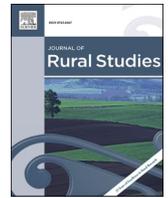




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# Why farmers perceive the use of e-government services as an administrative burden: A conceptual framework on influencing factors

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## ABSTRACT

In many countries around the world, family farms are expected to use e-government services to handle data exchange electronically via the internet with the government to fulfill their information obligations. This paper aims to explore the factors influencing the extent to which farmers perceive the use of such services as burdensome, and to develop a framework to categorize these factors for the farming sector. To do this, we extracted a conceptual framework designed for commercial businesses and adapted it to the farming sector. We employed a qualitative case study in Switzerland and conducted face-to-face interviews with six farmers using contrast sampling. The interviews were examined by applying thematic analysis. We found influencing factors from four different fields: (1) farm and farmer characteristics (e.g., farm structure, farmer's attitude toward ICT, farmer's ICT competence, use of external support, work organization, and infrastructure), (2) usage characteristics of e-government services (e.g. quantity and frequency of data entry, and period in use), (3) perceived characteristics of e-government (e.g., network, documentation, software design, complexity, farm compatibility, and duplication), and (4) perceived farm impact (data-security). We further found that the use of e-government services has no organizational benefits for family farms. Our findings provide a conceptual framework for understanding why e-government services for farmers might contribute to either a decrease or increase in their perceived administrative burden. It further provides policy-relevant information about the factors that play a role in digital direct payment administration to reduce farmers' administrative burdens.

## 1. Introduction

Over the past 20 years, many governments around the world have launched electronic government initiatives. These initiatives involve information and communication technology (ICT) development to enhance government interaction with citizens, with a view to providing various public services (Bekkers and Homburg, 2007; Verdegem and Verleye, 2009). Electronic government, abbreviated as "e-government," can be defined as the use of digital information technology to implement and support information, communication, and transaction processes between government institutions and the state's citizens (Arendsen et al., 2014). E-government services often increase government costs but lower the private costs of e-government stakeholders by eliminating paper handling costs, reducing message transportation time, and shortening wait and search times (Arendsen et al., 2014).

Many governments have invested in e-government systems in the

agricultural sector (Mahaman et al., 2005). European governments primarily developed electronic systems for two reasons: (1) to support the identification and traceability of animals from birth to slaughter, on the grounds of animal and public health (Aubert et al., 2012), and (2) to manage the application and disbursement of direct payments between the government and farmers (Bundesamt für Landwirtschaft, 2016). Due to these developments, farmers are increasingly expected to use e-government services. A 2019 study showed that about one-third of Swiss farmers managed the transition from paper to electronic forms quite well, while 40% reported an increase in their administrative workload due to the use of e-government services (Mack, 2019b).

The introduction of e-government services represents one element of digital transformation in agriculture. A growing body of research has focused on the economic, structural, social, and individual factors influencing farmers' adoption of digital technologies. Most of these studies have analyzed precision farming technologies (Konrad et al.,

; ICT, information and communication technology; GIS, geographical information system.

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2019; Pathak et al., 2019; Tey and Brindal, 2012) and concluded that these technologies have not yet been widely adopted in the agricultural sector at large (Finger et al., 2019; Groher et al., 2020b). The studies show that a diverse list of factors influence digital technology adoption, such as cost (Finger et al., 2019), operator age (Barnes et al., 2019; Daberkow and McBride, 2003; Konrad et al., 2019; Paustian and Theuvsen, 2017; Tey and Brindal, 2012), region and full- or part-time farming (Konrad et al., 2019; Reichardt et al., 2009), farm size and number of livestock units (Groher et al., 2020a; Konrad et al., 2019; Reichardt et al., 2009; Tamirat et al., 2018), organic versus conventional farming, farm or crop specialization (Konrad et al., 2019; Paustian and Theuvsen, 2017), and entrepreneurial behavior (Wyn Morris, 2017). Furthermore, various social and behavioral studies focusing on farmers suggest that the adoption of digital technologies is also influenced by farmer autonomy as part of the farming self (Stock and Forney, 2014) and by the role of training level and possible exchanges with other farmers and professionals regarding the technology (García-Cortijo et al., 2019). Hansen (2015) highlighted the influence of human and social capital, socio-cultural factors, and a well-developed agricultural knowledge system on the adoption of automatic milking systems. Furthermore, factors associated with farmers' wellbeing influence the use of digital technology, such as automatic milking systems (Hansen et al., 2020). While most studies in this context have focused on explaining voluntary adoption decisions regarding digital technologies, studies focusing on factors that influence farmers' perceptions of mandatory e-government services and why farmers might perceive them as an administrative burden are rare.

E-government services are primarily used to handle administrative procedures. Individuals experience administrative procedures often as a burden because they cause learning costs, compliance costs, and psychological costs (Moynihan et al., 2014). The use of e-government services might contribute to a reduction or an increase of the perceived learning, compliance, and psychological costs. However, the exact factors that influence the experienced administrative burden due to the use of e-government services in agriculture are a research gap. Previous studies were primarily carried out for the commercial sector. E. g. a recent review of the impacts of e-government concluded, "There are many areas where limited research has been conducted." (MacLean and Titah, 2021). Furthermore by citing Goh and Arenas (2020) and Stanimirovic and Vintar (2013), the review indicated that it is still not clear what benefits have been generated by e-government. Factors leading to the adoption and usage of e-government in the commercial sector were examined by Gupta et al. (2016) and Titah and Barki (2006) and factors affecting the client's decision to use the e-government rather than traditional channels to access government services were investigated by Madsen and Kræmmergaard (2015). A recent Greek study evaluated user satisfaction with agricultural e-government software characteristics, such as navigation, design, accessibility, interaction, and content, which was found to be high, but the software was also found to need a lot of improvements (Bournaris, 2020).

Following MacLean and Titah (2021) and their demand for more empirical and theoretical research to improve the understanding of the impacts of e-government services, this study aims to shed light on the impact of e-government on farmers' experienced administrative burden by developing a theoretical framework to categorize the relevant factors influencing why farmers might perceive the use of e-government services as an administrative burden. Thus, the aims of this study were (1) to explore relevant influencing factors in family farms and (2) to build a conceptual framework based on these factors to have a clear and consistent construct that explains why farmers perceive e-government services as a burden that can be applied for further research. Our study uses the definition of "administrative burden" published by Burden et al. (2012): an "individual's experience of policy implementation as onerous" (Burden et al., 2012). The definition implies that the administrative burden varies depending not only on the policy implementation but also on the person experiencing it (Herd and Moynihan, 2019). We

took a conceptual framework devised for commercial businesses (Arendsen et al. (2014) and adapted and expanded it to the farming sector. We explored influencing factors through a qualitative case study in the Swiss farming sector.

The added value of our study is twofold. First, we contribute to the scarce literature on why farmers perceive the use of e-government services as an administrative burden and which factors might influence this. Second, this paper contributes to the growing body of literature on the factors influencing the adoption of digital technologies in general (de Oca Munguia and Llewellyn, 2020; Michels et al., 2019; Pathak et al., 2019).

## 2. Background

In this section, we describe the development of e-government services in Switzerland and farmers' obligations to provide information. Then, we introduce a framework of factors influencing the adoption of e-government services in commercial businesses built by Arendsen et al. (2014). This framework builds the basis for developing a framework for family farms.

