



## **PROCEEDINGS**

*of the Joint Conference of the Slovenian Association of Agricultural Economists (DAES) and the Austrian Association of Agricultural Economists (ÖGA)*

# **Societal changes and their implications on agri-food systems and rural areas**

**22nd - 23rd September 2022**

**Ljubljana, Slovenia**



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Proceedings of the joint Conference of the  
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Economists (ÖGA)

Ljubljana, September 22 – 23, 2022

Edited by: Marija Tomšič, Ana Novak, Tanja Travnikar and Luka Juvančič



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## **Welcome to the joint conference of DAES and ÖGA at the University of Ljubljana!**

On behalf of the Local Organising team and Programme Committee, we take great pleasure in welcoming you to the joint conference of DAES and ÖGA at the Biotechnical Faculty of the University of Ljubljana. Thank you for deciding to participate at the Conference, and special thanks to those of you who provided valuable contributions to the Conference programme!

We live in turbulent times, marked by unforeseen economic (economic crisis), ecological (intense weather phenomena), health-related (Covid-19 pandemic) and geostrategic (trade and political conflicts) upheavals. Together with long-term environmental challenges and demographic trends, they are all resulting in profound and irreversible societal changes. Agri-food systems and rural areas in general are both, being affected by, and contribute towards these societal changes. Major challenges to be dealt with are changing food preferences and consumption patterns, changing agri-food production along the whole value chain, deglobalisation of agricultural trade, increasing importance of short supply chains and local food systems and the rediscovering and strengthening of economic, social and ecological resilience of rural areas.

With the theme "Societal Changes and Their Implications on Agri-Food Systems and Rural Areas", this year's joint conference takes up these important developments and offers the scientific community a wide space for discussion. We are very pleased that we succeeded in inviting two internationally broadly recognised keynote speakers, who will introduce the theme of the conference: Jutta Roosen analyses together with Larissa Drescher and Stephan Marette, the role of labels, scores and informative apps for signalling the sustainability of food, and Krijn Poppe will discuss the role of agricultural economists in policy design for the development of sustainable food systems of the future. In addition to these two plenary talks, this year's joint conference will feature 15 research forums and four workshops on various topics. More than 60 speakers will present their work in the field of agricultural economics and related scientific disciplines. In order to make it easy for the participants of the conference to select the most interesting forums and workshops, the two-page abstracts scientific contributions are compiled in this conference proceedings. All this would not have been able without committed work of the Conference Programme Committee, Local Organising Team and paper evaluators, members of DAES and ÖGA. Our warmest thanks to them!

We are looking forward to excellent presentations and an intensive scientific exchange. Needless to say, we wish you also a pleasant and exciting time at the Conference!

Dr. Luka Juvančič, Assoc. Prof.  
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Jochen Kantelhardt, Univ. Prof. Dr.  
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Doris Pick

# PLENARY SESSION



# Towards sustainability – Questions about the role of labels, scores, and informative apps for signalling the sustainability of food

Larissa S. Drescher, Stephan Marette and Jutta Roosen<sup>1</sup>

**Abstract – This paper discusses some questions related to the different possibilities of signaling food sustainability from a public economics perspective. We first insist on the recent emergence of scores and food apps for conveying information about sustainability. We show that the existence of numerous characteristics defining the sustainability of foods tends to favor a proliferation of labels, scores, and apps. This makes the involvement of public authorities hard, but necessary for conveying credible information and enabling real changes in behaviors. Labels, scores, and informative apps may improve the sustainability of food consumption, but other tools like mandatory standards and/or per-unit taxes/subsidies impacting prices appear essential for changing consumer behaviors towards the sustainability target.**

## INTRODUCTION

The sustainability of food systems appears as a central question regarding our future. The concept includes numerous dimensions related to nutrition, the environment, biodiversity, animal welfare, localness of food production, rural development, farm incomes and consumers wellbeing (Grunert, 2011). Already each of these dimensions summarizes many characteristics complexifying public choices regarding the specific characteristics to favour for improving sustainability. In this context, empowering consumers to make more responsible product choices is key to drive behavioral change, and various consumer information policies, including labels, consumer advisories, and consumer education campaigns, have been proposed. Consumers face numerous labels, scores, and informative apps supposed to help them to make informed decisions. For this paper, we consider the following definitions that will articulate the presentation. First, a label is a logo posted on the food when a set of specifications related to quality is satisfied by farmers or producers and processors. It is a binary signal of a specific quality being fulfilled. Second, a score is a rating of foods summarizing different characteristics, detailed or aggregated with a synthesized grading, and leading to various types of logos, namely “high-in” warning or recommending labels, star ratings, or traffic light labeling. Third, an informative app on smart phones allows the possible appearance of labels, scores, short or detailed information about one or several foods. The consequences of these new tools on consumers’ behaviors and markets adjustments are sometimes unknown and deserve more attention.

