TALLINN UNIVERSITY OF TECHNOLOGY
School of Information Technologies

Tii Tammik-Võsu 211993IVGM

DATA SHARING PRACTICES IN ESTONIAN AGRICULTURAL SECTOR: EXPLORING TRUST AS A FACILITATING FACTOR

Master's thesis

Supervisor: Richard Michael Dreyling III

Co-supervisor: Alena Labanava

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Infotehnoloogia teaduskond

Tii Tammik-Võsu 211993IVGM

ANDMETE JAGAMISE PRAKTIKAD EESTI PÕLLUMAJANDUSSEKTORIS: USALDUSE KUI SOODUSTAVA TEGURI UURIMINE

Magistritöö

Juhendaja: Richard Michael Dreyling III

Kaasjuhendaja: Alena Labanava

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Author’s declaration of originality

I hereby certify that I am the sole author of this thesis. All the used materials, references to the literature and the work of others have been referred to. This thesis has not been presented for examination anywhere else.

Author: Tii Tammik-Võsu

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Abstract

The digitisation of services and the development of new technologies are increasingly driving service users to change their habits. Processes can be simplified and enhanced, replacing time-consuming, manual, and paper-based activities. From one perspective, the public sector develops e-services for its customers (citizens), from another standpoint, the private sector is refining its business processes to simplify and optimize work in a cost-effective manner with the goal of maximizing profit.

Regarding the development and utilization of e-services, the availability of data stands out as a key factor for the state. This data is essential for better decisions and the provision of actively used, improved services. In the broader context, the cross-use of data across all sectors becomes crucial due to interconnections between various areas. The state is actively developing solutions that integrate all e-services. This thesis focus is on the agricultural sector, where new technologies hold immense potential, generating a wide range of data collected through diverse methods. The development of services in the agricultural sector is of particular significance as it is intricately linked to environmental and climate issues, as well as the crucial domain of human food. The challenge lies in harnessing the potential of data and creating efficient e-services in this sector.

The objective of this thesis is to analyse data-sharing practices within Estonian agricultural sector and to determine, how trust influences farmer's willingness to share data. Additionally, the goal is to identify factors that could aid the state in developing improved agricultural e-services.

This research uses a qualitative case study methodology. Data was collected through document analysis and interview results. Nine interviews with various stakeholders revealed that, although farmers willingly share various types of data with the state in the context of agricultural subsidies, there is limited motivation to share their data voluntarily. This study will look more in depth, whether trust plays a role in this dynamic and, if proven, suggests potential solutions to address the issue. The identification factors that could assist the state in developing enhanced e-services is also a key focus. The relevance

of this topic is underlined by the fact that, to the author's knowledge not much research, has been done on the subject.
This study contributes to the enhancement of e-services by proposing suggestions to increase farmer's trust in these services and make them more efficient.

This thesis is written in English and is 70 pages long, including 6 chapters, 4 figures and 4 tables.

Annotatsioon

Andmete jagamise praktikad Eesti põllumajandussektoris: usalduse kui soodustava teguri uurimine

Teenuste digiteerimine ja uute tehnoloogiate areng sunnib teenuse kasutajaid üha enam oma harjumusi muutma. Aeganõudvate, käsitsi ja paberil tehtavate toimingute asemel saab protsesse lihtsustada ja tõhustada. Ühelt poolt arendab avalik sektor oma klientidele (kodanikele) e-teenuseid, teiselt poolt arendab erasektor oma äriprotsesse, et lihtsustada ja tõhustada oma tööd kuluefektiivselt ning maksimeerida kasumit.

Seoses e-teenuste arendamise ja nende teenuste kasutamisega on andmete kättesaadavus üks võtmetegureid, et riik saaks neid andmeid kasutada ja analüüsida, et teha paremaid otsuseid ja pakkuda paremaid teenuseid, mida aktiivselt kasutatakse. Laiemas plaanis on oluline andmete ristkasutamine kõigi sektorite vahel, sest mitme valdkonna vahel on seoseid ja riik arendab lahendusi, kuhu kõik e-teenused on võimalik kokku viia. Käesolevas töös keskendutakse põllumajandussektorile, kus uutel tehnoloogiatel on tohutu potentsiaal, genereeritakse ja kogutakse mitmesuguseid andmeid erinevate meetoditega. Teenuste arendamine põllumajandussektoris on eriti oluline ka seetõttu, et see on otseselt seotud keskkonna- ja kliimaküsimustega ning inimeste toiduga seotud elutähtsa valdkonnaga. Andmete potentsiaali kasutamine ja tõhusate e-teenuste arendamine on siinkohal väljakutse.

Käesoleva lõputöö eesmärk on analüüsida andmete jagamise praktikaid Eesti põllumajandussektoris ning uurida, kuidas usaldus mõjutab põllumajandusettevõtjate valmidust andmeid jagada. Lisaks proovitakse töös leida lahendusi, mis aitaks riigil arendada paremaid põllumajanduslikke e-teenuseid.

Üheksast intervjuust erinevate osapooltega selgus, et kuigi põllumajandustootjad jagavad riigiga näiteks põllumajandustoetuste raames mitut liiki andmeid, on nende motivatsioon oma andmeid vabatahtlikult jagada väike. Käesolevas uuringus uuritakse põhjalikumalt, kas usaldus mängib selles rolli, ja kui see on tõestatud, tehakse ettepanekuid, kuidas probleemi lahendada. Teema on aktuaalne ka seetõttu, et autorile teadaolevalt ei ole sarnaseid uuringuid palju tehtud.

Lõputöö on kirjutatud inglise keeles ning sisaldab teksti 70 leheküljel, 6 peatükki, 4 joonist, 4 tabelit.

List of abbreviations and terms

AI	Artificial Intelligence
ARIB	Agricultural Registers and Information Board
ATP	Agriculture technology provider
CAP	European Common Agricultural Policy
EC	European Commission
EU	European Union
FADN	Farm Accountancy Data Network
FARMER	In this study, the term 'farmer' is used to refer to all relevant sectors e.g. crop and livestock production, including fisheries
GDPR	General Data Protection Regulation
IACS	Integrated Administration and Control System
ICT	Information and Communication Technology
IT	Information Technology
IOT	Internet of Things
KEA	Environmental Board
MS	EU Member State
PTA	Agriculture and Food Board
RQ	Research question
SQ	Sub-question
SDG	UN Sustainable Development Goal

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1 Introduction

Agriculture stands as one of the most critical sectors as it involves the production of safe and nutritious food thus ensuring human health. Its scope extends beyond crop cultivation to encompass livestock production, animal welfare, land management, fisheries, and plant health. Moreover, agriculture significantly contributes to regional development and sustainable rural life.
On a global scale, the modernization of agriculture assumes a key role in achieving of Sustainable Development Goals (SDG) outlined by the United Nations. Agriculture is intricately connected to climate-related challenges and aligns with the objectives of the European Green Deal (European Commission), thereby playing a crucial role in ensuring food sustainability, including in times of crisis.

As the technology becomes more prevalent, farmers and public authorities are faced with challenges of collecting, sharing, and utilizing data in ways that benefit all stakeholders (Zhang et al., 2021). Despite the collection of a wide variety of data, it is not always clear which data is being collected and shared, and if data sharing occurs, the recipients of the data may not be readily apparent. One barrier to collaboration between farmers and public authorities, as identified in the literature, is a lack of trust (Jakku et al., 2019, Zhang et al., 2021, Jayashankar et al., 2018.). This literature is based on two surveys conducted among farmers in Australia, where agriculture is a crucial sector of the economy (Australian Government, 2023), and in the USA, where the scale of agriculture is also extensive. According to Jakku et al., trust issues are a central concern for many actors. These concerns encompass procedural aspects related to transparency and distribution, specifically questioning who benefits from access to and use of 'farmer data' (Jakku et al., 2019). Jayashankar et al. investigated the relationship between trust and the use of the Internet of Things (IoT). The study found that increased trust can contribute to an increased perceived value of this. According to Zhang's survey on who would benefit most from agricultural aggregated data, it showed that farmers' willingness to share their data is linked to their trust in the stakeholders with whom they share their data. However, the success of the implementation of big data in agriculture will be determined by the

willingness of farmers to share their farm data (Zhang et al., 2021, Karunathilake, et al., 2023). Another study explores how technology can enable trust to reduce the risk associated with a transaction by giving unknown parties the ability to transact (Kumarathunga et al., 2021). There was a question of implementing and evaluating a smart market platform that would enable small farmers to obtain a better return on their harvests, with minimal financial constraints. It was concluded that, among other factors, more trust would provide smallholders with more opportunities (Kumarathunga et al., 2021). The above examples demonstrate that a lack of trust can be a significant problem in various agricultural activities, potentially hindering effective operations.

The focus of this master's thesis is to identify problem areas in data-sharing practices and to focus more thoroughly into trust as an influencing factor in data sharing, specially within in the context of using agricultural e-services.

Agriculture is an area that generates a wide variety of data. Increasingly, artificial intelligence and robotics are being developed to simplify farming while promoting sustainable agricultural practices (Karunathilake, et al., 2023). For example, milking robots are already used in most larger farms, and special applications help farmers keep track of animal health, for example, when it is time to feed or vaccinate (Tööinspektsioon, 2019). Soil sensors are being used in the field to determine the composition of the soil and calculate the amount of fertilizer to apply. Remote sensing systems can monitor the condition of agricultural land using satellite imagery. Drones are being developed to help monitor the condition of fields and apply fertilizers (Karunathilake, et al., 2023). All of this implies that agriculture generates a substantial amount of data. To qualify for agricultural subsidies, certain data needs to be shared with the state, as well as, for example, in relation to business-related requirements and statistical collection requirements. (ARIB). However, it can be assumed that there is also a wide range of data that farmers collect but do not necessarily share.

In Estonia, the state collects various types of data, including soil fertility data, environmental monitoring data, information on insect occurrence and forecasting, crop register data, locations of livestock buildings and apiaries, land management systems, environmental constraints, and agricultural statistics (ARIB). Agricultural registers include details about livestock, farmers, natural persons keeping the livestock, and the

places of business where activities subject to notification and authorization requirements are carried out (ARIB). Besides agricultural entities, the Land Board, Statistics, Tax and Customs Office, Environmental Board, and some other entities are also involved in data collection. Therefore, data is managed in different registers and collected on different bases. The European Strategy for Data outlines a general problem that there is a lack of an overview of the types of data collected and how data is used, both in terms of the sharing of privately held data, between public authorities, and the use of privately held data by public authorities (A European Strategy for Data, 2020). Clarity and transparency are crucial for both the public and private sectors. For farmers, having up-to-date market information and useful (e) services, along with knowledge on how they can benefit from data sharing, is essential. The state requires data for policymaking and data-driven decisions.