### 2.1. E-government services for Swiss agriculture

Our research is based on e-government services for Swiss family farms. The e-government era in Swiss agriculture started in 1999. In response to the BSE outbreak in Europe, the Swiss Government introduced an electronic database for animal identification and traceability. In 2011, it launched an electronic portal called AGATE, which supports all data exchanges between farmers and the federal and cantonal institutions involved (Bundesamt für Landwirtschaft, 2016). Initially, farmers were allowed to provide certain data in paper form. However, since 2016, most of the required data must be submitted electronically via the internet (Bundesamt für Landwirtschaft, 2016). Farmers have access to this electronic system via dedicated user interfaces developed by cantonal authorities. Five different interfaces are used in different cantons. Farmers in Vaud, Jura, Neuchâtel, and Geneva use the "Acorda" system. The "Lawis" system is available to farmers in Basel, Lucerne, Schaffhausen, Thurgau, and Zug. Berne, Freiburg, and Solothurn are provided with the "Gelan" system, Valais has a standalone tool, and farmers in Obwalden and Schwyz use the "Agricola" interface. The Federal Office for Agriculture published an overview of which digital systems the various cantons are using (BLW, 2018).

Twice per year, all farmers have to submit electronic land use and animal data records to the cantonal authorities to prove eligibility for subsidies under direct payment regulations in Switzerland (personal communication, cantonal department of Berne, 2020):

- (1) In spring, farmers must enter most of the required data records for the current year. Data records on land-use changes must be included in a web-based geographical information system (GIS).
- (2) In autumn, farmers have the option of revising these records if there have been any unexpected production changes due to extraordinary weather conditions, natural hazards, or other misfortunes. They must also decide which voluntary agri-environmental and animal welfare programs they intend to participate in the following year.

Data concerning animal identification and traceability must be reported within three days in the electronic system after the number of animals on the farm changed, according to the regulation of the federal office of agriculture (BWL, 2011). A recent study by Mack (2019a) found that Swiss farmers spend on average 3–5% of their total working time on administrative tasks imposed by the direct payment system. An overview on the administrative tasks that Swiss farmers have to carry out is described in detail by El Benni et al. (2021).

Cantonal authorities offer several support facilities for farmers facing

problems with specific e-government services. For example, they provide a permanent helpdesk for technical problems. In addition, during the spring data entry period, most cantonal authorities offer an upgraded support hotline. Moreover, many cantonal authorities select individual farmers in the municipalities as e-government super-users and train them. These super-users are asked to help their peers in case of problems. Some cantons, such as Berne, offer super-users for a fee who conduct data entry for those farmers who are unable or unwilling to do it themselves.

2.2. Framework on factors influencing the adoption of e-government services in commercial businesses

Arendsen et al. (2014) developed a conceptual framework to analyze the adoption of e-government services by commercial businesses. Their approach is based on models designed to study the adoption of technological innovations by organizations (Azadegan and Dooley, 2010; Frambach and Schillewaert, 2002; Thong, 1999). Arendsen’s model considers potential influencing factors, such as the perceived organizational benefits of e-government services and perceived innovation characteristics. It also considers more factual organizational characteristics, including social and individual ones, that might influence the successful implementation of e-government services. Fig. 1 outlines the conceptual framework for commercial businesses. It analyzes whether these factors contribute to an increase or decrease in the administrative burden. Perceptions regarding the organizational benefits of e-government services are captured by three variables measuring ease of use, increase in productivity, and data entry reduction. Perceptions regarding e-government characteristics are measured by complexity and compatibility with other software or data. Organizational characteristics are captured by three variables: size (number of employees), employees’ attitudes toward ICT use, and the availability of dedicated ICT staff in the organization. Arendsen et al.’s (2014) framework measures organizational usage characteristics of e-government services using three quantitative variables describing how e-government services are used in the organization: “quantity” measures the average weekly volume of electronic messages in the context of e-government services, “frequency” captures the usage rate of e-government services, and “period in use” measures the period for which the e-government system has been in

use. We used this framework as the basis for our interviews with the aim to adapt it to the farming sector.

3. Method

To explore relevant factors that might influence why farmers perceive e-government services as an administrative burden, we conducted face-to-face interviews with six farmers recruited from a total sample of 230 farmers who participated in a 2019 written survey on the administrative burden in Swiss agriculture. Based on their statements in an open textbox at the end of the questionnaire, interviewees were selected using contrast sampling. To develop an interview guideline, we also interviewed six agricultural researchers, two advisers, and one governmental official responsible for e-government services in western Switzerland to gain a better understanding of farmers’ e-government user interfaces. The guidelines for the semi-structured interviews are largely based on the conceptual framework for commercial businesses developed by Arendsen et al. (2014). Interviewees were asked:

- To what extent has the use of e-government services contributed to changes in your administrative workload?
- Size: How many hectares of land do you cultivate and/or how many animals do you rear? Has the farm size increased in recent years, and did these changes affect the workload for handling e-government issues?
- Ease of use: How easy or difficult do you find it to use e-government services?
- Attitude: How do you perceive e-government services? Do you support the digital format, or do you find it unsatisfactory?
- Use of support/competences: Do you handle e-government issues yourself, or do you receive support (e.g., from your spouse, children, relatives, acquaintances, advisers)?
- Quantity: What proportion of administrative activities do you now carry out exclusively electronically? Has that proportion changed in recent years?
- Frequency: How often do you enter data in e-government systems?
- Period in use: How long have you been using e-government systems?
- Perceived benefits: What benefits do you see for your farm in the use of e-government systems?

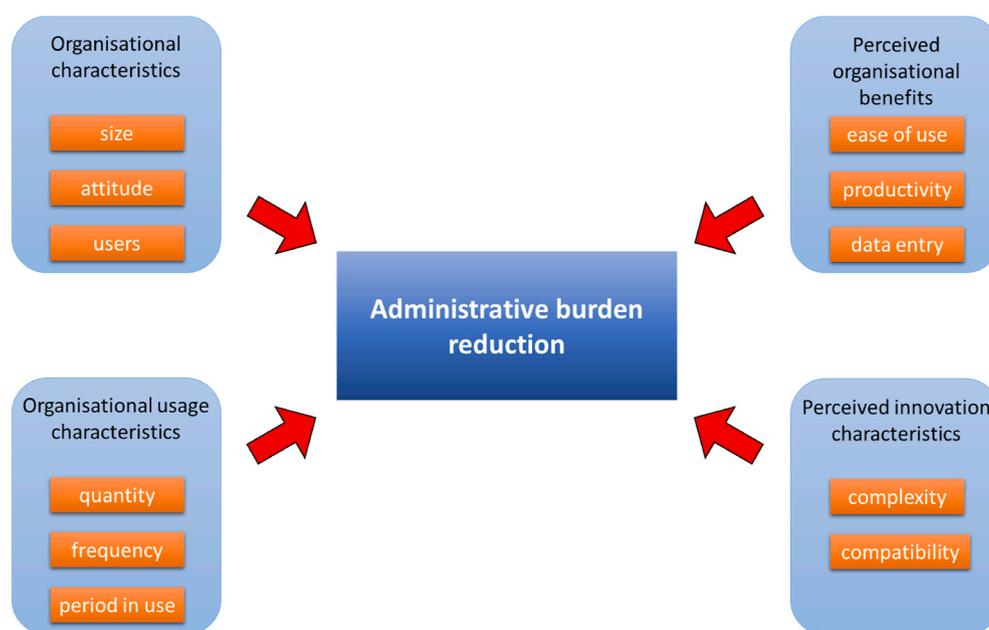


Fig. 1. Framework for analyzing factors influencing the successful adoption of e-government services by commercial businesses (an extract from a broader model developed by Arendsen et al., 2014, pp. 164.).

- Productivity: Has the labor productivity of your farm changed due to the use of e-government systems?
- Data entry: Has data entry changed due to e-government systems? Has it become easier or more difficult, or has it stayed the same? Why?
- Complexity: How easy or difficult would you rate the use of e-government software—that is, the software, apps, or online portals that you use? Why?
- Compatibility: Do you use different software programs for electronic data acquisition? Are there interfaces between different programs?

Our interview guidelines can be found in detail in the supplementary material.

The interviewee recruitment process was based on contrast sampling. The aim was to choose farmers with different perspectives on the topic to capture a broad spectrum of influencing factors of e-government in an exploratory manner.