## SOME RECENT RESULTS AND PUBLIC DEBATES

Today, many labels are present on markets across the world for signalling various characteristics related to sustainability (Gruère, 2014). There is a context of label proliferation and a multiplication of complex issues such as the deforestation, global warming or the depletion of soil fertility requiring a synthesized information for guiding consumer choice. This explains why synthetic scores and traffic lights blossomed in OECD countries, in particular for nutrition quality. However, while in other consumer good categories, synthetic scores are quite common, alternative labels coexist to highlight various characteristics in the food market.

The debate about the scores gathering several characteristics is particularly sensitive in Europe with the Nutri-Score, which was first developed in France and expanded to other European countries like Germany. Another emblematic project is epitomized by the forthcoming Ecological Score debated in France. A decision about the selected framework will be taken soon by the Ministry of Environment (Ministère de la Transition Ecologique), based on a study conducted by the French Agency for the Environment, ADEME. Under scrutiny are 20 projects of labeling schemes that were submitted by various associations for determining which one would appear as the best system for guiding consumers. At the same time, a retail chain in Germany tested the Eco-Score as a score that aggregates various environmental impact categories into a single score, while the organic food associations favor a score that also indicates subscores on various indicators as pesticide use, biodiversity, and climate.

For consumers searching for information, these new scores can be complemented by informative apps on mobile devices. These apps blossomed everywhere in the world. In a survey conducted in France, 43% of participants declared to have an informative app on their cell phone, and 25% of participants often or always use it for inspecting the quality of products (Marette, 2022). Very few things are known about their impact on food choice and consumption and new studies are necessary to understand the impact of these apps and whether these impacts last.

## OPEN AND OVERLOOKED QUESTIONS

The idea of labels, scores, and apps is to enable consumers to an informed choice. The behavioral implications of information overload through labels, scores, and apps, however, can lead to heuristics-based decision making, in particular if information is

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presented in a form that is hard to integrate. The following lists a few questions that are important in the study for the design of labels, scores, and apps.

*Which characteristics to integrate?*

The optimal number of characteristics to consider in a sustainability label, score, or app is challenging. This question is particularly salient with the issue of deforestation that is acute when tackling environmental problems coming from palm oil in Asia, soybean in South America and cocoa in Africa. Two popular labels employed in many countries, namely the fair trade and the organic labels, do not include criteria concerning deforestation. As a result, either the fair trade and organic label would be able to evolve for integrating “zero deforestation” criteria, or it will be necessary to use an additional label dedicated to this sensitive question. This last option is likely to increase confusion in the signals sent to consumers.

A similar problem arises for the new scores trying to go beyond the nutrition aspect of food. With the possible new ecological score, Marette (2022) suggests a smaller impact compared to the existing nutrition score.

*Controversies in the ranking of characteristics*

Various studies have shown the existence of consumer segments that differ in their evaluation of sustainability aspects in food production (Waldrop and Roosen, 2020). The prioritization between the different characteristics could be controversial and hard to disentangle, depending on the agricultural system that is targeted. For example, the Planet-Score proposal characterizes the consumption of beef from extensive farming practices more favorably than the Eco-Score project does. This also means that the same product coming from different production systems will be labelled differently. These contradictions between characteristics are particularly sensitive with local food that may or may not be sustainable.

*Lack of clarity about trade-offs for combinatory scores*

Given the development of new scores combining more than one characteristic, such as nutritional and ecological aspects, it remains unclear how consumers would trade-off between these characteristics. Consumers often form a halo around positive food attributes with healthy foods being perceived as safe and sustainable, and often, these properties are associated to natural foods.

*The scores: complements or substitutes with classical sustainable labels*

The relationship between scores and existing sustainability labels needs to be clarified. Janßen and Langen (2017) indicate that it is unclear whether different sustainability aspects on labels complement or substitute each other. While a coexistence may allow for individual trade-offs by consumers, it may also lead to more confusion and frustration. An interesting example is the Nutri-Score that qualifies many traditional geographic indications, i. e., cheeses

and meats) as poor in nutritional quality (e. g., high salt content).

*Apps tend to fragment the preferences of consumers*  
Different informative apps based on different criteria will create very heterogeneous consumers, fragmenting the market and complexifying choice. Apps might create many different niche markets which could be a chance for small-scale companies. It can also lead to new market entry barriers.

*The rebound effect*

The existence of sustainability scores and apps may yield a paradoxical result due to a licencing effect in that consumers consume more of a more sustainable product, in the end causing a negative impact.

