Agricultural and societal perspectives on pasture-based livestock production systems in Germany

Dissertation
to attain the doctoral degree (Dr. sc. agr.)
of the Faculty of Agricultural Sciences
Georg-August-Universität Göttingen

Submitted by

Henning Schaak

born on the 21.12.1989 in Eckernförde

Göttingen, May 2019

D7

1. Referee: Prof. Dr. Oliver Mußhoff
2. Referee: Prof. Dr. Achim Spiller
3. Referee: Prof. Dr. Ulf Liebe

Date of the oral examination: 30.04.2019

Acknowledgements

I would like to thank my supervisor Prof. Dr. Oliver Mußhoff for the trustful cooperation over the years, for his guidance and feedback and for encouraging me to pursue my own research agenda. I would also like to thank my referees and examiners Prof. Dr. Achim Spiller, Prof. Dr. Ulf Liebe and Prof. Dr. Johannes Isselstein.

Thanks to my colleagues from the Farm Management group and the DARE for sharing their knowledge and experience. Among many others, I especially thank Ulf, who endured my loud thinking in our office. I thank the Ministry for Science and Culture of Lower Saxony (MWK) and the German Research Foundation (DFG) for financial support.

I owe gratitude to my family and friends. I thank my parents for always supporting me along my way. The same holds for my grandparents and my sister. Lastly, I want to thank Henning, Robert and Sven.

Thank you for your support.

Table of contents

I Introduction

The agricultural sector faces various challenges, such as the effects of climate change, environmental issues, technological disruptions and structural change. These issues are broadly discussed in the political and social discourse. One major reason is that actions and decisions made by a farmer not only influence his or her low-order farm system (in the sense of the farming system scheme (McConnell and Dillon, 1997)) but also agricultural systems beyond the individual farm. This applies for the local scale (e.g. on local natural resources and landscape features), the supra-regional (e.g. through groundwater leeching of nutrients), as well as the global scale (e.g. through greenhouse gas emissions). This is particularly relevant in context of bovine (or generally ruminant) livestock production. As the required forage is typically not an input tradeable over large distances, this kind of production is usually not feasible without proximate pasture land used for the farms production. Therefore, bovine livestock production should be considered jointly with the usage of pasture. In this context, the role of grazing practices has staggered increasing interest. Generally, the term "grazing practice"[1] refers to management practices that allow animal access to pasture and the opportunity to feed themselves there.

Pastures are an important factor in context of many environmental issues. They serve as the habitat for over half of the plant species in Germany (BfN, 2018). Pastures and their conservation are also discussed with respect to climate change (BFN, 2014; Poeplau et al., 2011), flood protection (BFN, 2014) and the prevention of soil erosion (Hampicke, 2013). Livestock production based on grazing practices has been discussed in context of multiple issues. It is seen as an important measure for the preservation of pastures (Plachter and Hampicke, 2010). The role of grazing is particularly important for pastures with a high natural value (BFN, 2014; Matzdorf et al., 2010). Pastures, with and without grazing animals are also a part of many cultural landscapes in Europe (Plachter and Hampicke, 2010).

[1] Allen et al. (2011) give an agronomic systematization of different grazing systems. More practically oriented definitions of grazing systems are e.g. given by Hodgson (1990) or Blanchet et al. (2000).

In this context, stakeholders like environmental protection non-governmental associations have a preference for pasture-based production systems (e.g. Greenpeace, 2017). Further, it was found that some consumer groups have a higher preference and willingness to pay for pasture-based milk and beef products (Ellis et al., 2009; Hellberg-Bahr et al., 2012; Kühl et al., 2018). The underlying preferences are, for example, driven by perceived advantages in animal welfare (Weinrich et al., 2014), but also by individual underlying factors like ethical motives or social norms (Gassler et al., 2018). The findings are reflected by developments in the food chain, where the production system of a food product is an increasingly important factor for product differentiation and labeling. For example, dairy processors market pasture-raised milk separately (Fahlbusch et al., 2009; Kühl et al., 2016). These developments are also reflected in the related policy. For example, a policy-supported industry agreement (Grünlandzentrum, 2015) and a publicly funded product label (NMELV, n.d.) were introduced in northern Germany.

Still, little is known about the influence of the usage form on the perception of the respective pastures in context of the landscape. A landscape is defined as "the outdoor environment, natural or built, which can be directly perceived by a person visiting and using that environment" (Hull IV and Revell, 1989: 324). Generally, public preferences regarding landscapes have been analyzed by various studies (cf. van Zanten et al., 2014; Záková Kroupová et al., 2016). Still, only in a minority of the cases, studies used "presence of livestock" as a landscape attribute (van Zanten et al., 2014). When it was considered, it was found to be among the highest preferred landscape attributes. Regardless of these positive evaluations, fewer dairy farms in North-Western Europe utilize grazing practices (Reijs et al., 2013). The decline is driven by changes in the applied production systems and structural changes, e.g. increasing stock numbers per farm, or the availability of labor (Hennessy et al., 2015). Nevertheless, the economic viability of grazing practices depends on the chosen management style, farm specific conditions and/or other input costs (Knaus, 2016; Peyraud et al., 2010; Steinwidder et al., 2011; Thomet et al., 2011). Further, using grazing practices can have positive effects on animal welfare and health (Armbrecht et al., 2018; Keyserlingk et al., 2009).

These findings show the complexity of the related issues and point to a gap between the agricultural developments and the societal expectations. This indicates that there is the need for a better understanding of both the public and the farmer's perspective on this

matter. For example the decision making of farmers may not only be driven by economic considerations, but also by socioeconomic characteristics (Ondersteijn et al., 2003) or individual intentions, attitudes, or beliefs (Ondersteijn et al., 2003; Willock et al., 1999). Similar findings can be observed with respect to decisions of citizens, respectively consumers, for example with food purchase decisions (for recent review related to organic food see Rana and Paul (2017)). Still, these relationships are complex, and gaps between ones attitudes and intentions, respectively behavior can occur (cf. Vermeir and Verbeke, 2006).

The papers presented in this cumulative thesis contribute to the understanding of different aspects of pasture-based livestock production systems, taking both the farmers and the societal perspective into account. The first paper jointly studies factors influencing the adoption and the extent of grazing practices by German dairy farmers. The second paper also studies the adoption of grazing practices by German dairy farmers, but focusses on the role of beliefs and attitudes on the adoption decision. These first two papers focus on grazing practices in dairy production. The third and fourth paper study public landscape preferences for livestock presence. While the third paper focusses on methodological issues when estimating discrete choice models, the fourth paper focusses on practical insights and policy implications.

The first paper of the cumulative thesis (Chapter II) titled "Grazing Adoption in Dairy Farming: A Multivariate Sample-Selection Approach" (published in *Journal of Agricultural and Resource Economics*) studies the adoption of grazing practices and the role of socioeconomic factors for the farmer's decision making. There is a limited literature regarding this topic. Previous literature found that higher educated farmers are more likely to adopt grazing practices (Foltz and Lang, 2005), and previous experience with grazing practices and the financial situation of the farm have an effect on the adoption decision (Kim et al., 2008). More recently, Jensen et al. (2015) found that different socioeconomic factors influence the probability of the participation in grazing programs. This research mainly studied hypothetical adoption decisions of grazing practices in the USA. In context of the Irish dairy production, the adoption of specific pasture management practices is influenced by the farmer's beliefs (Kelly et al., 2015; McDonald et al., 2016). Here it has to be noted, that most cows in Irish dairy production are held in grazing based production systems (Reijs et al., 2013).

