Consulting
		Maintenance & Support
		Managed Services (Data Services, Analytics Services, Farm Operation Services)
		Assisted professional services (Supply chain management services, Climate information services)
	Platform	Cloud-Based/On-Premise
		Based on Application
By Agriculture and Application Type	Precision Farming	Yield Monitoring
		Drainage Mapping
		Crop Scouting

[6] https://www.prnewswire.com/news-releases/the-european-smart-farming-market-is-anticipated-to-reach-7-2-billion-by-2023--300704177.html
[7] https://www.prnewswire.com/news-releases/the-european-smart-farming-market-is-anticipated-to-reach-7-2-billion-by-2023--300704177.html
[8] https://www.marketsandmarkets.com/Market-Reports/smart-agriculture-market-239736790.html
[9] https://www.goldsteinresearch.com/report/global-smart-agriculture-market-outlook-2024-global-opportunity-and-demand-analysis-market-forecast-2016-2024
[10] https://www.marketresearchintellect.com/product/global-digital-agriculture-platform-market-size-and-forecast/

		Weather Tracking & Forecasting
		Variable Rate Technology
		Inventory Management
		Farm Labour Management
		Financial Management
	Precision Forestry	Genetics and nurseries
		Silviculture and fire management
		Harvesting management
		Inventory & Logistics management
	Livestock Monitoring	Milk harvesting management
		Feeding management
		Heat stress management
		Animal comfort management
		Behaviour monitoring and control
	Smart Greenhouse	HVAC Management
		Yield monitoring and harvesting
		Water & Fertilizer management
	Precision Aquaculture	Feeding management
		Monitoring, control and surveillance
	Others	
By Farm Size	Small Farms	
	Medium Farms	
	Large Farms	

Table 9. Smart Agriculture Market Segmentation

According to Transparency Market Research[11], the market attractiveness by application is:

- Precision Agriculture expected to hold the largest share rough 46% from 2020 to 2025, due to the fact of increasing demand for incorporating new technology solutions in agriculture among farmers and farming corporate houses
- The second most attractive segment is Precision Aquaculture. Smart fish farming covers from breeding, feeding and change pond water without any direct human labour, so interest in precision aquaculture is increasing among farmers and government bodies
- The third attractive market is held by Livestock monitoring, with an increasing demand for monitoring technologies such as feeding robots and milking robots in the coming years

By offering, the Hardware segment is divided into Automation & Control Systems, Sensing & Navigation systems, Indoor farming equipment, and others. The hardware segment is expected to dominate the market up to 2025, as reported by MarketsAndMarkets[12].

8.2.1 Farm management software market

Farm management software plays a key role in farmers' daily operations and supports farmers in managing farming operations, financials, labour management to improve profitability and productivity.

The global farm management software market size is expected to reach $4.22 Billion by 2025, according to a report by Grand View Research Inc[13], growing at a CAGR of 16.7% during the forecast period.

Some relevant insights can be extracted from the same report:

- The adoption of technologies such as cloud computing and IoT are fostering the usage of big data, AI and robots in smart farming, which are playing a crucial role for providing predictive insights for decision-making processes
- Market growth is fuelled by the increasing need of cloud-based models to manage real-time data
- The Cloud-based model is expected to experience the most growth, at a CAGR of 19.5% over 2019-2025 period
- Service providers are developing platforms to visualize the data collected by sensors and drones and integrating smartphones with agriculture solutions
- Service integrators play a key role in the integration of hardware equipment and software at the farm and the growing need of new hardware installations is generating more market opportunities for system integrators
- Managed Services is expected to dominate the market. Managed services are outsourced specialized services, such as drone services which requires special assistance
- Key players in farm management software market are Global IT companies such as IBM who offers big data analytics solutions for precision farming, on the contrary, start-ups on Agri-sector are extending their commercial solutions to advisory services and insurance

Farmer management software market has been divided into system integration and consulting, assisted professional services and managed services. The managed services which include Data

[11] Global Smart Agriculture Market: Global Industry, Size, Share, Growth, Trends and Forecast, 217-2025, Transparency Market Research
[12] https://www.marketsandmarkets.com/Market-Reports/smart-agriculture-market-239736790.html
[13] https://www.grandviewresearch.com/press-release/global-farm-management-software-market

Services, Analytics Services and Farm Operation Services is expected to dominate the market during 2018-2025 period, as reported by Grand View Research[14].

Within the assisted professional services, the climate information services segment is projected to lead the market at a CAGR of 21.9% from 2017 to 2018, due to the increasing use of precision agriculture system to provide predictive weather measurements.

8.3 Smart Agriculture Market Dynamics

This section explores the factors that affect the evolution of the Smart Agricultural market.

8.3.1 Market Drivers

There are numerous forces across the Agri-sector that are shaping the development of this domain. Here we introduce the most important ones:

- **World Population growth that leads to an increasing global demand for food and livestock monitoring and a rising interest in farm efficiency and productivity:** According to the Food and Agricultural Organization (FAO[15]), the agricultural production will have to produce 50% more by 2050 to satisfy the food demand, due to the growing world population. In addition to that fact, all regions of the world are projected to change positively their incomes what will led to increase the consumption of animal-based proteins such as meat, milk, eggs, etc.
  This urgent need to meet the global demand for food is leading to the search for new solutions to increase the efficiency and productivity of farms.
- **Growing adoption of modern technologies (Big Data, IoT, Blockchain, Automation, drones, etc.) in smart farming:** The usage of new technologies for smart farming is providing numerous benefits to the Agri-sector: precision agriculture solutions are increasing crop yields, enhancing ecological efficiency, optimizing water consumption, enhancing production technologies or pest management, among others.

Here we present how the adoption of new technologies is impacting the Agri-sector:

Technology	Impact on Agri-Sector
Internet of Things (IoT)	IoT to collect and process information from sensors on the production and the farm
Artificial Intelligence	Identification of plant disease, predictive analysis, etc.
Big Data	Support the decision-making process in different farm processes such as intelligent irrigation systems, weather prediction and alert, pest management and control, etc.
Global Navigation Satellite System (GNSS)	Soil monitoring systems, farm machinery guidance, etc.
Automation and Robotization	Reducing the need of human workforce for some agricultural works
Drones	Monitoring and analysis of crops and soils, management irrigation, etc.
Blockchain	Improvement of transparency, accountability, agricultural insurances, food traceability, etc.
Augmented Reality	Pest/insect detection process, analysis of soil, crops, etc.

[14] https://www.grandviewresearch.com/industry-analysis/farm-management-software-market
[15] FAO. 2017. The future of food and agriculture – Trends and challenges. Rome.

Table 10. Impact on Agri-Sector of new technologies

- **Increased governments support and new initiatives for the adoption of smart farming:** At EU level, the EU's Common agricultural policy (CAP[16]) is a policy for farmers and funded by the EU. CAP aims at supporting farmers to improve and increase productivity, tackling climate change, maintaining rural areas, etc.

During 2018, EU supported farmers with €58,82 Billions, split into a) income support to ensure incomes stability, b) market measures to deal with unexpected market situations such as abrupt drop in demand or fall in prices, and c) rural development measures to face rural needs and challenges.

The next picture depicts the CAP funding during 2018:

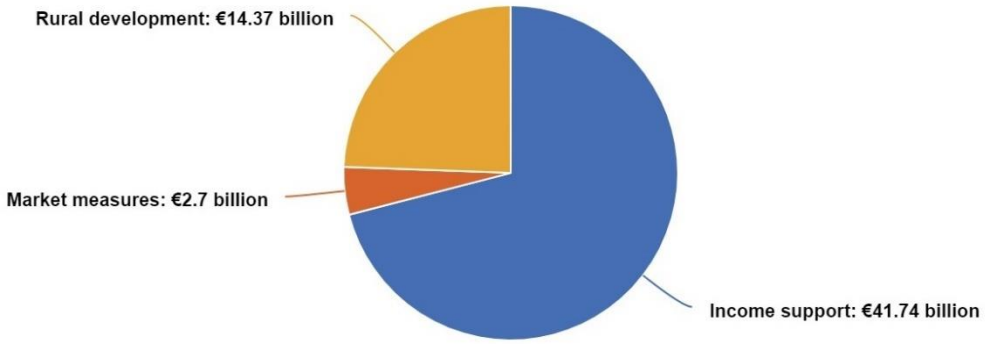

Figure 5. CAP financing during 2018[17]

For the next eight years (2021-27), the EU has proposed that the CAP will address nine objectives:

Figure 6. CAP's objectives for 2021-27 period[18]

There is no doubt that the adoption of smart agriculture by farmers will help to meet the objectives proposed by the EU and a great part of the CAP's funding will go to adopt new technologies in the Agri-sector.

[16] https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/cap-glance_en
[17] https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/future-cap_en
[18] https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/future-cap/key-policy-objectives-future-cap_en#nineobjectives

- **Increase in greenhouse farming:** Greenhouse farming system has demonstrated its effectiveness in intensifying food production[19], and this kind of systems represent a convenient alternative for ensuring food production. Greenhouse farming market is growing due to the increasing need to ensure food demand, and the need to improve the yield of crops and reduce crop waste[20]. Furthermore, the increasing demand for greenhouse farming is fuelling the growing need for technological solutions for greenhouse crop monitoring and controlling. The global indoor technologies market is expected to grow at a CAGR of nearly 20% from 2018-2022[21].

8.3.2 Market Restraints

The most limiting factors that influence the adoption of new technological solutions in agriculture are:

- **High initial capital investment, due to the still high price of the equipment and increasing price of advanced technologies:** The high prices of sensors and technologies in agriculture are still limiting the eruption of smart farming market. Farmers generally don't like to take risks and invest, and that is one of the reasons why farmers still see the digitalizing their farms as a large financial outlay without knowing exactly the return on investment. Farmers prefer to invest on proved and trusted technology.
- **Lack of knowledge of advanced technologies among the farmers:** The adoption of new technologies in agriculture lags other sectors due to the lack of technical knowledge of farmers, and the farmers' culture. There is still a great knowledge gap to overcome and educating and creating awareness on benefits of new technologies application is needed.

8.3.3 Opportunities

Here we present some of the trends in agriculture that represent significant growth opportunities for the smart farming market to grow:

- **Increasing focus on sustainability:** The greater focus on sustainability has affected the Agri-sector, and it is extended to all the agribusiness value chain: from farmers, to preserve the productivity of the soil in the long-term, to food companies, demonstrating a sustainability approach to engage consumers.
- **Rising consumer focus on healthy / clean label foods:** An increasing customers' commitment to a clean-label food has led to a shift in Customers' food preferences a more healthy, organic and sustainable.
- **Growing adoption of monitoring solutions for livestock in developing countries:** The evolution in protein demand due to the increase in the population's income has led to apply new technologies to the livestock monitoring and welfare.
- **Rising penetration of high-speed internet in remote areas:** The availability of internet in rural areas is enabling the use of new technologies and farming applications.
- **Technological advancement and extensive R&D in agriculture:** Local governments and EC are promoting and financing R&D in agriculture with specific funding programmes, encouraging the collaboration among different actors of the agricultural value chain such as farmers, SW/HW providers, suppliers, food companies, etc.