*Strategic adjustments*

Scores may lead food processors to reformulate the food recipes to assure that their products get a better label color. Threshold effects need to be acknowledged in the design of the scores and apps. In addition, a score on all products would shift the information environment not only for consumers but also for firms, creating a new strategic dimension. For example, a French retailer has recently developed a recommendation algorithm that offers to customers on its webstore alternative products, healthier and more ecological, to those they have already chosen and offer the option to replace their initial choices in their e-basket. Regarding public policies, the ranking of products may help to design policies that improve the sustainability of the food system in an efficient way (Marette et al., 2019).

CONCLUSION

Given the importance of sustainability on the policy agenda, the food label environment is changing. As labels can serve as informative nudges, it is easy to inform or to bias consumers into more sustainable food choices. The integration of different dimensions should be informed by the ecological and economic trade-offs. Also, existing labels will have to adjust their standards to take this new dimension into account.

REFERENCES

- Gruère, G.P. (2014). An Analysis of the Growth in Environmental Labelling and Information Schemes. *Journal of Consumer Policy* 38(1):1-18.
- Grunert, K. G. (2011). Sustainability in the Food Sector: A Consumer Behaviour Perspective. *International Journal on Food System Dynamics* 2(3):207-218.
- Janßen, D. and Langen, N. (2017). The bunch of sustainability labels - Do consumers differentiate? *J. Clean. Prod.* 143:1233-1245.
- Marette, S. (2022). Ecological and/or Nutritional Scores for Food Traffic-Lights: Results of an Online Survey Conducted on Pizza in France. *Sustainability*, 14(1):247.
- Marette, S., Nabec, L. and Durieux, F. (2019). Improving Nutritional Quality of Consumers' Food Purchases with Traffic-Lights Labels: An Experimental Analysis. *Journal of Consumer Policy* 42: 377-395.
- Waldrop, M.E. and Roosen, J. (2021). Consumer acceptance and willingness to pay for cow housing systems in eight European countries. *Q Open* 1:1-18.

# Sustainable Food Systems and the Role of the Agricultural Economist in Policy Design

Krijn J. Poppe<sup>1</sup>

**Abstract** – I discuss the role of agricultural economists in policy design by presenting the case of the framework law on sustainable food systems. The European Commission is working on that framework law, and a group of experts of the EEAC has prepared a policy advise on its content.

Such a proposal for a law is an artifact created by humans. Design thinking (aka design science) supports the creative process of delivering artifacts. This process is illustrated for three stages in design

thinking: problem framing, design principles and solution thinking. Co-evolution of problem framing and later stages is common in addressing wicked problems. Agricultural economists focus on studies of human behaviour and evaluation of policy proposals. This paper argues that the tool box can be enriched with scientific methods from design thinking to better contribute to the policy design processes in times of change.

member states' councils on sustainable development. Due to the Covid-19 situation all meetings were carried out online, with the exception of one meeting with stakeholders in Brussels. This hampered the use of creative tools, but was nevertheless a seamless process.

## INTRODUCTION

We live in a challenging time. Covid-19 still troubles supply chains. The Russian invasion in Ukraine has led to turbulence in markets for energy, fertilizer and food. Climate change threatens harvests and biodiversity. It all aggravates the debate on our future: are we at a tipping point to take bold actions for a more sustainable world, or should we scale back ambitions?

In this address I would like to discuss the role of agricultural economists in this debate and make the point that we should not only explain human behaviour and evaluate policy proposals but also actively contribute to the design of food system policies.

## DESIGN THINKING AS A METHOD

Agricultural economics develops over time. 'As a quasi-discipline agricultural economics should be reoriented to the grand challenges that require a food systems approach and consolidate its institutional strengths. [...] Food system economists should not only analyse but also design food systems at those levels.' (Fresco et al, 2021).

Design thinking tries to extend the boundaries of human and organizational capabilities by creating new and innovative artifacts. Artifacts are often material products but can also be software, a service or a new business concept. A policy(proposal) is also man-made and can be seen as an artifact that is designed.

In the next sections I illustrate the use of design thinking in three steps: Problem framing, design principles and solution thinking. The wicked problem to which this design thinking is applied are the grand challenges in the European food system and the proposal of the EU Commission to tackle these with a Framework law on sustainable food systems. This framework law is seen as the artifact that has to be created, and to which the advise the EEAC hopes to contribute (EEAC, forthcoming).

The work was carried out between October 2021 and June 2022 with an ad-hoc group of experts from the

## PROBLEM FRAMING

It is typical for wicked problems that they are socially complex with incomplete, contradictory, and changing requirements that are often difficult to recognize. Stakeholders typically do not agree on the problem description and they debate the problem and solutions based on different data, and with different interests and values (OECD, 2021). In such policy controversies the interaction between facts, interests and values makes the right framing a policy problem difficult, but also very important and part of the solution.