For the recruitment of the six interviewees, we used a total sample of 230 farmers who had participated in a 2019 written survey on farmers' administrative burdens and shared their thoughts in general in a textbox at the end of the questionnaire (Mack et al., 2019a, b). The comments in the textboxes brought up the topic of farmers' administrative burden by e-government and its characteristics.

Based on these statements, we selected the interviewees as follows:

- 1) All 230 statements were first transcribed, translated from the Swiss German dialect into Standard German, and then coded using thematic analysis (Braun and Clarke, 2006).
- 2) Statements were categorized into six groups and two sub-groups (Table 1).
- 3) Farmers in Groups I, II, and VI were excluded because their computer skills or negative attitudes toward government might bias their views on e-government services.
- 4) To ensure that we interviewed farmers who face different experiences with e-government services and to cover the heterogeneity of farmers, we selected two farmers each from groups Va and Vb, and one farmer each from groups III and IV.

The sample selection focused on farmers with comprehensive knowledge concerning e-government characteristics because interviews should provide valuable and unadulterated information on this topic. The categorization in Table 1 was made based on the additional statements farmers provided in the general survey on administrative burden in an open textbox (Mack et al., 2019a; Ritzel et al., 2020). For this study, we excluded farmers belonging to Group I who had no basic computer skills because they were not able to use the e-government services by themselves but outsourced them to family members or peers. For this reason, farmers in Group I would not have been able to provide detailed insights into the specific characteristics of e-government, as they were not familiar with it. The question of how to provide support and knowledge to this group to solve their overwhelming administrative burden by e-government was not part of this research question but is obviously a topic that needs to be addressed in the discussion. Farmers from Group II with a negative attitude toward the government in general were excluded because they used the written survey to express their frustration with the government in the open textbox. Hence, we supposed that they would not have been able to provide unbiased insights to answer the research question related to e-government issues. However, we included one farmer from Group III with a negative attitude toward the current Swiss direct payment policy. For this reason, we considered in our sample farmers who might have a negative perception of the e-government systems due to their negative agricultural policy perception. Group VI was excluded because these farmers did not mention e-government topics in the open textbox of the general administrative burden survey. Given that we used contrasting sampling, we selected farmers with positive and negative experiences with e-government

(Group V), and we excluded those who did not mention e-government in the context of administrative burden. In this exploratory stage of the study, we did not expect any additional information from the excluded groups. However, for a subsequent quantitative investigation of the determinants of the perception of e-government services, a random sample across Switzerland is recommended.

Table 2 provides an overview of the interviewees' farm structure. The interviewee selection process was designed to include farmers facing different experiences with e-government services. All farmers interviewed had livestock within their businesses (Table 2). They were geographically spread across the German-speaking part of Switzerland and came from different cantons. The interviewees used three different e-government user interfaces.

The interviewees' farm sizes ranged from 4 to 37 ha, reflecting the large heterogeneity in Switzerland. All interviews were conducted with the farm manager and with either one or two interviewees. The age range was from 45 to 65 years, with a mix of full-time and part-time farmers. One farmer managed his livestock cooperatively with his neighbor.

The interviews were carried out face-to-face on the farm by one or two interviewers from October to December 2019. An interview lasted 1–2 h. All six interviews were conducted in Swiss German. Afterwards they were transcribed into Standard German and then coded using thematic analysis (Braun and Clarke, 2006) to identify the underlying common themes. The content of the interviews was analyzed using MAXQDA 2018.2 software, and a scheme of construct categories was developed based on Arendsen et al. (2014). The coding process comprised two initial cycles. Two project members coded the interviews in parallel and then discussed and analyzed the results. We categorized the influence of each perceived administrative burden caused by e-government mentioned by the farmers during the interviews using the Arendsen model. If no influencing factor from the Arendsen model matched the statement, a new factor was introduced. If a concept could not be categorized, a new category was created to accommodate it. Thus, the categorization scheme was continuously revised during the analysis. The scheme was deemed to be stable after four interviews had been analyzed, with saturation achieved and no new constructs forthcoming. Before the third coding cycle, a chart was created with the categories to be coded. The coding of the six interviews was divided between two researchers to allow for a first run-through by one and a subsequent recheck by the other. The coding chart was continuously revised with additional or changing code groups. The constructs identified in the interviews were subsequently integrated into a new model explaining the influence of e-government on farmers' administrative burden. We thus extended Arendsen's conceptual model for the farming sector.

**Table 1**  
Interviewee recruitment.

Types of farmers	No of farmers in the survey	No of farmers in interview
I. Farmers without basic computer skills	12	–
II. Farmers with a negative attitude toward the government in general	25	–
III. Farmers with a negative attitude toward the current direct payment policy	86	1
IV. Farmers who feel overburdened by e-government services	32	1
V. Farmers who do not feel overburdened by e-government services and		
a) Farmers are content with current e-government services	10	2
b) Farmers are not content with current e-government services	22	2
VI. No information according to the digital format of direct payment administration	43	–

**Table 2**  
Farm structure of the interviewed farmers.

FARM NO	FARM GROUP	AGE YEARS	FARM TYPE <sup>a</sup>	FARM SIZE	LIVESTOCK	LABOR SUPPLY <sup>b</sup>
1	Va	62	Suckler cow	12 ha	12 suckler cows	Full-time farmer
2	Va	54	Suckler cow	4 ha	5 suckler cows	Part-time farmer
3	Vb	59	Dairy	20 ha	18 dairy cows + calves	Full-time farmer
4	Vb	59	Dairy + arable farming	14 ha	18 dairy cows	Part of a collective with neighbor
5	III	54	Dairy	37 ha	35 dairy cows +15–20 cattle	Full-time farmer
6	IV	45	Pigs + Dairy	26 ha	26–30 dairy cows +20 young cattle +65 breeding sows +100 fattening pigs	Full-time farmer + 2–3 apprentices

<sup>a</sup> According to the Swiss FADN farm type classification Dux, D., Jan, P., Renner, S., Hoop, D., Schmid, D., 2017. The new Swiss FADN income survey based on random sampling.

<sup>b</sup> All interviewed farmers are managers of their farms. Full-time farmer means that more than 50% of the farm manager's working time was spent on the farm.

## 4. Results

The results are structured into two subsections. First, we present relevant factors that influence the extent to which farmers perceive e-government services as burdensome. These factors represent the results of our coding process. As we achieved saturation after so few (four) interviews, yet the sampling strategy was to aim for maximum variety, this suggests that the sample must have been homogenous. We described the factors individually, although we found close interrelationships among factors. Interrelationships are addressed in the discussion section. A quote is always followed in brackets by the farm group to which the interviewee belonged (see Table 2). Since the interviews focused on the perception of e-government systems, e-government may not be explicitly mentioned in all quotes.

Second, we present our conceptual framework, which was developed based on the factors mentioned by the farmers. This section also describes the differences between the extracted framework adapted for the farming sector and the parent framework originally devised for commercial businesses.

### 4.1. Relevant influencing factors

#### 4.1.1. Characteristics of the farm

**4.1.1.1. Farm structure.** The variable “farm structure” considers farm size, farm type, and way of farming, for example, as part of a farm cooperative. The interviews showed that “farm structure” indirectly had a major impact on the perceived administrative burden, as it determined the administrative regulations to which farmers had to comply. One farmer ascribed the increasing administrative burden to farm growth and diversification: “I think because the farm has grown and we have a not-so-simple farm that is so multi-faceted” (III). The following statement illustrates the reduction in perceived administrative burden due to division of labor: “So, because we've divided it up a bit ... I actually do the bookkeeping, so my bookkeeping plus that of the cooperative and my colleague actually do the SwissBilanz and everything else there” (IVb). However, this type of specialization is more relevant for larger farms than for smaller ones, as one farmer described: “Just for the farm, then ... Where you can share it, so that one person does specifically that and has a worker who does the barn, it works well. For a large farm it's much easier. For small farms ... yes, there's less to do as well, but maybe it makes less sense.” (IIb).