[19] International Journal of Environmental Research and Public Health 2020. An Analysis of Global Research Trends on Greenhouse Technology: Towards a Sustainable Agriculture
[20] https://www.businesswire.com/news/home/20180429005067/en/Global-Indoor-Farming-Technologies-Market---Increasing-Need-for-Food-Security-to-Boost-Growth-Technavio
[21] https://www.businesswire.com/news/home/20180429005067/en/Global-Indoor-Farming-Technologies-Market---Increasing-Need-for-Food-Security-to-Boost-Growth-Technavio

- **Growing labour costs:** The labour costs are annually growing as reported by Eurostat[22]: "Hourly labour costs rose by 2.6% in the euro area (EA19) and by 3.1% in the EU28 in the third quarter of 2019, compared with the same quarter of the previous year".
- **Growing economies such Brazil, China and India provide a huge opportunity in the smart agriculture market:** Increasing populations in these countries and the needs to improve crop yields is driving the adoption of new technologies to increase farm productivity.

8.3.4 Challenges

To fully leverage the opportunities for the adoption of new technologies in Agri-sector, there still are significant technical challenges to overcome:

- **Management and aggregation of large volumes of data:** Business Insider Intelligence predicts there to be nearly 12 million agricultural sensors installed globally by 2023[23] and growing. IBM also estimates that an average farm will generate half a million data points per day[24]. This great amount of data from different types of sensors, devices, and other sources, with different formats must be correctly managed to get actionable insights as well as developing tools that collect, store and share data along the entire agriculture value chain.
- **Lack of standards regarding IoT protocols, integration and for interoperability:** The rapid increase of technological solutions for agriculture developed by different providers has made that arise interoperability and integration issues among them. In addition to this, the lack of standards of IoT protocols has worsened these issues. In 2015 and 2016, FAO[25] and ITU[26] jointly developed the "e-Agriculture Strategy Guide"[27] which aims at helping countries to adopt ICT into agriculture and develop strategies aligned with agriculture needs and priorities.
- **Data ownership and data security:** Farmers generally are reluctant to share their data, and the challenges of data ownership and security are not still properly addressed. Farmers are increasingly aware of the benefits of the Big Data but the expressed strong doubts on the ownership and security of their data.
- **Demonstrate cost-effectiveness of farming digitalisation:** As said before, farmers are not used to take investment risks when it comes to their farms, so to make investments in new technologies adoption they need to know the return on investments and the impact on farm productivity.

8.4 Competitor Analysis

There is a myriad of technological solutions to meet farmers' need in their farm production processes, which are being provided by different key actors from the agriculture value chain and from ICT sector.

Within DEMETER project, 25 pilots are being implemented to address different challenges for farmers. The pilot outcomes will become technological assets that will be provided through DEMETER platform to its stakeholders. However, DEMETER's goal goes further and aims at providing services and support to its stakeholders, from farmers to technology providers.

[22] https://ec.europa.eu/eurostat/documents/2995521/10081906/3-16122019-BP-EN.PDF/0f448edc-6195-5c2b-01d9-479ddecf0979
[23] https://www.businessinsider.com/smart-farming-iot-agriculture
[24] https://www.ibm.com/blogs/industries/yara-digital-farming-platform/
[25] www.fao.org
[26] www.itu.int
[27] http://www.fao.org/in-action/e-agriculture-strategy-guide/en/

It is difficult to identify a competitor in the market with the same novel farmer-centered approach than DEMETER, so here we have tried to make a classification of the existing players in the market who can provide similar or partial solutions as DEMETER's.

We have created two types of segmentations when looking at competitors: by type of competitor and by type of solutions.

- **By type of competitors**: They are competitors to the DEMETER platform but could also be potential partners to join it:
    - **Agriculture equipment producers/ Original Equipment Manufacturers (OEMs) (i.e. John Deere[28], AGCO Corp.[29], etc.):** Traditional OEMs in agriculture that are also providing technology solutions or adding software or communication capabilities to their equipment. For example, through the years, John Deere has included technology capabilities to their engines and tractors such as GPS or self-driving, and now it offers a platform to integrate data from machinery and sensors[30].
    - **Agrochemical and Seeds companies (i.e. Monsanto[31]):** Big Seed companies, mostly American that are offering technological solutions to farmer to leverage the digitalization opportunity**.** Monsanto, a key player in the global seeds market, now is expanding its business model to Ag-tech (agricultural technology) solutions and has developed "Monsanto's Integrated Farming Systems"[32] which provides recommendations to help farmers to better manage production by using precision agriculture technology.
    - **IT and Big Data solutions global providers (i.e. IBM, Microsoft, Google):** Big IT players such as IBM, Microsoft or Google have developed Big Data/IoT/AI specific solutions for Agriculture sector. IBM agriculture[33] combines AI, data analytics and predictive analysis with IoT data; Microsoft is partnership[34] with SMEs working in the agriculture sector to leverage Microsoft Azure capabilities in the agriculture field, besides it has developed Microsoft FarmBeats[35] that enable aggregation of agriculture datasets and provides actionable insights using AI or ML.
    - **Solutions providers (monitoring solutions, drone and sensor solutions, etc.) and Start-ups (developing ICT components, robots, drones, sensors and apps**): Medium size companies and SMEs are providing technology solutions and developing ICT components, like sensors, drones, irrigation systems, etc. for precision farming technologies. They usually focus on meeting a concrete need within a type of crop, livestock, etc. or developing electronic devices or apps specifically for agriculture. We can classify them as: a) device manufacturers, b) Software application providers or apps providers, c) Satellite providers, and c) Unmanned Aerial Vehicles (UAV) providers which provides drones, sensors, control systems.

[28] https://www.deere.com/en/index.html
[29] https://www.agcocorp.com/
[30] https://www.ces.tech/Articles/2019/John-Deere-Provides-Tech-Solutions-in-Agriculture.aspx
[31] www.monsantoglobal.com
[32] http://www.monsantoglobal.com/global/za-en/improving-agriculture/pages/inside-agronomic-solutions.aspx
[33] https://www.ibm.com/products/agriculture
[34] https://blogs.microsoft.com/blog/2019/08/07/harnessing-the-power-of-ai-to-transform-agriculture/
[35] https://azure.microsoft.com/en-us/blog/democratizing-agriculture-intelligence-introducing-azure-farmbeats/

- **R&D project (collaboration among Universities, industry, research centers, etc.):** Governments and CE are promoting R&D in the agriculture field and many projects are arisen in which they are developing novel solutions and prototypes applying new technologies to agricultural problems.

- **By type of solution**: They are existing solutions/platforms in the market that could be a potential competitor to the DEMETER platform as they provide some of the same services as DEMETER. These solutions/platforms have different maturity levels or business models, from current marketed solutions to R&D projects:
  - **General agriculture Platforms:** Platforms that offer services mostly to farmers.
  - **Software solutions specialized in specific applications:** Solutions for specific farmer needs, such as irrigation systems, soil monitoring, diseases prediction, pest management, etc.
  - **Platforms and marketplaces offering different agriculture resources and services:** Platforms and marketplaces that provide technological resources, mostly targeted to SW/HW providers working in the Agriculture sector, to help them to create their solutions and reduce the time to market.
  - **R&D Agricultural Technology project results:** They are project results, platforms or solutions using new technologies, for agriculture sector. Most of them have not achieve an advanced TRL[36] yet to be commercialized.

Annex A includes a list of the main platforms, solutions and EU projects that could be considered potential competitors to the DEMETER platform.

8.4.1 SWOT analysis and DEMETER positioning

After the competitor analysis, we can extract some insights:

- Big players (IT, OEMs or Seed companies) have developed technological solutions to drive the digitization of Agri-sector, but most of them are proprietary solutions that imply vendor lock-in and create interoperability and integration issues with other providers' solutions and devices.
- SW providers (SMEs and start-ups) are trying to develop OS solutions to avoid interoperability problems, although this means they must cope with all the existing protocols and standards. Some have also specialized in using a very specific technology to address just a very concrete set of needs.
- R&D projects results usually have two problems: the outcomes do not achieve a high TRL and on the other hand, they do not define a successful sustainability strategy for the R&D results after the project lifetime.

8.4.1.1 SWOT Analysis

DEMETER novel approach tries to meet the Agriculture value chain stakeholders' needs and overcome all the limitations for adopting technological solutions identified in the Agri-sector. DEMETER aims at providing a solution capable of competing with the existing market landscape.

[36] See TRL defined by the EC
https://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/annexes/h2020-wp1415-annex-g-trl_en.pdf

Here we present a preliminary SWOT[37] analysis of DEMETER platform after the competitor analysis. This ever-evolving analysis will be refined during the project lifetime and in subsequent workshops among stakeholders.

[37] SWOT analysis (or SWOT matrix) is a strategic planning technique used to help a person or organization identify strengths, weaknesses, opportunities, and threats related to business competition

	STRENGTHS	WEAKNESSES
INTERNAL	• Farmer-centered project to empower farmers • Strong consortium composed of relevant actors of the Agri-sector • DEMETER approach to engage farmers and IT providers to jointly develop technological solutions • DEMETER includes all the needed input to create a whole agriculture solution • DEMETER platform aims to attract all the stakeholders of the agricultural value chain • Support a wider adoption of interoperability standards • Provides an elementary building blocks mapped into a comprehensive Reference Architecture • Open Collaboration Space to engage farmers and help them to join their strengths for accessing to digital technologies • Possibility of providing real input of farmer needs to IT providers	• High dependency from farmer contribution and validation of solutions • Complexity in understanding the use of DEMETER platform by IT suppliers • Different TRL of the solutions developed within each pilots • Low maturity level of DEMETER platform • Many actors involved in the development of DEMETER platform • Not clear yet the sustainability strategy for pilots and for DEMETER platform
	OPPORTUNITIES	**THREATS**
EXTERNAL	• Increasing demand for farming digitalization • Lack of platforms in the market with a farmer-centric approach • Raising of farmers' awareness in increasing productivity while increasing profitability • Governments' support to farmers to adopt smart farming	• Poor knowledge of agriculture technologies by farmers • Lack of skills in internet use and limited access to new technologies • Failed definition of a robust and realistic sustainability plan • Unsuccessful identification of the DEMETER Business Model • Unsuccessful definition of Sustainability strategy

Figure 7. DEMETER SWOT Analysis

8.5 Farmer Segmentation

The need for data-driven solutions for farmers will increase with digital data being generated at a rate of 40 zettabytes per year by 2020 with over four million data points on average being generated daily on-farm by 2034[38] .

The global farm data management system market is anticipated to exhibit high growth during the coming years. According to TechNavio it is expected that the global farm data management software market is going to grow at a compound annual growth rate (CAGR) of 16.81% up to 2022[39] . Similar predictions can be found in other industry reports such as Markets and Markets, which claims that the global farm data management software market is expected to grow to €3.5 billion by 2022, at a CAGR of 17.2%[40] .