For our EEAC advise we could build upon literature that set out the sustainability issues in the food sector, calls for a systemic food system policy and some national work from advisory council but there is a lack of interesting designs for such a policy.

Discussing market imperfections and potential solutions we reformulated the problem as the need to redirect innovation from ever lower prices towards internalisation of external costs. This raises the issue of access to food for those with low incomes. We therefor designed a governance model for the food system in which social policies (income policy, minimum wages) are part of the solution space, and the problem of food access is treated as an income problem instead of a price problem.

Part of these discussions took place during the next stages of the design process, when design principles and solutions were discussed. In my experience this is characteristic in the design of a policy that has to address a wicked problem.

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#### DESIGN PRINCIPLES

Between problem framing and solution thinking it is useful to think about design principles. Although this might reduce the solution space, it can also help in thinking about ideas that might be part of the solution. It also helps a team to evaluate different proposed solutions. Design principles for the solution can also be seen as the pre-amble of a law and the considerations that have to be taken into account when the law is applied to create more detailed regulation with policy instruments.

Article 39 of the Treaty of the Functioning of the EU, that is the basis for the Common Agricultural Policy, was used as an example to come forward with a core for a Framework Law on Sustainable Food Systems (Box 1).

**Box 1.** *General principles for a Framework law for sustainable food systems (as developed in EEAC, forthcoming).*

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To guarantee a resilient European food system that ensures sustainable diets with low environmental and ethical impacts that contribute to food and nutrition security and to a healthy life for present and future generations by enabling that

1. healthy, sustainable diets are available for all European consumers at prices that reflect their true cost in coherence with 'the polluter pays' principle.
  2. food is produced in adequate quantities, with processes that result in environmental and ethical performance that is as best as reasonably achievable and regenerate climate-resilient, healthy agro-systems.
  3. the food system works as inclusively as possible and relations between food chain actors are balanced which results in livelihoods with fair incomes and working conditions for farmers and workers.
  4. new technologies are developed and best available technologies in relation to climate change and ecosystem services are promoted, respecting the precautionary principle.
- 

#### SOLUTION THINKING IN THE POLICY DESIGN

Ideation is a term often used in design thinking to come up with innovative artifacts. This is a stage where much creativity can be applied. Experience helps as well as a mental or more explicit model on how (in our case) the food system works, where there are promising new developments and where there are bottlenecks in innovation. Benchmarking with other sectors can also be inspirational. A sense of what is politically feasible also helps to come up with realistic policy advice.

I discuss important solutions that we present in the EEAC advise, as well as 2 suggestions on monitoring and governance. Benchmarking with other sectors led to the solution to treat where possible agriculture and the other actors in the food system in the same way as normal businesses. More than 90% of the agricultural production comes from producers that have a bank account, and can be treated as normal small and medium sized business. A similar reflection on the structure of the agricultural sector is behind the idea of certification. This is built upon the trend towards dedicated supply chains. Benchmarking with

the energy transition let to the solution to oblige first stage food processors (dairy companies, slaughterhouses) to blend sustainable products into mainstream flows. This gives more sustainable farms a better position in the land market. It also incentivises food companies to promote these more sustainable products. The big advantage of a certification and blending instrument over an ETS-like system or other economic instruments on inputs or emissions at farm level, is that it directly supports the income of more sustainable farmers.

Old instruments like the FADN could be refit for new purposes in a Farm Sustainability Data Network (Poppe and Vrolijk, 2018). That is a fourth result of our solution thinking and an example of how knowledge of the past could inspire solutions.

#### REFLECTION AND CONCLUSION

Agricultural economists should not restrict themselves to the evaluation of proposals for a food system policy but actively contribute to its design. We do not have many tools in our toolbox to do this in a scientific mode. This is problematic. For a researcher active in such design, it leads to a risk of be seen as a political activist instead of scientific researcher. It also makes such work hard to publish which discourages the activity and leads to less quality control.

Against this background this paper offered an approach from design thinking. As such it is only a first attempt. The process of creating the EEAC advise was not explicitly set up as an example for a design exercise, the authors are not experts in it and the Covid-19 situation prevented the use of creative techniques in online sessions. Nevertheless, the explicit attention to problem framing, design principles and solution thinking proved to be useful and lead to – we think – interesting suggestions for a framework law on sustainable food systems.

My conclusion is therefor that the profession of agricultural economists could do itself and the world a favour by further exploring the path of design thinking in the discipline and enrich the toolbox.