Nor can we forget the challenges that crises can pose. The recent COVID-19 crisis caused lockdowns of entire countries and even areas that would otherwise have been only physically moved online (MCKinsey & Company, 2020). The agricultural sector also had to take measures that supported digital innovations, for example facilitating e-commerce, the exchange of information, and regarding the job opportunities in the agricultural sector (OECD, 2021, Farmer's Weekly, 2021). It proved that the added value of data in societies increased even further.

1.1 Research problem

As mentioned above, agriculture is a very important sector with a direct impact on human health, the environment, and food security and availability (FAO, 2022). However, technological progress has a much broader impact. The integration of digital technologies in agriculture has opened new opportunities to revolutionize the way farmers manage crops, resources, and activities. Agriculture is evolving very rapidly and involves a wide variety of approaches and applications. At the same time, its impacts are significant. (Tungkasthan et al., 2019; Karunathilake et al., 2023).

The state requires a variety of data and analytics to make data-driven decisions. Data-driven decision making is essential for effective governance. Such an approach involves decisions based on verified data. (TechTarget, 2016). In agriculture, data-driven decisions can enhance the efficiency of operations in various ways, such as increasing yields, promoting environmental conservation, and informing general business decisions

(Statistics Estonia, Agriculture). An effective state needs data to create useful e-services for citizens.

It is also important for farmers to make smart decisions and better utilize data because, in addition to business decisions, their choices and actions significantly impact the environment and human health. Abioye et al. studied smart irrigation decisions, acknowledging that farming activities utilize about 70% of available freshwater (Talaviya et al., 2020). They found that farmers traditionally base irrigation decisions on their experience, but with advances in machine learning, predictions can be made more efficiently (Abioye et al., 2022).

Through the automation and digitisation of its activities, a farm will have a significant amount of data to collect and manage. Simultaneously, the state collects data as part of the process of granting agricultural subsidies and other business-related bases. The data collected from the farm and the data quality depend on the technology used on the farm. If a farmer does not trust the technology or the government agencies collecting his data, he may refrain from using the technology. This, in turn, prevents the proper reporting of data about the farm. (Schönfeld et al., 2018). Therefore, the question arises of how to make collected data more useful to various parties, including the state and farmers. It is crucial to gather sufficient data and conduct monitoring to shape policies and respond to markets. This data can be analyzed to determine which measures are better targeted at agriculture, fisheries, food, and other sectors related to the bioeconomy (Zhu, 2021). Simultaneously, efforts should be made to minimize the administrative burden associated with data collection. Precision agriculture faces several challenges, including unsustainable use of resources, long-term monoculture, intensive livestock production, environmental trade-offs, uneven use of digitalisation, food safety concerns, food supply chain issues and lack of awareness of innovative solutions. (Tungkasthan et al., 2019). Therefore, the availability of high-quality data is essential. Precision farming utilizes cutting-edge technologies to enhance agricultural productivity while simultaneously reducing environmental impact (Tungkasthan et al., 2019).

According to the OECD, the benefits of digitization for farm productivity, sustainability, and resilience are well-documented in many countries, with an additional benefit of reducing manual work. However, barriers to uptake include costs, user-friendliness, skills, distrust of algorithms, and technological risk (McFadden et al., 2022).

Given the substantial amount of data circulating in different areas of agriculture and the involvement of big data in modern agriculture, optimizing resource use and meeting needs would require a combination of technologies such as the Internet of Things, cloud computing, and blockchain (Schönfeld et al., 2018). Data platforms play a crucial role in harnessing the value of data and aiding in making smart decisions (Zhu et al., 2021). According to the OECD report, one recommendation for an agricultural policy more conducive to innovation is to develop further Information Technology (IT) solutions to collect and manage data, reduce control costs, and implement more targeted policies, it includes also to improve traceability along the food chain. it also includes the monitoring of results using ICT (OECD, 2019).

As can be seen, there are a number of problems related to data collection in agriculture, such as the extent of regulation of data collection and its fragmentation. Although there are certain obligations, data retention policies and projects, the problem often lies in the lack of clarity about where parties can find the necessary data. Additionally, businesses are often hesitant to share their data. For instance, if they have purchased special software that collects data for their activities, such as calculating the quantity and consistence of animal feed, the ownership of the collected data is unclear. The question also revolves around drivers and motivators. If an agri-food business owner has invested a substantial amount in software, there may be little motivation to share the received data, especially with competitors who could leverage it to their advantage. Allowing the private sector access to government-held data also raises questions about data ownership (OECD, 2019). A more specific example can be given in relation to agricultural machinery, where, in some cases, there is no coherent system for the collection of data on machinery, and in legal terms, it may not be a regulated area managed by the state (Žukov, 2023).

These examples highlight how the potential of data could be better realised if there was more clarity on how data is handled, which would promote trust.

At the central focus of the public sector is the state as a whole and the organisation of its governance in the public interest. The state provides certain services and maintains control over the provided services. In contrast, private enterprise is profit-driven, leading to potentially different interests in data sharing. Business owners expect reassurance that their business's confidential information is well-protected. The challenge lies in the fact

that the state has numerous different data sets and services (E-Estonia), including various registers and datasets in agriculture. However, there are still insufficient data, cross-use of data, and effective utilization of data potential. This, in turn, can impact the diversity and quality of e-services, influencing the development of different innovative solutions. There are also questions about whether data sharing should be regulated by law, or any voluntary agreements would be more effective. One of the key issues is how to ensure trust between the public and private sectors to facilitate data sharing and deliver efficient e-services. Digitalization and increased data availability will improve planning and resource use efficiency, enhance cost-effectiveness for all parties, and have a global impact on climate challenges (Balasundram et al., 2023).

1.2 Research objective and questions

The research objective of this thesis is to analyse data sharing practices in the agricultural sector and investigate trust as an enabler of data sharing. Additionally, the study explores how these factors could contribute to the state's development of agricultural e-services. This thesis addresses these issues using Estonia as a case study.

The study examines data sharing practices between farmers and public sector in Estonia, including its legal framework and delves into the definition and concept of trust. In Addition, the study aims to identify options for building trust between the public and private sectors to encourage the use and development of e-services in agriculture.

Trust plays a crucial role in the functioning of e-services and in the relationship between farmers and the state, as the willingness to share data is contingent on trust. This study seeks to identify the main problem areas related to data sharing and define the major challenges for both the public and private sectors in this context. The study will focus on two main areas:

1. How data sharing between farmers and the public sector functions, particularly in relation to e-services.
2. How the public sector can facilitate data sharing and develop well-functioning e-services.

Research questions

The research poses two research questions (RQ) and one sub question (SQ) to be answered.

RQ 1 What are the key challenges in data sharing in the Estonian agricultural sector?

SQ 1: how trust affect the willingness to share the data in agricultural sector?

RQ 2 How can the Estonian state authorities encourage data sharing with farmers to develop e-services?

1.3 Significance of the study

The outcomes of the study are expected to enhance understanding of the problems associated with data sharing and contribute to the development of agricultural e-services in Estonia and potentially beyond. The study also aims to determine the expectations of farmers in the data-sharing process.

Various stakeholders, including farmers, public authorities, consultants, software developers, and representatives from other countries, stand to benefit from the study's findings. The public sector can leverage this information to enhance services, while farmers can gain certainty about how their data is used and understand the potential benefits of sharing their data. The study, therefore, has the potential to positively impact the agricultural sector by fostering improved collaboration and effective utilization of data.

2 State of the art

The theoretical framework of the study encompasses an examination of general data sharing practices, with a specific focus on the agricultural sector. The legal framework surrounding data sharing practices in agriculture is also explored. Trust is identified as a central enabler in this context, and the author delves into various approaches to understanding trust.

Given the complexity of the concept of trust, the study acknowledges its multi-faceted nature and draws insights from different perspectives. These include the economical, technological, and managerial approach. The study aims to explore where the agricultural perspective fits within these broader frameworks, providing an understanding of trust in the specific context of data sharing practices in the agricultural sector. In the legal analysis, the author primarily relies on the European Union (EU) framework. This choice is grounded in the fact that the EU has a common agricultural policy that is implemented by its Member States.

2.1 Data sharing

The use of various information technology (IT) applications in the public sector has brought several benefits to the public, such as improved quality of services. The wider value may even be the creation of a more democratic society (Picazo-Vela et al., 2016). The important question is how to make government data more useful to citizens. At the same time, it raises questions about data ownership if the private sector is given access to government data. (OECD, 2019). There can also be several obstacles, such as differing systems, a lack of specialists or data collection tools that do not meet the required structure (Tungkasthan et al., 2019).

Former European Union Trade and Agriculture Commissioner Phil Hogan warned that *"data sharing could be very controversial if not handled properly". We need to protect farmers in regard to the data they generate and make sure everybody participates; not*

only the big companies" (Tungasthan et al., 2019; Stam and Michalopoulos 2018; van der Burg et al., 2021). Both business and public administrations need quality data to achieve their goals (Tungkasthan et al., 2019). The government holds a vast amount of public sector data, collected daily to deliver services to citizens (Tungkasthan et al., 2019). Data management, as part of an organization's activities, allows it to treat data as an asset. To operationalize this, it needs to establish policies and frameworks, action plans, processes, metrics, and subsequently monitor the management of data as an asset (European Commission, Eesti andmehalduse raamistik, 2020). Data is broadly categorized into data format and meaning (Tungkasthan et al., 2019). Many countries have proposed data sharing frameworks, especially for data exchange between government agencies to enhance government services (Tungkasthan et al., 2019). However, when defining the data framework, it is crucial to identify what data to share, for what purpose, set user groups, and establish standards. Also, certain data is confidential and must be strictly controlled under national laws and regulations. (Tungkasthan et al., 2019).

A successful example can be found in Estonia, where 99% of public services are available online twenty-four hours a day. The only exception is divorcing, which is not currently available as an e-service (E-Estonia). The interoperability data exchange platform, X-Road, has been implemented since 2001 and has been developed historically in line with the principles of the European Interoperability Framework, providing a foundation for future e-service concepts (Jackson et al., 2022). "X-Road is a technical and organizational environment that facilitates secure and trusted online data exchange between public authorities and the private sector" (Information System Authority, 2023). The X-Road platform can exchange various types of information, ranging from text in simpler cases to files (Information System Authority, 2023).