This is further backed up by Goldman Sachs who concluded that the total addressable market for farm records and data management could be €30 billion globally[41] .

In order to reach out the farmer ecosystem and better know its characteristics and needs, we have carried out a preliminary classification of farmers and analysed the most relevant aspects from DEMETER project applied to each type.

The preliminary farmer classification is:

- Large Scale Farms
- Smaller Scale Farms
- Smaller/Local Farmer purchasing & producer Groups
- Farmer Cooperatives
- Farm Organizations & Associations

Firstly, we provide information about the characteristics of each type of farmer. The tables below provide the potential DEMETER End Users within each type of farmer, the farmers characteristics, and information about the market.

DEMETER End User	
Large Scale Farm	Farm owner Farm manager Farm employees Farm family
Smaller Scale Farmer	Farm owner Farm family

[38] OnFarm, BI Intelligence Estimates (2015)
[39] Hristoski, I. et al. *Farm Management Software for Increased Productivity and Competitiveness.* Paper presented at the International Balkan and Near Eastern Social Sciences Congress Series, Kirklareli.
[40] Hristoski, I. et al. Farm Management Software for Increased Productivity and Competitiveness. Paper presented at the International Balkan and Near Eastern Social Sciences Congress Series, Kirklareli.
[41] Revich, J., Boroujerdi, R. D., Scott-Gall, H., Archambault, P., Koort, R., Nannizzi, M., Burgstaller, S. (2016). Precision Farming: Cheating Malthus with Digital Agriculture

DEMETER End User	
Smaller/Local Farmer Purchasing & Producer Groups	Purchasing and producer groups (typically 10 – 50 members)
Farmer Cooperatives	Co-op board Co-op members Advisors Sales Dept Procurement Dept
Farm Organizations & Associations	Technology and innovation committees Farm business committees

Table 11. Potential DEMETER end users considering farmer classification

Farmers customers characteristics	
Large Scale Farm	Highly-functioning and visionary farmers interested in boosting productivity Farms generally focused on one main farm production system (dairy, arable, fruit etc.) Operations which have already adopted precision agriculture and precision livestock farming Highly visible and reference-able in the industry
Smaller Scale Farmer	Farmers interested in Agri-technology but lacking expertise Family oriented operation that combines traditional knowledge with technology aspirations Operating mixed production enterprises
Smaller/Local Farmer Purchasing & Producer Groups	Group administrators Typically focused one main farm production system Price-sensitive groups looking to leverage economies of scale
Farmer Cooperatives	Co-op board Highest performing co-op members Advisory and extension staff

Farmers customers characteristics	
	Procurement and sales staff with experience of using Supply Chain Management (SCM) systems
Farm Organizations & Associations	Technology and innovation executive staff and committees Policy executives and chairs Training and Education Staff

Table 12. Main Characteristics of farmers types

Market Characteristics	
Large Scale Farm	Early adopters of technology in what is a conservative market Willingness to invest in digital solutions Relatively younger farmers and employees in comparison to the average age of farmers Underserved by existing data-driven solutions Ambitious and eager to scale but in a measured way Productivity focused UX is a high priority
Smaller Scale Farmer	Later adopters of technology More sensitive to return on investment, technology must be proven to work Technology investment likely to be a lower priority Closer to standard farm demographics such as age, farm income and farm size The farm family is more likely to be the decision-making unit
Smaller/Local Farmer Purchasing & Producer Groups	High trust between members Decision making is consensus driven Willingness to invest in digital solutions with consensus Cost and price driven Inclusive Collaboration and sharing of info are a high priority Strong negotiators

Market Characteristics	
Farmer Cooperatives	Early adopters Underserved by existing SCM and farm management software solutions Productivity focused Experience using enterprise systems so UX is not a top priority
Farm Organizations & Associations	Represent farmers across the range of digital capabilities – digital solutions must work for all Policy focused Decision making is committee and consensus driven Conservative in new technology advocacy and promotion Some operate affinity partnerships to offer better value services to members – telecoms, energy etc.

Table 13. Market characteristics of farmers

Size of Market	
Large Scale Farm	1.73 million farms in the EU with output =+ €25,000. This equates to 16% of all EU farms
Smaller Scale Farmer	7.5 million farms in EU with output < €10,000 1. This equates to 69% of all EU farms
Smaller/Local Farmer Purchasing & Producer Groups	There are 3,400 recognised producer groups in EU with the fruit and vegetable sector representing 52% of these groups followed by at 39%.
Farmer Cooperatives	There are approximately 22,000 cooperatives in the EU consisting of approximately 6 million members
Farm Organizations & Associations	Copa & Cogeca represent 60 EU farming associations with a further 36 partner organisation

Table 14. Size of Market for Farmers

Key Ecosystem Partners/Players	
Large Scale Farm	Precision agricultural and machinery companies Broadband and telecoms infrastructure providers Farm software and hardware vendors Local, national and European authorities for regulatory and compliance elements often available and delivered online

Key Ecosystem Partners/Players	
	Agri-advisors, merchants and co-ops
Smaller Scale Farmer	Broadband and telecoms infrastructure providers Machinery and equipment companies and service providers Local, national and European authorities for regulatory and compliance elements often available and delivered online Agri-advisors, merchants and co-ops
Smaller/Local Farmer Purchasing & Producer Groups	Input suppliers, processors, suppliers Broadband and telecoms infrastructure providers Machinery and equipment companies and service providers Local, national and European authorities for regulatory and compliance elements often available and delivered online Agri-advisors, merchants and co-ops
Farmer Cooperatives	Farmer members Distributors Retailers Enterprise software and hardware vendors
Farm Organizations & Associations	Farmer members Local and national government European Commission Other EU and world farming associations and organisations Affinity partners

Table 15. Key Ecosystem Partners/Players for farmers

Next, we provide information about DEMETER benefits, applications and competition considering this farmer classification.

DEMETER benefits for farmers	
Large Scale Farm	Reduced administration Time savings Cost savings Increased productivity

DEMETER benefits for farmers	
	Interoperability with new and existing technologies Advanced predictive and forecasting capabilities Greater intelligence and insight Year-on-Year optimisation Lowering environmental impact DEMETER can support farms as they grow and expand their operations through access to additional DEMETER features Transparent data sharing and privacy Peace of mind
Smaller Scale Farmer	Reduced administration Time savings Cost savings Increased productivity Demonstrable Return on Investment (ROI) Interoperability with new and existing technologies Enhanced collaboration with advisors Lowering environmental impact DEMETER can support farms as they grow and expand their operations through access to additional DEMETER features Transparent data sharing and privacy Peace of mind
Smaller/Local Farmer Purchasing & Producer Groups	More effective group administration Inclusivity for all members Time savings Cost savings Interoperability with new and existing technologies across group members Increased benchmarking capabilities Increased productivity Greater collective bargaining ability through better information and data insights

DEMETER benefits for farmers	
	Advanced predictive and forecasting capabilities Greater intelligence and insight Year-on-Year optimisation Lowering environmental impact DEMETER can support farms as they grow and expand their operations through access to additional DEMETER features Transparent data sharing and privacy Peace of mind
Farmer Cooperatives	Enhanced support and advice targeting and management Enhanced collaboration and relationship management with members Enhanced sales targeting Procurement foresight moving towards Lean/JIT procurement through access to aggregated data via DEMETER Better marketing due to greater insights into production levels, seasonal sensitivities etc.
Farm Organizations & Associations	Ensuring access to digital capabilities for farmers of all digital experience levels Drive awareness and adoption of digital technologies for betterment of the industry Potential to remove sole reliance on extension agents

Table 16. DEMETER benefits for farmers

DEMETER Competition	
Large Scale Farm	Pen and paper Spreadsheets Other data-driven technologies and farm software management systems Modular sensor and IoT providers
Smaller Scale Farmer	Pen and paper Spreadsheets Other data-driven technologies and farm software management systems Modular sensor and IoT providers

DEMETER Competition	
	Full-stack advisory and extension agencies
Smaller/Local Farmer Purchasing & Producer Groups	Pen and paper Spreadsheets Productivity and collaboration software suites Other data-driven technologies and farm software management systems with collaborative and data governance features Modular sensor and IoT providers
Farmer Cooperatives	Enterprise software solutions and support Other data-driven technologies and farm software management systems with collaborative and data governance features
Farm Organizations & Associations	Other digital and data integration platforms offering valued added reseller (VAR) solutions and packages

Table 17. DEMETER competition within each farmer type

Complementary Assets required	
Large Scale Farm	Computer and smartphone Web connection Email Proficiency in using DSS, analytics and reporting software IoT networks Provision of technical support and onboarding documentation
Smaller Scale Farmer	Smartphone Web Connection Email IoT networks Basic proficiency in using Decision Support Systems (DSS) Phone/video access to technical support and onboarding agents
Smaller/Local Farmer Purchasing & Producer Groups	Computer and smartphone Collaboration software Web connection

Complementary Assets required	
	Email Proficiency in using DSS, analytics and reporting software IoT networks Provision of technical support and onboarding documentation
Farmer Cooperatives	Same as above
Farm Organizations & Associations	Same as above

Table 18. Complementary assets required to use DEMETER by farmers

Annex B provides information about total number of farms as well as a breakdown of farm types across EU.

As DEMETER consortium is extended to Georgia country, Annex C provides comprehensive information on Georgia farmer sector.

9 EU Context

9.1 Digital Transformation and the DEI Policy

As mentioned along this document, DEMETER addresses some of the challenges and opportunities of the digitization of the agrifood sector. Digital Transformation of not only the food value chain, but the European industry as a whole is the focus of the *Digitizing EU Industry Policy (DEI).* With four major pillars, it intends to make a sound impact on the level of adoption of digital technologies by European companies, looking not only at pure technical aspects, but also including elements like skills and barriers that many players (but especially those that work is low-digitized sectors or are small in terms of size) usually encounter when they design their digital transformation path, such as understanding the value of the technology, pricing and business models or access to testing infrastructure ("test before you invest" services) and capital/funds. The following diagram illustrates the four pillars put in place in the last years to overcome such challenges.