#### REFERENCES

- EEAC (forthcoming in 2022): *Towards a sustainable food system: a policy brief on the framework law*. Brussels
- Fresco, L.O., F. Geerling-Eiff, A.C. Hoes, L. van Wassenaeer, K.J. Poppe and J.G.A.J. van der Vorst (2021): *Sustainable food systems: do agricultural economists have a role?* in: *European Review of Agricultural Economics* Vol 48(4) pp. 1–25.
- OECD (2021) *Making Better Policies for Food Systems*, Paris.
- [see also a longer version of this paper]

# PARALLEL SESSION 1

# AGRICULTURAL

# POLICY



# Evaluation framework for the CAP's agri-environmental knowledge transfer measures

Ana Novak, Luka Juvančič and Tanja Šumrada

**Abstract-** The research paper aims to contribute to the efforts for a more results-oriented (and thus better-performing) CAP in the policy area, which is currently underperforming. We developed a novel evaluation framework for the knowledge transfer activities in the field of agri-environment. Furthermore, we tested two new survey instruments on the case of the Slovenian Rural Development Programme in 2022. In contrast to the diversified and structured evaluation system of CAP's measures in other fields, the evaluation framework for knowledge transfer is surprisingly weak and needs further improvement. The critical challenge is the need for the impartial, continuous and long-term collection of data.

## INTRODUCTION

In the European Union (EU), knowledge transfer is promoted by various measures under the Common Agricultural Policy (CAP), which enable farmers to access information and knowledge through a diverse set of extension activities (ENRD, 2019). Unlike the more exposed and financially extensive CAP interventions, such as investments and agri-environmental-climate measure (AECM), the methodology for evaluating instruments promoting knowledge transfer is relatively weakly defined (SCAR 2019). This is especially true at the level of results and impact indicators, which enable the most in-depth assessment of the measures' effectiveness (ECA, 2017). However, the effectiveness of different approaches to knowledge transfer remains relatively poorly researched in the scientific literature as well (Faure et al., 2012).

Improvement of the evaluation framework is an important priority of the CAP after 2022, since policy-makers envisaged strengthening of its performance and reorientation towards a more result-oriented policy (EC, 2017). The aim of this contribution is to develop a novel rigorous, yet flexible evaluation framework and a set of performance indicators in the field of knowledge transfer. Furthermore, new survey instruments for assessing results and impacts of agri-environmental knowledge transfer were developed and tested on the case of Slovenian agricultural policy.

## METHODOLOGICAL APPROACH

Public policy often evolves in a cyclical manner, which can be divided into a series of stages: definition of areas of action, design, legitimation, implementation and evaluation (Cairney, 2019). In the EU programmes, evaluation of interventions, which is necessary for providing feedback in the next policy cycle, uses a three-level indicator hierarchy. The first level includes output indicators that assess activities and direct products of interventions. The result indicators are used to assess immediate results of interventions, whereas the impact indicators evaluate their long-term effects (Figure 1) (EC, 2017).

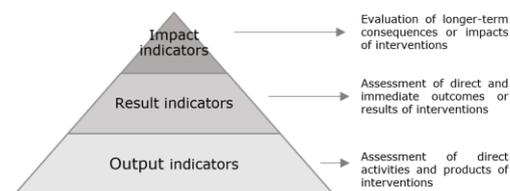


Figure 1. Hierarchy of evaluation indicators within the EU's Common agricultural policy (EC, 2017)

In this study, the design of the output indicators was based on the EU Guidelines for the preparation of national CAP strategic plans in the programming period 2020-27, and on the existing monitoring and evaluation framework for the programming period 2014-2020 (EC, 2017). The draft was checked and verified through two stakeholders' workshops with the representatives of the Slovenian Public Agricultural Advisory Service and the Ministry of Agriculture.

Next, we designed a survey instrument for evaluating immediate results of agricultural extension (i.e. satisfaction of participants with the received training) and a survey instrument for long-term impacts of knowledge transfer on farmers' knowledge, attitudes and behaviour. We selected statements for measuring relevant constructs in the literature. The selection of constructs was based on the Theory of Planned Behaviour (TPB) (Ajzen 1991), which has proven to be a useful conceptual and methodological framework in educational and behavioural research (Mark et al., 2011) and is often used to explain decision-making process and behaviour of farmers (e.g. Rezaei idr. 2019). In addition to TPB, we supplemented the questionnaires with constructs that are important for evaluating the knowledge transfer measures. In the case of result indicators, we used constructs such as the satisfaction with the training content, organisation and implementation (Gopal et al., 2021). In the impact indicators' questionnaire, we added a section for testing the farmers' knowledge of agri-environmental issues.