To achieve the goals of The European Data Strategy, the Commission plans to establish a common EU data space, aiming to increase the availability of data for use in the economy and society (A European Strategy for data, 2020). This initiative also seeks to maintain control over the companies and individuals generating the data. The common European data space aims to integrate data infrastructures and governance frameworks, fostering data pooling and sharing (A European Strategy for data, 2020). Further details on this will be discussed in the next sub-chapter.

2.2 Legal framework

The EU Digital Decade policy program outlines digital ambitions for the next decade, with main goals focusing on digital skills, secure and sustainable digital infrastructures, digital transformation of businesses, and digitalization of public services. There is also a significant emphasis on access to data (European Commission, 2023).

The European Digital Strategy aims to facilitate digital transformation for individuals and businesses, contributing to the target of achieving a climate-neutral Europe by 2050 (European Commission priorities 2019-2024). The European Commission's data strategy seeks to position the European Union as a leader in a data-driven society by establishing a single market for data, enabling the free movement of data within the EU (A European Strategy for Data, 2020).

Various digital services, including those in agriculture, are being developed at both the EU and national levels. In May 2016, the EU adopted the data protection package, including the General Data Protection Regulation (GDPR), which aims to safeguard individuals in the processing of personal data and ensure the free movement of such data (General Data Protection Regulations, 2016).

In Estonia, relevant entities process data from national registers, and the composition of personal data in these registers, as well as the retention periods, are defined by legislation. Data processing, including personal data, is conducted in strict compliance with legal requirements (Mulla et al., 2016). However, concerns arise regarding the most sensitive data, particularly personal data, and business secrets, prompting questions about how data protection will be ensured in the context of voluntary data exchange. Additionally, issues surrounding the ownership of data collected by e-service providers and machine software need to be addressed. The Commission 2020 proposal for a Data Governance Act foresees the re-use of certain categories of public sector data. It also aims to build trust in data sharing services and promote data altruism in the EU (European Court of Auditors, 2022). It stresses the importance of building trust in data sharing by creating appropriate

mechanisms to enhance the development of a competitive and data-driven economy (Data Governance Act, 2022).

In EU, agriculture is regulated by the Common Agricultural Policy (CAP). Unlike other sectors where expenditures are covered by national budgets, the CAP is a collective policy of the EU Member States, managed at the European level, and funded by the EU budget (European Commission, 2021). The CAP encompasses various objectives for which farmers can seek several types of support, and these are administered by the paying agencies of the Member States, including the Agricultural Registers and Information Board (ARIB) in Estonia.

A significant portion of agricultural statistics is collected in a harmonized manner across the European Union. These statistics serve purposes such as analysis, development planning, and assessing the performance of EU agricultural policy (Statistics Estonia, Agriculture). Eurostat, which produces European statistics and data (Eurostat, EU Key indicators), collects data on agriculture among other things in the member states. "EC Directorate General Agriculture and Rural Development (DG AGRI) collects mostly administrative data, and mainly uses conventional tools for data analysis" (European Court of Auditors, 2022). For example, farm accountancy data and market prices (European Court of Auditors, 2022).

The European Farm Accountancy Data Network (FADN) (to be renamed in future FSDN under the EU Green Deal), covers economic reports on EU agriculture. The system monitors farm income and business activity. It is also an important source of information for understanding the impact of CAP measures. "FADN is the only source of microeconomic data based on harmonised bookkeeping principles. It is based on national surveys and only covers EU agricultural holdings which, due to their size, can be considered commercial". (European Commission, Farm accountancy data network).
FADN sample represents around 90% of the utilised agricultural land and agricultural production across the EU (Centre of Estonian Rural Research and Knowledge, FADN).
Under the Inspire directive, the Inspire Geoportal serves as the central European access point to the geospatial data provided by member states. Additionally, "Member States publish certain geospatial data through their independent national or regional geoportals"(European Court of Auditors, 2022).

On 23 April 2018, a European Union Code of Conduct on Agricultural Data Sharing by Contractual agreement (Copa and Cogeca, 2020) was drawn up by various agricultural associations. Its content is providing guidance on how data could be used and to encourage farms to share their data, highlighting the benefits that this will bring. The broader aim is to strengthen trust through contracting between different parties. Businesses that use farmers' data to develop digital agricultural technologies and services have special technologies and knowledge to analyse data for different purposes, at the same time, farmers often have less digital knowledge. Also, farmers spend a significant part of their time at the field, and lack of time to develop their digital skills and make the necessary adjustments. (Van der Burg, 2021).

The Code of Conduct is useful voluntary tool, it consisted of definitions, data security questions, definition of data types and case studies. The contract check list is also valuable (Copa and Cogeca, 2020). However, there are still questions about the Code of Conduct that need clarification to enhance transparency. For instance, aspects such as the rights and obligations of the parties, data sharing rules, data security, and the legal framework require more explicit details (Härtel, 2020; Van der Burg, 2021).

European Union level agricultural data initiatives

The EU has initiated several agriculture projects in which the member states are involved. One notable project is the DG AGRI Data Portal, which consolidates information from various agricultural platforms. This platform integrates indicators from the CAP, geoportals, agri-food markets, financing details, country factsheets, and information related to food supply and security (European Commission, Agri-Food Data Portal).

The Integrated Administration and Control System (IACS) data sharing under INSPIRE is a project by European Commission together with JRC (Joint Research Centre) to build a framework and support procedures for sharing non-personal IACS spatial data across EU (European Court of Auditors, 2022). IACS manages, monitors, and serves for EU countries to control all the area and animal-based common agricultural policy interventions (such as direct payments interventions and area and animal-based rural development interventions), and ensures that comprehensive and comparable data is available throughout the EU (European Commission, Integrated Administration and Control System). Estonia has also participated in a pan-European project- New IACS

Vision in Action NIVA (Agricultural Registers and Information Board, Project New IACS Vision in Action).

Digital development in agriculture is closely connected to EU research and innovation programs. Notably, the Horizon research program invests in digital technologies with the goal of advancing precision farming, sustainable agriculture, and the entire agricultural value chain. Horizon has played a central role in funding digital innovation in the sector (European Commission).

The Digital Europe program is another EU funding initiative aiming to promote digital technologies for active use by businesses, citizens, and public authorities. (European Commission). This program takes a comprehensive approach to promoting innovation and digital transformation in the agricultural sector and encompasses various sectoral initiatives.

According to EU Data Strategy, the Commission describe the vision for a Single European Data Space – "an internal market for data, where data could be used regardless of its physical location in the Union, in accordance with the applicable laws and regulations, which could be crucial, among other things, for the rapid development of artificial intelligence technologies" (A European Strategy for Data, 2020). Under the Digital Europe programme 2021, the most recent EU-level activities have been related to the development of EU Common Agricultural Data Space (EU Common AGRI dataspace) creation. Due to the large amount of data in the agricultural and food production sector, the European Commission initiated the creation of an Agri Data Space to facilitate data exchange, processing, and analysis to better exploit the exchange and potential of this data. In 2023, the European Commission has taken this forward and is engaged in mapping the landscape (EU Common AGRI dataspace).

There are still concerns, such as how to precisely regulate data sharing between parties, how to incentivize parties to voluntarily share their data, and what the real benefits for the farmer will be. Therefore, before the data space can become operational, these questions need to be clarified.

2.3 Data sharing in agriculture

As technology evolves, data sharing is becoming increasingly important in all areas of life. Agriculture is a very broad field, with multiple players and a variety of technological solutions. It can be stated that "we are at the start of a new agricultural revolution, with a data-intensive approach to deploy farm machinery for diagnosis, decision-making, and implementation. In this scenario, human power is primarily involved in monitoring and maintenance" (Tungkasthan et al., 2019).

Data is very much at the core of precision agriculture, which is increasingly being used to make better business decisions and protect the environment. "Precision farming is an agricultural approach that uses advanced technology and data analysis to maximise yields, reduce waste and increase productivity" (Tungkasthan et al., 2019). "In precision farming, data on individual fields and crops are collected by observation, measurement and monitoring using a variety of sensors, crop and soil monitors, and remote sensing tools such as drones, crews, aircraft, or satellite imaging" (Tungkasthan et al., 2019).

National surveys and data from OECD countries show that the use of digital technologies is widespread in the cultivation of real crops, but there is less evidence of uptake in livestock and specialty crops (McFadden et al., 2022). There are several challenges, for example costs related to investments or maintenance. State support is needed here, for example as an information broker, in promoting innovation and in fostering competitive markets (McFadden et al., 2022).

Another term used for digital technologies in agriculture is smart farming. Smart farming is farm managing in a modern way, using ICT technologies, while optimizing the human workforce required (Sciforce, 2023). "It can include sensing technologies, software applications, data analysis solutions, hardware and software systems, telematics, positioning technologies, communications systems, e.g cellular" (Sciforce, 2023). Smart farming enables farmers to make better decisions and be more efficient in their operations (Smart Farming Thematic Network). At the same time, the process of creating value from data is not clear enough (Wysel et al., 2021).

"Data driven agriculture uses big data to supplement on-farm precision agriculture, using the right farm data at the right time and the right formats to make better decisions" (Maru et al., 2018). The above shows the importance of using smart farming techniques to improve operational efficiency and the development of big data projects.

Agri-food systems contain a number of different components and are complex in nature (Maru et al., 2018). It means the use of big data and advanced technologies contributes to systematisation and better performance.

Farmers using multiple dataflows, it is also appropriate to set up the relevant data platforms. Stakeholders, system and data are needed to create value from data and through data sharing platforms can add value to smart farming data (Wysel et al., 2021). Wysel et al have propose the definition of data sharing platforms: „A data sharing platform is a community of stakeholders who share a common, data-related goal; data collected from, and for, the community; and a system that uses the data to enable and incentivise stakeholders to make valuable interactions" (Wysel et al., 2021). There are certainly benefits to be gained from experimenting with different solutions, especially when smart farming data helps to value smart farming. Considering the vast volume of data and the ongoing shift of agricultural management towards digital channels, it is imperative to underscore also the diverse cyber vulnerabilities associated with this transition (Alahmadi et al., 2022).