**4.1.1.2. Farmers' attitudes toward ICT.** The following statements show that farmers' attitudes toward ICT are a key factor in the extent to which they perceive e-government services as burdensome. One farmer had no difficulties using e-government tools: “And it's easy to manage, so relatively simple”. This statement agrees with his currently positive attitude toward ICT: “I'd say today you can't do it any other way. That's part of it nowadays. I'd say it's positive” (IVb). He accepted the current digital

developments in society. Another interviewee described his attitude toward ICT as neutral, accepting the changes in his work caused by digitization: “for me, ..., it's neutral now. Probably two or three years ago I'd have said negative. But that's the way things are going, and if you resist, you won't get anywhere. It's a matter of attitude. I'm not over-keen on it.” (IVa). Another interviewee mentioned the positive relationship between attitude and successful adoption of e-government services: “I think again it comes down to personal attitude toward the whole digitization process. Some people find it harder, and others are curious. The more you do, the better you get.” (IIb). One interviewee described the advantages of e-government services for direct payment administration and how they positively influence his attitude: “The benefits are huge, especially on the accounting side. If you can take that with you and always see the positives, then you don't see it like that” (IVb). Another element that seemed important was familiarization: “But once you've got used to it, it's good” (IVb). Farmers' attitudes toward ICT depended on how familiar they were with it. A negative attitude could be transformed into a positive one when farmers became more familiar with ICT. One interviewee hypothesized why some farmers might perceive an increasing administrative burden due to the use of e-government services: “It could be work-related, but it could also be a bit psychological, in the mind” (IVa).

Additionally, farmers' attitudes toward the occupation of farmers also influence their perceptions of e-government services: “Robot-operated dairy farms. So a lot. The farmer just sits in the control room, and for me that's ... I have my scruples. I like being around the animals .... That's too mechanical and impersonal for me. It's an ethical issue” (IVa). This reveals the farmer's negative attitude toward the digitization of the job profile in general.

**4.1.1.3. User competence.** The interviews suggested a correlation between attitudes toward ICT and user competence. Farmers had to acquire specific skills to use ICT, often different from their traditional job profile. Several interviewees' computer skills were very limited when e-government services were first introduced, while others managed to improve their skills: “But working on the PC still gives me trouble in the end. I just haven't learned it” (III). “No, I haven't really done anything. If you have some time and give it a bit, you can manage. And otherwise you ask your neighbor how he did it ... So, it's not so difficult that you can't do it. No, it was fine. I think with me it's already the case that the attitude is lacking. Had a lot at the start, but as things went on ... Maybe people just change.” (IIb). This statement demonstrates that new skills and competences must be acquired at the beginning and continuously be developed to use e-government services with its ongoing development, and that support may also be necessary. This was consistent with the self-responsibility for acquiring ICT skills: “You have to look at that. The self-responsibility has increased. I think it's right” (IVa). The group of farmers without computer knowledge at all was excluded from the research because we did not expect that they would have comprehensive knowledge on e-government topics. The lack of computer skills makes the use of e-government difficult or impossible.

4.1.1.4. *Farmers' use of external support.* We also found that the use of external support played a role in the extent to which farmers perceived the use of e-government services as burdensome. External support can be a neighbor or a colleague: “So in the end, I just discuss it with a trust office”<sup>1</sup> (IVb), or the “Agriculture Commissioner” (III) or “field manager” (IVb). In addition, the organization form “farm cooperative” can supply “external support,” competence, and assistance outside the farm. This can help reduce the administrative burden: “Yes, we’ve divided it up a bit so it’s easier. He works that out and I see to the bookkeeping so it works relatively” (IVb). In addition, one interviewee mentioned that family members played an important role: “The ... son studied computer science .... And he’s always helped. He ... has now got me a new computer, and if I have a problem, he can solve it” (IVa). Another interviewee mentioned that training courses can also be understood as external support. This both increased the farmer’s knowledge and reduced the perceived administrative burden: “For each region where recording was introduced, there was an information event ... and then you have to do the course” (IVb). The agricultural commissioner, the agricultural wholesaler “Landi,” or the organization for agricultural training “Agridea” also provide support: “They also offered a course so you could get additional information” (III). One farmer stated that efficient, helpful external support reduced his administrative workload: “If you have a problem, you can call and they’ll help you. So I really must say I get good support ...” (IVb). One interviewee regarded the use of external support via the internet as helpful: “But I see it directly on the PC, what he enters. .... I could click in and see what he’s entering” (IVb). Support can be offered by software firms or cantonal agricultural administration offices. One interviewee pointed out that farmers (i.e., colleagues) with a negative attitude toward ICT did not use external support: “And if you’re negative about it anyway, you’ll also be less willing to attend such a course” (IVa).

Thus, the results showed that the existence and use of external support were key factors in farmers’ perceptions of e-government services. This support could be either practical or psychological. However, it became obvious that these offers did not reach all farmers, especially if their attitudes toward the e-government tool were negative.

4.1.1.5. *Work organization.* The interviews showed that work organization was also a key factor influencing farmers’ perceptions of e-government services. One interviewee mentioned that the use of e-government required new forms of work organization, for example, in terms of data filing and back-up: “So if you set up a good folder structure or something like that, then you’ve certainly done a good job in terms of clarity” (IVb). The same interviewee pointed out that the e-format made documentation easier, but it still had to be done: “Yes. When I hear my colleagues say ‘oh, inspection announced,’ and they’re six months behind, then they huddle down over their field diary again and think about which cows they left where ... that doesn’t cut it” (IVb). Farmers who had an ineffective work organization found it more difficult to use e-government services, and they perceived their administrative burden as elevated.

4.1.1.6. *Digital infrastructure.* The interviews showed that adequate internet access was an important requirement for using e-government services: “We’ve had fiber optics for two years now and that’s changed things” (IVb). The same perception applied to mobile networks: “We have almost no mobile reception, that’s not exceptional” (IVb). Infrastructure enormously influenced the extent to which e-government services were perceived as burdensome. Infrastructure includes software

acquisition: “You could buy it too. ... I really still do it by hand” (IVb). The interviewee mentioned that sometimes additional software was necessary if e-government was to be perceived as less burdensome: “Yes, you simply need to have the software. Maybe the canton will come up with software someday. The software on offer is still a bit expensive. It’s not worth it yet for me” (IVb). Another interviewee stated that, besides the internet and software, hardware was necessary for an efficient infrastructure: “A PC is a must. And it keeps getting outdated. That’s actually a cost factor” (IVb), and “A tablet would definitely be better, but ... it’s just another cost item” (III).

#### 4.1.2. Farm usage characteristics

4.1.2.1. *Quantity.* One interviewee considered the total administrative workload involved in applying for direct payments as low: “... related to direct payments. So this workload, I’d say, is of course not—because it’s relatively simple—the effort isn’t really that high” (IVb). Another interviewee mentioned that the volume of electronic messages was directly influenced by farm size and degree of diversification: “I think because the farm has grown and we have a not so simple farm that’s so multi-faceted” (III). Farmers who participated in multiple voluntary direct payment programs tended to have a higher volume of electronic messages within the system. Some interviewees pointed out that the required data records had actually increased since the introduction of e-government services: “The exact recording of land area. They’d never have come up with this idea, because there was no way they could monitor it at all. And I think that’s a consequence of the fact that this is possible today” (IVb), and “More and more data is required, let’s put it that way. Simply because of the recording, you can read something everywhere, and projects can still be done” (IVb). Another interviewee stated that the quantity had decreased: “But basically it’s easier and I have to say it doesn’t take me a huge effort to report this data” (IVa). The required data volume was considered to increase permanently: “And so, the volume has actually increased in recent years? Yes, in fact since ‘93” (IVb). Another interviewee stated that: “So it’s just more. Maybe the entry itself is simplified, but if you keep making it more complex, that is, you keep asking for more data and more detail, then it cancels that out. Maybe it works to simplify the entry itself, but on the other hand, the workload increases again.” (IVa). This statement illustrates the influence of the amount of data entry on how farmers cope with e-government systems. This shows a connection with the complexity of agricultural policy.