Survey instruments for both results and impact indicators were validated on four focus groups with 6 agricultural economic and policy experts and 5 extension officers. They were also piloted on a sample of 29 and 15 farmers, respectively. A 7-point Likert-type scale was used for the assessment of individual statements, ranging from strongly disagree (= 1) to strongly agree (= 7). The final and aggregated assessment for the indicators was formulated as the median of the individual responses within one construct.

Pilot application of a survey instrument for result indicators was performed on the case of annual training for farmers enrolled in the AECM and Organic farming. A total of 2,873 farmers responded to the online survey, of which 2,467 were considered in the analysis. The survey for the impact indicators was conducted face-to-face with 305 farmers. Data collection took place in spring 2022.

PILOT APPLICATION OF THE EVALUATION FRAMEWORK

*Output indicators*

Output indicators consist of five sets relating to (1) public expenditure for knowledge transfer activities; (2) the number of extension officers and their training; (3) the number of publications, website visitors, posts and reach on social media and publication media related to agri-environmental issues; (4) the number of activities and the number of participants by type of knowledge transfer activity; and (5) the number of other supported knowledge-transfer activities (e.g. communication and EIP projects). The proposed indicators should be monitored annually and mostly remain within the scope of current reporting for the CAP monitoring purposes.

*Result and impact indicators*

The result and impact indicators are aggregated from the constructs and statements in the survey instruments. Result indicators consisted of the farmers' aggregated assessment of the overall satisfaction with the training (based on 7 statements) and the satisfaction with specific aspects of the training (moderator, organisation and content) (Table 1). In addition, an aggregation of 5 statements was used to assess attitude towards knowledge transfer activities, of 4 statements for social norms regarding agri-environmental knowledge acquisition, and of 4 statements for farmer's availability to attend the training. Finally, 4 statements were used to assess farmers' intention for further participation in such training programmes.

**Table 1.** Aggregated estimation of the result indicators measuring farmers' satisfaction with agri-environmental and organic farming training in spring 2022 (n=2,467)

Indicator	Scale	Trial results
Overall satisfaction		6
Quality of moderator		6
Design and organisation		7
Content	1-7	4
Attitude		7
Social norm		6
Ability to attend		6
Intention for further participat.		6.5

A total of 34 statements were utilised to estimate impact indicators (Table 2). Farmers' knowledge of nature conservation and agri-environmental policy was assessed with 10 multiple choice questions. Farmers' attitude was aggregated based on 9 statements, social norms on 7 and perceived control regarding nature protection and implementation of agri-environmental practices on their farms on 7 statements. To monitor behavioural change, 12 statements on farmers' intentions to implement various nature conservation agricultural practices were added, and four on their intention to participate in agri-environmental measures.

CONCLUSIONS

The developed evaluation framework strives for a comprehensive and meaningful evaluation of CAP measures for agri-environmental knowledge transfer. A framework with relatively simple quantitative data collection can provide a basis for planning short-term changes in the knowledge transfer system in the agri-environmental field, such as the organisation of different approaches and methods of knowledge transfer. At the same time, it provides insight into longer-term needs, which need to be addressed in the planning of CAP measures and other activities, such as the requirements and needs of the agricultural

advisory service. The framework and developed survey instruments are flexible and can be used to evaluate the knowledge transfer measures on other agriculture topics, e.g. digitalisation and farm management. The critical challenge of this framework is the need for the impartial, continuous and long-term collection of data.

**Table 2.** Aggregated estimation of the impact indicator, measuring farmers' knowledge, attitude and behavioural intention in the field of agri-environment in 2022 (n=305)

Indicator	Scale	Trial results
Knowledge	1-10	5
Attitude		7
Social norm		6
Perceived control		5
<i>Intention:</i>		
Participation in AEMs		2.5
Knowledge acquisition	1-7	5
Agri-environmental practices:		5
• arable land biodiversity		3.5
• grassland biodiversity		5
• landscape features		5
• direct conservation action		7
Valorisation of biodiversity		5

ACKNOWLEDGEMENT

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REFERENCES

Ajzen, I. (1991). The Theory of Planned Behavior. *Organisational Behavior and Human Decision Processes* 50(2):179–211.

Cairney, P. (2019). *Understanding Public Policy: Theories and Issues, 2nd ed.* London: Red Globe.

EC. (2017). *Technical handbook on the CMEF of the CAP 2014-20.* Luxembourg: Publications Office of the European Union.

ECA. (2017). *Special report No 16/2017: Rural Development Programming; less complexity and more focus on results needed.* Luxembourg: ECA.

ENRD. (2019). RDP analysis: Support to environment & climate change - M01 & M02: Knowledge transfer & Advisory services. Brussels: ENRD.

Faure, G., Yann, D. and Gasselin, P. (2012). New Challenges in Agricultural Advisory Services from a Research Perspective: A Literature Review, Synthesis and Research Agenda. *The Journal of Agricultural Education and Extension* 18(5):461–92.