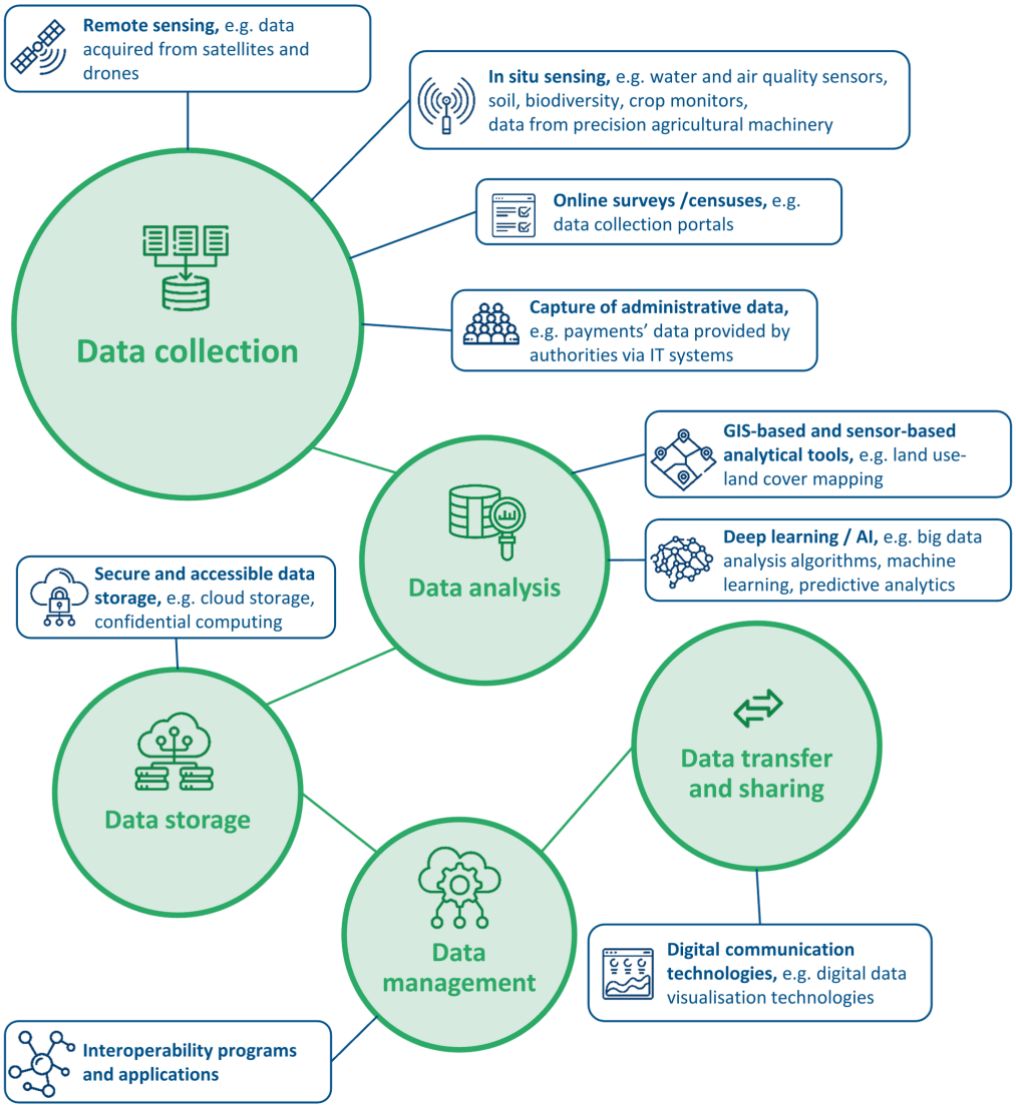

Figure 1. Digital technologies for agriculture. Source: European Court of Auditors, based on Table 2.1 of the OECD's "*Digital Opportunities for Better Agricultural Policies*", OECD Publishing, Paris, 2019

Birner et al points out that digital agriculture has had an impact on the sector in three ways- by increasing investment, including new investors, e.g. large ICT companies like IMB, Google, secondly industrial firms like Bosch or XAG, third group start-ups universities related, software and entrepreneurs familiar with farming etc. (Birner et al., 2021). Digital platforms are created to offer farmers recommendations regarding decision making to move from input-based business models (e.g. providing herbicides) to service-based business models (e.g. weed-free fields) (Birner et al., 2021).

Forecasts for global growth in digital agriculture in 2019 were 12.6% and more recent estimates, still predict annual growth (Đuric, I. 2020). This growth is being boosted by the steep fall in the cost of several technical solutions as high-speed internet, cloud computing, satellites, computers, mobile phones, and smartphones, also pressure to reduce the nature resources such as water and land, and reduce the use of agrochemicals, as well as rising food prices (Birner et al., 2021).

"Public intervention is also important in the event of market failures, which often occur in agriculture and fisheries due to both weather and continuous price fluctuations" (Estonian Agriculture and Fisheries strategy 2030).

The digital revolution in agriculture includes the accelerated deployment of technologies such as low-cost sensors and data collection platforms, resulting in the increasing availability of agricultural data (Raturi et al., 2022). Increasingly, farmers are interested in various tools that would enable to make better decisions and manage their information (Raturi et al, 2022). Farmers need information about different solutions, costs, and subsequent returns, to make better decisions (McFadden et al., 2022).

At the same time, big data analyses based on different data are also essential. For example, when it is necessary to study the impact of climate change on crops, researchers need to process large amounts of climatic and agronomic data to understand the complex dynamics of the system and develop recommendations (Raturi et al, 2022). Such problems can also be quite urgent, if rapid outbreak of a pest occurs or an unexpected animal disease.

Precision farming have been used since in early 1980s and has been adopted on millions of hectares of agricultural cropland around the world (Mulla et al., 2016). Precision livestock farming is analogy to the concept of precision farming for crops" (Wathes et al., 2008; Birner et al 2021). It is related to the use of sensors in livestock production. "Sensors can be used to monitor a cow's health status, identify when she comes in heat, or is about to calve. Moreover, such sensors measure phenotypic fitness traits of cows that can be used in breeding programs. Cameras are also used to monitor livestock, including pigs and poultry" (Wathes et al., 2008; Birner et al 2021). Precision livestock farming aims to increase animal productivity, improve animal welfare and health, whilst reducing environmental impact. It uses real time monitoring and management systems, alerting the farmer instantly when problems arise (Cox, 2023).

There are positive examples also on precision fertilization based on precision soil sampling and geostatistics related to soils that can be used for soil mapping and analysis (Burgess and Webster, 1980).

The growth of big data has raised concerns across science and technology about the collection and use of personal data and its security (Ekbia et al., 2015). Farmers also have these concerns as the public and private sectors are making more efforts to use farm data to transform farming practices **(**Raturi et al., 2022; Slattery et al., 2021).
The use of smart techniques comes with a concern that additional strategies for data sharing and trust are needed in the farming community. (Moore et al., 2022).
In the following chapter, the author examines the impact of trust in more detail.

2.4 Trust as an enabler

In this chapter, the author explores the role of trust as an enabler for sharing data and using e-services. The author has selected some theories, which will be examined in more detail.

Technology adoption in general influences the use of e-services and data sharing. Such as digital skills of farmers, connectivity, data privacy, ease of use, trust (Ekbia et al., 2015). Adequate skills have been identified as a challenge - big data engineers and data analysts lack an farming knowledge and farmers lack the skills to use the equipment and solutions. (Karunathilake, et al., 2023).
The main determinants of technology uptake across all sectors include not only farm size but also the age of farmers, human capital, perceptions of technology and improvements in quality of life. The main constraints to uptake continue to be technology cost, user-friendliness, relevance, clearly indicated net benefits, lack of high-speed internet access and distrust of tools, sometimes considered as "black box" technologies. (McFadden et al., 2022). Examples from Australia, Europe and North America show that farmers are not always ready to share their data. (Jakku et al., 2019). No less important is data security, which also has an impact on trust. If a party is not confident that their data is being handled securely, they will be reluctant to share data. Trust – both institutional and generalised trust – is central also to monitoring progress towards the SDGs. In particular, the Goal 16 of the SDGs- “Promote peaceful and inclusive societies for sustainable

development, provide access to justice for all and build effective, accountable, and inclusive institutions at all levels", focuses explicitly on governance, institutional quality, and political participation (OECD, 2017). These elements have clear links to trust.

There are still several other factors that can influence willingness to share data.

The concept of trust has been analysed in many disciplines before the widespread use of the Internet (Colesca, 2019). However, the measurement of trust does not have a long tradition, At the same time, several recent policy initiatives have underlined the urgent need for better measures of trust - in other people as well as in institutions (OECD, 2017). Colesca pointed out that "trust is a method of dealing with uncertainty" (Colesca, 2015; Belanger and Carter, 2008). He investigated it in e-commerce and made conclusion that there is a strong link between trust and perception of risk. While citizens perceive companies differently from the public sector (Colesca, 2015; Belanger and Carter, 2008). "Trust is a much-discussed concept in ethics of digital technologies" (Taddeo, 2011; Colesca, 2009). In digital ethics, Taddeo's concept of e-consciousness is based on non-human actors like robots or systems, he considers trust as the result of rational deliberation: there are reasons for choice. (Taddeo, 2011; Colesca, 2009).

In general, trust is also very rich concept, which includes very different objects and relations. "The concept of trust is closely linked to risk and expectations: trust is used as a substitute for risk, but it also creates a risk for the trustor" (Bouckaert and Van de Walle, 2001; Colesca 2009).

According to Baier, trust involves personal vulnerability caused by uncertainty about the future behaviour of others, "we cannot be sure, but we believe that they will be benign, or at least not malign, and act accordingly in a way which may possibly put us at risk" (Baier 1986).

But trust has also been seen as an abstract and psychological concept, as it involves cognitive, emotional, and behavioural dimensions (Johnson and Grayson 2005; Colesca, 2009).

There are also several other viewpoints to the concept of trust, such as economic, managerial, technological, sociological. However, the development of trust is influenced by, for example, individual, institutional characteristics, technological attributes, and interactive factors (Colesca, 2009).

The OECD guidelines on measuring trust also states that "trust is a concept of fundamental importance to the well-being of individuals, and to society more broadly" (OECD, 2017). Guidelines points out that at the individual level it is important to feel that

the surrounding community can be trusted, and at the societal level trust also includes day-to-day transactions (OECD, 2017).

“Citizens' trust leading to the adoption and use of e-Government systems has two dimensions: trust in governments and trust on the internet. Before trusting e-Government initiatives, citizens must believe that government has the managerial and technical resources to implement and secure these systems” (Colesca, 2009), so it is important also in the agricultural sector that farmers have trust in e-Government.

Colesca investigated what factors can affect citizens' trust in e-Government services. The survey was carried out by interviewing 793 citizens from all Romanian regions. The results show that citizens' increased perceptions of technological and organisational reliability, quality, and usefulness of e-Government services, online experience and trustworthiness directly increased trust in e-Government. The analysis showed that citizens' increased perceptions of technological and organisational trustworthiness, the quality and usefulness of eGovernment services, online experience and trustworthiness directly increased trust in eGovernment (Colesca, 2009).