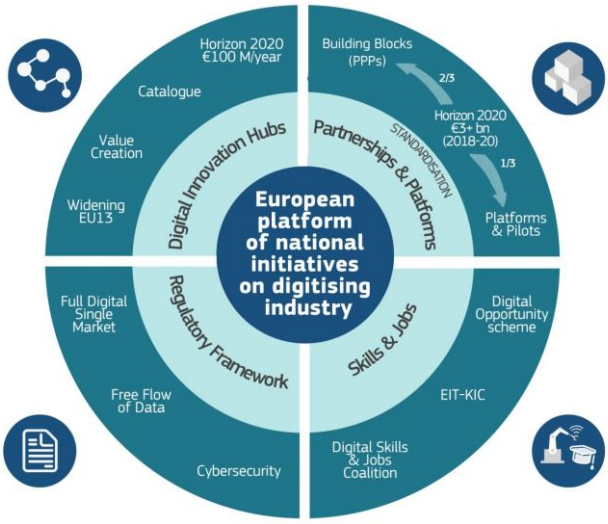

Figure 8. Pillar of the DEI Policy (source: European Commission, DG CNECT)

- DEMETER contributes essentially to the pillar of Partnerships and Platforms, supplying solutions and platforms that foster interoperability among vendors and give tools to maximize the usage of data, increasing competitiveness of the different stakeholders of the value chain. Other projects like ATLAS address similar objectives and build upon experiences of former initiatives such as IoF2020.
- Digital Innovation Hubs are initiatives that act as one-shop-floor for actors that are working in their digital transformation and need support for any of the barriers mentioned above. They usually have a service portfolio customized to the needs of the local industries they serve, since one of their main benefits is that they are located within easy reach by the stakeholders that benefit from those services (this includes the use of the same language). SMEs and startups are two of the main target communities but others are not excluded. While some DIHs focus on concrete vertical sectors, others specialize on a range of technologies that can be applied across sectors. In the last years the amount of DIH has increased enormously, with a high impact at political level and financial support by regional, local and national governments. In the latest period some projects have been working on supporting the collaboration between DIH so that users can benefit from services offered through other DIH. Following that collaboration spirit the Digital Europe Program will foster a network of the so called European DIHs. DEMETER is using the existing DIHs working in the agrifood domain as a network to disseminate the benefits of our approach and facilitate on the one hand

gathering feedback on our work and on the other hand fostering adoption of our enablers through their channels.

- Regarding skills and the regulatory framework, even though they are considered key to succeed in the transformation of the sector, DEMETER makes a less important contribution. Still, we are setting up activities looking at facilitating the adoption of the technology and ensuring understanding through training sessions. D6.4, as part of the Impact WP, provides a good overview of the legal and regulatory framework associated to the particular area of agrifood.

9.2 Towards a Data Economy

In the last years we have seen a very active development of the data landscape in Europe, both at technology and regulatory levels. The European Big Data value Partnership was signed in October of 2014 and since then a portfolio of more than 50 projects has been funded in the area of data involving technologies for data management, data infrastructures, data visualization, data analytics, data incubation and more recently, data platforms addressing the use of personal data, industrial data or both. A glimpse of the projects of such program can be found here[42], of which some have made (or are still in the process) important contributions to the data-driven transformation of the agrifood sector, such as DataBio (large scale pilot for bioeconomy), BigDataGrapes or ExtremeEarth, to name a few.

From a policy point of view, some of the relevant initiatives that have been pushed forward in the last years include (besides the Digitizing European Industry Strategy previously mentioned): the European Strategy for data, directive on Free flow of non-personal data, European data governance (Data Governance Act) and the Strategy for artificial intelligence. In the current context and especially looking at making AI applications possible, one of the main efforts is that of fostering data sharing and in general making data available (through platforms, marketplaces, etc). The Digital Europe Program will precisely address the implementation and operation of the so-called Data Spaces. Agriculture is in fact one of the domains where such data spaces will be promoted and as such, in the last months many discussions have been carried out in order to understand what a data space is, how it can be used, which building blocks should be part of that infrastructure and which standards should be promoted. The OPEN DEI project is in fact leading an activity aiming at identifying such building blocks and existing implementations that could already be capitalized as well as identifying embryonic data spaces that could serve as example of the future data sharing infrastructures.

[42] https://www.big-data-value.eu/

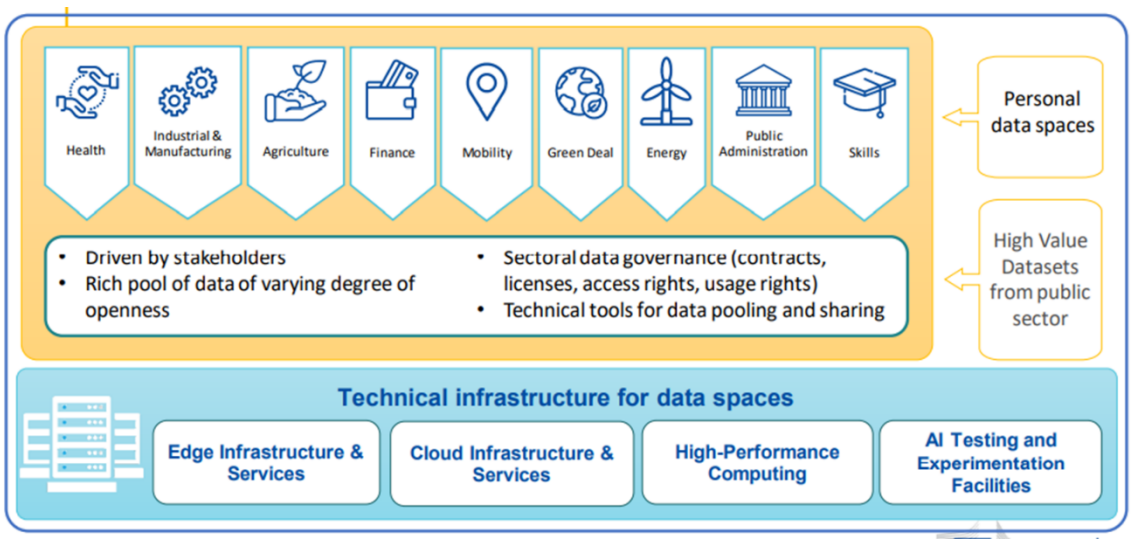

Figure 9. European Data Spaces (source: European Commission)

In October 2019 some initial thoughts on needs and challenges about this concept were shared by major players in the domain[43]:

- New data supply chains that have the potential to redefine the role of farmers; some of the use cases that could grasp value out of data are: Improved use of resources (seeds, fertilisers, machinery) through precision farming techniques, yield (gap) forecasts or reduction of bureaucratic burden in reporting.
- Because of the potential speculation on prices for agricultural commodities and other harming effects of data sharing, farmers are careful when talking about sharing data. This does not mean that they are against sharing data; in essence "they are willing to share data generated on their farm with government organisations and with commercial organisations in an environment of trust, with respect to specific use cases and when there is (also) a direct benefit for the farmers themselves". This highlights the need for a trusted environment where data sovereignty can be guaranteed. Good examples on data value and new business models is also an emerging area of work to encourage actors to take a step forward.
- Distinction between personal and non-personal data is still an issue, since sometimes this depends on the context where the data is used. Initiatives like the Code of Conduct can help in that. For data generated by machines, such as IoT data, data ownership may also be a conflicting point.
- Data sharing architectures driven by standards and interoperability are key in order to create interesting and balanced business cases where different players get a value as a result to their contribution to the ecosystem. DEMETER plays precisely in this area. The future Support Centre for data sharing (one of the investments of the DEP) will contribute to provide guidance on (i) examples of successful data sharing arrangements, (ii) technical means enabling data sharing and (iii) legal guidance as well as model contract clauses.

More recently other workshops have gone deeper into some of these topics. Specifically the workshop "How to build a common European Agriculture Data Space" held by DG CNECT in September 2020 highlighted the relevance of working on the federation of existing data sharing platforms and initiatives, acknowledging that there will probably not be a single agreed standard, but several

[43] Conclusions extracted from the reports of the workshops on "common European data spaces", July to November 2019 held by DG CNECT, European Commission.

standards will co-exist. From a technical point of view, the preference is also on distributed architectures building on public-private cooperation.

One of the areas where DEMETER is working in cooperation with other projects and that may have an impact on the future Data Spaces for Agriculture is semantic interoperability. AIM appears as a sound contribution and is being discussed with other players and initiatives. DEMETER is also fostering the dialogue on this topic by organizing and contributing to diverse events and workshops (the recently organized workshops at the *Digital Around the World* event, the *European Big Data Value Forum* or the upcoming *Data Week* in May 2020 are examples of this; a complete record of activities can be checked in D6.5.

10 DEMETER Exploitation and Sustainability strategy

DEMETER is a large-scale project involving 60 partners from the demand and supply side of the Agriculture value chain. DEMETER develops 20 pilots across 18 countries, and over 38.000 sensors and devices are being deployed through 25 deployment sites. So, one of the most important challenges of the DEMETER consortium is to ensure the sustainability of DEMETER outcomes after the project ends.

Although the project is still in an early stage, the DEMETER exploitation strategy approach is structured as depicted in the figure:

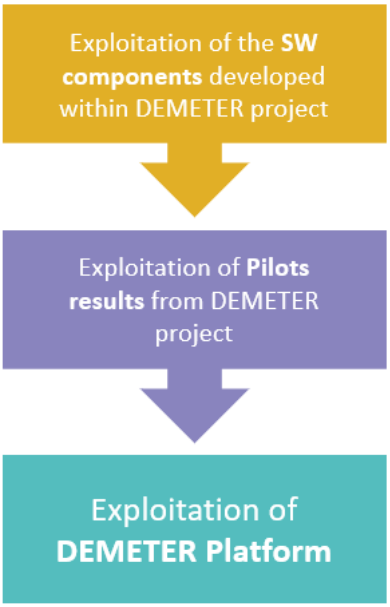

Figure 10. DEMETER exploitation structure

The DEMETER exploitation strategy will have three parts:

- **Exploitation of the SW components developed by partners within DEMETER project**: SW providers that are developing SW components within DEMETER project will draw up their individual exploitation plans to show their exploitation intentions with their developments as standalone software and exploit them in future R&D projects (if the Technology Readiness Level (TRL) achieved is low) or commercialize them (if TRL is high)
- **Exploitation of the Pilots results:** Groups of partners with different profiles are working together and implementing the DEMETER pilots. Each pilot will deliver an outcome consisting in group of SW components and use case knowledge. The groups of partners involved in each pilot will have to explore joint exploitation possibilities for pilots outcomes as well as for ensuring the sustainability after the project.
- **Exploitation of DEMETER platform:** Exploitation of DEMETER platform as a whole (Dashboard, SOCS, AIS, Enabler Hub, Enhanced-resources, Enabled-services, Enabled-applications), for which a business model will be defined. DEMETER platform exploitation will require different levels of involvement of DEMETER partners.

The exploitation team has elaborated 2 templates for partners and pilots to help them to draw up their exploitation plans and collect information on DEMETER exploitable assets such as ownership, exploitation license, TRL, etc. The starting point will be the initial list of components included within *D5.2 Revised Stakeholders requirements, pilots design, and specifications*. In addition, for the identification of the exploitation of DEMETER platform, a survey among partners will be circulated to

evaluate, a) technical requirements to exploit DEMETER platform, b) ideas on the best-suited business model for DEMETER platform, c) partners' roles in the joint exploitation, d) partners' willingness to participate in a future joint exploitation.

The outcomes of the templates and the survey will be reported in subsequent deliverable D6.3 Intermediate DEMETER exploitation plan in M18. This information will be the basis for a more detailed discussion during the project lifetime on the sustainability and exploitation of DEMETER results, in order to identify the most realistic and compelling path to ensure sustainability.

After D6.3 and till the end of the project, other activities among partners will be focused on joint exploitation and sustainability, as mentioned in Section 6: Business Model Workshop, Sustainability Workshop, and Final Business Model and Plan Workshop. These activities will help to shape the final joint exploitation proposed for DEMETER platform.