4.1.2.2. *Frequency.* The interviewees mentioned that the frequency of use of the e-government system varied. While animal movements must be registered within three days, registration for direct payments took place once a year in February: “That’s once a year. When’s that? In February” (III). Moving the date to register for direct payments from May to February has greatly eased the administrative burden because it no longer coincides with the most labor-intensive period on the farm. The administration for direct payments takes place three times a year: “The Gelan<sup>2</sup> business is three times a year” (IVb). The data for the expiry journal must be documented continuously. The frequency seemed to have remained the same over the past few years. Our results did not show that the frequency of data entry led to an increase in the administrative burden if farm data were recorded regularly. Data entry at long intervals each year decreased the administrative burden because the work was bundled. Conversely, however, it may also increase it, since farmers can no longer remember what to enter where: “And I have to get used to it again every year. Of course, that’s a bit difficult, especially with direct payment applications, which you do once or twice or three times a year. That’s not very often and there’s no routine in this sense, and you have to

<sup>1</sup> A trust office is not directly connected to the direct payments administration and usually offers accounting services, although, of course, questions relating to direct payments can also be asked. The Agriculture Commissioner (Lucerne area) and the field manager (Bern area) are community-specific farmers accredited by the federal government to provide support for questions concerning the direct payments system, avoiding the need to report directly to the Agriculture Office.

<sup>2</sup> Agricultural information system, complete IT solution for agriculture and nature.

keep checking to see how it works” (IVa).

**4.1.2.3. Period in use.** One interviewee mentioned that at the start of the use of a new system or application, the perceived administrative burden due to e-government services seemed to increase: “Yes, it’s difficult at the start. You were used to the written word and paper, and suddenly, it’s all done on PC.” (III). The familiarization phase took up to two to three years. If habituation was successful, the perception was: “In my eyes, they were able to simplify certain things” (III). Another aspect of this factor is participation in a new direct payment program. Once the changeover phase ended, the digital format reduced the administrative burden: “So once it’s working properly, it’s easier” (IVb).

#### 4.1.3. Perceived farm impact

**4.1.3.1. Data security.** We found that the interviewees fear data abuse. One interviewee reported that he already had bad experiences: “The guy from the agricultural office sent out an email, and it contained everyone’s email addresses.” (IVb). The digital format of e-government required a different data backup system, which might lead to data insecurity: “... you have some clever archiving. Then there’s just the risk that you’ve secured it so that if the PC really goes out, you’ve still got it” (IVb). Farmers were aware that data security was an important topic in e-government administration, which reinforced the administrative burden.

#### 4.1.4. Perceived e-government characteristics

**4.1.4.1. Data merging.** The interviewees were aware that cantonal or federal authorities can merge different data entries: “It’s quicker and ... the benefit is: you can rule out any cheating. Everything’s linked. I like that” (IVa). Data merging simplified the data entry: “So, it’s actually a bit simpler, because they didn’t want to know it in so much detail, and the different things are linked together. I’d say it’s actually improved a bit” (III). One example of data merging provided was: “No, it actually works well. For example, if I register a calf and report the animal via the PC, it’s actually updated in both places within a day” (IVb). Data merging was connected with data security. Even though some farmers were aware that data security could limit the full use of data merging, merging helped reduce the administrative burden.

**4.1.4.2. Software documentation/information.** The farmers surveyed said little about whether there was any documentation or information on the e-government software, or about its quality. They did not use it or miss it. They mentioned no influence of documentation or information on the perceived administrative burden but instead used “external support” in the form of courses: “For each region where recording was introduced, there was an information event and you have to go there and get information and then you have to do the course.” (IVb) or “There’s just the example videos. But that wouldn’t actually be so bad, in, and of itself. It would probably be a simple matter to get someone to show it to you.” (IVb). The individual appropriation of e-government tools was not a priority for the farmers interviewed.

**4.1.4.3. Software design.** Software design was another key influencing factor. The intuitiveness of the design and structure was important, but, interestingly, changes in the design and the data to be entered led to an increase in the administrative burden: “And when you’ve got used to something, it’s almost worse ... so even though there’s maybe a bit less work, it would still take longer to get to grips with it” (IVb). “I’d say the positive thing is that they haven’t changed much else. You don’t have to search again or anything. Because if they’ve changed only one or two positions, then you think again, how do I do this?” (III). It turns out that the input has been simplified. There were also some tools where data entry was challenging, for example, the entry of plots of land: “Is this the registration of plots? Yes! That’s a pain” (IVb).

**4.1.4.4. Complexity.** The direct payment system changes continuously, becoming more complex, and so does e-government: “I don’t feel it’s become easier. In fact, it’s become more complex” (IVa). This was consistent with the increase in perceived administrative burden due to difficulties in understanding: “But the problem then is the complexity, what if I tick something, what does that mean and what happens afterwards in the background and what effects that has. That’s sometimes quite hard to understand.” (IVa).

**4.1.4.5. Software quality.** If e-government software was poorly conceived, farmers perceived e-government systems as burdensome. The farmers cited different examples: “At LAWA, it’s sometimes a bit tedious, at the Lucerne Agricultural Office. When you have to do a farm data survey, sometimes you can’t correct things yourself that you actually need to be able to correct and where even the agricultural commissioner thinks he can’t get in either.” (IVa), “Yes, there’s one error that still annoys me” (IVb), and “That whole technology wasn’t ready yet” (IIB).

**4.1.4.6. Compatibility.** Compatibility refers to how well different systems fit together. The farmers were aware of the huge potential but stated that improving compatibility can decrease the administrative burden of e-government systems: “And that you also link the stuff together. I don’t like having to enter things three times. ... I feel there’s still potential for that” (III).

**4.1.4.7. Duplications.** Many data items in the administration of direct payments still need to be completed and submitted, both on paper and digitally. It seemed to be a transitional period: “I enter it, and so does the vet.” (IIB).

#### 4.2. Conceptual framework on influencing factors for the farming sector

Fig. 2 shows our conceptual framework for the farming sector based on the results of the interviews. The framework includes all the relevant influencing factors mentioned by the farmers. We found the following differences and similarities compared to the Arendsen model:

- Because our framework focuses specifically on family farms, we specified the category “organizational characteristics” in more detail. Based on the interview results, we found that not only organizational characteristics of the farm (the item “farm structure” captures size and farming type) but also farmer characteristics (such as attitude toward ICT, ICT competence, use of external support, and work organization and infrastructure) influenced how burdensome family farms perceived the e-government services. Under the category “farm usage characteristics,” we subsumed the factors “quantity of data entry, frequency, and period in use”. The factors in this category correspond to those in the Arendsen model for commercial businesses.
- The interviews revealed that the use of e-government services provided no organizational benefits for farms that might affect productivity and income positively (e.g., using administrative data to support production or investment decisions). For this reason, our conceptual framework does not include the category “perceived organizational benefits,” in contrast to Arendsen’s model. Given that interviewees raised data security concerns in the context of e-government services, our framework includes the category “perceived farm impact” with the item “data security.”
- In contrast to the Arendsen model, we do not consider the factor “ease of use”. Instead, we created the category “perceived e-government characteristics,” which includes all items influencing ease of use, such as documentation, data entry quantity, software design and duplication. The factors “complexity” and “compatibility” were also included in this category.