The study carried out on the example of Estonia reveals that it is easier to conduct the digital transformation of public services in smaller countries. The success does not depend on technological readiness, the other important factor here is public trust in services. (Stephany, 2020).

Colesca points out that the public sector's transition to electronic services is more than a technical or organisational change, it also involves ethical dimensions between state and citizen, where trust and consent are at least as important as legal power in a democracy. (Colesca, 2009). The Colesca study shows that privacy concerns have significant impact on trust in e-Government. Also, agricultural stakeholders have pointed out that to a lack of trust and growing concerns about the privacy of farm-level data among farmers buying or considering buying data analysis services from agricultural technology providers (Jasmin et al., 2022).

Some authors have also studied trust in technology. The Internet of Things (IoT) and big data related applications play a key role in increasing global food production and ensuring food security. The number of connected agricultural devices is expected to grow from 13 million in 2014 to 225 million by 2024 (Mehta et al., 2016).

Priyanka Jayashankar et al investigated in USA's experience of Internet of Things (IoT) deployment among US farmers to understand, how trust in the technology influences its

adoption. The authors investigated how trust influences perceived value and risk, and how these in turn influence IoT adoption. The results showed that there is a positive correlation between trust and perceived value and a negative correlation between trust and perceived risk (Jayashankar et al., 2018). The authors of the study consider trust to be a precursor to IoT. Scientists have in the past established a direct positive link between trust and the uptake of information technologies such as cloud computing (Akinwunmi et al., 2015). The majority of the work in e-Government research space such as Colesca and Carter and Belanger have focused on the individual level. However, according to the Jayashankar et al, Obal (Obal, 2013) showed a positive correlation between trust and the perceived value of adopting new technologies B2B level, so it is reasonable to believe that trust also has a role in organisational adoption of technologies.

Transparency is an element of trust (Grimmelikhuijsen, 2012). Transparency and legitimate data processing can influence farmers to share their data with agriculture technology providers (ATPs) and other stakeholders and it is one of the most important practices in privacy (Jakku et al., 2019). According to Jakku et al, there are several problems related with trust. They surveyed Australian cereal growers and industry stakeholders and found that while advances in smart farming and big data applications have the potential to help the agricultural sector address productivity and sustainability challenges, the analysis shows that trust issues are a central concern for many actors. These factors create scepticism among farmers about the value of "smart" technologies. (Jakku et al., 2019). Also, what will be revealed in their examination of farmers concerns over data licences is that the willingness to share data is implicitly linked to trust (Jakku et al., 2019). This, in turn, has a negative impact on the state, which needs data to make the necessary decisions, both for policymaking and e-Governance, also the quality of e-services is affected. Farmers, however, do not benefit from poor e-services and their trust is affected.

Regarding large farms, there is primarily a question about data storage and processes, as well as what restrictions the government can impose (Jakku et al., 2019).

Zhang et al conducted a study in Australia, to explore farmers' perspectives on who would benefit most from aggregate agricultural data. They conducted computer-based telephone interviews with 880 Australian farmers. The results show that only 34% of participants identified farmers as the main beneficiary of aggregate agricultural data, followed by agribusiness (35%) and government (21%) as the main beneficiary. The authors of this

research theorise, that “the extent to which farmers are willing to share farm data will be associated with their concerns with the aggregated farm data and trust in the stakeholders with whom to share data with.” However, the success of big data application in agriculture is determined by whether farmers are willing to share their farm data (Zhang, 2021).
Building trust is a long-term process. if there are many digital platforms of dubious value in the market, some of which will also disappear, this will affect the trust as a whole and distrust among the farmers. To develop a framework for addressing these issues between the different actors, trust between the technology communities is needed, as trust in the community is an inherently social process (Raturi, 2022; Lewis and Weigart 1985). At the same time, efforts must be made to maintain transparency, privacy, and clear data ownership.
Cash et al point out that, in agricultural research, it would be most useful to increase the use of citizen science with farmers, as they have an interest in the directions and results of agricultural research. This type of citizen science tends towards knowledge coproduction. (Moore, 2022). Such an approach could be expected to foster trust between the parties.

Farmers describe problems with the transparency of data licenses, uncertainties over data ownership and subsequent data sharing and use, privacy protection, power imbalances between farmers and data aggregators, and a general concern about who gets access to farmers' data and benefits from (Raturi, 2022)**.** The benefits of data sharing are also sometimes questioned. (Slattery et al, 2021).
Raturi points that the first step to solving these problems is to recognise them as legitimate concern.

It is distinctly difficult to attribute property rights. For example, if scientists conduct measuring soil moisture on a farm, who is the owner of this data? The landowner, the field technician, the lead scientist? Agricultural data are often considered to be owned by the farmer, although this is difficult when, for example, technology providers claim ownership of machine-collected data (e.g., yield monitors) or when data are collected on the farm through collaborative research (Raturi, 2022). It can be concluded that when data ownership is clear and transparent, it is easier to build trust in the services provided.
“Agricultural technology providers should be transparent about the collection, use, sharing, and disclosure of the farmers’ data. This can be achieved by creating clear,

complete, and unambiguous data agreements that discuss the data practices and terms of use. Furthermore, these legal documents should be written in simple language so that it is easy to understand" (Jakku et al., 2019).

State authorities should focus on strengthening networks and the functioning of relations between farmers and service providers. Often it is a neighbour or an adviser to whom a farmer can turn when he needs information. In this regard, access to the advisory service is crucial, as trust in digital technologies may increase as a result (Raturi, 2022, Oerlemans et al., 2011).

An option to build trust would also be through co-creation projects. One example is in Finland, where several different organizations from both the public and private sectors are involved in the large state AI project called Aurora. In this project, extra attention has been paid to stakeholder cooperation and trust, involving all actors from both the public and private sectors (Ministry of Finance in Finland).

3 Methodology

In this chapter, the author focuses on the methodology of the research. First, the author introduces the research design, justifies the choice of the method, and introduces the sample and the conduct of the study.

3.1 Research design and methodology

The methodology of this research was a qualitative case study. Qualitative research is an approach for exploring and understanding the meaning individuals or groups ascribe to a social or human problem (Creswell & Creswell, 2017). According to Ellis (Ellis et al., 2008), it is important that research is based on a problem statement, which the author tries to follow and provide solutions. The research included content analysis. The main methods of data analysis were qualitative document and regulation analysis. The research included listing and analyzing agricultural e-services in Estonia.

The research strategy was mainly observational, describing and explaining the reality.

The specific group of participants were considered, and phenomenon confined to a specific region and industry (Merriam et al., 2015). In this case, Estonian agricultural sector. To enhance the value of the findings, 20 interviews were initially planned. However, 25 interview requests were sent out, resulting in 9 conducted interviews. The interview questions were categorized into three thematic sections. The first part comprised demographic inquiries, the second part delved into the utilization of agricultural e-services, and the third part aimed to explore how Estonian state authorities could foster trust for data sharing, ultimately contributing to the improvement of agricultural e-services. The author adhered to OECD guidelines on measuring trust, which suggest considering trust measures within the broader survey context (OECD, 2017). These guidelines target both producers and users of trust data, emphasizing trust between individuals and trust in public institutions (OECD, 2017).

The documents analysed as part of the research were publicly available. The selection of documents included mainly OECD analyses and EU regulations, as well as Estonian guidance materials and regulations. The materials were specifically chosen to investigate

data sharing practices, relevant regulations, and to explore the correlation between trust and the utilization of e-services.

3.2 Sampling and collection of data

Sampling is the selection of a subset of the population of interest in a research study. In most research endeavours, the participation of an entire population of interest is not possible, so a smaller group is relied upon for data collection. (Turner, 2020).

To obtain diverse perspectives from public sector representatives, e-service providers, farmers, and all stakeholders involved, semi-structured interviews were conducted with experts and government officials. During these interviews, participants were given the freedom to express their opinions and provide suggestions, allowing for an in-depth exploration of the topics.

The sample selected was as diverse as possible, considering the sector of activity, the Estonian region, and the size of the farm to ensure diversity input. The choosing of the sample from the state representatives were based on the author's knowledge and recommendations from the relevant experts. The interviews took place in between October 20 to November 17, in 2023. Overall responses were received nine. Most interviews were conducted by mobile phone, but also online (Skype) and face-to-face format, depending on the choice of participant. Some preferred to send their replies in writing and commented afterwards. Two representatives from one institution participated in answering the questions. The names of the participants and organisations will not be published in research and the results will be used in anonymised form, although there will be recordings and proof of written responses. As the interviews were conducted in Estonian, the transcription is in Estonian.

The author stressed the importance of confidentiality in the interviews, since the OECD guideline also indicates that according to the evidence, trust questions can be sensitive, as the respondents may answer in socially desirable way or prefer to not answer at all (OECD, 2017).

Semi-structured interviews conducted with the representatives of farms in four different Estonian counties and representatives of three different public authority organisation.

The first target group was public authority view: the representatives at ministry and administrative authorities' level, with the aim of receive an opinion in the context of policy making and gain a practical perspective in dealing with farmers. The request was sent to two private e-service providers, but no responses were received.
Second target group: farmers in different areas, also different field of activity (plant production, livestock, fisheries, cereal farming, honey production), were surveyed.

Table 1. The list of the interviewees. Source: author

Interviewee	**Participant**	**Private/public**	**Description**[1]	**Farm age**
Interviewee F1	Farm Manager	Private sector	Small sized South	10 years
Interviewee F2	Farm Manager	Private sector	Small sized East	27 years
Interviewee F3	Farm Manager	Private sector	Small sized North	5-10 years
Interviewee F4	Farm Manager	Private sector	Small sized Middle-Estonia	5-10 years
Interviewee F5	Farm Manager	Private sector	Medium sized South	31 years
Interviewee F6	Farm Manager	Private sector	Small sized South	Over 30 years
Interviewee P1	Official	Public sector		
Interviewee P2	2 Officials	Public sector		
Interviewee P3	Official	Public sector		

[1] farm (business) size is determined according to the EU regulation https://eur-lex.europa.eu/EN/legal-content/glossary/small-and-medium-sized-enterprises.html

4 Case of Estonia

Estonia is one of the leading countries regarding the e-Governance and the state services (United Nations E-Government Survey, 2020). In Estonia, data security is considered the basis for the functioning of the Estonian digital society (e-Estonian development plan). Anyone with a social security code can view their activity and see who has accessed their data and when. Estonia has become known for its image as a digital country, with success stories such as x-road and e-residency (e-Estonia). Citizens have easy access to a wide range of e-services through the state portal eesti.ee.