11 Conclusions

D6.2 analyses the market and business opportunities for DEMETER. As such it provides an insightful view on internal aspects associated to the project (DEMETER value proposition, innovation, benefits) and also external aspects (a view on the market and its size, competitors, the dynamics) and puts both of them in connection through a SWOT analysis and a reflection on the DEMETER positioning.

One of the areas where more effort has been devoted is the segmentation of the target market of DEMETER. This project is not about technology companies (suppliers) that develop something to be adopted by farmers (users). On the contrary, it addresses all players that can become suppliers or users depending on their specific role and context with respect to the platform. For different use cases the role may vary; for example, a farmer can be a provider of data or a user of data or combine both- Going deeper into this, we realize that needs of farmers can be different depending on many factors, such as size, geography or the type of business activity they have. That is why a detailed segmentation of farmers has also been included. The analysis of stakeholders is also done at pilot level in order to understand in depth the relationship between the technology and models provided by DEMETER and their use by the different actors involved in them. This gives us more hints on the different operational and deployment environments.

Several studies are referenced along the text for the analysis of the market size. For example, MarketsAndMarkets states that the smart agriculture global market is projected to reach $22.0 B by 2025, CAGR of 9.8% from 2020 to 2025. While the positive impact of digitization in many use cases seems obvious, there are still concerns and challenges to address when dealing with data, especially when it comes to data sharing or integration of heterogeneous data sources, some of them from outside the farmer's environment. As such, DEMETER is contributing to shape the concept of Common Agricultural Data Spaces.

The information of this deliverable triggers the discussion on the exploitation and future sustainability model of DEMETER, whose preliminary version is reflected in D6.3. Other deliverables add contextual information that will be used in our decision-making process, such as D6.4-. Marketing, dissemination and standardization activities led by T6.3 and T6.5 work in full alignment with T6.1 and are conveniently reflected in D6.5. Finally, it is worth noticing that to avoid a siloed approach, DEMETER combines the infrastructure and skills of the different WPs. In particular, WP6 works especially close to WP5 (pilots) and WP7 (Multi-actor approach).

Annex A List of Competitors

A.1. Traditional Players (IT, OEMs and Seed Companies)

Company	Profile	Description	Solutions
John Deere	OEM	Former multinational machinery provider, now reconverted into HW/SW/Smart Machinery/IT infrastructure provider mostly focused on precision agriculture technologies	Machinery with connected capabilities for automated guidance, devices for all types of applications, sensors, etc. The precision Ag Technology provides Operations Center for managing the information collected from sensors, Mobile Apps, etc. https://www.deere.com/en/technology-products/precision-ag-technology/
AGCO Corp.	OEM	AGCO is one of the largest machinery and equipment manufacturer focused on Agriculture.	AGCO provides "FUSE Smart Farming" that is a platform to collect information from sensors and machinery, supporting the entire farm operation. https://www.fusesmartfarming.com/
AgJunction	OEM	AgJunction is a leader of advanced guidance and autosteering solutions for precision agriculture.	In addition to their hardware offering, AgJunction has developed a suite of software solutions to support its machinery and hardware. This SW solutions are ISO TC BAS, ISO TEC GEO, ISO TC SC, ISO UT. It also offers cloud solutions for collecting data from machinery. https://www.agjunction.com/software
Dickey-john Corporation	OEM	Dickey-john provides an extensive offering of sensors and electronics for different agriculture uses.	Ground speed sensing, moisture testing, soil compaction testing, etc. http://www.dickey-john.com/products/agriculture/
CropMetrics	OEM	Hardware and software providers for irrigation management	CropMetrics provide irrigation management with virtual predictor technology https://cropmetrics.com/the-solutions/
Cropx	OEM	Hardware and software providers	They provide a solution for irrigation management that collect information from

Company	Profile	Description	Solutions
		for irrigation management. In January 2020, they have acquired CropMetrics to provide its offering with the cloud-based precision irrigation tools	soil sensors, weather stations, Topography maps, aerial imagery, etc. https://www.cropx.com/technology/
The Climate Corporation (Monsanto Corporation)	OEMS Agrochemical Company	Monsanto acquired The Climate Corporation, to merge it with its Integrated Farming System and Precision Planting divisions	Climate FieldView is the the digital farming software platform for decision making, provided by the company, to analyse the data from the entire farm operations. https://climate.com/features
IBM	IT	IBM is one of the software provider leaders in Cloud, AI, and IoT fields	IBM agriculture provides AI capabilities, data analytics and predictive insights through a customized platform for decision making. https://www.ibm.com/products/agriculture
Microsoft	IT	Microsoft has a partnership with several smart agricultural companies to extend its offering the Agri-sector	With Azure FarmBeats, Microsoft provides AI, Edge & IoT capabilities to Agriculture. https://www.microsoft.com/en-us/research/project/farmbeats-iot-agriculture/
Google	IT	Google is also acquiring start-ups working in the smart agriculture domain to extent its offering to Agri-sector	Google provides Cloud Computing, Analytics, AI, capabilities to solutions for farmers. www.cloud.google.com

A.2. Most innovative SMEs and Startups (providing solutions for precision agriculture)

Company	Profile	Description	Solutions
Mothive	Start-up	Agri-tech company that provides precision agriculture solutions for farm operations.	It provides Mothive Ladybird, a turnkey solution to provide farmers with information from the harvest, predict diseases and improve yields. https://www.mothive.com/
Arable Labs	SME	An innovative SME with huge experience in crop modelling, resource management	It provides an IoT-enabled irrigation management tool, weather station, and crop monitor for decision making.

Company	Profile	Description	Solutions
		and weather forecasting	https://www.arable.com/solutions_irrigation/
Ceres Imaging	Start-up	Ceres imaging is an aerial spectral imagery company	It provides high-resolution multispectral images that are captured via low-flying planes and processed using highly advanced image processing and crop modelling techniques https://www.ceresimaging.net/solutions
Gamaya	Start-up	Gamaya provides solutions for farmers using mapping and diagnostics of farmland	Gamaya provides a platform integrating remote sensing, hyperspectral imaging and AI. It has developed a tailor-made portfolio of digital imaging of products CaneFit and SoyFit. https://www.gamaya.com/solutions/canefit https://www.gamaya.com/solutions/soyfit
AgEagle	Start-up	AgEagle is a drone manufacturing and provider of agtech solutions using drones' data	It provides different solutions, such as Farmlens and HempOverview. https://ageagle.com/agriculture/farmlens/ https://ageagle.com/agriculture/hemp-overview/
PrecisionHawk	SME	PrecisionHawk is an information delivery company that combines unmanned aerial systems, remote sensing technologies and advanced data analytics to improve business operations and day-to-day decision making	It provides solutions for drones, sensors, crops insurance, vegetation indices, etc. https://www.precisionhawk.com/agriculture
AkerTechnologies	Star-up	AkerTechnologies develops smart in-season crop management tools to accelerate the adoption of precision farming practices across the industry	Aker has developed a patented computer vision and biometric sensor together with software and services to detect, classify, and measure pest pressure, crop diseases, etc. https://aker.ag/services/monitoring-reporting/
OneSoil	Start-up	OneSoil develops web and mobile precision	

Company	Profile	Description	Solutions
		farming apps that are based on satellite imagery and machine learning technologies	

A.3. Platforms and Marketplaces

Project	Description
FIWARE	FIWARE is a "curated framework open-source platform components to develop smart solutions[44]". Using the open-source components of the platform, FIWARE proposes the use for Smart Agrifood and define a "Reference Architecture of Smart Farm Management Systems powered by FIWARE"
AgriMetrics	AgriMetrics is a Data Marketplace for Food and farming sectors, in order to monetise agri-food data. This marketplace is mostly targeted for farmers and food companies.
Api-Agro	Api-Agro is a data exchange platform for agricultural sector. It offers the means to disseminate data and control the destination and also offer an open catalogue or raw and aggregated data and support to develop data-driven solutions for agriculture.

A.4. European Projects (ongoing)

Project	Description
AfarCloud	AfarCloud is an Industry4.E lighthouse project composed of 59 partners. It provides a "distributed platform for autonomous farming that will allow the integration and cooperation of agriculture Cyber Physical Systems in real-time in order to increase efficiency, productivity, animal health, food quality and reduce farm labour costs"[45].
IoF2020	Over 120 partners from the agriculture value chain are participating in IoF2020 project. This project aims at developing, testing and demonstrating IoT technologies in an operating farm environment[46].
Atlas	Atlas aims at "building an open an open, distributed and extensible data Interoperability Network, based on a microservice architecture which will offer a high level of scalability from a single farm to a global community"[47]. The technology developed within the project will be tested and validated through four use cases: precision agriculture tasks, sensor-driven irrigation management, data-based soil management and behavioural analysis of livestock.
AI4EU	AI4EU project aims at "building the first EU Artificial Intelligence On-Demand Platform and ecosystem[48]". One of the experiments within this project is called AI4Agriculture, focused of the quality and production of grapes and implemented in Ribera del Duero wine region in Spain. The objectives of the pilot are assessing the quality of the grapes, counting

[44] https://www.fiware.org/about-us/
[45] https://industry4e.eu/project/afarcloud/
[46] https://www.iof2020.eu/about
[47] https://www.atlas-h2020.eu/objectives/
[48] https://www.ai4eu.eu/about-project

Project	Description
	the number of grapes and predicting the harvest yield[49], using drones and AI.
CYBELE	CYBELE project aims at "generating innovation and create value in the domains of agri-food by implementing Precision Agriculture and Precision Livestock Farming methods[50]". CYBELE will provide High-Performance Computing (HPC) solutions to process very large datasets and will facilitate data sharing and interoperability.

[49] https://www.ai4eu.eu/ai4agriculture
[50] https://www.cybele-project.eu/the-project

Annex B Farmer Segmentation Market

B.1. Total Numbers of Farms EU (2016)

The information provides is extracted from EUROSTAT[51] 2016.

