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Understanding the adoption of grazing practices in German dairy farming

Henning Schaak*, Oliver Mußhoff

University of Goettingen, Department of Agricultural Economics and Rural Development, Platz der Goettinger Sieben 5, 37073 Goettingen, Germany

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ABSTRACT

Due to a simultaneous decline in agricultural practice and an increased favorability and demand by society, grazing based milk production has become a topic of heightened interest in European agricultural policy, as well as dairy product marketing. This paper studies the behavior of German farmers with respect to the adoption of grazing practices. To do so, a structural equation model based on the technology acceptance model (TAM) is developed. Generally, the TAM hypothesizes that the perceived usefulness and the perceived ease of use are key determinants of the intention to use and the actual usage behavior of a technology. The results indicate that the perceived usefulness and perceived ease of use statistically significantly influence the adoption of grazing practices. Other important aspects are the production limitations on the individual farm, and the farmers' subjective norm towards grazing. Furthermore, the analysis reveals differences between conventional and organic farmers, showing that the influence of farmers' beliefs on the usage behavior tends to be greater for conventional farmers. The results show that farmers' subjective norm influences multiple other constructs of the model, including the intention to use. Under the assumption that farmers' perceptions of societal expectations depend on the public discourse, this indicates the relevance of public information and communication for the farmer's decision-making processes.

1. Introduction

In many European countries, grazing practices have gained increased attention in social and political discourse in recent times. In discussions concerning preferable milk production systems, many stakeholders favor grazing-based systems. From the consumer perspective, this preference is driven by perceived advantages towards animal welfare (Weinrich et al., 2014). It is also reflected by a higher willingness to pay for pasture-based milk of some consumer groups (Ellis et al., 2009; Hellberg-Bahr et al., 2012). These findings have been acknowledged by the dairy sector, as dairy processors in Europe have started to market pasture raised milk separately (Fahlbusch et al., 2009; Kühl et al., 2016). Pasture-based milk production is also discussed with respect to pasture conservation issues. Grazing as a form of pasture usage is seen as an important measure in order to preserve pastures (Plachter and Hampicke, 2010). Related, also low-input milk production has gained attention (Bijttebier et al., 2017). Grazing can have positive effects on the welfare of cows (von Keyserlingk et al., 2009), which confirms consumer perceptions. From a perspective restricted to a single farm, there is a consensus that the economic viability of grazing depends on the on-farm conditions, other input costs, and the chosen management style (cf. Knaus, 2016; Peyraud et al., 2010; Thomet et al., 2011).

Regardless of these findings, the share of dairy farms utilizing pasture for grazing practices has been decreasing in many European countries (Reijs et al., 2013). The decline is driven by structural changes (such as increasing stock numbers per farm and changes in the availability of labor) and by other changes in the production system (e.g. changing calving patterns) (Hennessy et al., 2015). This indicates an existing gap between the developments in agriculture and the expectations of society. Therefore, the future development of pasture usage and its extent has become a lively political topic. Most recently a "Grazing-Charter" ("Charta Weideland Norddeutschland"; Grünlandzentrum, 2015), an industry agreement supported by policy measures, was introduced in northern Germany. The existing gap in the extent of grazing-based milk production indicates the need for a better understanding of the corresponding decision-making processes, as decision-making in economic contexts may not be purely driven by economic reasoning. Instead, it can also be influenced by intentions, attitudes, and beliefs of the decision maker (Ondersteijn et al., 2003; Willock et al., 1999). The decisions a farmer makes are not only directly influencing the low order farm systems (cf. the farming system scheme described by McConnell and Dillon, 1997). By influencing factors beyond immediate production, the decisions also influence agricultural systems beyond the individual farm. They have an impact on a local scale (e.g. on landscape features and local biodiversity) as well as the

* Corresponding author.
E-mail addresses: henning.schaak@agr.uni-goettingen.de (H. Schaak), oliver.musshoff@agr.uni-goettingen.de (O. Mußhoff).

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supra-regional (e.g. through groundwater leeching plant of nutrients) and the global scale level (e.g. through greenhouse gas emissions). This is particularly relevant to dairy production systems, where pastures are an essential part of the production system, as elaborated before. The specific dairy production system also becomes increasingly important with respect to the wider food sector, as it the production system is an increasingly important factor for product differentiation and labeling. Varying demand patterns of different production systems also influence preceding parts of the agricultural industry.

In the past, several models have been developed to explain the behavior of an individual. A prominent early approach is the "Theory of Reasoned Action" (Ajzen and Fishbein, 1980) which assumes that behavioral intentions are the main predictors of behavior. It was later extended to the "Theory of Planned Behavior" (Ajzen, 1985), which additionally accounted for the individuals perceived control of the behavior. Although widely used, these approaches failed to produce reliable measures in the context of technology usage (Marangunić and Granić, 2015). In order to overcome this issue, the technology acceptance model (TAM) was developed. The TAM is a model for the analysis of acceptance processes of information technologies and was introduced by Davis (1986), and later refined by Davis (1989) and Davis et al. (1989). While originating from the prior models, the TAM has a different structure and relies on therefor conceptualized beliefs. Although initially developed in information systems research, it has been widely used to study technology-adoption behavior in a broader sense and in various domains (Venkatesh et al., 2007). An overview of the initial developments and later extensions of the model is given by Marangunić and Granić (2015).