According to OECD report, in Estonia, mobile telephone subscriptions are very high and 80% of individuals use internet, but there is need to provide high-speed broadband access to all end-users, for example in rural areas (OECD, 2018).

In Estonia, the Ministry of Economic Affairs and Communications coordinates the organisation of digital services across institutions. The Estonian Digital Society 2030 development plan has also been completed. Newer developments relate to reducing the bureaucracy for citizens and businesses in the provision of public services, or event services. (Ministry of Economic Affairs and Communication, Digital Agenda 2030).

4.1 Overview of Estonian agriculture

This chapter centres on Estonian agriculture. The author initially provides a general overview of e-Governance in Estonia and describes the situation of Estonian agriculture. The last sub-chapter in this section focuses on the e-services and data-sharing practices in use in agriculture.

The agri-food sector is strategically important in ensuring daily food security.

According to the agricultural census conducted by Statistics Estonia in 2020, there were 11 369 agricultural holdings in Estonia. (Centre of Estonian Rural Research and Knowledge, FSDN). The food industry accounts for 13% of the value added of the manufacturing industry, with the largest share coming from the dairy and meat industries

(24% and 19% respectively). Estonia's agriculture and food industries are export-oriented, accounting for about 8% of total exports of Estonian goods. (Viira et al., 2020). The food industry has not developed as fast as the agricultural sector. Businesses have invested in new equipment and launched new products, but the uptake of new technologies has been modest. Small food producers develop innovative products in addition to traditional ones. (Viira et al., 2020).

Agriculture is also important from an environmental perspective, and it is essential to use available data for that. Agriculture and Fisheries development plan (AFDP) 2030 sets that state intervention to meet the future objectives, its chapter 3.1.5 states that "in order to achieve the objectives of the agri-environment measures, it is essential for the state to have the capacity to collect and analyse data on agri-environmental pressures and to monitor compliance. (Ministry of Regional Affairs and Agriculture, Agriculture and Fisheries Strategy 2030). AFDP points out that, although Estonia's overall IT capacity is high and Estonian farmers are more innovative, better use should be made of the opportunities offered by technology (including digital solutions), both in agriculture and in monitoring.

A wide range of support schemes are in place in Estonia to support and promote agriculture, fisheries, and rural development - rural development grants, fisheries development grants, project grants for applied research; as well as direct payments and market management measures, agricultural and fisheries state aid, national grants and de minimis aid.

The main subsidies:

Agricultural and rural subsidies, conditionality, Leader program, regional aid, fisheries aid, research and development aid, knowledge transfer and information aid, innovation clusters, state aid, national aid, de minimis aid, direct grants and market management measures, school scheme aid, information and promotion measures, national budget allocations and ad hoc aid (Ministry of Regional Affairs and Agriculture, Grants and state aid). In connection with these measures, the state also collects various data from farmers.

4.2 Agricultural e-services and data sharing practices

The development of quality e-services requires high-quality data and data interoperability. However, it is important to analyse the specific requirements, challenges, and implementation of the technology in the context of current agricultural operations. (Karunathilake et al., 2023). The state requires data for decision-making and having data from different registers automatically available (data interoperability) is essential. However, before implementing new applications and setting requirements, a thorough analysis should be conducted to ensure that it does not create additional burdens for farmers.

Statistics Estonia acts as the national centre of competence, coordinating data management in the country. National statistics are in line with international classifications and methods and are based on the National Statistics Act (Riigi Teataja, Statistika seadus). Enterprises registered in Estonia are obliged to provide correct and complete data to Statistics Estonia in time. Agricultural statistics provide an overview of the situation of agriculture in Estonia on a monthly, quarterly, and annual basis. Statistics Estonia publishes agricultural indicators for Estonia as a whole, as well as for the counties. In addition to other reviews, the following agricultural data will be published:

- crop production (soils, yields, fertilisation);
- livestock production (live animals, livestock production, purchase prices);
- milk utilisation (production of dairy products);
- organic farming;
- agricultural income generation (value of production, costs and value added);
- sales and rental prices of agricultural land;
- consumption of products;
- labour force and other gainful activities;
- production methods;
- size and types of farm holdings.

(Statistics Estonia, agriculture).

Estonian Ministry of Regional Affairs and Agriculture is the government body responsible for planning and implementing of regional development, rural, agricultural and fisheries policies (Ministry of Regional Affairs and Agriculture). The Ministry coordinates and supports various research and development activities and sectoral

innovation through the targeting of resources for various projects, as well as through participation in international research and development cooperation. In order to support and promote agriculture, fisheries and rural development, a wide range of support schemes are implemented in Estonia - rural development grants, fisheries development grants, project grants for applied research; as well as direct payments and market management measures, agricultural and fisheries state aid, national grants and de minimis aid.

The Agricultural Registries and Information Board (ARIB) is one of the administrative bodies of the Ministry of Regional Affairs and Agriculture. ARIB acts as a paying agency accredited by European Union.

In addition to processing the various subsidies, ARIB is also responsible for managing national registers, such as the customer register, farm animals and the register of agricultural subsidies and field associations (ARIB). In the context of the European Green Deal and Digital agenda (European Commission), the ARIB is also developing itself as a repository of information and knowledge in support of the digital and greening agenda.

E-PRIA is the ARIB self-service environment through which customers can use the electronic services offered by the Agency. Since autumn 2014, the new self-service environment has been running in parallel with the old e-PRIA. PRIA's self-service environment is constantly being developed and new e-services are being added all the time. Currently, it is not possible to use all the services offered by PRIA as e-services and some services are offered through the old self-service environment (ARIB, e-PRIA).

The Rural Development Foundation (Maaelu edendamise sihtasutus, MES) provides agricultural and rural advisory services and has a nationwide structure. The purpose of the foundation is to support the economic development of the Estonian countryside through the implementation of the indicative programmes conducive to entrepreneurship. (MES advisory service, pikk.ee).

The Food and Agriculture Board supervises food and feed safety, animal health and welfare, breeding of farm animals, land management and use, plant protection and plant health, plant propagating material, fertilisers, organic farming, and professional fishing. It also acts as an authorised processor of the National Alcohol Register, the National Register of Food and Feed Operators, the Register of Professional Fishing, the Register of Land Reclamation Undertakings, the Register of Land Management Systems, the Register of Plant Health, the Register of Plant Protection Products, the Register of

Organic Farming, the Register of Fertilisers and the Register of Plant Varieties and as a responsible and authorised processor of the Register of Veterinary Surgeons, and maintains the database referred to in § 61(3) of the Act on the Implementation of the Common Agricultural Policy of the European Union; (Riigi Teataja, Põllumajandus- ja toiduameti põhimäärus).
In Estonia, Land Board manages through the Geoportal the topographic database and offers a range of services, such as X-road services, map applications, soil map applications, etc., which are certainly useful for farmers (Land Board).

The Centre of Estonian Rural Research and Knowledge is a state managed research and development institution operating under the governance of the Ministry of Regional Affairs and Agriculture. Its main activities are related to research, monitoring, assessment, and analysis in the field of agriculture, rural life, and rural economy, including laboratory analyses, and knowledge transfer, extension, and innovation services (The Centre of Estonian Rural Research and Knowledge). They are offering the farmers for example a soil sampling service. This is important because soil sampling gives the company an overview of the current state of the soil and information on how to improve the nutrient content of the soil. The collection of soil samples, which started in 2002, has also created a database that can be used for research, evaluation of the Rural Development Programme and policy decisions (Ministry of Regional Affairs and Agriculture). This is a good example of how to benefit from the data collected. But at the same time, the description of the current situation in the Agriculture and Fisheries Development Plan 2030 points out that, although Estonian farmers have a good understanding of the characteristics of their soils, they have little knowledge of the biological state of their soils. For example, data on fertiliser use and manure storage are lacking. In addition, the digital services needed to keep field records, to make fertilisation and plant protection recommendations and to draw up balances are not sufficiently developed (Ministry of Regional Affairs and Agriculture, Agriculture and Fisheries Strategy 2030).
One of the newer projects initiated by the state (ARIB) is the development of an e-book. According to the Water Act, a person engaged in agriculture must keep a field book in which information on agricultural activities must be entered. (Riigi Teatava, Veeseadus). By 2022, there were around 14 000 farmers in Estonia who are required by the Water Act to keep a record of their farming activities, known as a field book. Farmers do this in

several different ways - on paper, in an Excel spreadsheet or in a commercial software package (Klais, 2022).

Estonian Environmental Board is a government agency which operates within the area of the Ministry of the Environment. (Environmental Board). Certain activities require an environmental permit, for example those related to water use or pollutant emissions. Hence also closely linked to agricultural activities. (Riigi Teataja, Environmental permit regulation). Environmental Board information system “Kotkas” brings together the relevant registers and information (Environmental Board, Kotkas).

5 Research results and data analysis

The analysis was based on written material, the regulations and the interviews conducted and written feedback from participants. The interviews aimed to discern farmers' current practices in data sharing, the utilization of e-services, and their trust in government services. Additionally, the goal was to understand the perspectives of state representatives on enhancing e-services. Due to the small sample size, the primary analysis was conducted manually. Atlas.ti and NVIVO data analysis software were employed to structure the data by coding the interview transcripts, and subsequently, an analysed summary was created. Flourish.studio was used to generate a graph of code words, visualizing the major challenges aligned with the research questions. To ensure respondent anonymity, the identification and answers were presented in a random order.

Table 2. Summary of the analysis of the interviews with farmers. Source: author

Farmers (respondents F1, F2, F3, F4, F5, F6)

What type of data do you collect?	temperature, weather, animal productivity, livestock, registers data, yield data, all that comes from the field, agricultural machinery collected data; for cost-benefit calculations
What is your method of data collection?	F1,2,3- manually, F4- manually+ agricultural machinery, F5- manually+having special sensors, F6- doesn´t collect data.