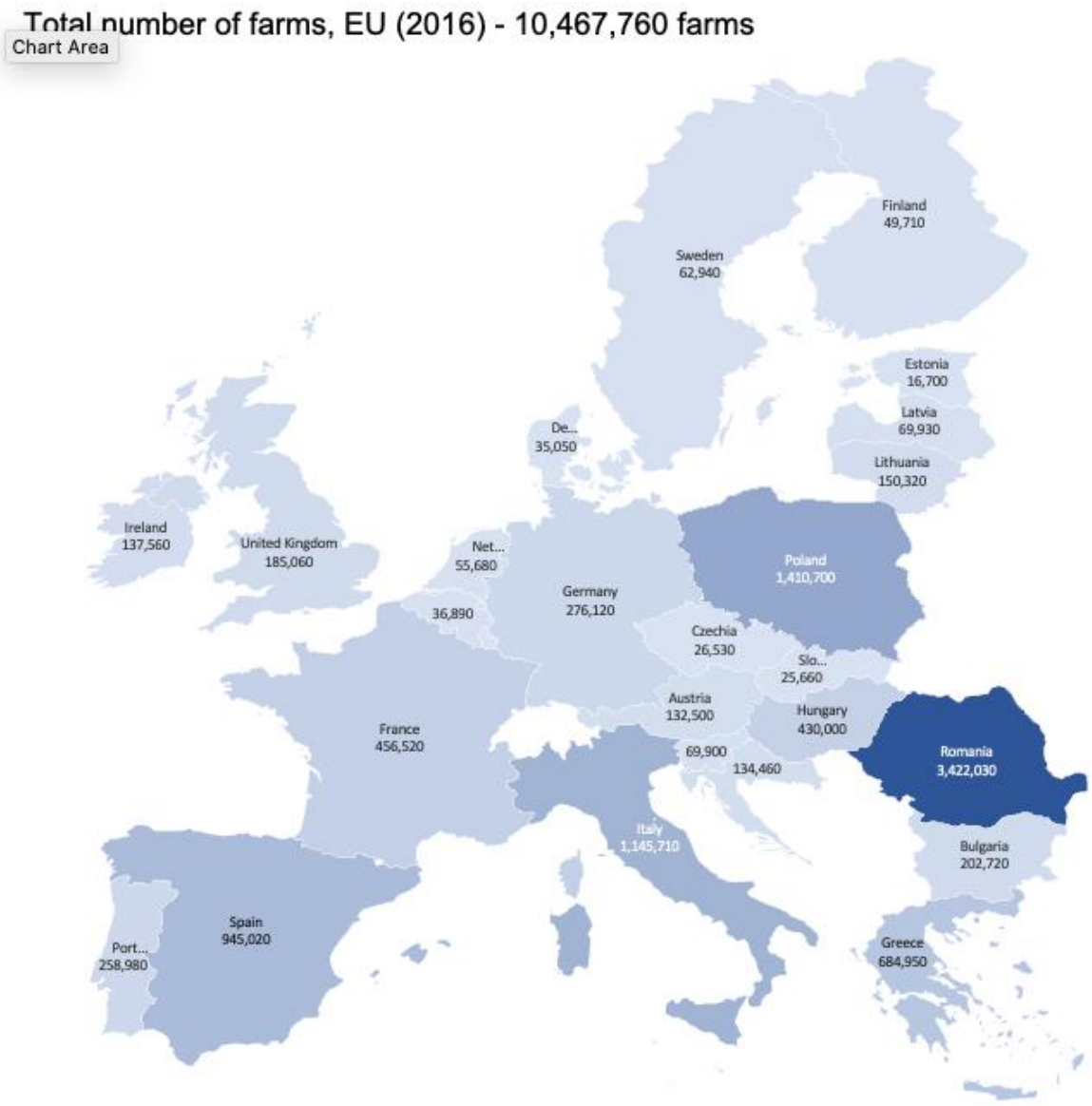

Figure 11. Total numbers of farms EU 2016

[51] https://ec.europa.eu/eurostat/home?

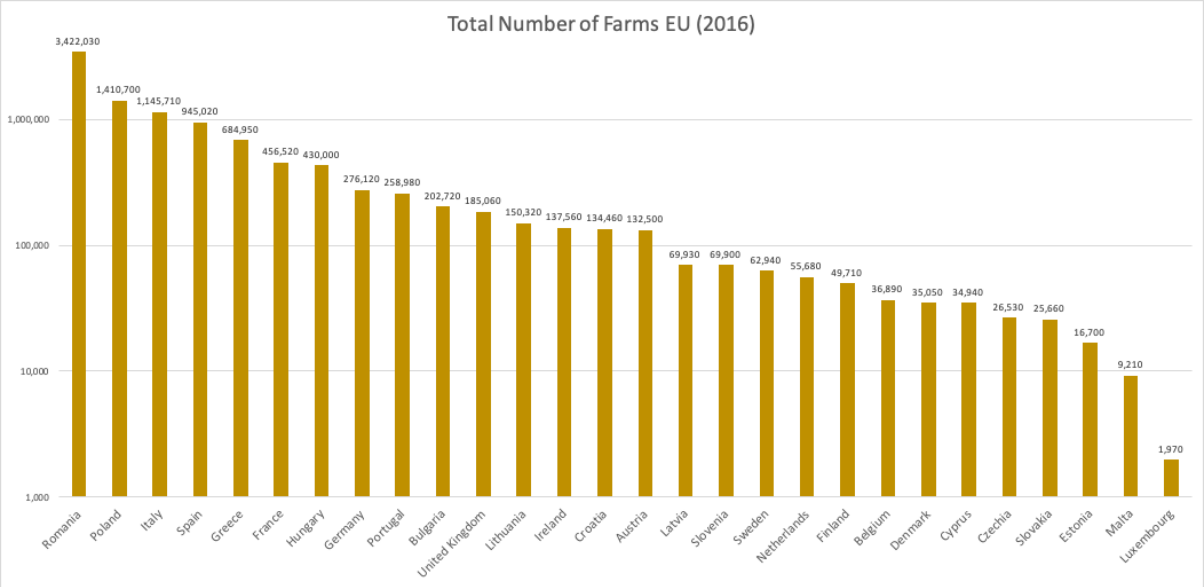

Figure 12. Total numbers of farms from highest to lowest countries

B.2. Breakdown of Farm type across EU (2016)

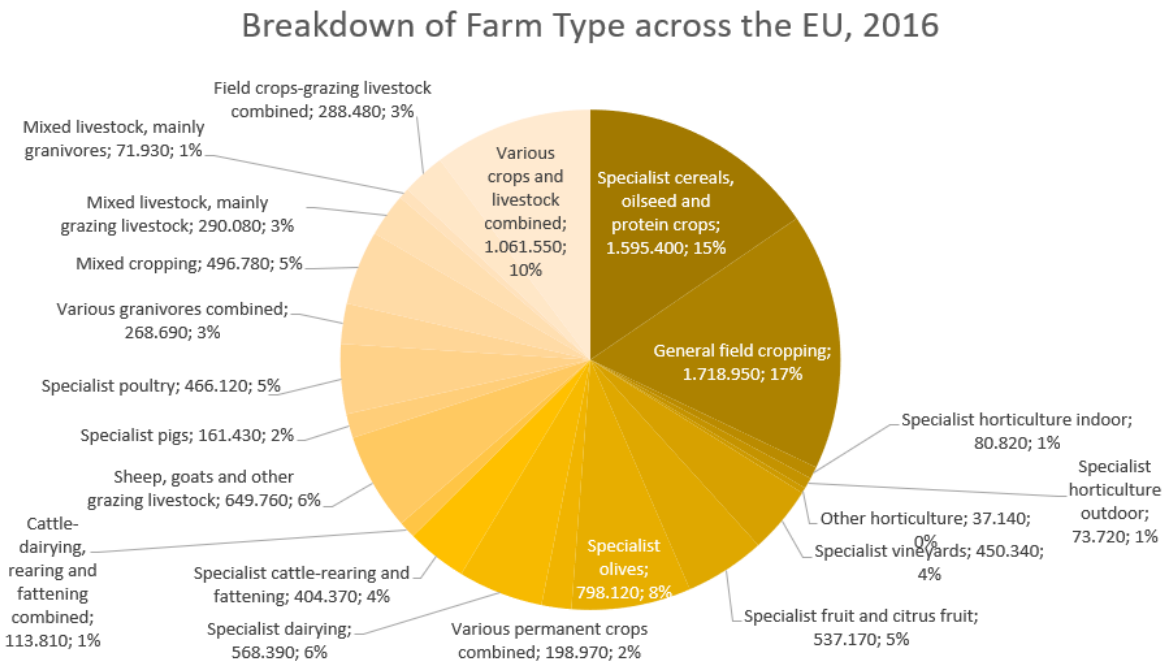

Figure 13. Breakdown of farm type across the EU 2016

Annex C Georgian Farmer Market

Georgia is a small market economy of 3.7 million people with a per capita gross domestic product (GDP) of $4,763 and an unemployment rate of nearly 11.6%. About two-thirds of the workforce is self-employed, predominantly as subsistence farmers. Since the 2003 Rose Revolution, the Government of Georgia has carried out numerous economic and governance reforms, enabling a rise in the living standards of its citizens, but agriculture was not viewed as a national priority. At its low point in 2010, government spending on agriculture was only 0.44% of the total budget[52]. Since 1999, the share of agriculture in total GDP declined from 26.2% to 9.3% in 2011, and to 7.2% in 2017 and where it remains today[53]. However, economic reforms and initiatives by the government, private sector and the donor community since 2012 have started to reinforce Georgia's agriculture sector. The state budget for agriculture increased to 3.8% in 2018 suggesting a growing commitment to the government to the sector[54].

In Georgia, agriculture sector employs about the 41.3% of the population and provides around 7.2% of GDP[55]. As expressed in Figure 1, GDP has been growing through the last 10 years, however agricultural output increases slightly. The gray line in Figure 1 represents the proportion of agricultural output in GDP, which is declining significantly up to 2010 and then it was stable around 9.0% and in 2019 it is 7.2%. The decline of agricultural output in GDP can be explained by growth of other sectors (e.g. construction, manufacturing, wholesale and retail trade) rather than a decline in agricultural production.

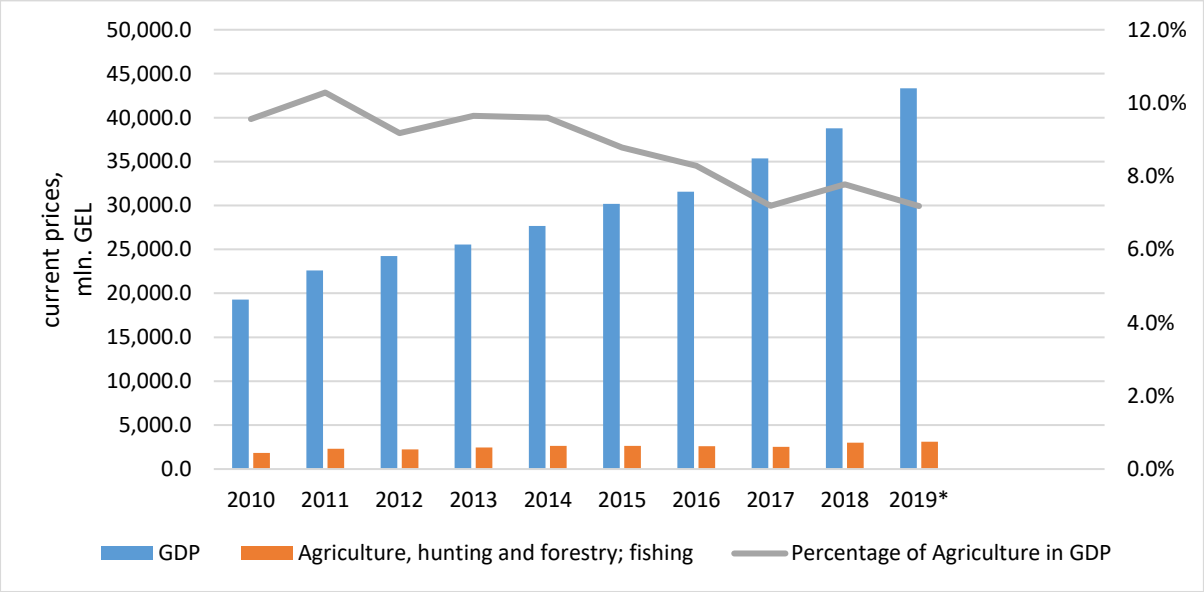

Figure 14. GDP and Agriculture in Georgia

* Adjusted data will be published on November 16, 2020.