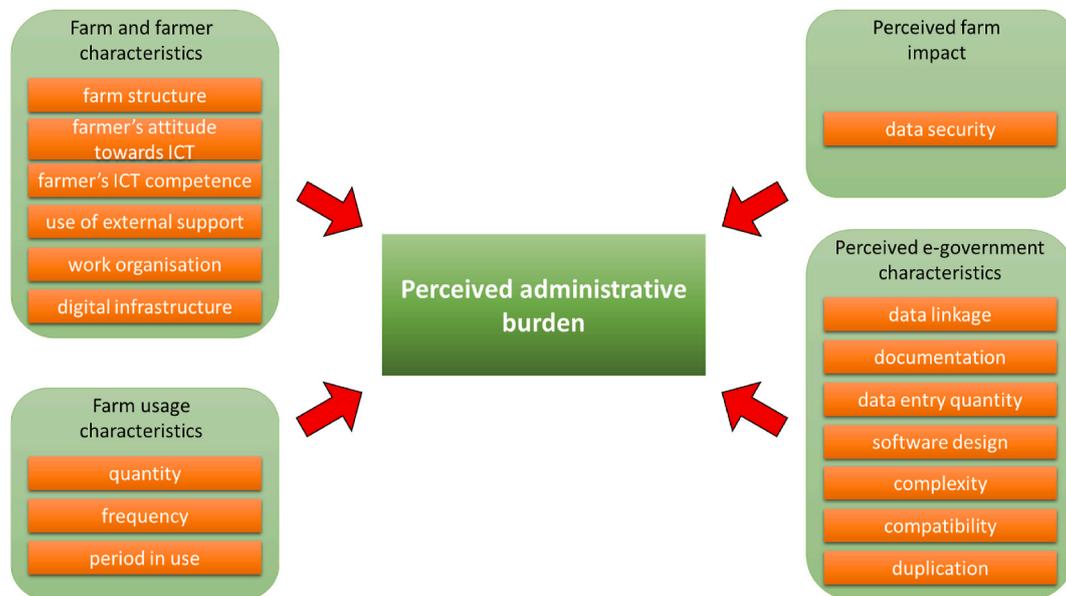


Fig. 2. Conceptual framework for analyzing why family farms might perceive the use of e-government services as an administrative burden.

## 5. Summary and discussion

We developed a conceptual framework to categorize the factors influencing farmers' perceptions of e-government services. The framework was devised and adapted based on the findings of a similar framework designed for commercial businesses by [Arendsen et al. \(2014\)](#). We chose an explorative approach to identify the relevant influencing factors for farmers beyond those of commercial businesses. Our explorative study was based on six interviews with farmers recruited from a total sample of 230 using contrast sampling. Although the sample size was small, we reached saturation with coding, which is a clear indication that we captured the most relevant influencing factors. The early saturation could also be a sign of a homogenous sample, which we do not expect because of the contrast sampling, the wide range of farm types, and influencing factors.

Although [Arendsen's](#) framework was specially developed for commercial businesses using e-government services, we were able to expand and adapt it for family farms. Our conceptual framework was developed based on Swiss farmers; hence, it should be validated for family farms beyond Switzerland, where farm managers or family members use e-government tools, even though e-government services may differ between countries. However, we expect our framework to be transferable to agricultural software systems used voluntarily.

Although farmers might not adopt these systems when they exhibit the same characteristics as mandatory systems, the framework should be validated for voluntary software systems.

We found that the use of e-government services tended not to lead to more timely or cost-effective production and management on family farms. This is one of the main differences compared to digital technologies applied in arable or animal farming systems ([Villa-Henriksen et al., 2020](#)).

Our results show that farmers' perceptions of e-government services cannot be understood without considering their attitudes toward ICT and related factors, such as work organization. We also found that attitudes toward ICT were influenced by the farmer's personality and previous experiences, as technique acceptance studies have shown ([O'cass and Fenech, 2003](#)). Interviewees who identified with ICT stated that e-government was not a burden for them. These results confirmed behavioral studies in agriculture ([Gillmor, 1986](#)), arguing that farmers' attitudes drive their behavior and their perception of situations. In line with [Burton's \(2004\)](#) findings, we also found that normative

values—what kind of jobs a farmer *should* do—influenced the attitude toward ICT. The same was true of those who believed they had the skills and experience to manage the use of digital tools. We found that these factors influenced farmers' attitudes towards ICT. These results are in line with various studies suggesting that knowledge and competence have a positive influence on attitude by reducing learning costs (i.a. [Burden et al., 2012](#); [Moynihan et al., 2014](#); [Warkentin et al., 2002](#)). Our findings agree with those of [Munz et al. \(2019\)](#) that farm cooperatives have an advantage in managing the adoption of ICT in agriculture because they share not only financial resources but also knowledge.

Another relevant influencing factor in the category “farm characteristics” was the use of external support, that is, from neighbors or friends but also professional offers ([Lowe and Talbot, 2000](#)). According to our results, helpful external support seemed to have a major influence on the perception of e-government services. This support could be either practical or psychological. However, we found that these offers did not reach all farmers, especially those with negative attitudes toward e-government tools. Other sources of information, such as articles in agricultural newspapers or events organized by the farmers' association, provided support only for those farmers with no barriers. This is in line with the findings of [Hansen et al. \(2020\)](#), who analyzed how automatic milking systems (AMS) influence farmers' wellbeing.

They stated that “Suppliers and advisory services need to provide adequate training in AMS”, and that exchanges with other farmers are important for farmers' wellbeing while using AMS ([Hansen et al., 2020](#)). To summarize, we found that if farmers expected to cope well with e-government or were able to seek support, they perceived e-government services as less burdensome.

We further found that work organization, also part of the category “farm characteristics,” influenced the perception of e-government services. Obviously, attitude, competence, and size generally influenced the way that farmers organized their work, and specifically in terms of handling e-government. Thus, our results are in line with the quantitative results ([Arendsen et al., 2014](#)) indicating that “organizational characteristics” are the dominant factors influencing the perceived administrative burden, beyond size and ICT staff (represented in our research by “competence” and “use of external support”).

Trust was discussed by the interviewees as part of attitude. This is a main factor influencing the perception of e-government services, according to the literature, but it was also visible in our interviewees. Institution-based trust, such as trust in fair and independent judicial

systems, is considered a major factor in building trust in e-government (Teo et al., 2008; Warkentin et al., 2002). Bélanger and Carter (2008) pointed out the importance of trust in the internet and in the government as key factors playing a role in e-government adoption. A further study by Mack et al. (2021) found that farmers with a negative perception of agricultural policy stated significantly more problems with e-government tools than farmers supporting the agricultural policy. To consider how attitudes toward agricultural policy might shape farmers' views on e-government systems in our study, we included one farmer with a negative attitude toward the current Swiss direct payment policy. In addition, two farmers who were not satisfied with e-government services were interviewed.

We found that e-government tools do not influence farm productivity, as none of the farmers surveyed mentioned that e-government services affected productivity. For this reason, the category “productivity” was not relevant for our framework.

Beyond these categories, the characteristics of e-government services determined how farmers perceived e-government systems. Our interviews showed that e-government characteristics, such as data entry amount, software design, optional versus obligatory use, software quality, and duplication (on paper and e-format and in different tools), were factors that might influence the perception of e-government services. These factors can be summarized as website design and perceived usefulness, as presented by Arendsen et al. (2014) and Kumar et al. (2007). Software changes or adjustments might contribute to an increase in the administrative burden. Changes should be made as sparingly as possible and should always be communicated. In the event of a program change, automatic data collection from the previous form should be enabled, or it should be possible to insert description boxes. Furthermore, farmers perceived that the use of e-government services allowed public authorities to increase the amount and complexity of data entry. These results are in line with those of Veiga et al. (2016), who found that government measures, such as the amount of fertilizer used, can be surveyed more effectively through e-government tools. Although the government collects increasing data through e-government systems, further research is required to answer the open question whether this data collection from e-government systems leads to a more effective agricultural policy.