In Germany, only a fraction of dairy farms apply grazing practices (Lassen et al., 2014, 2015; Reijs et al., 2013). Therefore, the adoption decision itself is of interest. Still, only focusing on a binary decision would also fall short, as there is a spectrum on which grazing practices can be implemented. For example, the daily pasture access can range from only a few hours to a day-long access. Also the length of the annual grazing period can vary significantly. While there are other important aspects which can be used to describe an implementation of grazing (e.g. rotational vs. permanent stocking), the length of the daily pasture access and the length of the annual grazing period are two important variables to describe the importance of grazing for the farmer's production system. As discussed earlier, dairy processors market pasture-milk separately and farmers are usually compensated for the participation in the respective pasture-milk programs. Therefore, the paper also studies the effect of the farms participation in a pasture-milk program on the grazing extent.

The objectives of the paper can be summarized by the following research questions:

(1) What influences the adoption of grazing practices?
(2) Conditional on the adoption decision, which factors influence the extent of the grazing practices?

In order to be able to study these research questions simultaneously and to allow for differentiation of the grazing extent, a modification of the Multivariate Sample Selection Model (MSSM) introduced by Yen (2005) is developed. The model can be understood as a generalization of the Heckman-, or Tobit-II-Model (Amemiya, 1985; Heckman, 1979). In the model, the decision to adopt grazing is represented by a single selection equation. Given the adoption, the grazing extent is then modeled by two dependent variables: the length of the annual grazing period and the length of the daily pasture access. The model is estimated using data from 279 German dairy farms. With respect to dairy production, this paper is the first to jointly study the adoption decision for grazing and the conditional grazing extent.

Chapter III contains the paper "Understanding the adoption of grazing practices in German dairy farming" (published in *Agricultural Systems*). The paper aims to further study the understanding of the adoption process of grazing practices by German dairy farmers, focusing on their intentions, attitudes, and beliefs. Several psychological models have been

developed to explain an individual's behavior. Prominent examples are the "Theory of Reasoned Action" (Ajzen and Fishbein, 1980) and the "Theory of Planned Behavior" (Ajzen, 1985). These models assume a structural relationship between attitudes, intentions and beliefs and were designed to generally explain an individual's behavior. Originating from these models, the Technology Acceptance Model (TAM) has been developed (Davis, 1989; Davis et al., 1989). The TAM assumes that an individual's intention to use a technology is influenced by the perceived ease of use and the perceived usefulness of the technology. Further, the actual usage behavior is influenced by the usage intention. The TAM was initially developed to explain the adoption of information systems technologies, but was later used to study the adoption of technologies in a broad sense and in various domains (Venkatesh et al., 2007), including agriculture. Within agriculture, it was for example used to study the adoption of precision farming technologies (Adrian et al., 2005; Rezaei-Moghaddam and Salehi, 2010) or information systems in pig production (Arens et al., 2012).

With respect to grazing practices and dairy farming, the conceptual basis of the TAM has been used to study pasture management practices and grazing-related production technologies in Ireland (Kelly et al., 2015; McDonald et al., 2016). One drawback of these studies is that they do not consider the full structure proposed by the TAM. Their transferability to other countries is also limited, as most Irish farms use grazing practices, whereas this is different in many European countries (Reijs et al., 2013).

The objectives of the paper can be summarized by three research questions:

(1) What influences the intention to use and ultimately the actual usage of grazing?
(2) Can differences between conventional and organic farmers be identified?
(3) Which implications beyond the perspective of an individual farm can be derived from the analysis?

The paper relies on an extended form of the TAM, using data from 334 German dairy farmers. Additional to the constructs of the initial TAM, the model includes the perceived output quality of grazing as well as the subjective norm towards it. It also includes farm specific conditions and the farmer's age, as a proxy for his or her experience. The model is estimated in form of a Partial-Least-Squares-Structural-Equation-Model (Hair et al., 2017).

The paper represents the first application of the TAM in its structural form in context of grazing practices.

Chapter IV contains the paper "Public preferences for pasture landscapes and the role of scale heterogeneity" (published as *Forland working paper 2018-04*). The knowledge about the influence of the pasture usage form on the public perception is limited. The preferences of the public towards landscapes are assessed by letting citizens valuate the aesthetic quality of landscapes (Rambonilaza and Dachary-Bernard, 2007). This research mostly relies on the contingent valuation method and discrete choice experiments (DCE) (Hoyos, 2010). As already discussed, there is little knowledge regarding the role of livestock presence in landscapes (cf. van Zanten et al., 2014). Noteworthy, in cases where livestock presence was considered, this was only done in a binary manner (presence or absence). Taking the perspective of agricultural production into account, this distinction potentially falls short, as different grazing systems require different levels of livestock density on a particular plot. In order to study the public preference for pasture landscapes, including the livestock presence, a DCE is designed in the third paper. The experiment explicitly considers different livestock densities in the landscape. Besides the livestock presence, the experiment considers the presence of linear and point landscape elements and the structuredness of the pasture (in terms of parceling). It also includes a cost attribute. This allows for the calculation of the willingness to pay for the considered landscape attributes. In order to allow for the assessment of the aesthetic quality of the landscapes, graphical representations are used. With respect to previous research on consumer preferences regarding pasture-based foods, the difficulty arises, that stated preferences for the livestock presence have to be attributed to perceived benefits from the related products. Therefore, the experiment established a policy szenario, which also allows for the embedment of the cost attribute. Further, the question arises, whether the potential preference for livestock presence only follows from use values, or whether also non-use values (like existence or heritage values play a role) (Millennium Ecosystem Assessment, 2003). Therefore, the data collection was carried out on the national German level. Quotas were applied to ensure representativeness regarding age, household income, federal state of residence and size of the place of residence. The final dataset contained data from 449 participants.

One unsolved issue in DCE-based research is the question of the most appropriate way to account for the heterogeneity of the studied preferences. Multiple models have been

proposed in the literature, whose advantages and disadvantages are critically discussed in the literature (c.f. Hess and Train, 2017). The widely applied Mixed Multinomial Logit model (MIXL) (McFadden and Train, 2000; Train, 2009) allows for individually varying preferences parameters by assuming an underlying continuous distribution of preferences in the population. Another commonly applied model is the Generalized Multinomial model (GMNL), a variant of the MIXL proposed by Fiebig et al. (2010). This model additionally allows for so-called "scale-heterogeneity". Interestingly, the GMNL has not been applied in the field of landscape evaluations. The third paper addresses this research gap and compares the results of both the MIXL and the GMNL. In order to do so, not only the ordinary parameter estimates, but also the distributions of the conditional means of individual parameters (Fiebig et al., 2010; Sarrias and Daziano, 2017) are compared.

The objectives of the paper can be summarized by three research questions:

(1) What are the public preferences for pasture landscapes in Germany?
(2) Which implications arise from the usage of the GMNL in landscape preference research?
(3) Does the livestock density has an effect on the preference for livestock presence?

The analysis of the issues of Chapter IV is continued in Chapter V. The paper contained in the chapter is titled "Public preferences for pasture landscapes in Germany – A latent class analysis of a nationwide discrete choice experiment" (forthcoming in *Land Use Policy*). It has been shown that the heterogeneity between individuals in DCE experiments can be partially explained by including socioeconomic variables in the analysis. With respect to landscape preferences, it has been for example shown that preferences can vary between regions (van Zanten et al., 2016) or with an individual's gender (Häfner et al., 2018). The paper presented in Chapter V applies a Latent-Class Logit Model (LCM) (Greene and Hensher, 2003). In this approach, an individual's preferences are assumed to be a mixture of preferences of different groups (or classes). Within these groups, the preferences are assumed to be homogenous. In the LCM, the effect of additional explanatory variables on the class assignment can be studied. In the paper, socioeconomic variables as well as variables representing the individual's regional residence are included in the analysis.

The following research questions summarize the objectives of the paper:

(1) Are there different preference patterns for pasture landscapes in the German public?
(2) Which sociodemographic variables influence the preferences?
(3) Are there regional differences in the pasture landscape preferences?