Source: National Statistics Office of Georgia

[52] Ministry of Environment Protection and Agriculture of Georgia. https://mepa.gov.ge/En/PublicInformation/30

[53] FAO. Assessment of the Agriculture and Rural Development Sectors in the Eastern Partnership countries: Georgia. 2012

[54] IFAD, Dairy Modernisation and Market Access Programme (DiMMA). Final project design report, 2018.

[55] National Statistics Office of Georgia. https://www.geostat.ge/en/modules/categories/196/agriculture

43.4% (more than 3 million hectares) of the whole territory of Georgia is designated as agricultural land, which also includes pastures and meadows. 43% of the remaining area is covered with forest. Due to certain developments (e.g. collective farms stopped functioning) after the collapse of the Soviet Union, the sown and planted areas of annual and perennial crops have reduced, as well as livestock numbers, however number of poultry have increased. (Table 1).

Year	Sown Area (ha)	Cattle	Pig	Sheep and Goat	Poultry	Share of Agriculture in GDP
2006	330,200	1,080,300	343,500	789,200	5,400,700	12.8%
2007	297,200	1,048,500	109,900	797,100	6,149,700	10.7%
2008	329,300	1,045,500	86,400	769,400	6,682,300	9.4%
2009	289,700	1,014,700	135,200	673,800	6,674,800	9.4%
2010	256,700	1,049,400	110,100	653,900	6,521,500	8.4%
2011	262,400	1,087,600	105,100	630,400	6,360,200	8.8%
2012	259,600	1,128,800	204,300	742,600	6,159,100	8.6%
2013	310,700	1,229,700	191,200	856,800	6,760,700	9.3%
2014	274,900	970,000	169,700	916,900	6,657,800	9.3%
2015	263,700	992,100	161,500	891,400	8,308,600	9.1%
2016	240,000	962,700	136,200	936,500	8,237,800	9.0%
2017	220,300	909,700	150,700	907,000	8,386,000	7.2%
2018	207,100	878,900	163,200	869,500	8,110,900	7.8%
2019	203,000	869,500	155,500	891,600	9,466,400	7.2%

Table 19. Sown Area, Livestock Numbers, and Share of Agriculture in GDP 2006-2019

Source: National Statistics Office of Georgia

The agricultural output of Georgia as of 2019 amounts to 4 737.9 mln. GEL, 50% of which comes from animal husbandry, 43% from plant growing and 7% from agricultural services. Cattle are the predominant type of livestock husbandry, with the vast majority of farmers in all regions owning 3.8 head of cattle on average[56].

[56] FAO. 2017. www.fao.org/georgia/news/detail-events/en/c/1073576/

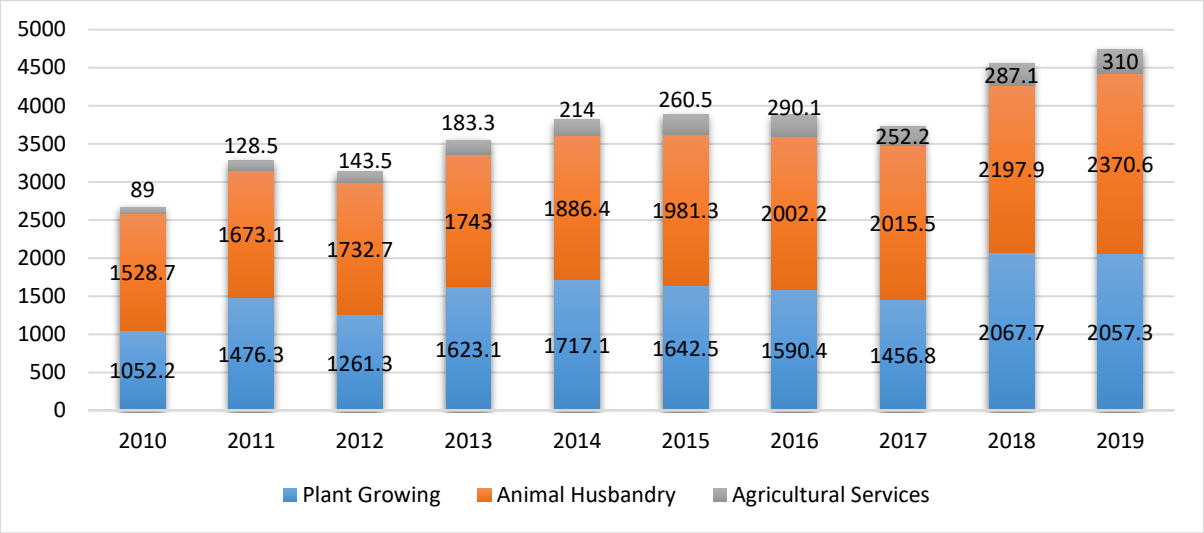

Figure 15. Output of Agriculture (Million. GEL)

Source: National Statistics Office of Georgia

According to Agricultural Census 2014, total number of agricultural holdings in Georgia is 642,209 out of which number of agricultural holdings with cattle is 271,118 (out of which 235,197 is holdings with dairy cows), number of agricultural holdings with pigs is 93,914, holdings with poultry is 364,916 and holdings with land under vineyards is 123,532. It should be noted that the agricultural holdings are not involved only in one activity. It means that a holding who is involved in livestock production also grows potatoes and produces honey, for example.

As of 2019, there are 869,500 heads of cattle (of which 50.8% are cows) in Georgia.

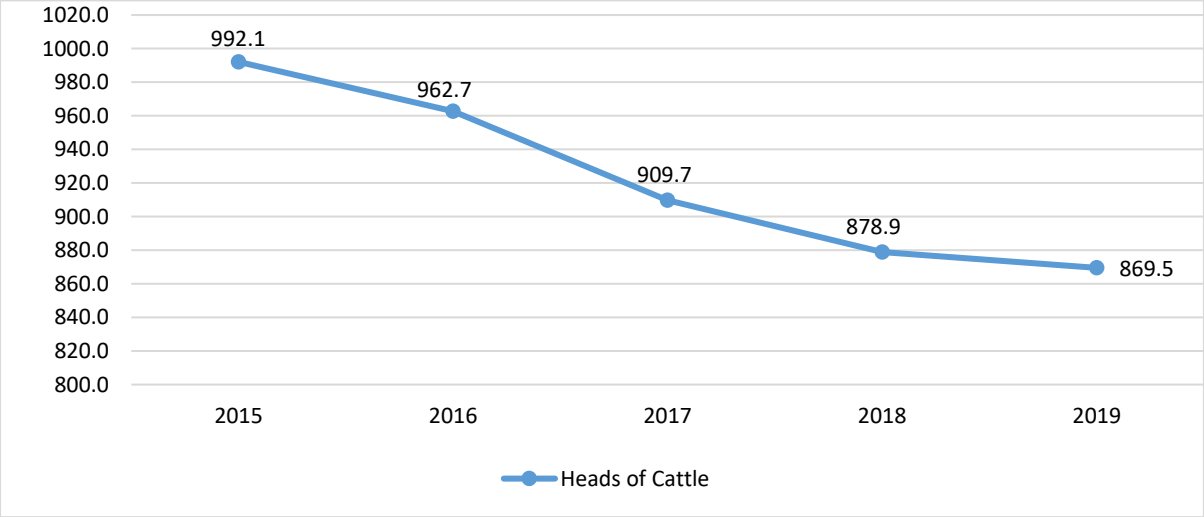

Figure 16. Livestock numbers in holdings of all categories (as of end of year, thou. heads)

Source: National Statistics Office of Georgia

As seen from Figure 8, number of cattle was highest in 2015 (992.1 thou. heads). Since 2015 number of cattle declined from 992.1, thou. heads to 869.5 thou. heads in 2019[57].

[57] https://www.geostat.ge/en

Due to climate and geographic location, historically cattle breeding is mainly concentrated in Samegrelo-Zemo Svaneti, then comes Kvemo Kartli, Imereti, Samtskhe –Javakheti, and Kakheti.

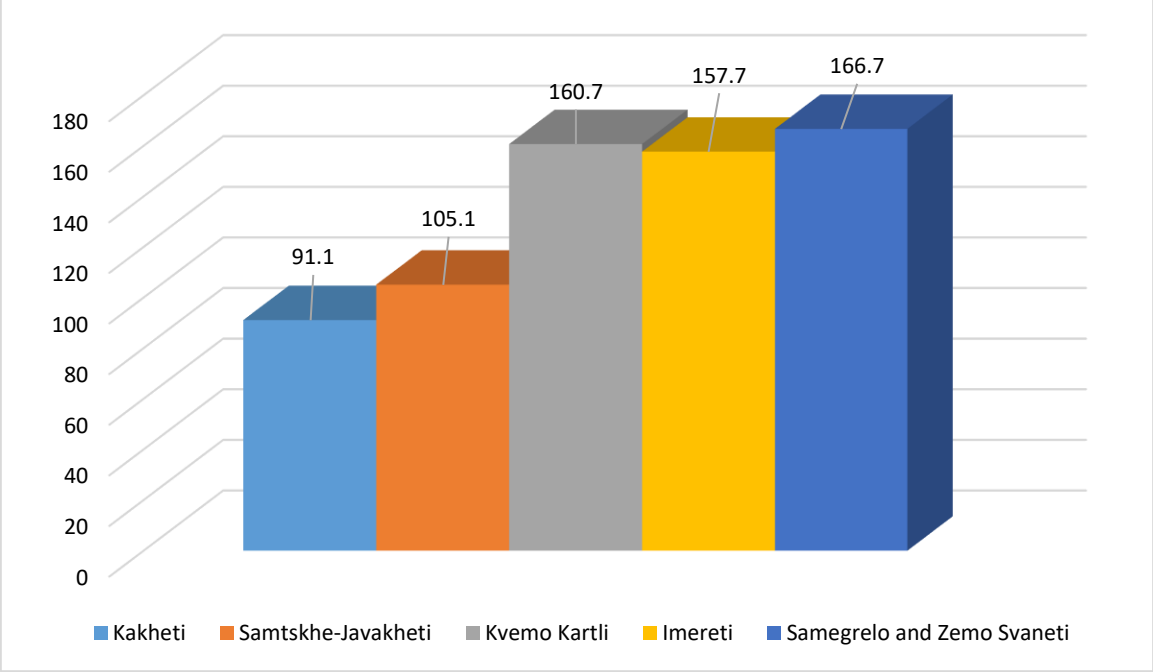

Figure 17. Numbers of cattle by regions in 2019 (as of end of year, thou. heads)

C.1. Members of Georgian Farmers' Association

By the end of 2019, GFA had 1835 individual member farmers and 191 cooperatives. Besides that, GFA has 99 associate members. These associate members are companies, mainly Ltd-s, operating in Georgia.