This study analyzes the impact of individual beliefs[1] of German farmers on both the intention to use, and the actual application, of grazing management practices. Furthermore, individual farm specific conditions (such as herd size and available pasture) are taken into account. The analysis allows for the identification of possible differences between conventional and organic farmers. The study relies on a structural equation model, which augments the TAM (Davis, 1989; Davis et al., 1989). With respect to agriculture, the TAM has been applied to precision farming technologies, and the meat and dairy sector. The adoption of precision farming technologies was studied by Adrian et al. (2005) and Rezaei-Moghaddam and Salehi (2010). Arens et al. (2012) studied the acceptance of information systems by pig farmers. For the dairy sector, the adoption of technologies such as mineral supplementation and soil quality testing, was studied by Flett et al. (2004). Focusing on particular grassland management practices, Kelly et al. (2015) found that intention to implement a practice is strongly determined by the beliefs of the individual farmer. The adoption of different grazing related production technologies by new entrant farmers was studied by McDonald et al. (2016), who found a substantial influence of farmers' beliefs regarding a technology in the decision-making process. These studies used solely the conceptual basis of the constructs of the TAM. They also either considered the intention towards the adoption, or the actual adoption of grazing practices. These analyses then relied on binary regression frameworks. Best to the authors' knowledge, the structural form of the TAM has not been applied in the grazing context before. The structural form incorporates all constructs and relationships stated in the original TAM, including the influence of the intention towards adoption on the actual adoption. Further, these applications did not consider possible extensions of the TAM, which have been proposed in the literature. The present paper closes this research gap.

Compared to previous research considering the adoption of grazing, the present study includes several novelties. First, while those applications of the TAM focused on Ireland, the focus here is on German farmers, where the overall general situation is quite different. Since up to 100% of Irish cows graze (Reijs et al., 2013), previous studies focused on specific aspects in dairy farming (e.g. grass growth measurement or the usage of rotational grazing techniques). In contrast, milk production in Germany is rather heterogeneous (Lassen et al., 2014, 2015; Reijs et al., 2013) and grazing is not a ubiquitous management technology. Given the similar situation in other western European countries (Reijs et al., 2013), the results of the study are more suited to be transferred to other settings. Second, compared to the previous work, the study takes a broader perspective by analyzing the drivers of the adoption of grazing management practices in general. We use the general term *grazing* for management practices which allow the herd access to pastures and the opportunity to graze there. *Grazing* requires several complementary identifiable actions and measures on the farm[2]. Third, as discussed above, the study is the first to apply the structural form of the TAM in the grazing context. Besides incorporating all constructs and relationships stated in the original TAM, as well as common extensions, the model also allows the analysis of the adoption extent in a continuous way. In contrast to previously used binary approaches, it allows for a more nuanced understanding of the adoption decision. Further, a comparison between conventional and organic farmers is carried out.

The objectives of the paper can be summarized by three research questions: (1) what are the influences on the intention to use, and ultimately the actual usage of grazing?; (2) can differences between conventional and organic farmers be identified?; (3) does the analysis have implications beyond the perspective of an individual farm?

2. Theoretical framework

As mentioned before, the decision of whether to adopt a management technology may not only depend on economic reasoning. The intentions, attitudes, and beliefs of the decision maker can also influence the decision (Austin et al., 1998; Willock et al., 1999). By adapting the TAM to dairy farming, we follow previous research (cf. Flett et al., 2004; Kelly et al., 2015; McDonald et al., 2016). Based on the TAM, a theoretical framework to analyze behavioral drivers towards the application of grazing is developed. The graphical representation of the model can be found in Fig. 1. The core of the model is the initial TAM model. Suitable extensions and their corresponding linkages are derived from the literature. Extensions are considered to be suitable, when they are a) widely applied in the literature and b) applicable to other contexts than information systems research. Further, an additional construct, which accounts for possible limitations of the actual farm of the individual, is introduced. In the following, the research hypotheses regarding the adoption of grazing are described and reasoned.

The technology acceptance model (TAM) introduces the concepts of *Perceived Usefulness* (PU) and *Perceived Ease of Use* (PEOU). The PU is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989). The PEOU is defined as "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989). Both beliefs are used to explain the *Intention to Use* (IU) a technology (also referred to as the "Behavioral Intention"). Further, the PU is influenced by the PEOU. The target construct of the TAM is the actual *Usage Behavior* (UB). It is influenced by the IU a technology. These relationships have been found to be robust in various technologies (King and He, 2006; Marangunić and Granić, 2015). The first four hypotheses of our model represent these relationships (cf. Fig. 1):

H1:. The intention to use (IU) positively influences the usage behavior (UB) of grazing.

H2:. The perceived ease of use (PEOU) positively influences the

[1] Generally, beliefs "refer to a person's subjective probability judgments concerning some discriminable aspect of his world" (Fishbein and Ajzen, 1975, p. 131).

[2] Overviews over different approaches and their implementations for grazing practices are e.g. given by Blanchet et al. (2000) and Hodgson (1990).