The four described papers study different aspects of the agricultural as well as the societal perception of pasture based livestock production systems. In the following chapters, the four papers are presented consecutively. In the last chapter of the thesis (Chapter VI), the results of the individual papers are summarized. Further, methodological and policy implications of the presented results are discussed.

References

Aertsens, J., Verbeke, W., Mondelaers, K. and Van Huylenbroeck, G. (2009): Personal determinants of organic food consumption: a review, *British Food Journal*, 111(10): 1140–67. DOI: 10.1108/00070700910992961.

Adrian, A. M., Norwood, S. H. and Mask, P. L. (2005): Producers' perceptions and attitudes toward precision agriculture technologies, *Computers and Electronics in Agriculture*, 48(3): 256–71. DOI: 10.1016/j.compag.2005.04.004.

Ajzen, I. (1985): From Intentions to Actions: A Theory of Planned Behavior, in J. Kuhl and J. Beckmann (eds) *Action Control: From Cognition to Behavior*,. Berlin, Heidelberg: Springer Berlin Heidelberg (SSSP Springer Series in Social Psychology). DOI: 10.1007/978-3-642-69746-3_2.

Ajzen, I. and Fishbein, M. (1980): *Understanding Attitudes and Predicting Social Behavior*. Englewood Cliffs, NJ: Prentice-Hall.

Allen, V. G., Batello, C., Berretta, E. J., Hodgson, J., Kothmann, M., Li, X., McIvor, J., Milne, J., Morris, C., Peeters, A. and Sanderson, M. (2011): An international terminology for grazing lands and grazing animals, *Grass and Forage Science*, 66(1): 2–28. DOI: 10.1111/j.1365-2494.2010.00780.x.

Amemiya, T. (1985): *Advanced Econometrics*. Cambridge, Massachusetts: Harvard University Press.

Arens, L., Plumeyer, C.-H. and Theuvsen, L. (2012): Akzeptanz von Informationssystemen durch Schweinemäster: Eine Kausalanalyse, in A. Balmann and et al. (eds) *Unternehmerische Landwirtschaft zwischen Marktanforderungen und gesellschaftlichen Erwartungen*,. Münster: Landwirtschaftsverlag Münster (Schriften der Gesellschaft für Wirtschafts- und Sozialwissenschaften des Landbaus e.V., 47).

Armbrecht, L., Lambertz, C., Albers, D. and Gauly, M. (2018): Does access to pasture affect claw condition and health in dairy cows?, *Veterinary Record*, 182(3): 79–79. DOI: 10.1136/vr.104554.

Blanchet, K., Moechnig, H. and DeJong-Hughes, J. (2000): *Grazing Systems Planning Guide*. University of Minnesota, Extension Service.

Bundesamt für Naturschutz (BFN) (ed.) (2014): *Grünland-Report – Alles Im Grünen Bereich?* Bonn.

Bundesamt für Naturschutz (BfN) (2018): *Grassland Conservation in Germany*, *Grassland conservation in Germany*,. Available at: https://www.bfn.de/en/activities/agriculture/grassland-conservation-in-germany.html (Accessed: 23 May 2018).

Davis, F. D. (1989): Perceived usefulness, perceived ease of use, and user acceptance of information technology, *MIS Quarterly*, 13(3): 319–340.

Davis, F. D., Bagozzi, R. P. and Warshaw, P. R. (1989): User acceptance of computer technology: a comparison of two theoretical models, *Management Science*, 35(8): 982–1003.

Ellis, K., Billington, K., McNeil, B. and McKeegan, D. (2009): Public opinion on UK milk marketing and dairy cow welfare, *Animal Welfare*, 18(3): 267–82.

Fahlbusch, M., Bahr, A., Brummer, B. and Spiller, A. (2009): Der Markt für Milch und Milcherzeugnisse, *Agrarwirtschaft*, 58(1): 52–71.

Fiebig, D. G., Keane, M. P., Louviere, J. and Wasi, N. (2010): The Generalized Multinomial Logit Model: Accounting for Scale and Coefficient Heterogeneity, *Marketing Science*, 29(3): 393–421. DOI: 10.1287/mksc.1090.0508.

Foltz, J. and Lang, G. (2005): The adoption and impact of management intensive rotational grazing (MIRG) on Connecticut dairy farms, *Renewable Agriculture and Food Systems*, 20(4): 261–66. DOI: 10.1079/RAF2005127.

Gassler, B., Xiao, Q., Kühl, S. and Spiller, A. (2018): Keep on grazing: factors driving the pasture-raised milk market in Germany, *British Food Journal*, 120(2): 452–67. DOI: 10.1108/BFJ-03-2017-0128.

Greene, W. H. and Hensher, D. A. (2003): A latent class model for discrete choice analysis: contrasts with mixed logit, *Transportation Research Part B: Methodological*, 37(8): 681–98. DOI: 10.1016/S0191-2615(02)00046-2.

Greenpeace (2017): Kursbuch Agrarwende 2050. Available at: https://www.greenpeace.de/sites/www.greenpeace.de/files/publications/20170105_studie_agrarwende2050_lf.pdf (Accessed: 11 March 2019).

Grünlandzentrum (2015): *Charta Weideland Norddeutschland*. Ovelgönne. Available at: http://www.weideland.gruenlandzentrum.org/images/Charta_-Weideland.pdf (Accessed: 8 January 2016).

Häfner, K., Zasada, I., Zanten, B. T. van, Ungaro, F., Koetse, M. and Piorr, A. (2018): Assessing landscape preferences: a visual choice experiment in the agricultural region of Märkische Schweiz, Germany, *Landscape Research*, 43(6): 846–61. DOI: 10.1080/01426397.2017.1386289.

Hair, J. F., Hult, G. T. M., Ringle, C. and Sarstedt, M. (2017): *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*. 2nd edn. Los Angeles: Sage Publications.

Hampicke, U. (2013): *Kulturlandschaft Und Naturschutz: Probleme - Konzepte - Ökonomie*. Wiesbaden: Springer Spektrum (Praxis).

Heckman, J. J. (1979): Sample Selection Bias as a Specification Error, *Econometrica*, 47(1): 153–61. DOI: 10.2307/1912352.

Hellberg-Bahr, A., Steffen, N. and Spiller, A. (2012): Marketingpotentiale für Weidemilch, *Jahrbuch der Österreichischen Gesellschaft für Agrarökonomie*, 21(1): 3–12.

Hennessy, D., Delaby, L., Van den Pol-van Dasselaar, A. and Shalloo, L. (2015): Possibilities and constraints for grazing in high output dairy systems, *Grassland Science in Europe*, 20: 151–62.

Hess, S. and Train, K. (2017): Correlation and scale in mixed logit models, *Journal of Choice Modelling*, 23: 1–8. DOI: 10.1016/j.jocm.2017.03.001.

Hodgson, J. G. (1990): *Grazing Management: Science into Practice*. Harlow: Longman Scientific & Technical.

Hoyos, D. (2010): The state of the art of environmental valuation with discrete choice experiments, *Ecological Economics*, 69(8): 1595–1603. DOI: 10.1016/j.ecolecon.2010.04.011.

Hull IV, R. B. and Revell, G. R. B. (1989): Issues in sampling landscapes for visual quality assessments, *Landscape and Urban Planning*, 17(4): 323–30. DOI: 10.1016/0169-2046(89)90086-8.

Jensen, K. L., Lambert, D. M., Clark, C. D., Holt, C., English, B. C., Larson, J. A., Yu, T. E. and Hellwinckel, C. (2015): Cattle Producers' Willingness to Adopt or Expand Prescribed Grazing in the United States, *Journal of Agricultural and Applied Economics*, 47(2): 213–42. DOI: 10.1017/aae.2015.6.