Are you aware of existing data protection regulations? **How do you protect your data?**	F1- no capacity to keep up to date my knowledge of data protection regulations. F2,3,4,5- know data protection regulation to some extent. F1,2,3,4- doesn´t protect their data, F5- pointed that they don´t share their data, regarding data protection issues, F6- not in focus
Whether existing e-services are useful to you?	F1- I find usable e-ARIB, PTA e-services, KEA information system, F2- not usable, F3- I don´t know, basic exists, I don´t need it, F4- usable, for example ARIB services are now better, but not sure, if there is enough of e-services, F5- not using much, F6- there are enough e-services, I don't need.
Do you share your data with state (agricultural) authorities?	Data is shared for grants, production data for Statistics etc. F1,2,3,4,5 sharing their data because it is mandatory. F6 does not want to highlight anything.
Have you encountered any problems?	F1,2- Generally being online and finding the time for using computer; duplication of data collection functions by the state authorities; need to order special monitoring regarding the reports. F3- no problems, but it is very bad that state doesn´t collet the data on a common basis, this generates burden and bureaucracy. F4- no problems. F5- Regarding ARIB, it is clear, but Statistics sometimes collects data that is not understandable, why it is needed.

Suggestions for better e-services	F1-Simple bottom-up developments, this is not done most of the time and there are systems that are not logical for the user. The state should carefully consider the necessary data, avoiding unnecessary collection, and account for the capacity of companies, as multiple agencies may be collecting data. It is especially problematic if companies are required to hire additional employees solely for enter the data into various e-systems. F2- Could develop PTA website easier to use. There is a new and old e-ARIB. For a new farmer, the system is completely illogical. F3- The private sector is doing better, the state shouldn't be creating or thinking. F5- the state could collect data on a common basis.
Trust	F1- I don't think there is control over my data, or a firm trust in users or sharing, while there is no data to be concerned about. I don't know what data officials can access. F2- I know that PTA database is accessed by PTA officials, the local veterinarian can´t get necessary data from that database. F3,4,5- not sure what is done with their data.

Table 3. Summary of the analysis of the interviews with representatives of public authorities. Source: author

Public sector (respondents P1, P2, P3)

What type of data do you collect?	P1- From time to time, research is carried out to collect data on, P2- collect data for the procedures they carry out and for the authorisation procedure, P3-for registers
How do you protect farmers data?	P1- Data collected in the context of research are mostly in the public domain, with some exceptions, P2- technically can't specify, I assume compliance with all the relevant requirements, otherwise our registers would not be authorised, P3- its organisation has been awarded the ISO 27001 information security certificate, to which data protection is also organised in line with the increased requirements.
Whether there are any problems in the context of data sharing by your customers?	P1- Farmers often don't manage their data themselves, it is done for them by "farm software", which is internal and sharing data outside is a separate development that requires resources and has to be paid for. P2- Possible fear of who will use the data and for what. The state does not have a lot of experience with voluntary exchange of data, most of the time the state is in the stronger position when asking data.
Suggestion for better e-services	P1- the more data you provide, the more transparent you are and the more invisible checks the state can make. The state helps to process the various data

	sources without the person having to hire data analysts, P3- There is a lot of room for improvement in the design of e-services, data flows, etc., which could make them more customer-friendly and efficient.
Trust	P1- It can be estimated that yes, insofar as the use of e-services has been increasing over time. P2- I believe that farmers trust the research provided through pikk.ee site, P3- there is data from which it can be concluded that there is trust, but there is a preference to provide as much data as necessary but as little as possible. We hope to change this attitude through the development of knowledge services.

Figure 2. Key challenges in visualised form, based on information from farmers. Source: created in flourish.studio application by the author

The state processes data that is crucial for various services such as subsidies, the animal registry, and operational monitoring. There is an obligation to collect specific data for purposes like statistics and FADN. Additionally, various research activities contribute to collecting different types of data on farms.

In response to the question about data collection practices, all participating farmers indicated that they collect data manually, primarily for their own use. Some farmers have developed their own models for forecasting or analysis. The collected data typically includes information on production, animal productivity, livestock, yield, weather, and water characteristics. Farmers also mentioned that newer farm machinery is equipped with software that collects data, and they find it beneficial for machinery dealers to access information, such as the machine's working status.

Regarding data sharing, farmers expressed a preference for voluntary participation. If mandatory, they emphasized the importance of clarity regarding the required data and a sufficient advance notice period.
The responses from the public sector highlighted that data collected in scientific research are mostly public, with a few exceptions. Data collection serves various purposes, including processing and payment of grants, collection and processing of registry data, and authorization procedures. One respondent mentioned that data is protected in accordance with the Data Protection Act, and at least one institution is ISO 27001 certified for information security (see footnote: ISO 27001).

Most respondents expressed the belief that farmers trust their e-services, citing an increase in the use of services over time. A representative of a public authority received feedback indicating that some of the data is more accurate than the business register, suggesting a level of trust. The payment of subsidies can result in penalties for the farmer, emphasizing the importance of providing as much necessary data as possible while minimizing unnecessary information, farmers must meet certain requirements to qualify.
There is a hope that this attitude can be transformed through the development of knowledge services. These services would benefit the data provided by offering personalized feedback on their actions, fostering a proactive approach rather than a punitive one. In terms of research, there is also a perception that the provided data is valuable.

When asked about data protection, the majority of farmers mentioned that they have some knowledge of data protection regulations. Most farmers (5) stated that they do not actively protect their data or that data protection is not a significant focus for them. Some farmers highlighted that data protection or e-services might not be the highest priority among the various important issues they face.

From the public sector perspective, the data collected is primarily used for control purposes, and the provision of data is seen as a manual activity, representing additional bureaucracy without a direct benefit in return.

Farmers express concerns about sharing data, particularly in relation to subsidies, which are crucial for their survival and sustainable operation. There is a fear that sharing data could potentially lead to a reduction in income. Additionally, farmers are apprehensive about the unknown aspects of data sharing with the state, including uncertainties about data usage, access by other parties, and the potential linking of different datasets that could reveal problematic areas and result in enforcement actions.

Another factor contributing to farmers' reluctance is the reliance on farm software for data collection. The software may not always facilitate easy extraction of data, adding to the challenges of sharing information.
From public sector view, in line with the new development plan, the portfolio of services should be increased.
To encourage data sharing and address farmers' concerns, there is a need to enhance services, particularly in the form of data-based knowledge services. Farmers express that there is a lack of knowledge services that are easily understandable to them. Offering agricultural companies well-designed knowledge services derived from valuable data could be beneficial. For instance, providing recommendations on sustainable practices, such as the usage of plant protection products, could be valuable to both the state and the company, promoting regenerative and sustainable agriculture. While data from registers is considered reliable, additional value and context in decision-making and recommendations would enhance its usefulness. There is ample room for improvement in the design of these services, including data flows, to make them more customer-friendly and efficient. Farmers emphasize that the increasing obligations on businesses each year may lead to fewer choices. They express the expectation for voluntary systems

that are easily accessible and purposefully structured. The development of such systems should ideally be driven from the bottom-up, taking into consideration the practical needs and preferences of farmers.

Several businesses highlighted the high administrative burden and the increasing data collection demands, with the burden primarily falling on businesses. Farmers suggest that the state should avoid requesting data from multiple channels simultaneously if they are not compatible, aiming for more streamlined and cohesive data collection processes.

Farmers expressed concerns about the administrative burden associated with obtaining grants, citing the need for various financial and production information, project justifications, and the submission of numerous reports. They highlighted challenges related to tight timeframes, especially considering the seasonal nature of their work. Farmers emphasized the importance of clarity regarding mandatory data reporting requirements, suggesting that the state should clearly communicate the data it needs and plans to collect early in the process.

Another concern raised by farmers was the duplication of tasks by various public institutions, leading to redundant data submissions. For instance, farmers mentioned the need to provide data for environmental permits, financial information for grants, production data for Statistics, and activity data for inspections by the PTA. The frequent rotation of officials involved in data collection raised concerns about the potential disclosure of sensitive agricultural data and trade secrets. Additionally, farmers questioned the detailed data collection by the Statistics office, suggesting that some information could be directly obtained from a company's annual report. The PTA website could be more user-friendly, especially for newcomers to the industry. One farmer highlighted the potential for the private sector to contribute more to the development of e-services, given its expertise and capability to enhance services.

From the state's perspective, there was an emphasis on transparency through data provision. The viewpoint was that increased data transparency could lead to lower levels of control, making data more invisible. The state highlighted the reusability of the provided data, suggesting that, for instance, data from equipment manufacturers could still be valuable even if the manufacturers change or cease to exist. The state also acknowledged its potential role in assisting companies with processing necessary data, potentially eliminating the need for companies to separately purchase analytical services.

Farmers suggested that the use of certain services, such as adding data to state registers, should be mandatory. However, they emphasized that knowledge services, providing additional insights and recommendations, should be voluntary.

Improving the structure of services was seen as essential, making businesses more interested and willing to share data with the state even when not explicitly obligated to do so. The suggestion was to conduct analyses to determine the most cost-effective way for both the state and farmers to exchange data. This exchange could potentially lead to fewer on-site inspection visits by the state, providing benefits for farmers. However, the state lacks experience with voluntary data exchange, and building trust in such practices may be a challenge.

Trust was examined in the context of data sharing and the state's role as a service provider. The focus was on whether farmers have trust in specific e-services and how the state can foster trust to enhance e-services. According to state representatives, farmers generally trust the e-services provided by their respective authorities. The growth in the usage of e-services over time was highlighted as an indicator of this trust. Additionally, feedback was mentioned, indicating that customer contact details provided by farmers were considered more accurate than those in the business register, further suggesting a level of trust in the services. At the same time, they are aware of that since subsidies can be sanctioned if a farmer fails to meet certain requirements, it is preferable for the farmers to provide as much information as necessary but as little as possible. Hopefully this attitude can be changed through the development of knowledge services, where sharing data will allow to get very useful and personalised feedback on your own activities, which is proactive rather than punitive.

From the farmers' perspective, four out of six respondents expressed uncertainty about the specific use of their data by the state and to whom it is shared. One respondent emphasized a lack of trust, noting concerns about officials potentially having access to business secrets, especially considering the potential turnover of officials. Two farmers mentioned that they collect data primarily for their own business purposes. All farmers acknowledged that they share their data mainly due to mandatory requirements rather than voluntary willingness.

