Preparing for the digital agriculture era – why should we and who should we educate?

Michael Paulus, Andrea Knierim and Sara Pfaff[1]

Abstract - In recent years, efforts and calls have increased to include digital agriculture in existing curricula and to create learning opportunities to foster knowledge dissemination. It is expected that digital agriculture will affect agricultural education actors. The present work reflects on why education on digital agriculture is necessary and who should be educated. The results originate from 38 interviews with digital agriculture stakeholders. The explorative analysis reveals that socio-technical change and new learning requirements are the most important reasons why digital agriculture should be educated. Besides different types of farmers, learning opportunities should be offered for advisors, teachers, and students. The study provides valuable insights into how education can support the knowledge dissemination about digital agriculture.

INTRODUCTION

Digital agriculture has become the epitome of a transformation of existing farm practices induced by the combination of technical (data, smart technology) and social (farmers) units in new ways (Wolfert et al., 2017; Klerkx et al., 2019). In recent years, adoption rates for digital technologies in Europe have increased (e.g. Lowenberg-DeBoer & Erickson, 2019). In the literature, authors argue that farmers need to acquire new knowledge and skills to enable them to use digital technologies (Kitchen et al., 2002; Beinert, 2017). To our knowledge, relatively few studies in the literature investigate the educational implications of digitalization. Therefore, the present study responds to the following research questions: (1) Why should digital agriculture be included in existing or new learning programs, and (2) who should be educated? The chosen research approach is rather explorative and provides insights into digital agriculture stakeholders' perceptions.

MATERIAL AND METHODS

The used data originates from 38 semi-structured interviews with digital agriculture stakeholders from Southern Germany, Austria, and Switzerland. The data was collected in early 2021. We chose participants based on their affiliation to digitalization in small-scale agriculture and their connection to organizations engaged in technology and knowledge transfer (see Table 1).

Table 1. Number of interviewees according to their group affiliation.

Group	Number	Abbreviation
Farmer and contractor	5	B30, B31, B32, B33 B34,
State institutes and administration[1]	8	B9, B11, B15, B17, B19, B20, B25, B35
Research[2]	12	B1, B2, B3, B6, B7, B10, B12, B18, B22, B24, B26, B36
Educational institutions	1	B37
Vendors and Service	3	B4, B21, B29
Farmers' association	1	B5
AgTech (arable, livestock, software)	8	B8, B13, B14, B16, B23, B27, B28, B38

Most interviewees are also involved in vocational (1) or academic (2) education.

While the main objective was to investigate the implications of digitalization for German small-scale agriculture, open questions referred to a broad range of causes and consequences and raised answers concerning knowledge dissemination, learning, and educational aspects. By using qualitative content analysis (Mayring, 2015), we extracted all text segments related to education in the first step. In the second step, we inductively coded the material to identify key topics with the software MAXQDA.

RESULTS

Socio-technical change – Some of the mentioned reasons are connected to the socio-technical change induced by digitalization. Common arguments are that highly digitalized farms will become the norm (B4; B5), technologies will be even more sophisticated and complex (B26), and that occupational profiles will change fundamentally (B18). These arguments imply that creating learning opportunities is necessary so that the social side (workforce) can keep pace with the progressing technical change.

New learning requirements – Another stream of arguments outlines new learning requirements. So far, it is questionable whether potential users are already adequately prepared to use basic digital technologies (B4). It is also expected that farmers need to acquire new skills and competencies to make full use of digitalization (B6; B25; B26). Additionally, previous farming knowledge will be increasingly outdated because of new technical solutions taking care of specific tasks (B10). Moreover, lifelong learning gains growing importance (B7, B18, B37). Hence, new and adapted educational formats are

[1]Michael Paulus and Andrea Knierim are from the University of Hohenheim, Department of Communication and Advisory Services in Rural Areas, Stuttgart, Germany (m.paulus@uni-hohenheim.de).
Sara Pfaff is from the Nuertingen-Geislingen University, Institute for Applied Agricultural Research, Nuertingen, Germany (sara.pfaff@hfwu.de).

needed, which allow potential users to acquire these new skillsets.

Accessibility and Independence – Another topic is related to the question of why digital agriculture should be included in existing educational programs. All interested people should have access to learning opportunities regardless of their personal farming background (B21). Additionally, corresponding opportunities should be free from the commercial interests of technology suppliers (B37). To be more precise, such arrangements ensure that all students can experience digital technologies practically (B35) and are, at least to some extent, prepared for their future use (B12; B26). Thus, the development of accessible and independent formats improves knowledge dissemination.