Kelly, E., Heanue, K., Buckley, C. and O'Gorman, C. (2015): *Proven Science versus Farmer Perception*. 229067. Available at: https://ideas.repec.org/p/ags/iaae15/229067.html.

Keyserlingk, M. A. G. von, Rushen, J., Passillé, A. M. de and Weary, D. M. (2009): Invited review: The welfare of dairy cattle—Key concepts and the role of science, *Journal of Dairy Science*, 92(9): 4101–11. DOI: 10.3168/jds.2009-2326.

Kim, S.-A., Gillespie, J. M. and Paudel, K. P. (2008): Rotational grazing adoption in cattle production under a cost-share agreement: does uncertainty have a role in conservation technology adoption?, *Australian Journal of Agricultural and Resource Economics*, 52(3): 235–52. DOI: 10.1111/j.1467-8489.2007.00434.x.

Knaus, W. (2016): Perspectives on pasture versus indoor feeding of dairy cows, *Journal of the Science of Food and Agriculture*, 96(1): 9–17. DOI: 10.1002/jsfa.7273.

Kühl, S., Fahlbusch, M., Ermann, M., Bruemmer, B. and Schulze-Ehlers, B. (2016): Der Markt für Milch und Milcherzeugnisse im Jahr 2015, *German Journal of Agricultural Economics*, 65(Supplement): 18–39.

Kühl, S., Gauly, S. and Spiller, A. (2018): Analysing public acceptance of four common husbandry systems for dairy cattle using a picture-based approach, *Livestock Science*,. DOI: 10.1016/j.livsci.2018.12.022.

Lassen, B., Nieberg, H. and Kuhnert, H. (2015): *Status Quo-Analyse Ausgewählter Nachhaltigkeitsaspekte Der Milcherzeugung in Schleswig-Holstein*. Thünen Working Paper 43. Braunschweig, Germany: Johann Heinrich von Thünen-Institut.

Lassen, B., Nieburg, H., Kuhnert, H. and Sanders, J. (2014): *Status-Quo-Analyse Ausgewählter Nachhaltigkeitsaspekte Der Milcherzeugung in Niedersachsen*. Thünen Working Paper 28. Braunschweig, Germany: Thünen-Institut für Betriebswirtschaft.

Matzdorf, B., Reutter, M. and Hübner, C. (2010): *Gutachten-Vorstudie – Bewertung Der Ökosystemdienstleistungen von HNV-Grünland (High Nature Value Grassland)*. Müncheberg: Institut für Sozioökonomie Leibniz-Zentrum für Agrarlandschaftsforschung (ZALF) eV.

McConnell, D. J. and Dillon, J. L. (1997): *Farm Management for Asia : A Systems Approach*. Rome : Food and Agriculture Organization of the United Nations.

McDonald, R., Heanue, K., Pierce, K. and Horan, B. (2016): Factors influencing new entrant dairy farmer's decision-making process around technology adoption, *The Journal of Agricultural Education and Extension*, 22(2): 163–77. DOI: 10.1080/1389224X.2015.1026364.

McFadden, D. and Train, K. (2000): Mixed MNL Models for Discrete Response, *Journal of Applied Econometrics*, 15(5): 447–70.

Millennium Ecosystem Assessment (ed.) (2003): *Ecosystems and Human Well-Being: A Framework for Assessment*. Washington, DC: Island.

Niedersächsisches Ministerium für Ernährung, Landwirtschaft und Verbraucherschutz (NMELV) (no date): *Das Niedersächsische Weidemilchprogramm*. Available at: https://www.ml.niedersachsen.de/themen/landwirtschaft/tierische_produktion/das-niedersaechsische-weidemilchprogramm-145663.html (Accessed: 10 March 2019).

Ondersteijn, C. J. M., Giesen, G. W. J. and Huirne, R. B. M. (2003): Identification of farmer characteristics and farm strategies explaining changes in environmental management and environmental and economic performance of dairy farms, *Agricultural Systems*, 78(1): 31–55. DOI: 10.1016/S0308-521X(03)00031-3.

Peyraud, J., Van den Pol-Van Dasselaar, A., Dillon, P. and Delaby, L. (2010): Producing milk from grazing to reconcile economic and environmental performances, *Grassland Science in Europe*, 15: 865–879.

Plachter, H. and Hampicke, U. (2010): *Large-Scale Livestock Grazing*. Berlin, Heidelberg: Springer Berlin Heidelberg.

Poeplau, C., Don, A., Vesterdal, L., Leifeld, J., Van Wesemael, B., Schumacher, J. and Gensior, A. (2011): Temporal dynamics of soil organic carbon after land-use change in the temperate zone - carbon response functions as a model approach: soil organic carbin and land-use change, *Global Change Biology*, 17(7): 2415–27. DOI: 10.1111/j.1365-2486.2011.02408.x.

Rambonilaza, M. and Dachary-Bernard, J. (2007): Land-use planning and public preferences: What can we learn from choice experiment method?, *Landscape and Urban Planning*, 83(4): 318–26. DOI: 10.1016/j.landurbplan.2007.05.013.

Rana, J. and Paul, J. (2017): Consumer behavior and purchase intention for organic food: A review and research agenda, *Journal of Retailing and Consumer Services*, 38: 157–65. DOI: 10.1016/j.jretconser.2017.06.004.

Reijs, J. W., Daatselaar, C. H. G., Helming, J. F. M., Jager, J. and Beldman, A. C. G. (2013): Grazing dairy cows in north-west Europe, *LEI Report 2013*, 1. Available at: https://www.wageningenur.nl/upload_mm/b/b/3/dd5ba8e2-8543-453b-904d-0189ae8341c4_Rapport%202013-001%20Reijs_DEF_WEB.pdf (Accessed: 26 July 2016).

Rezaei-Moghaddam, K. and Salehi, S. (2010): Agricultural specialists intention toward precision agriculture technologies: integrating innovation characteristics to technology acceptance model, *African Journal of Agricultural Research*, 5(11): 1191–99. DOI: 10.5897/AJAR09.506.

Sarrias, M. and Daziano, R. (2017): Multinomial Logit Models with Continuous and Discrete Individual Heterogeneity in R : The gmnl Package, *Journal of Statistical Software*, 79(2). DOI: 10.18637/jss.v079.i02.

Steinwidder, A., Starz, W., Podstatzky, L., Gasteiner, J., Pfister, R., Rohrer, H. and Gallnböck, M. (2011): Einfluss des Abkalbezeitpunktes von Milchkühen auf Produktionsparameter bei Vollweidehaltung im Berggebiet, *Züchtungskunde*, 83: 203–215.

Thomet, P., Cutullic, E., Bisig, W., Wuest, C., Elsaesser, M., Steinberger, S. and Steinwidder, A. (2011): Merits of full grazing systems as a sustainable and efficient milk production strategy., *Grassland Science in Europe*, 16: 273–85.

Train, K. E. (2009): *Discrete Choice Methods with Simulation*. Cambridge university press.

Venkatesh, V., Davis, F. and Morris, M. G. (2007): Dead or alive? The development, trajectory and future of technology adoption research, *Journal of the Association for Information Systems*, 8(4): 1.

Vermeir, I. and Verbeke, W. (2006): Sustainable Food Consumption: Exploring the Consumer 'Attitude – Behavioral Intention' Gap, *Journal of Agricultural and Environmental Ethics*, 19(2): 169–94. DOI: 10.1007/s10806-005-5485-3.

Weinrich, R., Kühl, S., Zühlsdorf, A. and Spiller, A. (2014): Consumer attitudes in Germany towards different dairy housing systems and their implications for the marketing of pasture raised milk, *International Food and Agribusiness Management Review*, 17(4): 205.