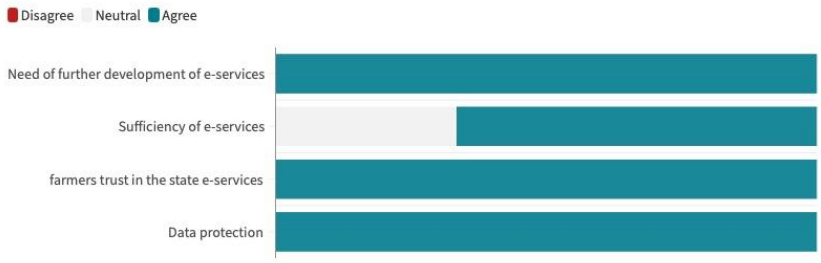

Figure 3. Key challenge bar chart from public authority perspective. Source: created in Flourish.studio by the author

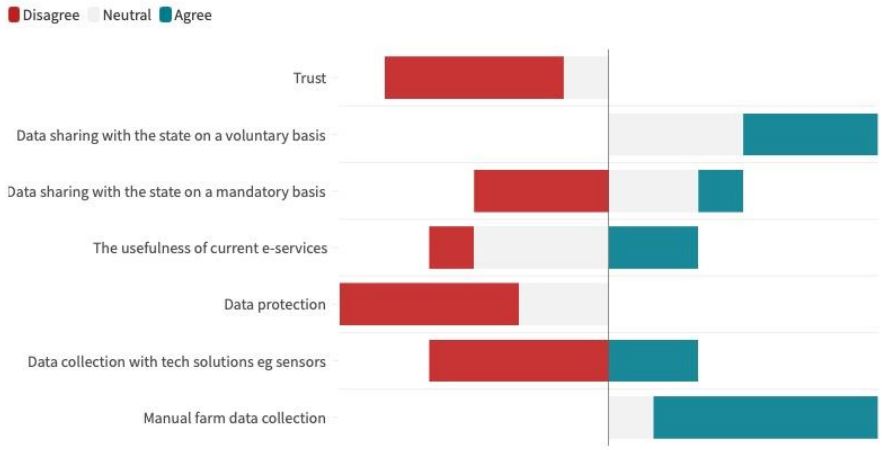

Figure 4. Key challenge bar chart from farmers' perspective. The questions on voluntary and mandatory data sharing are asked in response to a question on how farmers think data sharing could be organised, rather than on actual situation. Source: created in Flourish.studio by the author.

While the content of the interviews varied between farmers and public authorities, the two figures illustrate differences in results. Notably, trust, data protection, and opinions on existing e-services can be highlighted.

5.1 Results and discussion

The purpose of the thesis was to describe the data sharing practises in agricultural sector, also identify, how can the public sector contribute to well-functioning agricultural e-services and build trust in their services.

The first RQ (RQ1) was what are the key challenges in data sharing in the Estonian agricultural sector? And SQ (SQ1): how trust affect the willingness to share the data in agricultural sector?

The second RQ (RQ2) was how can the Estonian state authorities encourage data sharing with farmers to develop agricultural e-services?

The author worked through the material and analysing the interviews conducted. Although there were limitations in the research, the author made the following conclusions:

RQ1

It can be inferred that smaller producers are hesitant to voluntarily share data with the state, opting to share only the information that is mandatory. While farmers collect various data for their own use, focusing on making informed business decisions, improving yields, and planning activities, they exhibit reluctance to voluntarily share this data with the government. A noteworthy concern highlighted by the author is the apparent lack of attention to data protection among farmers. Notably, 5 out of 6 interviewed farmers admitted to taking no measures to protect their data or showed minimal awareness of existing data protection regulations. For instance, F1 responded to the question regarding awareness of data protection regulations and protective measures against unauthorized access, stating, "I am not aware of; not protecting my data." This finding is significant in light of global threats and the escalating frequency of cyber-attacks. The state could consider intensifying efforts to address this issue by providing support and training to farmers and potentially extending such initiatives to other small businesses.

SQ1

The author notes that farmers demonstrate reluctance to share their data, primarily attributing it to a lack of trust. Farmers express uncertainty about their control over data and its utilization by the state. The conclusion drawn is that trust is significantly impacted by uncertainties related to data protection regulations, the data protection practices of state authorities, and a lack of information. Trust is further compromised when government services lack interoperability, leading to issues such as disparate data

collections by various state authorities. To address this, data requests should adhere to a 'once only' principle, and there should be more effective collaboration among different agencies.

RQ2

Given that the potential interviewees were difficult to find, particularly due to their limited availability and fieldwork commitments, and considering the reasons for interview refusals, the author concludes that the development of all services should prioritize simplicity and ease of use.

Concerning mandatory versus voluntary data sharing, several parties emphasized that collecting specific data should be obligatory. However, voluntary data sharing can be encouraged by offering discernible benefits to the data owner, providing them with incentives to share the data. Importantly, trust in the recipient of the data remains a crucial factor in promoting voluntary data sharing.

Analyzing the materials and information collected from interviews, the author has compiled a table outlining the primary challenges associated with data sharing. The table also delineates aspects of data sharing related to trust and suggests ways in which Estonian public authorities can encourage data sharing to aid in the development of e-services.

Table 4. Key challenges in data sharing. Created by author.

Key challenges in the Estonian agricultural sector	• in the light of the development of technology and e-services, the state must be able to keep up with trends and new solutions and provide value for the data it shares with the farmer. • Absence of quality data from the agricultural sector on which to base data driven policy decisions. • Lack of ability to offer value from shared data. • Information is not harmonized and easily accessible. Farmers often spend time in the

	fields and don't have time to search for information. There are too many different data collections by various state authorities
Ways in which trust affects the willingness to share the data in agricultural sector	• The lack of information about where the shared data is going and how it will be used affects trust and, consequently, the willingness to share data. If a business is unfamiliar with data protection regulations, it is unsure about how much data to share and who processes it, and how. • Rotating officials who carry out spot checks can affect the trust to share data (can be related to business trust)
Ways in which the Estonian state authorities can encourage data sharing with farmers to develop better e-services	• Reduce administrative burden, e.g. organise data collection on a harmonised basis across different public authorities, so that there is no duplication and the data collected can be cross-used. • deliver more value and benefits from shared data for farmers, so that farmers can make better business decisions. It can be done through data analysis or visualisation provided by the state (proposed by one interviewee). • Provide transparent communication so that businesses know what the government is doing with their data and who has access to it. (simple description of regulations and other aspects). • Support businesses with training and advice on data protection and cyber threats, for example, involve the advisory service or local municipalities in this project.

	• Involve and consult businesses at early (planning) stage if new data collection is planned and what data is needed. If necessary, provide assistance in the form of advice to make it easier to submit data. • Emphasise the user-friendliness of e-services and channels. • Could consider a single cross-sector platform where all services would be brought together, and which structure would be focused specifically for the farmer.

5.2 Limitations and future work

It must be acknowledged that it was challenging to find farmers chosen for the sample who would were amenable to providing an interview or even responding in writing, despite this was suggested by the author. A considerable number either lacked the time or expressed an unwillingness to participate. Consequently, the actual number of interviews conducted differs from the initially planned number.

In the future, exploring alternative techniques could be considered to encourage small farmers to share their practices, providing a more comprehensive overview of the entire segment. Specific legal issues related to voluntary and mandatory data sharing, digital solutions, devices, and data ownership could be examined more thoroughly, as these aspects are not clearly addressed. Additionally, if feasible, comparisons with other EU member states could be made to better identify problems and potential solutions.

6 Conclusion

The aim of the thesis was to identify problem areas in data sharing practices within the Estonian agricultural sector and explore the impact of trust on farmer's willingness to share data. Additionally, the study aimed to identify factors that could aid the state in developing improved agricultural e-services.

The author posed two research questions and one sub-question. While farmers were the primary target group for the study, interviews also included public authority representatives to provide a comprehensive view from the state perspective.

Enhancing the efficient use of data and promoting data-driven decision making in both government and business management is a high priority, both in Estonia and globally.

Transparency in how shared data is handled and who has access to it is crucial for fostering trust in data-sharing practices.

The availability and interoperability of high-quality data also contribute to broader environmental benefits and human health.

The research findings indicate that farmers have low trust in sharing their data. The primary reason for this is attributed to farmers being unaware of how the state processes their data and who has access to it.

Farmers experience highly intensive working seasons, dedicating a significant portion of their time to fieldwork. Therefore, their administrative burden could be significantly reduced if the state optimizes and harmonizes data collection, ensuring easy access to information. Transparent communication by the state is also crucial, allowing farmers to understand how the government manages their data and who has access to it.

Increased cyberattacks underline the critical importance of data protection. Most interviewed farmers expressed a lack of awareness regarding data protection regulations and reported not implementing measures to protect their data. An awareness campaign or increased focus on data protection could prevent potential issues and bring trust. It is imperative for the state to offer support, particularly to small businesses lacking the technical capacity, to enhance data protection in the agricultural sector.

If the state could provide added value through data processing and ensure transparency in data handling, both parties would benefit. The state would gain a better overview of the sector, more data for future actions and decisions, while simultaneously reducing the administrative burden for both the state and farmers. This, in turn, contributes to the overall development of the agricultural sector. Furthermore, farmers would gain access to best practices and know-how, leading to potential economic benefits.

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Appendix 1 – Interview guideline

Semi-structured interviews were carried out as part of the thesis, which added value to the research findings.

Preparatory questions were sent to participants in advance by e-mail.

The questions for farmers were as follows:

Demographic

- In which region (county) of Estonia your company operates?
- What is your company's field of activity?
- What is the size of your company and how many employees your company has?
- How long has your company been in business?

Data collection

- Do you collect data on your farm (e.g. weather, soil, crop yields data)?
- If yes, how do you collect this data (e.g. manually, through sensors, using farm management software)?
- Are there any specific technologies or tools you use for data collection?
- Are you aware of any data privacy regulations that apply to your farm?
- How do you protect your data from unauthorized access or breaches?

Agricultural e-services

- How useful do you find the existing agricultural e-services?
- Have you ever been asked to share some of your company's data with the state (agricultural) authorities?
- What is the main reason, why you agree/disagree to share your data with the agricultural authorities?
- How can the Estonian state authorities build trust for data sharing with farmers to help ensure better agricultural e-services?

- Do you think there are currently enough public agricultural e-services in Estonia? Please explain. Do you have control over how your farm data is used?
- Which public agricultural e-services do you need the most? Which services do you lack the most?
- How could the state better regulate and create agricultural e-services? Whether their use should be voluntary or mandatory?

The questions for the state representatives and e-services providers were as follows:

Demographic

- What is your company's/organisation's field of activity?
- How many customers/members your organisation has?

Agricultural e-services

- What kind of e-services do you offer?
- What data do you collect from agricultural companies?
- How do you provide the data security of collected data?
- How do you think, does the farmers have trust towards your institution? Please explain.

How can the Estonian state authorities encourage data sharing with farmers to develop better e-services?

- Do you think there are currently enough public agricultural e-services in Estonia? Please explain.
- In your opinion, what is the main reasons why farmers agree/disagree to share their data with the state authorities?
- How could the state better regulate and create agricultural e-services, whether their use should be voluntary or mandatory?

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