The need for functional digital infrastructure to use e-government in a satisfactory way seemed to be a problem for the Swiss farmers, because some farmers still have inadequate internet or cell phone infrastructure. While the entry of data by mobile technology is not yet used, in the literature it is already relevant. Karetsos et al. (2014) further subdivided digital government into e-government (electronic government) and m-government (mobile government), that is, input via mobile devices. This part is generally subsumed under e-government. This distinction was not relevant to our investigation because there were few m-government offers. One farmer wished to have a tablet or data entry. This could be an argument for the implementation of m-government capabilities. There were only individual apps with which data could be recorded in practice and then linked to the general AGATE tool on the desktop. The need for m-government tools should be evaluated in further studies. Even if mobile data entry does not yet play a role in direct payment administration in Switzerland, future developments are already emerging. In Switzerland a widely used farm management tool is BARTO (Barto AG, 2021) is providing different digital building blocks via their online platform and is in discussion with the Swiss cantons to provide interfaces to include the direct payment administration into this farm management tool to reduce administrative burden for farmers. This solution is planned and is part of the development of digitalization in agriculture towards a systemic character. At this stage the public administration and private company software is combined. This question about data security and rights of the data is becoming more relevant, while it is legally not regulated and need to be solved before the next step in the development of farm data management and administrative burden reduction. Here, too, the need for comfort and the need

for security play a role. This topic was already discussed in detail by Carolan (2018) who refers to the need of identifying “practices of agro-digital governance that afford sovereignty” (Carolan, 2018, p. 745).

## 6. Conclusion

We propose a conceptual framework for improving the understanding of why farmers might perceive the use of e-government tools as an administrative burden. Our framework includes influencing factors from four different fields: (1) farm and farmer characteristics (e.g., farm structure, farmer's attitude toward ICT, farmer's ICT competence, use of external support, work organization, and infrastructure), (2) usage characteristics of e-government services (e.g., quantity and frequency of data entry, and period in use), (3) perceived characteristics of e-government (e.g., network, documentation, software design, complexity, compatibility, and duplication), and (4) perceived farm impact (data-security). Correspondingly, our results extend the understanding of why e-government services for farmers might contribute to either a decrease or increase in their perceived administrative burden. We refer to a limitation of the study, the conclusions coming from direct interviews must be referred only to the “type” of farmers present in Table 2a. Further quantitative study could use our framework to evaluate factors that might lead to an increase or decrease in the administrative burden of specific e-government software. Of course, some variables in our framework are farmer specific.

Further, our results improve the understanding of the factors influencing farmers' perceptions and adoption of digital technologies. The factors identified from the interviews were based on the conceptual research model devised by Arendsen et al. (2014), which was adapted to the farming sector based on our interview results. We chose an explorative approach to identify relevant influencing factors. We focused on farm and farmer characteristics, including attitudes toward ICT, and perceived and experienced influencing factors of e-government services that might influence farmers' perceptions of e-government tools.

We find a new hypothesis, that the factors influencing the perceived administrative burden can be transferred transposed to the adoption of digital technologies in agriculture in general and recommend further research on this. However, the adoption of e-government in Switzerland is compulsory, which is why adoption is influenced by legislation. Nevertheless, the influencing factors that play a role in reducing the administrative burden seem interesting for the adaptation of other technologies as well. “Farm characteristics,” “farm usage characteristics,” “perceived farm impact,” and “perceived digital technology characteristics” instead of “perceived e-government characteristics” could be analyzed for different digital technologies and validated based on their influence on adoption decisions, using a quantitative study design as originally set up by Arendsen et al. (2014).

The findings of this empirical study contribute to our knowledge about the administrative burden of e-government as perceived by Swiss farmers, in particular of the analyzed farm types, and allow us to formulate hypotheses regarding perceptions of digitization in agriculture in general. Perceptions are very complex and are influenced by user characteristics and e-government characteristics or by digital technology characteristics. Our results also refer to conflicts of interest between government institutions and farmers. E.g. farmers dislike software changes. We recommend, beyond the nature of e-government and its impact on administrative burden, an analysis that measures the impacts of e-government in Swiss agriculture concerning the propositions of MacLean and Titah (2021).

We expect this study to encourage researchers to continue exploring and designing research on the reduction of administrative burdens for farmers. We also hope that our research will inspire national governments to design e-government systems that reduce farmers' administrative burdens.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jrurstud.2022.01.002>.