Willock, J., Deary, I. J., Edwards-Jones, G., Gibson, G. J., McGregor, M. J., Sutherland, A., Dent, J. B., Morgan, O. and Grieve, R. (1999): The role of attitudes and objectives in farmer decision making: Business and environmentally-oriented behaviour in Scotland, *Journal of Agricultural Economics*, 50(2): 286–303. DOI: 10.1111/j.1477-9552.1999.tb00814.x.

Yen, S. T. (2005): A Multivariate Sample-Selection Model: Estimating Cigarette and Alcohol Demands with Zero Observations, *American Journal of Agricultural Economics*, 87(2): 453–66. DOI: 10.1111/j.1467-8276.2005.00734.x.

Záková Kroupová, Z., Havlíková, M., Hálová, P. and Malý, M. (2016): Economic Valuation of Mountain Landscapes and Ecosystems: A Meta-Analysis of Case Studies, *Agris on-line Papers in Economics and Informatics*, VIII(3): 103–12.

van Zanten, B. T., Verburg, P. H., Koetse, M. J. and van Beukering, P. J. H. (2014): Preferences for European agrarian landscapes: A meta-analysis of case studies, *Landscape and Urban Planning*, 132: 89–101. DOI: 10.1016/j.landurbplan.2014.08.012.

van Zanten, B. T., Zasada, I., Koetse, M. J., Ungaro, F., Häfner, K. and Verburg, P. H. (2016): A comparative approach to assess the contribution of landscape features to aesthetic and recreational values in agricultural landscapes, *Ecosystem Services*, 17: 87–98. DOI: 10.1016/j.ecoser.2015.11.011.

II The adoption of grazing in dairy farming – A multivariate sample selection approach

Authors: Henning Schaak and Oliver Mußhoff

Published in: Journal of Agricultural and Resource Economics, *43*(2), 292-305.

http://dx.doi.org/10.22004/ag.econ.273451

Abstract

Milk production methods and pasture usage have gained increasing attention in recent years. This paper studies possible influences on the decision to adopt grazing practices as well as on the extent of these practices. German dairy farms were analyzed using a multivariate sample-selection model. Results indicate that specialized farms and farms with greater pasture acreage per cow are more likely to adopt grazing practices; farms with larger herds are less likely to adopt. For farmers utilizing grazing, length of daily pasture access depends on production-related variables, while the annual period depends only on farm specialization.

Keywords: dairy production, grazing practices, maximum likelihood, multivariate sample-selection model

III Understanding the adoption of grazing practices in German dairy farming

Authors: Henning Schaak and Oliver Mußhoff

Published in: Agricultural Systems, 165, 230-239

https://doi.org/10.1016/j.agsy.2018.06.015

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.

Keywords: technology acceptance model; structural equation model; grazing practices; dairy production

IV Public preferences for pasture landscapes and the role of scale heterogeneity

Authors: Henning Schaak and Oliver Mußhoff

Published as: FORLand-Working Paper 04(2018)

https://doi.org/10.18452/19478

Abstract

Despite its relevance for agricultural production, biodiversity and landscape aesthetics, grazing livestock is rarely considered in research on public landscape preferences. This paper studies public preferences for pasture usage in Germany by the means of a discrete choice experiment. The results indicate that there is a general willingness to pay (WTP) for livestock presence in landscape. The mean WTP is independent of its density. The paper discusses the implications of different econometric models and the role of preference heterogeneity on the results. The results show that a detailed analysis of the preference heterogeneity can provide deeper insights on their structure.

Keywords: discrete choice experiment; public landscape preferences; livestock; mixed logit model

V Public preferences for pasture landscapes in Germany – A Latent Class Analysis of a nationwide Discrete Choice Experiment

Authors: Henning Schaak and Oliver Mußhoff

Forthcoming in: Land Use Policy

https://doi.org/10.1016/j.landusepol.2019.104371

Abstract

Biodiversity, landscape aesthetics and grazing livestock have considerable relevance for agricultural production, however rarely considered in public landscape preferences research. This paper studies public preferences for pasture usage by the means of a discrete choice experiment using a representative sample of 449 individuals from Germany. Graphical representations of the choice sets were used to assess the preferences for the presence of livestock and typical pasture landscape elements. To account for preference heterogeneity, the paper utilised a latent-class logit model. Four different latent classes were identified. The results showed different preferences between the latent classes, not only in terms of the magnitude of the estimated parameters, but also in terms of the parameter signs. This indicated that there are multiple types of preferred pasture landscapes. Within the groups, the preference for livestock presence did not depend on its density. Furthermore, it was found that point elements were more important for the landscape preference than linear elements. The class membership probabilities were influenced by multiple sociodemographic variables, including the individual's residence.

Keywords: discrete choice experiment; landscape preferences; latent class logit model; livestock; pasture landscapes

VI Summary and conclusion

The thesis studies factors and attitudes influencing farmers' behavior and societal preferences in context of pasture-based livestock production systems. The particular topics are the adoption of grazing practices from the farmers and preferences for pasture landscapes from the public perspective. In order to answer the research questions, survey data partially incorporating experiment data are used. The results and the conclusions of the four papers are summarized in the following. Additionally, starting points for potential future research are listed.

In the first paper, factors influencing the adoption decision and the usage extent of grazing practices were studied. For this, survey data from German dairy farmers was analyzed. The data was analyzed using a specifically developed modification of the multivariate sample selection model, introduced by Yen (2005). The results show that the major influences on the adoption decision are the farm specialization, the herd size and the available area per cow suitable for grazing. On average, specialized farms and farms with more suitable grazing area per cow are more likely to use grazing practices. The adoption probability decreases with the farms herd size. Given that a farmer applies grazing practices, the only statistically significant effect on the length of the annual grazing period is the farm specialization. In contrast, the length of the daily pasture access is negatively influenced by average milk yield per cow and positively by the grazing area per cow. The participation in a pasture milk program has no significant influence on the grazing extent.

The results indicate that with respect to the length of the annual grazing period, unobserved factors like climate conditions may have to be considered. This could for example be relevant with respect to the requirements of pasture milk programs or organic certification standards. The results of the paper imply that the current programs do not extend the application of grazing practices. Instead, this reveals a potential freeloader effect, as farmers usually receive an expense allowance for the program participation. When interpreting the results in a broader context, the structural changes of the agricultural sector need to be taken into account. On the one hand, many farms grow in larger steps, where the provision of sufficient grazing land can be challenging. On the other hand, producing pasture-milk may become a specialization for farmers not willing or not able to increase

their farm size. Nevertheless this may require an adequate compensation by the dairy processors. The approach applied allows for multiple potential directions of future research. Taking the model presented in the paper as a starting point, future research could account for regional differences, for example by including climatic variables. Alternatively, researchers could consider incorporating concepts from geoadditive modeling (Kammann and Wand, 2003). Another potential extension would be to allow for a differentiation in different grazing systems. This would lead to a selection process with multiple steps (similar to multiple hurdle models (Croissant et al., 2018)).

The objective of the second paper was to study behavioral drivers for the adoption of grazing practices by German dairy farmers. In the paper, an extended Technology Acceptance Model (TAM) (Davis et al., 1989; Davis, 1989) was studied using Partial-Least-Squares Structural-Equation-Modelling (Hair et al., 2017). In addition to the original TAM, the latent constructs "Perceived Output Quality" and the farmer's "Subjective Norm" were included in the model. The model also considers the effects of the on-farm-conditions and the farmer's age. The results presented in the paper provide multiple insights: First, they show the importance of the perceived usefulness and the perceived ease of use of grazing practices on the usage intention as well as the usage behavior. These results support previous findings in the literature (Kelly et al., 2015; McDonald et al., 2016). Second, the analysis further showed differences between conventional and organic farmers. In most cases, the effects of the constructs are weaker in the organic subsample. The overall experience of the farmer has statistically significant effects on the behavioral constructs. This can be interpreted that conventional farmers with more experience perceive grazing practices less positively. These effects are not present in the organic subsample.