Groups of interest - The results of the second research question reveal that educational efforts should be developed to address different actors in the agricultural sector. For example, relevant groups in the farming community are part- and full-time farmers (B25, B37), technophile and technophob farmers (B25, B37), farmers of different age and professional experience (B4, B7, B25, B28, B37), farmers with different educational background (B4, B7; B25), or farmers with a varying degree of awareness about digitalization (B12). Besides, employed farmworkers (B18) are another group of interest that should not be neglected. Moreover, agricultural students at all levels of the agricultural vocational and academic education system are identified as a relevant group (B5, B22, B24, B28, B36, B37). Furthermore, educational opportunities must also be provided to farm advisors (B9; B24) and teachers at vocational and academic institutions (B6, B9; B10, B12; B20; B24).

DISCUSSION

It is relatively unsurprising that the stakeholders identify the socio-technical change induced by digitalization and new learning requirements as reasons to include the topic in educational formats. This ties well with studies outlining new knowledge requirements to enable the appropriate use of digital technologies (Kitchen et al., 2002; Beinert, 2017). In contrast to this, it is striking that only a few experts emphasize the need to create independent and accessible formats to ensure that all interested actors can inform themselves about digital agriculture. Yet, in practice, farmers prefer learning opportunities provided by manufacturers and vendors instead of formats offered by the state or farmer associations (Beinert, 2017). However, we presume that non-commercial learning opportunities may be scarce since digital transformation is mainly driven by the interest of private companies (Birner et al., 2021). In addition, the study reveals that besides farmers, educational opportunities should also be offered to other actors in the agricultural sector, especially those involved in knowledge transfer. For instance, educators and students often still miss relevant knowledge about digitalization to properly teach or practically apply it, respectively (BMEL, 2020; Ammann & El Benni, 2022).

CONCLUSION

Based on our findings, we conclude that educational programs on digital agriculture should be accessible to different types of actors to enable them to (independently) assess the benefits and downsides of digitalization. For this purpose, we suggest that existing educational programs should be adapted, and new learning formats established. In this regard, it is also essential to clarify what topics, formats, and forms of private-public cooperation are needed to improve knowledge transfer and information accessibility for all interested actors.

REFERENCES

Ammann, J., El Benni, N. (2022). Digitale Technologien in der landwirtschaftlichen Ausbildung. URL: https://ira.agroscope.ch/de-CH/publication/48880 (20.04.2022).

Beinert, M. (2017). Fachliche, methodische und persönlich-soziale Anforderungen an landwirtschaftliche Arbeitskräfte vor dem Hintergrund der zunehmenden Technisierung und Digitalisierung in der Landwirtschaft. *Schriftenreihe der Rentenbank* 33: 7-42.

Birner, R., Daum, T., Pray, C. (2021). Who drives the digital revolution in agriculture? A review of supply-side trends, players and challenges. *Applied Economic Perspectives and Policy* 43(4): 1260-1285.

Bundesministerium für Ernährung und Landwirtschaft (BMEL) (2020). Arbeitsmarkt Landwirtschaft in Deutschland. URL: https://www.bildungsserveragrar.de/fileadmin/Redaktion/Bildungswege/studie-arbeitsmarkt-landwirtschaft-in-deutschland.pdf (04.04.2022).

Kitchen, N.R., Snyder, C.J., Franzen, D.W., Wiebold, W.J. (2002). Educational Needs of Precision Agriculture. *Precision Agric* 3(3): 341 – 351.

Klerkx, L., Jakku, E., Labarthe, P. (2019). A review of social science on digital agriculture, smart farming and agriculture 4.0: New contributions and a future research agenda. *NJA – Wageningen Journal of Life Sciences* 90-91: 100315.

Lowenberg-DeBoer, J., Erickson, B. (2019). Setting the Record straight on Precision Agriculture Adoption. *Agronomy Journal* 111(4):1552-1569.

Mayring, P. (2015). Qualitative Inhaltsanalyse. Grundlagen und Techniken, 12., überarb. Auflage, Weinheim und Basel: Beltz.

Wolfert, S., Ge, L., Verdouw, C., Bogaardt, M.-J. (2017). Big Data in Smart Farming – A review. *Agricultural Systems* 153: 69-80.