Figure 5 shows the distribution of GFA individual members by regions. 34.6% of individual members are from Racha-Lechkhumi and Kvemo Svaneti region, 13.6 % and 10.2% from Samegrelo and Zemo Svaneti, and Kakheti, respectively.

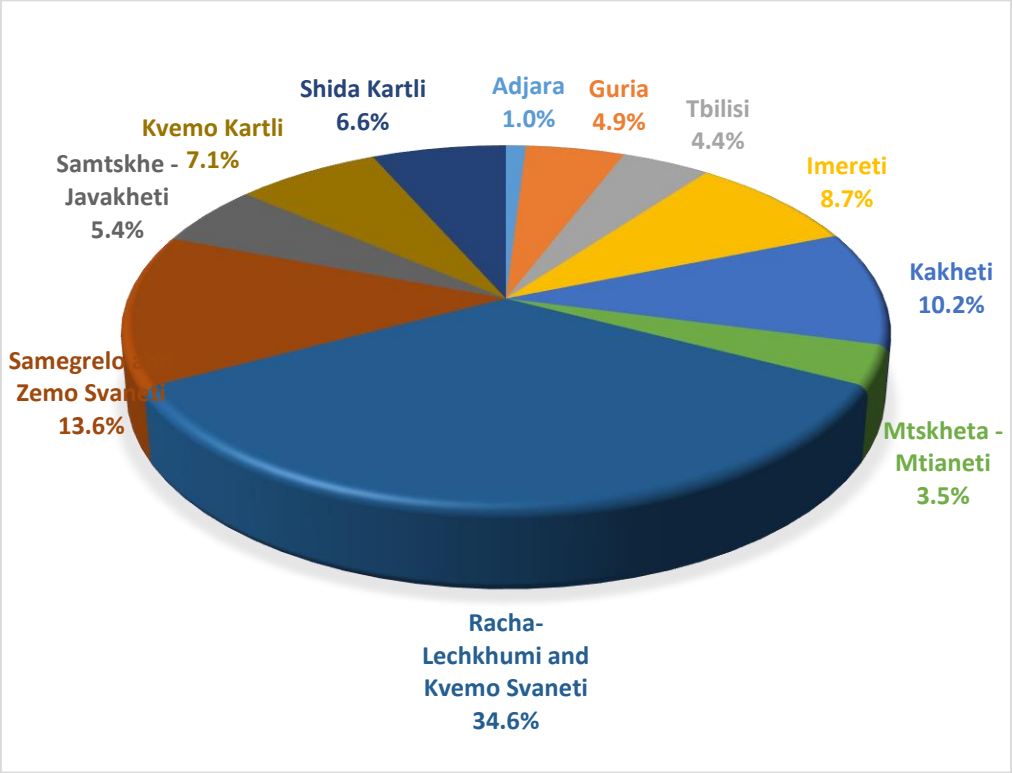

Figure 18. Individual members by regions (%)

Main activities of the member farmers are presented in the diagram below:

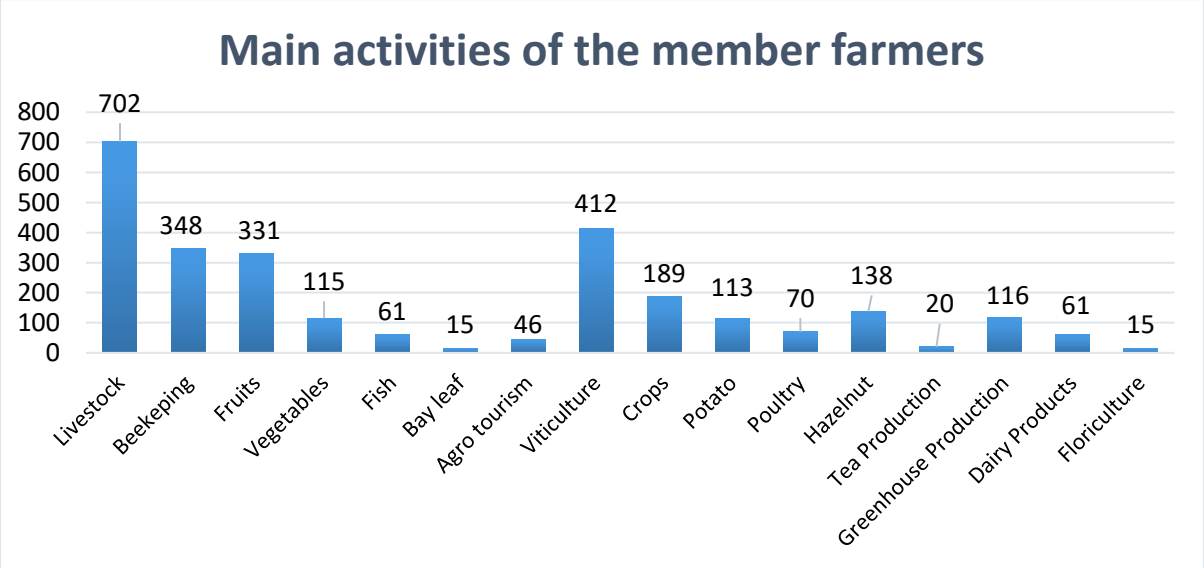

Figure 19. Main activities of GFA farmers

It should be noted that the farmers are not employed only in one activity. It means that a farmer who is involved in viticulture also grows crops and produces dairy products, for example. As we see from the diagram, 702 out of 1835 farmers (which is 38%) are employed in livestock production. Viticulture is the second largest category; then comes beekeeping, fruits and hazelnut.

Figure 6 shows the distribution of GFA cooperatives by regions. 23.9% of cooperatives are from Samegrelo and Zemo Svaneti region. Then comes Imereti with 18.1% and Samtskhe -Javakheti with 9.6%.

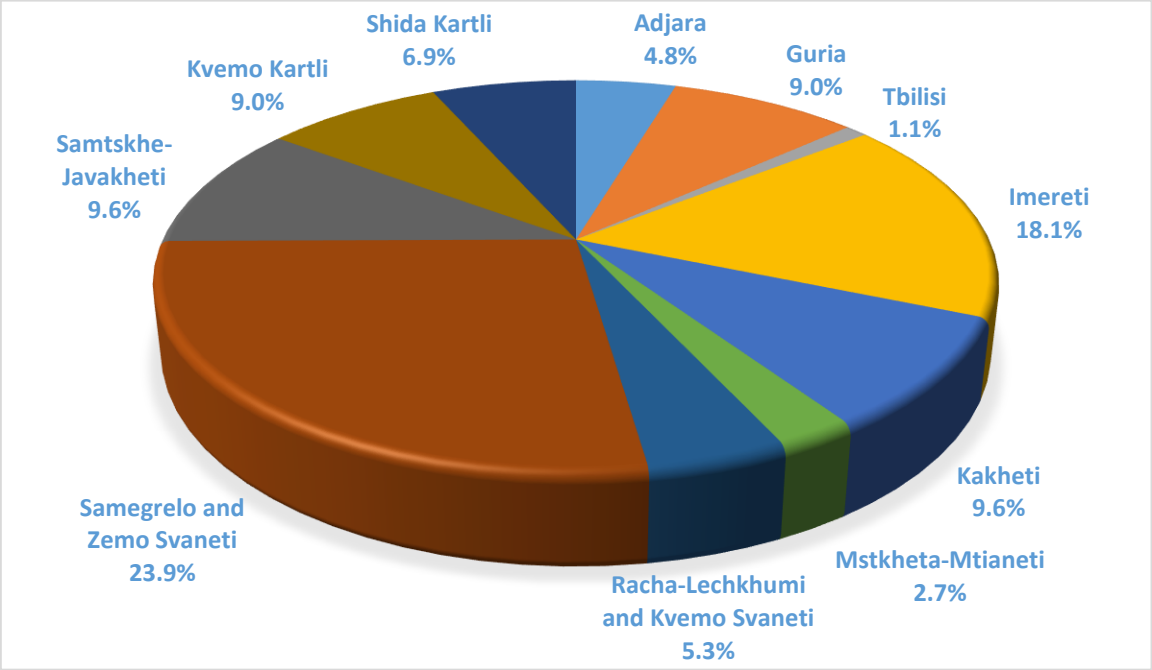

Figure 20. Member cooperatives by regions

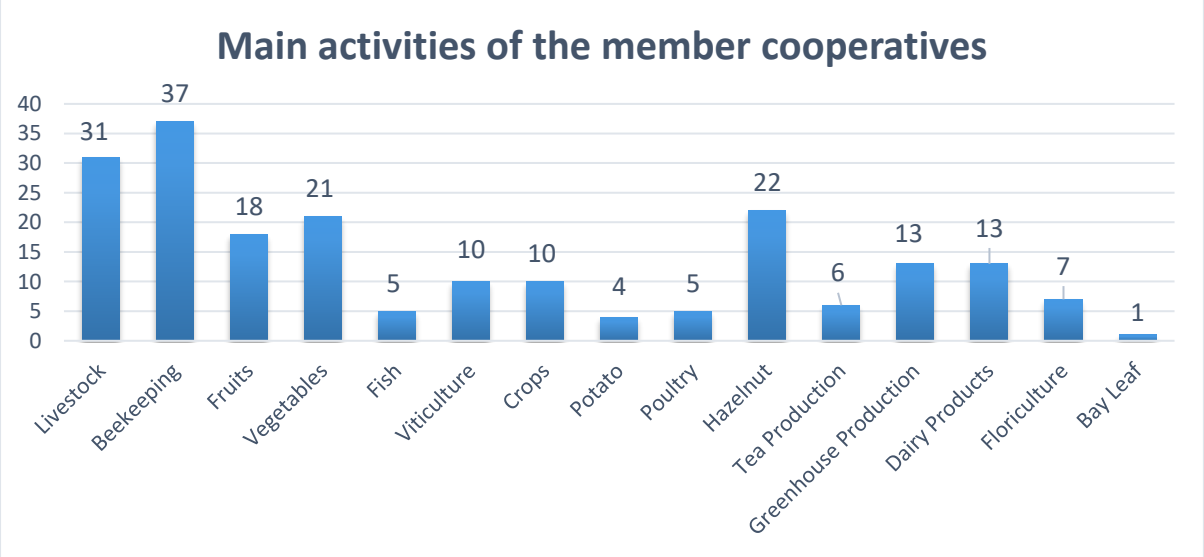

Figure 21. Main activities of the member cooperatives

Beekeeping and livestock are more common among cooperatives who indicated their field of activity. Then comes hazelnut and vegetables, fruits, crops, dairy products and greenhouse production. Unlike farmers, only 10 cooperatives are involved in viticulture.

Regarding the scale of GFA members, we can say that all the member farmers are small scale ones. Only some of the cooperatives and associate members can be considered as large-scale entities.