The effects of the subjective norm have some implications beyond the individual farm. They generally indicate that the farmer's perception of the societal expectations influence his or hers beliefs. Under the assumption that these perceptions are shaped by the public and the political discourses, this shows that the farmer's beliefs and thus his or hers intentions may be influenced through these discourses. This highlights the importance of communication in context of agricultural politics. Given the results of the paper, this especially applies in context of conventional farming. The paper found that the on-farm condition significantly influences both the perceived ease of use of grazing practices, as

well as the actual usage behavior. Still, the conceptualization of this construct and the conceptualization of the usage behavior represent a bottleneck of the present and potential future analyses. The combination of structural equation modelling with multivariate regressions techniques may be a fruitful direction for future research. For example, the model applied in this paper could be combined with categorical regression approaches to study the adoption probability of grazing systems with varying complexity. Still, such an approach would require cautious model development, in order to avoid endogeneity issues.

The third paper studies the public preferences for the landscape preferences of pasture landscapes in Germany, particularly the effect of livestock presence in these landscapes. The paper also studies the implications which can arise from the utilization of different statistical models. Therefore, the model provides the first comparison of the Mixed Multinomial Logit Model (MIXL) (Train, 2009) and the Generalized Multinomial Logit Model (GMNL) (Fiebig et al., 2010) in context of landscape preference research and provides an in-depth discussion of the implications following from the potential scale heterogeneity introduced in the GMNL. In the paper, the models were estimated in willingness-to-pay-(WTP)-space, thus the WTP for the different landscape attribute levels was directly estimated. The GMNL was found to outperform the MIXL in the studied sample. The paper found significant WTPs for linear as well as point landscape elements, a high number of parcels on the pasture and the presence for livestock presence in the landscape. The mean WTP for the point landscape elements was found to be statistically significant higher than linear landscape elements (74 € vs. 8€ per household and year). The mean WTP for livestock presence does not statistically significant differ with the livestock density in the landscape and is around 85 € per household and year. Preference heterogeneity for most attributes in the experiment can be identified. The specification of the GMNL has to be additionally taken into account. It implies that the scaling factor of the GMNL statistically significant varies between individuals and scales the mean parameters up or down. In order to investigate the implications of this result, the distributions of the conditional means of the individuals in the sample were derived for both the GMNL and the MIXL. The comparison of the distributions revealed differences, even when the estimated mean and standard deviations were comparable between the models. When considering the conditional means of the attribute WTPs, one other result is that for some individuals the estimated WTP is larger than the highest level of the cost attribute. This

could indicate that the chosen range of the price attribute was too low and therefore the WTPs were overestimated (Kjær, 2005).

The paper showed that the GMNL is a viable alternative to the MIXL in context of landscape preference studies. Still, it also showed the importance of considering all model parameters or the empirical distributions of the parameters, in order to ensure an appropriate interpretation of the results. The paper leaves some open questions. For example it did not consider the potential influences of sociodemographic variables on the preferences. It also did not account for potential regional preference differences. Usually, these variables would be included in form of interaction effects. Still, when following the approach presented in the paper, this adds severe complexity to the interpretations. This would oppose the overall objective of this kind of research, where ultimately the research outcomes should allow for a meaningful interpretation for policy makers.

Taking this conclusion regarding the third paper as a starting point, the fourth paper uses an alternative approach to the data analysis. The objective is to include sociodemographic variables in the analysis and to provide insights which require less technical knowledge and allow for more meaningful interpretations with respect to policy implications. In order to achieve this goal, the paper analyses the data by the means of a latent-class logit model (LCM) (Greene and Hensher, 2003). In the paper, four different classes were identified. The four classes can be characterized in the following way: Individuals in Class 1 prefer a moderately structured landscape with livestock presence. Compared to the other classes, the magnitudes of the preference parameters are relatively moderate, with the exception of a high preference for the implementation of a pasture protection program. Class 2 prefers a "fully" structured landscape. In contrast, individuals in Class 3 have negative preferences for livestock presence, with no clear preferences for the other considered landscape attributes. There was a similar preference pattern in Class 4 and Class 1 (only being indifferent with respect to the number of parcels). Still, for Class 1 they have higher parameter magnitudes regarding livestock presence. The model predicts that 23.5 % of the individuals belong to Class 1, 36.5 % to Class 2 and 5.5 % to Class 3. 34.5 % of the individuals are predicted to belong to Class 4. Graphical representations of most preferred attribute level combinations (based on the highest statistically significant parameter estimates) were presented to provide further intuition.

Overall, the paper finds that there are multiple groups, with different preference patterns. Still, with respect to the livestock density, there are no statistically significant differences within a group. From the perspective of agricultural production, this is a particularly interesting result. It implies that, although there are different groups, it does not matter within a group whether the livestock presence originates from extensive or intensive production systems. Further, in three out of four classes there is a general preference for the implementation of a pasture protection program. Additionally, the WTPs for the attribute levels were also calculated. They also exhibit the likely upward bias discussed with respect to the third paper.

The LCM allows for the consideration of explanatory variables in order to study influences on the predicted class assignment of an individual. In the paper, socioeconomic variables, including variables regarding the individual's residence were included. In the LCM, the effect of a variable on assignment probability is estimated. Thus, the model results indicate whether a variable has a positive or negative effect on the assignment to the different classes (in comparison to a reference class). The results show that most included variables have statistically significant effects on the class assignment. The only exceptions are the individual's gender and income. Particularly strong effects are found for the individual's environmental attitude (measured by the New-Environmental-Paradigm scale (Dunlap et al., 2000)), diet (being a vegetarian or vegan) and frequency of nature visits.

Statistically significant effects on the assignment were found for all Classes. Individuals living in larger municipalities were less likely to be in the Class 4. Similarly, individuals who report to use natural areas more frequently were more likely to be in Class 2 and 4. The participants' gender has no significant effect on the class assignment, while older individuals were more likely to either belong Class 2 or 3. Also, the household income had no statistically significant influence on the class assignment. Interestingly, individuals who reported a personal relationship with agriculture had a significantly lower probability to be indifferent regarding the landscape structuredness. They were also more likely to reject livestock in the landscape (Class 3). One potential interpretation of this finding is that, given the decreasing share of farms applying grazing practices, a negative perception of these practices in the social environment could be present. Both vegetarians and vegans were less likely to be in Class 4, which could be explained by a potentially higher skepticism towards animal production.

In order to also account for regional differences in the class prevalence, a set of dummy variables indicating the participant's federal state of residence was included in the analysis. Here the main findings are that individuals living in city states are less likely to be in Class 3 and more likely to be in Class 4. A similar pattern is found for individuals living in the area of the former German Democratic Republic, while individuals from Northern Germany are less likely to be in Class 4. People from Southern Germany are most likely to belong to Class 1. Given the different agricultural structures in the different German regions, this can interpreted such that the preference of individuals is influenced by structural differences between residencies. These results are closely linked to the found effects of the local landscape around the area of an individual's residence. Here, individuals from forest or structured landscapes are more likely to belong to one of the Classes 2, 3 or 4 than individuals living in urban agglomerations. On interpretation is that individuals living in forest or structured landscapes are more likely to have distinct landscape preferences as individuals from urban agglomerations.

