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The Smarterfarmer Project

Farms and the Digital Frontier:

Mapping the Digital Landscape of Farming in Denmark

Introduction

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1. Introduction

1.1 The Importance and Challenges of Danish Agriculture

The agrifood sector continues to play a crucial and multifaceted role within and beyond the Danish society. Although agriculture accounts for only about one to two percent of Denmark's GDP¹, the sector provides a reliable supply of high-quality agricultural products, making it a cornerstone of national well-being, security, and public health. In this regard, Denmark's agricultural productivity is remarkable, with it producing enough food to feed nearly three times its population². This is made possible, in part, by the country's extensive land use, with approximately 65% of its territory currently dedicated to agriculture³. Given this high level of productivity, Denmark's food industry and its extensions represent a significant force internationally, with the food and food technology cluster accounting for 25% of the total export from Denmark⁴, reinforcing Denmark's resilience while also supporting that of its neighbors and beyond². This role is increasingly critical, as rising geopolitical tensions, global population growth, and climate change amplify the importance of maintaining a resilient and reliable food supply as a foundation for societal stability and sustainable economic development.

However, while the collective efforts of farmers ensured - and continue to ensure - a stable supply of high-quality food, agriculture is increasingly wrestling with a multitude of challenges that require farmers and other stakeholders to rethink how they operate⁵. These challenges include changes in labor markets, regulatory frameworks, consumer expectations, and an increasingly competitive international landscape. In addition, agriculture both impacts and is impacted by environmental change: shifting climatic conditions and biodiversity loss are pressing issues that affect farm productivity while also being shaped by agricultural practices. Since farms operate within natural ecosystems, responsible resource management is essential to ensure long-term sustainability. As such, there is a growing imperative to reduce the sector's ecological footprint. Meeting these challenges calls for farmers and farm managers to re-evaluate how they steward resources, cultivate their land, care for their livestock, and engage with a wide range of stakeholders.

² Danish Agriculture & Food Council, 2023

³ Trading Economics, n.d.

⁴ Christensen, 2019

⁵ Food and Agriculture Organization of the United Nations, 2017

1.2 Meeting Challenges through Digitalization

In light of the growing complexity of challenges facing modern agriculture - ranging from environmental pressures and labor shortages to evolving regulatory and market demands – agricultural digitalization has emerged as a critical pathway for strengthening the resilience, efficiency, and sustainability of the agrifood sector^{6 7}. Digital technologies can support farming operations in numerous ways: by improving monitoring and decision-making, streamlining processes and daily activities, simplifying communication and reporting, and automating specific tasks. By collecting and integrating data from diverse sources, farmers and farm managers gain more precise and timely insights into their operations. These insights enable more informed decisions and optimization, which can help to reduce resource use and environmental impact, while improving working conditions and maintaining high productivity⁸. Policy frameworks such as the European Union’s Digital Strategy for Agriculture and research by institutions like the Food and Agriculture Organization of the United Nations (FAO), therefore, emphasize the importance of integrating digital technologies into farming systems⁹.

The digital technologies that generate and utilize such insights can generally be grouped into two main categories¹⁰: Farm management information systems (FMIS) and precision agriculture technologies (PATs), including technologies for automation and robotics. FMIS are primarily software-based tools designed to integrate, process, store, and distribute data in a form that supports the planning and execution of a farm’s operations and management activities. Precision Agriculture refers to a farm management approach focused specifically on optimizing production by leveraging digital technologies to measure the condition of fields, crops, or animals and apply resources and care exactly where and when they are needed. Together, these systems support a wide range of agricultural tasks and hold strong potential to significantly enhance farm efficiency.

1.3 Digitalization – a challenge in and by itself

Despite the promising potential of agricultural digitalization, research consistently shows that the digital transformation of farming is far from straightforward. This is because the adoption of

⁶ FAO- Food and Agriculture Organization, 2017

⁷ FAO - Food and Agriculture Organization, 2019

⁸ Balafoutis et al., 2017

⁹ European Commission, 2025

¹⁰ Balafoutis, 2020

digital technologies and the growing emphasis on data brings significant changes to farm operations.

Agriculture digitalization is not solely about implementing new technologies, but also demands the development of new skills, strategic planning, and a broader organizational shift. To fully harness the benefits of digital technologies, farms must adopt a comprehensive approach. This involves understanding, selecting, and integrating a diverse range of technologies that suit their specific needs and having a clear vision for how digital solutions can enhance their operations. It also means developing the necessary technical skills to effectively operate these systems and building the capacity to manage, integrate, and analyze the data they generate. Only by aligning technology adoption with strategic planning and operational readiness can farms unlock the full potential of digitalization.

This is why agricultural digitalization should be understood as an ongoing process rather than a binary state. Digital advancement is not simply a matter of being “digital” or “not digital”—it unfolds gradually, with both technological infrastructure and the strategic and operational capacities evolving over time. Given the complex and multifaceted nature of this transformation, it is essential to examine agricultural digitalization from multiple perspectives and identify the key factors influencing it. Equally important is the need to understand the specific roadblocks that hinder progress, as well as the incentives that can accelerate adoption. By addressing these aspects, we can help ensure that the benefits of digitalization take hold sooner rather than later.

1.4 Taking a farmer’s perspective

To better understand agriculture digitalization, it is essential to focus on those at the heart of its implementation: the farmers and farm managers. Any meaningful discussion about the digital transformation of agriculture must include their perspective, as they are the ones who ultimately adopt, adapt, or reject these technologies. Farmers operate within diverse contexts, shaped by their individual backgrounds, production systems, farm sizes, and regional conditions. These factors can significantly influence not only the level of digital advancement on a farm but also farmers’ perceptions of digital technologies, as well as the specific barriers and motivations they encounter in the adoption process.

In this report, we inquire about the state of agricultural digitalization in Denmark through a large-scale survey of Danish farms. Specifically, we asked farmers and farm managers about the extent to which FMIS and PA technologies are used on their farms and how they assess their strategic orientation and operational integration with these technologies. Additionally, we explored their

views on the operational, economic, and environmental impacts of their digital setups, as well as their perceptions of key barriers and incentives to adopting (more) digital technologies.

The purpose of this report is to provide a foundation for a productive dialogue on the future of agriculture, which acknowledges the diversity of the farming community and supports the alignment of stakeholder interests. Our goal is to help address the previously mentioned challenges and contribute to the development of food production systems that are economically viable, ecologically sound, and socially sustainable.

1.5 Structure of the report

The report is structured as follows: In the next section, we briefly outline our research approach and our perspective on examining agricultural digitalization, followed by a detailed description of the SmarterFarmer sample based on the available data of farm- and farmer characteristics. We then present our findings, beginning with an overview of how farms assess their engagement with digital technologies and the factors associated with (not) being on the digitalization track. Next, we focus on farms identified as digital adopters, examining their level of digital advancement from both technological and managerial perspectives, and exploring the factors associated with each. We finally analyze how farmers evaluate the impact of their digital technologies, as well as perceived barriers to and incentives for further adoption.