Gopal, R., Varsha, S. and Aggarwal, A. (2021). Impact of Online Classes on the Satisfaction and Performance of Students during the Pandemic Period of COVID 19. *Education and Information Technologies* 26(6):6923–47.

Mark, M.M., Stewart, I.D. and Campbell, B. (2011). *Social Psychology and Evaluation.* New Yor: Guilford.

Rezaei, R., Safa, L., Damalas, C.A. and Ganjkanloo, M.M. (2019). Drivers of farmers' intention to use integrated pest management: Integrating theory of planned behavior and norm activation model. *Journal of Environmental Management* 236:328–39.

SCAR. (2019). *Preparing for future AKIS in Europe.* Brussels: European Commission

# How does North Macedonia's agricultural policy support adhere to the EU CAP?

Aleksandra Martinovska Stojcheska, Ana Kotevska, Ivana Janeska Stamenkovska and  
Dragi Dimitrievski<sup>1</sup>

**Abstract** -This paper presents the recent development of agricultural policy support in North Macedonia in the context of the EU approximation process. The applied conceptual framework focuses on the key principles of agricultural policy harmonization with the EU CAP. The Agricultural Policy Measures Classification (APMC) tool is used to obtain a detailed understanding of the structure and level of the existing support (and comparison with Western Balkan countries and the EU CAP). The results show an increasing trend in total budgetary transfers to the agricultural sector. Agricultural support is composed mostly of coupled direct payments and on-farm investment support, whereas the support for environmental and other societal benefits has minor representation. While largely committed to adhere to the CAP in future, the agricultural policy actually implemented diverges from the declared planning, reflecting domestic interests.

## INTRODUCTION

The European perspective of North Macedonia sets out the basic direction of the country's agricultural and rural development policy and as such has influenced the country's legal, administrative and institutional set-up, as well as its strategic orientation, which tends to align with the EU Common Agricultural Policy (CAP). North Macedonia has developed strategic goals and priorities continually aligned with the EU's CAP, with a functional operative framework.

## METHODS AND DATA

The conceptual framework applied builds along the six key principles underlining the EU's agricultural policy priorities (Erjavec et al., 2021): strategic policy framework; size and allocation of financial resources; direct producer support; measures to improve competitiveness; policy for sustainability and public goods provision by the farming sector; and quality of life and employment in rural areas. These principles contain the CAP broad priorities which the acceding countries are expected to follow in order to align their agricultural policies with the EU. The framework allows for qualitative and quantitative assessment of national policy, as well as its harmonisation with the CAP. The quantitative analysis is performed using the Agricultural Policy Measures Classification (APMC) tool developed in Rednak, Volk, and Erjavec (2013). The APMC allows to gain a detailed understanding of national agricultural policy and enables a cross-country comparison with other Western Balkan (WB) countries and the EU. The information available in APMC were primarily collected from the paying agency and supplemented with additional information from official statistics, policy documents, governmental budgetary plans, research studies and personal communications with government officials. The APMC contains information going back to 2010; however, we focus mainly on the period 2017-2019.

## RESULTS

**Strategic policy framework.** The strategic policy framework is well established. Key administrative capacities to implement the agricultural policy are largely established, still, they are constrained by the limited resources allocated relative to the needs. Regarding policy monitoring and evaluation, further functionality is underway with general improvement of IACS, the farm register and LPIS, and FADN is being upgraded. There is a still a requirement for stronger management and control systems, as the existing systems lack data quality and relevance owing to insufficient resources to maintain them. The use of analytical support for policy formulation and implementation is modest and carried out *ad hoc*. Overall, North Macedonia can be considered to be in the initial to medium stages for establishing the strategic policy framework.

**Financial resources size and allocation.** North Macedonia's agricultural and rural development policy budgetary transfers are gradually increasing over the past decade and reach close to EUR 150 million annually in average for the period 2017-2019 (Figure 1). North Macedonia's support is among the highest in the region, especially when assigned per area (111 EUR/ha, compared to EUR 32 and EUR 39/ha in Albania and Bosnia and Herzegovina, respectively, to EUR 150/ha in Kosovo) or per inhabitant (68 EUR/capita, in the other countries ranging from 13 in Albania up to 39 EUR/capita in Serbia). Total support is still far below the EU average (344 EUR/ha, and 120 EUR/capita). First pillar measures are somewhat higher represented than in the EU (85% in North Macedonia as to 78% EU average) and at comparable level with Bosnia and Herzegovina, and Serbia.