Overall, these results highlight that there are different groups in the public, which exhibit severe differences in their preference patterns. Still, within a group, the preferences for livestock presence do not appear to depend on the underlying production system (at least when considering the effect on the landscape). Given the often critical assessment of agricultural policies, the results indicate that the effects of policies on the landscape should be considered on the regional or local level. In order to overcome the issue of the determination of the cost attribute, future research could consider experimental designs which allow for individual specific reference points. It would also be interesting to consider specific policy measures in an experiment. Outcomes of such an experiment could be used to inform cost-benefit analyses.

Summarizing, the four papers of the thesis contribute to the understanding of the perception and attitudes of both farmers and the public towards the land utilization of pastures and different aspects of pasture-based livestock production systems in Germany. The results provide insights for policy makers as well as individuals involved in communication with both farmers and the public (e.g. extension officers or campaigners). Each of the papers contributes to its particular body of literature and shows potential directions for future research.

References

Croissant, Y., Carlevaro, F. and Hoareau, S. (2018): *Mhurdle: Multiple Hurdle Tobit Models*. Available at: https://CRAN.R-project.org/package=mhurdle.

Davis, F. D. (1989): Perceived usefulness, perceived ease of use, and user acceptance of information technology, *MIS Quarterly*, 13(3): 319–340.

Davis, F. D., Bagozzi, R. P. and Warshaw, P. R. (1989): User acceptance of computer technology: a comparison of two theoretical models, *Management Science*, 35(8): 982–1003.

Dunlap, R. E., Van Liere, K. D., Mertig, A. G. and Jones, R. E. (2000): New Trends in Measuring Environmental Attitudes: Measuring Endorsement of the New Ecological Paradigm: A Revised NEP Scale, *Journal of Social Issues*, 56(3): 425–42. DOI: 10.1111/0022-4537.00176.

Fiebig, D. G., Keane, M. P., Louviere, J. and Wasi, N. (2010): The Generalized Multinomial Logit Model: Accounting for Scale and Coefficient Heterogeneity, *Marketing Science*, 29(3): 393–421. DOI: 10.1287/mksc.1090.0508.

Greene, W. H. and Hensher, D. A. (2003): A latent class model for discrete choice analysis: contrasts with mixed logit, *Transportation Research Part B: Methodological*, 37(8): 681–98. DOI: 10.1016/S0191-2615(02)00046-2.

Hair, J. F., Hult, G. T. M., Ringle, C. and Sarstedt, M. (2017): *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*. 2nd edn. Los Angeles: Sage Publications.

Kammann, E. E. and Wand, M. P. (2003): Geoadditive models, *Journal of the Royal Statistical Society: Series C (Applied Statistics)*, 52(1): 1–18. DOI: 10.1111/1467-9876.00385.

Kelly, E., Heanue, K., Buckley, C. and O'Gorman, C. (2015): *Proven Science versus Farmer Perception*. 229067. Available at: https://ideas.repec.org/p/ags/iaae15/229067.html.

Kjær, T. (2005): *A Review of the Discrete Choice Experiment-with Emphasis on Its Application in Health Care*. Syddansk Universitet Denmark.

McDonald, R., Heanue, K., Pierce, K. and Horan, B. (2016): Factors influencing new entrant dairy farmer's decision-making process around technology adoption, *The Journal of Agricultural Education and Extension*, 22(2): 163–77. DOI: 10.1080/1389224X.2015.1026364.

Train, K. E. (2009): *Discrete Choice Methods with Simulation*. Cambridge: Cambridge University Press.

Yen, S. T. (2005): A Multivariate Sample-Selection Model: Estimating Cigarette and Alcohol Demands with Zero Observations, *American Journal of Agricultural Economics*, 87(2): 453–66. DOI: 10.1111/j.1467-8276.2005.00734.x.

Publication list

Papers published in peer-reviewed journals

Schaak, H. and Mußhoff, O.: Public preferences for pasture landscapes in Germany – A Latent Class Analysis of a nationwide Discrete Choice Experiment. Forthcoming in *Land Use Policy*. https://doi.org/10.1016/j.landusepol.2019.104371.

Römer, U., **Schaak, H.**, Mußhoff, O. and Goudschaal, H.S. (2019): Was denkt die Agrarbranche über Pflanzenschutz wirklich? Ergebnisse eines impliziten Assoziationstests. *German Journal of Agricultural Economics 68(4), 250-262. (in German).*

Römer, U, **Schaak, H.** and Mußhoff, O. (2019): The Perception of Crop Protection: Explicit vs. Implicit Association of the Public and in Agriculture. *Journal of Environmental Psychology*, 66 (December): 101346. https://doi.org/10.1016/j.jenvp.2019.101346.

Schaak, H. and Mußhoff, O. (2018): Understanding the adoption of grazing practices in German dairy farming. *Agricultural Systems*, *165*, 230-239. https://doi.org/10.1016/j.agsy.2018.06.015.

Schaak, H. and Mußhoff, O. (2018): Grazing Adoption in Dairy Farming: A Multivariate Sample-Selection Approach. *Journal of Agricultural and Resource Economics*, *43*(2), 292-305. http://dx.doi.org/10.22004/ag.econ.273451.

Discussion papers

Schaak, H. and Mußhoff, O. (2018): Public preferences for pasture landscapes and the role of scale heterogeneity. Humboldt-Universität zu Berlin. FORLand-Working Paper 04(2018).

Papers published in conference proceedings

Pol-van Dasselaar, A. van den, Chabbi, A., Cordovil, C.M.D.S., Vliegher, A. de, Dean, M.D., Hennessy, D., Hutchings, N., Klumpp, K., Koncz, P., Kramberger, B., Price, J.P.N., Poilane, A., Richmond, R., Rocha Correa, P.F., **Schaak, H.**, Schönhart, M., Sebastià, M.T., Svoboda, P., Teixeira, R.F.M., Eekeren, N. van, Rijn and C.H. van, (2018): Grazing for carbon., in: Horan, B., Hennessy, D., O'Donovan, M., Kennedy, E., McCarthy, B., Finn, J.A., O'Brien, B. (Eds.), *Sustainable meat and milk production from grasslands. Proceedings of the 27th General Meeting of the European Grassland Federation, Cork, Ireland, 17-21 June 2018*. Teagasc, Animal & Grassland Research and Innovation Centre, Fermoy, Irish Republic, pp. 682–684.

Schaak, H., Buchholz, M., Hermann, D., Holst, G.S. and Mußhoff, O. (2017): Predictive Power of Experimental Risk Attitude Measures for Farm Diversification. In: Rickert, U., Britz, W., Bröring, S., Hartmann, M., Heckelei, T. & Holm-Müller, K. (Ed.): *Schriften der Gesellschaft für Wirtschafts- und Sozialwissenschaften des Landbaues e.V.*, Volume 52: 87-97.

Schaak, H. (2016): The Impact of Free Trade Agreements on International Agricultural Trade: A Gravity Application on the Dairy Product Trade and the ASEAN-China-FTA. In: Kühl, R., Aurbacher, J., Herrmann, R., Nuppenau E.-A., Schmitz, Michael (Ed.): *Schriften der Gesellschaft für Wirtschafts- und Sozialwissenschaften des Landbaus e.V.*, Volume 51: 181-190.

Schaak, H. and Dörschner, T. (2013): Das Planspiel "Produktion und Artenschutz?" - Ein Experiment zur Analyse des Entscheidungsverhaltens landwirtschaftlicher Betriebsleiter auf Verhaltensheuristiken. In: Clasen, M., Kersebaum, K.C., Meyer-Aurich, A., Theuvsen, B. (Hrsg.): Lecture Notes in Informations (LNI) - Proceedings. Volume 211: 295-298. *(in german).*

Conference contributions

Schaak, H and Mußhoff, O. (2019) Public preferences for livestock presence in pasture landscapes – A Latent Class Analysis of a Discrete Choice Experiment in Germany. 8th PhD Workshop of the EAAE, Uppsala, Sweden, June 10-12, 2019.

