

## Digitalisation in agriculture and its impact on social sustainability

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### ABSTRACT

Digitalisation in agriculture will lead to changes in the way farms are operated. In addition to the predicted changes in the ecological and economical dimensions of sustainability the social dimension which is examined in this publication, will also undergo a fundamental change. The social dimension of sustainability very often does not receive the same attention as the ecological and economical components. However, it is equally important and must not be neglected just because of the fact that quantification in this field is more complex than in the ecological or economical field. In order to predict which changes digitalisation will bring to agriculture a Delphi survey was conducted. The questions are based on the UNEP SETAC Guideline for social life cycle assessment. It should be mentioned that at DiWenLa the material flows are in Germany. Issues such as child labor and forced labor which are major issues worldwide and which the UNEP SETAC guidelines aim to eliminate are not considered in this project. The focus is on how digitalisation is changing the social sustainability of agriculture in Southern Germany. The 17 questions were answered by experts in the fields of agriculture, sociology, agricultural extension, agricultural research, digitalisation and academia. The questionnaire is designed to determine the effects of digitalisation in agriculture on social sustainability.

The main objective of this study is to develop a consensus on how digitalisation in agriculture affects the social dimension of sustainability. In Delphi Surveys, several rounds of interviews are conducted until the experts reach a consensus on the issue. A standardized questionnaire with predefined answers is sent out. After a successful response to the first round, the questionnaire is evaluated and the experts received the same questionnaire, amended with the answers from the first round, so that they can reconsider their decision. This procedure is repeated until a consensus is reached among the experts.

*Keywords: Digitalisation, social sustainaibility, small-scale agriculture, Delphi methodology*

### Introduction

High hopes are associated with the digitalisation of agriculture (Klerkx et. al. 2019). On the one hand, yields are expected to increase, while the environmental impact of the crop production is reduced. On the other hand, digitalisation is expected to lower the workload of the farmers and farm workers, thus contributing to an improved work-life-balance for them (Shamshiri et. al. 2018). Against this background, it can be assumed that digitalisation has a positive effect on the social sustainability of intensive crop production.

For a sustainability assessment, the economic, ecological and social dimensions should be considered. While the economic dimension can largely be quantified and mapped using the concept of profitability and ecology using widely accepted environmental indicators, a consensus on indicators for social sustainability is by and large lacking (Janker et. al. 2019). As a result, social sustainability often plays a secondary role, even though it is considered of the same importance in a holistic sustainability assessment. A few frameworks exist that propose indicators for social sustainability such as the UNEP-SETAC guideline (UNEP SETAC 2009) and the SAFA guidelines of FAO (SAFA 2014). However, these indicators lack the granularity needed to capture the potential impacts of digitalisation in agriculture on the social sustainability. For example, the SAFA guidelines are only suitable for the consideration of entire companies or processes and not for the consideration of individual products. In the SLCA according to UNEP SETAC, entire value chains are taken into account. In this work, the focus is on small- and mid-size farms in southern Germany, which are highly technified and run by one family is often involved. For this reason, the existing frameworks do not well address the social sustainability in this context.

This publication shows how digitalisation in agriculture affects the social dimension of sustainability. The state of Baden-Württemberg is characterised by small-scale agriculture, which applies to both farms and the agricultural landscape. Many farms are run on a part-time basis and the average field size is significantly smaller than in other regions in Germany (Jongeneel et. al. 2005 p. 7). In order to predict what changes digitalisation will bring to small-scale agriculture, a Delphi survey was conducted with experts. In a total of 17 questions, 20 experts answered the questionnaire in question round 1 and 14 experts in question round 2. In the process, the impact of digitalisation on social sustainability in small-scale agriculture was elaborated.

## **Material & Methods**

### **1. Background of the Delphi Method**

The Delphi method was developed in the 1950s with the aim of predicting the future. Nowadays, this method is established in a wide variety of fields and is now used in the most diverse areas of application (Trevelyan 2015). There are different methods of interviewing experts for a Delphi survey: To aggregate ideas, to determine a factual basis, to determine experts opinions and to obtain a consensus decision (Brady 2016 p. 66). In this study, the aim was to develop a consensus on how digitalisation in agriculture affects the social dimension of sustainability. In Delphi surveys, several rounds of questioning are conducted until the experts reach a consensus on the issue being questioned (Aldrighetti et. al. 2021). A standardised questionnaire with predefined answers is sent out. After a successful response to the first round of questioning, the questionnaire is evaluated and the experts receive the same questionnaire, supplemented with the answers of the first round, so that they can reconsider their decisions. This procedure is repeated until a consensus is reached among the experts. According to Keeney et. al. (2001) however, two rounds of questions are sufficient to reach a consensus, since the marginal utility decreases with each additional round and fewer and fewer experts participate with each additional questioning.

### **2. Selection of Experts**

The right choice of experts has an extremely important influence on the Delphi survey (Allen et. al. 2018). In addition to the technical expertise, the number of experts is also an important influencing factor in a Delphi

survey. According to Kühnen and Hahn (2019) an optimal number of experts is reached with 10-30 participants. Although involving more experts might result in more insights, studies have shown that the results are not necessarily more accurate with a larger number of experts. Moreover, consensus building becomes increasingly difficult with more participants (Boulkedid et. al. 2011). The experts in this Delphi survey work in the fields of agriculture, sociology, agricultural extension, digitalisation, agricultural research and science/teaching.