## References

- Arendsen, R., Peters, O., ter Hedde, M., van Dijk, J., 2014. Does E-Government Reduce the Administrative Burden of Businesses? an Assessment of Business-To-Government Systems Usage in the Netherlands, vol. 31. *Government Information Quarterly*, pp. 160–169.
- Aubert, B.A., Schroeder, A., Grimaudo, J., 2012. IT as enabler of sustainable farming: an empirical analysis of farmers' adoption decision of precision agriculture technology. *Decis. Support Syst.* 54, 510–520.
- Azadegan, A., Dooley, K.J., 2010. Supplier innovativeness, organizational learning styles and manufacturer performance: an empirical assessment. *J. Oper. Manag.* 28, 488–505.
- Barnes, A., Soto, I., Eory, V., Beck, B., Balafoutis, A., Sánchez, B., Vangeyte, J., Fountas, S., van der Wal, T., Gómez-Barbero, M., 2019. Exploring the adoption of precision agricultural technologies: a cross regional study of EU farmers. *Land Use Pol.* 80, 163–174.
- Barto, A.G., 2021. BARTO Smart Farming Management System.
- Bekkers, V., Homburg, V., 2007. The myths of e-government: looking beyond the assumptions of a new and better government. *Inf. Soc.* 23, 373–382.
- Bélanger, F., Carter, L., 2008. Trust and risk in e-government adoption. *J. Strat. Inf. Syst.* 17, 165–176.
- BLW, 2018. *Kantonale Datenerhebung*. <https://www.blw.admin.ch/blw/de/home/politik/datenmanagement/agate/kantonaledatenerhebung.html>.
- Bournaris, T., 2020. Evaluation of e-government web portals: the case of agricultural e-government services in Greece. *Agronomy* 10, 932.
- Braun, V., Clarke, V., 2006. Using thematic analysis in psychology. *Qual. Res. Psychol.* 3, 77–101.
- Bundesamt für Landwirtschaft, 2016. *Agrarbericht 2015*. Bundesamt für Landwirtschaft (BLW). Bern.
- Burden, B.C., Canon, D.T., Mayer, K.R., Moynihan, D.P., 2012. The effect of administrative burden on bureaucratic perception of policies: evidence from election administration. *Publ. Adm. Rev.* 72, 741–751.
- Burton, R.J., 2004. Reconceptualising the 'behavioural approach' in agricultural studies: a socio-psychological perspective. *J. Rural Stud.* 20 (3), 359–371.
- BWL, 2011. 916.404.1 Verordnung über die Tierverskehrsdatenbank.
- Carolan, M., 2018. 'Smart' farming techniques as political ontology: access, sovereignty and the performance of neoliberal and not-so-neoliberal worlds. *Sociol. Rural.* 58, 745–764.
- Daberkow, S.G., McBride, W.D., 2003. Farm and operator characteristics affecting the awareness and adoption of precision agriculture technologies in the US. *Precis. Agric.* 4, 163–177.
- de Oca Munguía, O.M., Llewellyn, R., 2020. The adopters versus the technology: which matters more when predicting or explaining adoption? *Appl. Econ. Perspect. Pol.* 42, 80–91.
- Dux, D., Jan, P., Renner, S., Hoop, D., Schmid, D., 2017. The New Swiss FADN Income Survey Based on Random Sampling.
- El Benni, N., Ritzel, C., Heitkämper, K., Umstätter, C., Zorn, A., Mack, G., 2021. The cost of farmers' administrative burdens due to cross-compliance obligations. *J. Environ. Plann. Manag.* 1–23.
- Finger, R., Swinton, S.M., El Benni, N., Walter, A., 2019. Precision Farming at the Nexus of Agricultural Production and the Environment.
- Frambach, R.T., Schillewaert, N., 2002. Organizational innovation adoption: a multi-level framework of determinants and opportunities for future research. *J. Bus. Res.* 55, 163–176.
- García-Cortijo, M., CarmenCastillo-Valero, J.S., Carrasco, I., 2019. Innovation in rural Spain. What drives innovation in the rural-peripheral areas of southern Europe? *J. Rural Stud.* 71, 114–124.
- Gillmor, D.A., 1986. Behavioural studies in agriculture: goals, values and enterprise choice. *Ir. J. Agric. Econ. Rural Sociol.* 11, 19–33. <http://www.jstor.org/stable/25556546>.
- Goh, J.M., Arenas, A.E., 2020. IT value creation in public sector: how IT-enabled capabilities mitigate tradeoffs in public organisations. *Eur. J. Inf. Syst.* 29, 25–43.
- Groher, T., Heitkämper, K., Umstätter, C., 2020a. Digital technology adoption in livestock production with a special focus on ruminant farming. *Animal* 14, 2404–2413.
- Groher, T., Heitkämper, K., Walter, A., Liebisch, F., Umstätter, C., 2020b. Status Quo of Adoption of Precision Agriculture Enabling Technologies in Swiss Plant Production. *Precision Agriculture (Eingereicht)*.
- Gupta, K.P., Singh, S., Bhaskar, P., 2016. Citizen adoption of e-government: a literature review and conceptual framework. *Electron. Gov. Int. J.* 12, 160–185.
- Hansen, B.G., 2015. Robotic milking-farmer experiences and adoption rate in Jæren, Norway. *J. Rural Stud.* 41, 109–117.
- Hansen, B.G., Bugge, C.T., Skibrek, P.K., 2020. Automatic milking systems and farmer wellbeing—exploring the effects of automation and digitalization in dairy farming. *J. Rural Stud.* 80, 469–480.
- Herd, P., Moynihan, D.P., 2019. *Administrative Burden: Policymaking by Other Means*. Russell Sage Foundation.
- Karetso, S., Costopoulou, C., Sideridis, A., 2014. Developing a smartphone app for m-government in agriculture. *Agrárinformatika/J. Agric. Info.* 5, 1–8.
- Konrad, M.T., Nielsen, H.O., Pedersen, A.B., Eloffson, K., 2019. Drivers of farmers' investments in nutrient abatement technologies in five Baltic Sea countries. *Ecol. Econ.* 159, 91–100.
- Kumar, V., Mukerji, B., Butt, I., Persaud, A., 2007. Factors for successful e-government adoption: a conceptual framework. *Electron. J. E-gov.* 5 (1), 63–76.
- Lowe, P., Talbot, H., 2000. Providing advice and information in support of rural microbusinesses. In: Newcastle, U.o. (Ed.), *Research Report*. Centre for Rural Economy, Department of Agricultural Economics and Food, Newcastle.
- Mack, G., Heitkämper, K., El Benni, A., 2019a. Welche Faktoren beeinflussen die Wahrnehmung des administrativen Aufwands? *Agrarforschung* 10, 104–109.
- Mack, G., Ritzel, C., Heitkämper, K., El Benni, N., 2021. The effect of administrative burden on farmers' perceptions of cross-compliance based direct payment policy. *Publ. Adm. Rev.* 81 (4), 664–675.
- Mack, G.S., A., Heitkämper, K., 2019b. Zur Wahrnehmung des administrativen Aufwandes. *Agroscope Sci.* 92, 92.
- MacLean, D., Titah, R., 2021. A Systematic Literature Review of Empirical Research on the Impacts of E-Government: A Public Value Perspective. *Public Administration Review*.
- Madsen, C.O., Kræmmergaard, P., 2015. Channel Choice: A Literature Review, International Conference on Electronic Government. Springer, pp. 3–18.
- Mahaman, B.D., Ntaliani, M.S., Costopoulou, C., 2005. E-Government for Rural Development: current trends and opportunities for agriculture. In: *Proceedings 005 EFITA/WCCA Joint Congress on IT in Agriculture*.
- Michels, M., Fecke, W., Feil, J.-H., Musshoff, O., Pigisch, J., Krone, S., 2019. Smartphone Adoption and Use in Agriculture: Empirical Evidence from Germany. *Precision Agriculture*.
- Moynihan, D., Herd, P., Harvey, H., 2014. Administrative burden: learning, psychological, and compliance costs in citizen-state interactions. *J. Publ. Adm. Res. Theor.* 25, 43–69.
- Munz, J., Gindele, N., Doluschitz, R., 2019. Opportunities, Risks and Obstacles to the Implementation of Digitisation Technologies in German Agriculture.
- O'cass, A., Fenech, T., 2003. Web retailing adoption: exploring the nature of internet users Web retailing behaviour. *J. Retailing Consum. Serv.* 10, 81–94.
- Pathak, H.S., Brown, P., Best, T., 2019. A systematic literature review of the factors affecting the precision agriculture adoption process. *Precis. Agric.* 20 (6), 1292–1316.
- Paustian, M., Theuvsen, L., 2017. Adoption of precision agriculture technologies by German crop farmers. *Precis. Agric.* 18, 701–716.
- Reichardt, M., Jürgens, C., Klöble, U., Hüter, J., Moser, K., 2009. Dissemination of precision farming in Germany: acceptance, adoption, obstacles, knowledge transfer and training activities. *Precis. Agric.* 10, 525.
- Ritzel, C., Mack, G., Portmann, M., Heitkämper, K., El Benni, N., 2020. Empirical evidence on factors influencing farmers' administrative burden: a structural equation modeling approach. *PLoS One* 15, e0241075.
- Stanimirovic, D., Vintar, M., 2013. A critical insight into the evaluation of e-government policies: reflections on the concept of public interest. *Int. J. Adv. Life Sci* 5, 52–65.
- Stock, P.V., Forney, J., 2014. Farmer autonomy and the farming self. *J. Rural Stud.* 36, 160–171.
- Tamirat, T.W., Pedersen, S.M., Lind, K.M., 2018. Farm and operator characteristics affecting adoption of precision agriculture in Denmark and Germany. *Acta Agric. Scand. Sect. B Soil Plant Sci* 68, 349–357.
- Teo, T.S.H., Srivastava, S.C., Jiang, L., 2008. Trust and electronic government success: an empirical study. *J. Manag. Inf. Syst.* 25, 99–132.
- Tey, Y.S., Brindal, M., 2012. Factors influencing the adoption of precision agricultural technologies: a review for policy implications. *Precis. Agric.* 13, 713–730.
- Thong, J.Y., 1999. An integrated model of information systems adoption in small businesses. *J. Manag. Inf. Syst.* 15, 187–214.
- Titah, R., Barki, H., 2006. E-government adoption and acceptance: a literature review. *Int. J. Electron. Govern. Res.* 2, 23–57.
- Veiga, L., Janowski, T., Barbosa, L.S., 2016. Digital government and administrative burden reduction. In: *Proceedings of the 9th International Conference on Theory and Practice of Electronic Governance*. ACM, pp. 323–326.
- Verdegem, P., Verleye, G., 2009. User-centered E-Government in practice: a comprehensive model for measuring user satisfaction. *Govern. Inf. Q.* 26, 487–497.
- Warkentin, M., Gefen, D., Pavlou, P.A., Rose, G.M., 2002. Encouraging citizen adoption of e-government by building trust. *Electron. Mark.* 12, 157–162.
- Wyn Morris, A.H., Dowell, David, 2017. Farm diversification, entrepreneurship and technology adoption: analysis of upland farmers in Wales. *J. Rural Stud.* 53, 132–143.