Schaak, H. and Mußhoff, O. (2019): The Relationship of Land Prices and Land Rents: Local Variation and the Effect of the Farming Structure. 165th EAAE Seminar, Berlin, Germany, April 4-5, 2019.

Schaak, H. and Mußhoff, O. (2019): Public preferences for livestock presence in pasture landscapes – Results of a discrete choice experiment in Germany. 63rd Annual Conference of the Australasian Agricultural and Resource Economics Society, Melbourne, Australia, February 12-15, 2019.

Römer, U., **Schaak, H.** and Mußhoff, O. (2019): The perception of crop protection: Explicit vs. implicit association of the public and in agriculture. 63rd Annual Conference of the Australasian Agricultural and Resource Economics Society, Melbourne, Australia, February 12-15, 2019.

Römer, U., **Schaak, H.** and Mußhoff, O. (2019): The perception of crop protection: Explicit vs. implicit association of the public and in agriculture. EAAE Seminar 168: Behavioural Perspectives in Agricultural Economics and Management, Upsalla, Sweden, February 6-7, 2019.

Schaak, H. and Mußhoff, O. (2018): Are public preferences for pasture landscapes heterogeneous? Results of a discrete choice experiment in Germany. 30th International Conference for Agricultural Economists (ICAE), Vancouver, Canada, July 28 - August 2, 2018.

Pol-van Dasselaar, A. van den, Chabbi, A., Cordovil, C.M.D.S., Vliegher, A. de, Dean, M.D., Hennessy, D., Hutchings, N., Klumpp, K., Koncz, P., Kramberger, B., Price, J.P.N., Poilane, A., Richmond, R., Rocha Correa, P.F., **Schaak, H.**, Schönhart, M., Sebastià, M.T., Svoboda, P., Teixeira, R.F.M., Eekeren, N. van and Rijn, C.H. van (2018): Grazing for carbon. 27th General Meeting of the European Grassland Federation, Cork, Ireland, June 17-21, 2018.

Römer, U., **Schaak, H.**, Mußhoff, O. and Goudschaal, H.S. (2017): True attitudes of the agricultural sector towards GM and chemical crop protection. University of Goettingen-Kyoto University Workshop on „Sustainable International Agricultural Development“, Goettingen, Germany, December 07-09, 2017.

Römer, U., **Schaak, H.**, Mußhoff, O. and Goudschaal, H.S. (2017): The public implicit attitude towards GM and synthetic pesticides for crop protection. 5th IAAE Inter-Conference Symposium, Talca, Chile, October 17-19, 2017.

Schaak, H. and Mußhoff, O. (2017): The Adoption Of Grazing In Dairy Farming – A Multivariate Sample Selection Approach. 5th IAAE Inter-Conference Symposium Agricultural Productivity, Climate Change and Sustainable Resource Management, Talca, Chile, October 17-19, 2017.

Schaak, H. and Mußhoff, O. (2017): The Adoption Of Grazing In Dairy Farming – A Multivariate Sample Selection Approach. XV Conference of the European Association of Agricultural Economists (EAAE), Parma, Italy, August 29 - September 1, 2017.

Schaak, H., Mußhoff, O. and Römer, U. (2017): Grazing decision of German farmers. 3rd International Workshop on Study of Family-run Farming, Kyoto, Japan, March 15-17, 2017.

Schaak, H. and Mußhoff, O. (2017): Behavioral drivers for grazing practices in dairy farming. 61st Annual Conference of the Australian Agricultural and Resource Economics Society, Brisbane, Australia, February 7-10, 2017.

Schaak, H., Buchholz, M., Hermann, D., Holst, G.S. and Mußhoff, O. (2016): The predictive power of experimental risk attitude measures for farm diversification. 56th Annual Meeting of the Gesellschaft für Wirtschafts- und Sozialwissenschaften des Landbaus (GEWISOLA), Bonn, Germany, September 28 - 30, 2016.

Schaak, H., Buchholz, M., Hermann, D., Holst, G.S. and Mußhoff, O. (2016): The Predictive Power of Experimental Risk Attitude Measures for Farm Diversification. 2nd Future Leaders Global Workshop on Social Science of Agriculture, Food and Environment, University of Kyoto, Kyoto, Japan, March 2016.

Schaak, H. (2015): The Impact of Free Trade Agreements on International Agricultural Trade: A Gravity Application on the Dairy Product Trade and the ASEAN-China-FTA. 55th Annual Meeting of the Gesellschaft für Wirtschafts- und Sozialwissenschaften des Landbaus (GEWISOLA), Gießen, Germany, September 23 – 25, 2015.

Schaak, H. and Dörschner, T. (2013): Das Planspiel "Produktion und Artenschutz?" - Ein Experiment zur Analyse des Entscheidungsverhaltens landwirtschaftlicher Betriebsleiter auf Verhaltensheuristiken. 33rd Annual Meeting of the Gesellschaft für Informatik in der Landwirtschaft (GIL), Potsdam, Germany, February 20-21, 2013 *(in german).*

Declaration of contribution

I hereby declare my own contribution to each paper of this dissertation in detail:

The first article (Chapter II), entitled "The adoption of grazing in dairy farming – A multivariate sample selection approach", was written in cooperation with Prof. Dr. Oliver Mußhoff. The following areas were taken over by me: Idea and development of the model; data collection in cooperation with Prof. Dr. Oliver Mußhoff; execution of the calculations, interpretation of the results and writing of the article in close cooperation with Prof. Dr. Oliver Mußhoff. Furthermore, the revision of the article was carried out in cooperation with Prof. Dr. Oliver Mußhoff.

The second article (Chapter III), entitled "Understanding the adoption of grazing practices in German dairy farming", was written in cooperation with Prof. Dr. Oliver Mußhoff. The following areas were taken over by me: Idea and conception, data collection and execution of the calculations in cooperation with Prof. Dr. Oliver Mußhoff; interpretation of the results and writing of the article in close cooperation with Prof. Dr. Oliver Mußhoff. Furthermore, the revision of the article was carried out in cooperation with Prof. Dr. Oliver Mußhoff.

The third article (Chapter IV) entitled "Public preferences for pasture landscapes and the role of scale heterogeneity", was written in cooperation with Prof. Dr. Oliver Mußhoff. The following areas were taken over by me: Idea and conception of the experiment in close cooperation of Prof. Dr. Oliver Mußhoff; data collection, execution of the calculations as well as the interpretation of the results and writing of the article in cooperation with Prof. Dr. Oliver Mußhoff.

The fourth paper (Chapter V) entitled "Public preferences for pasture landscapes in Germany – A Latent Class Analysis of a nationwide Discrete Choice Experiment", was written in cooperation with Prof. Dr. Oliver Mußhoff. The following areas were taken over by me: Idea and conception of the experiment in close cooperation of Prof. Dr. Oliver Mußhoff; data collection, execution of the calculations as well as the interpretation of the results in cooperation with Prof. Dr. Oliver Mußhoff. While writing the article, I benefited

from comments and suggestions of Prof. Dr. Oliver Mußhoff. Furthermore, the revision of the article was carried out in cooperation with Prof. Dr. Oliver Mußhoff.

Eidesstattliche Erklärungen

Hiermit erkläre ich eidesstaatlich, dass:

1. Diese Arbeit weder in gleicher noch in ähnlicher Form bereits anderen Prüfungsbehörden vorgelegen hat.
2. Ich mich an keiner anderen Hochschule um einen Doktorgrad beworben habe.

Göttingen, den 21. März 2019 _____

(Unterschrift)

Hiermit erkläre ich eidesstaatlich, dass diese Dissertation selbstständig und ohne unerlaubte Hilfe angefertigt wurde.

Göttingen, den 21. März 2019 _____

(Unterschrift)