When selecting the experts, the aim was not only to ensure professional expertise but also to achieve as equal a distribution as possible among the professions. In this way, social sustainability is reflected from different perspectives, resulting in a more comprehensive outcome. Furthermore, in the second round of questioning, the experts can see how the other participants answered the questions. This gives the experts the opportunity to change their opinion again. Since the entire Delphi survey is anonymous, the experts do not know who the other participants are and in which fields they work. Not all of the experts contacted took part in the survey. Since the survey is anonymous, it is not possible to say whether experts in a particular field participated more often, less often or not at all.

### **3. Questionnaire**

How digitalisation in agriculture affects the social dimension of sustainability had not yet been scientifically investigated. Therefore, the Delphi method was used to answer this question. The participating experts were sent a standardised questionnaire containing 17 questions by email. The procedure was explained to the experts when they received the first questionnaire. This questionnaire was divided into six categories: working hours, training/workplaces, data protection, marketing, barriers to digitalisation and other. All quantitative questions had predefined answer options on a scale of 1 to 6, so that a quasi-metric level of measurement could be applied (Wu, Leung 2017). In the last, qualitative question, the experts were asked what digitalisation means to them in the context of social sustainability. Before the survey started, a pretest was conducted. This ensured that the survey process worked without any technical problems. A total of 20 experts participated in the first round of the survey. After the first round of questioning was completed, the results were evaluated. In order to find a consensus on the topic, these results were added to the same questionnaire and sent out again. In this second round, the number of participants decreased to 14, but the consensus on the individual questions improved.

### **4. Results & Discussion**

Digitalisation will change all areas of society (Valenduc, Venramin 2017). This also affects agriculture, which, however, has evolved for hundreds of years and will continue to evolve this time as well (Fielke et. al. 2021). The effects of digitalisation on the social dimension of sustainability in small-scale agriculture have not yet been extensively researched. With the results of the Delphi survey, a few conclusions can be drawn in this regard.

The experts are sure that digitalisation will tend to reduce the working time of agricultural employees. Digital technology will take over tasks, which will reduce the working time of the individual employee and result in an overall reduction in workload (Buhr et. al. 2016). As a result, the experts are certain that the profession of a farmer will not cease existing. In contrast to other professions, such as in administration or in the mobility sector, digitalisation is expected to complement the farmers activities and not to replace his entire work (Clauberg 2020). Farmers' know-how, closeness to nature, weather and soil are still essential for successful and sustainable farm management.

The experts see an increased risk in farmers being overwhelmed by digital technology. This overtaxing could slow down the digitalisation process. One way to counter this potential challenge would be the provision of 'digitalisation officers' by companies. These could support farmers with the new technology. In addition, this could compensate for job losses as the experts are certain that digitalisation in agriculture will also eliminate jobs on the part of manually intensive and routine work.

The issue of 'data protection' must not be neglected in the course of digitalisation. The experts are of the opinion that there is a great risk of the misuse of data. Moreover, farmers fear that their activities and management practices will become transparent if all data is processed digitally. However, transparency of their management practices for them also bears a substantial benefit: On the one hand, digital technology can help to better monitor and lower costs. On the other hand, particular (often premium specialty markets) markets can be entered more easily, as transparency of production practices and traceability of the product is typically a prerequisite for such value chains. For instance, food market under a "regionally produced" label requires such information in order to differentiate from non-regional produce. Furthermore, products can be marketed more easily as the risk of reputational damage because of violations of social standards in the value chain is lowered (Baldy 2019 p. 16). However, the experts also see obstacles in the digitalisation process. They are of the opinion that smaller businesses could be "left behind" in the course of digitalisation because they do not want to or cannot afford the significant investments into digital technology.

Only a few experts were involved in the results of this study. The number was sufficient for a Delphi survey. However, this survey is not representative. This fact should make clear that further research is needed in this area. Nevertheless, the result of this work is a first step into a new field of research. As digitalisation in agriculture continues to develop and will be used more widely in the future, the results of this work can pave a way into more quantitative research. With the participating stakeholders in this Delphi survey, experts with an excellent knowledge in this field shared their views such that this study could provide a good basis for future research to build upon.

## **5. Conclusion**

Delphi surveys are used for future scenarios to make predictions for tomorrow. Digitalisation in agriculture will lead to changes. When and how quickly digitalisation will reach the agricultural practice of small- and mid-size farms in Southern Germany remains unclear. Overall, however, it can be anticipated that digitalisation will support farmers by reducing their workload, in particular with respect to routine and monotonous activities. However, it is not expected that digitalisation will replace the profession of the farmer completely. Most management decisions will ultimately still be made by farmers. Whether and to what extent these decisions will be influenced and supported by digital technology is uncertain. Furthermore, digitalisation will help to bring more transparency into the value chain. This makes farmers work visible and increases the appreciation of food production. This change will also have a positive impact on the social sustainability of the respective agricultural production.

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