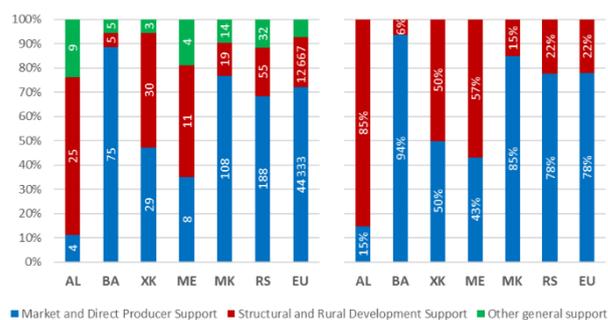


Figure 1. Total budgetary support (% and million EUR; left) and ratio of market and direct producer support to structural and rural development support (right) (2017-2019)

**Direct producer support** is the most prevalent of the first pillar measures in pre-accession countries; in North Macedonia it accounts for almost all first pillar payments. Dominant support measure are the coupled direct payments; payments per output (per unit of agricultural product) take about 40% and payments based on capacity (per area of agricultural

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land or per head of livestock) take about 60%. Two thirds of direct payments are spent on crop commodities, with tobacco the main single supported commodity, followed by vineyards and arable crops. Decoupled payments, which constitute the main type of direct payment measure in the EU, are not incorporated in the agricultural policies in North Macedonia, similar to the other WB countries.

**Measures to improve competitiveness** within the agricultural sector are the most dominant instruments within the second pillar – structural and rural development support – in the WB countries and North Macedonia likewise. The amount allocated however varies throughout the years (EUR 7.3 million in 2017, EUR 8.6 million in 2018 and EUR 23.6 million in 2019) (Figure 2). The implementation of pre-accession IPARD funds, although modest in budget (2.4%), contribute to the development of the administration for implementing the national policy.

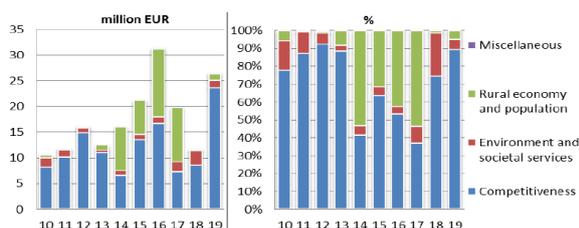


Figure 2. Structural and rural development measures

**Policy for sustainability and public goods provision** by the farming sector is represented with 11% of the total support for structural and rural development, which is the highest proportion when compared to other WB countries. Still, this is modest in EU terms where environmental support accounts for more than half of second pillar support. Within agri-environmental support, organic farming makes up the largest proportion (from 75% in 2017 to 100% in 2019).

**Quality of life and employment** measures include developing rural infrastructures, social services, village renewal, diversified activities and local development strategies. The amount of resources allocated to support for the rural economy and population accounts for about 20% of the second pillar, with large variations across years.

#### DISCUSSION AND CONCLUSION

The agricultural policy developments in North Macedonia, comparable to other WB countries, suggest commitment to adhere to the sustainable policy model of the CAP as declared in the medium and long-term agricultural policy strategic planning. The uncertain date of EU accession, and the changing nature of the CAP, lead to a situation where the agricultural policy design resembles to the CAP requirements, which is strictly required for accession into the EU. In practice, that does not necessarily reflect an optimal policy choice from a domestic perspective. The actual implementation of agricultural policies is almost exclusively with sectorial focus and production-oriented support, in the forms of coupled direct payments and on-farm investment support. Adapting direct producer support is the most politically sensitive area of agricultural policy, as it is currently its largest component. It involves providing a significant amount of support to the farming sector, which can have substantial implications for distributional income across sectors and farm types. Upon accession, candidate countries are expected to modify their producer support system shifting to CAP-style support (Erjavec et al., 2021). The direct

support granted to primary agricultural producers significantly departs from the EU decoupled model, where payments are linked to capacity, but do not require specific production, or production at all. Some cross-compliance measures are in place, though their scope needs to be further expanded to approximate more closely to the EU's CAP. Frequent changes in measures and allocated funds cause a rather unstable policy environment for both the agricultural sector and rural communities. Another important difference between EU's CAP and North Macedonia's policy, and the other WB countries for that matter, is the composition of structural and rural development support. Given the structural deficiencies of the sector, with dominant small, often semi-subsistent farms, combined with their low productivity, results in targeting support to improving competitiveness. That leaves modest allocations to measures for promoting quality of life and employment in rural areas. The need for enhancing this policy is validated by the issues that rural areas suffer from such as depopulation, lack of employment opportunities, underinvestment in infrastructure and social services. Even less support is dedicated to promoting the delivery of environmental and agricultural public goods. In contrast, the composition of structural and rural development support is reverse in the EU's CAP, where environmental orientation is most emphasised.

An additional major challenge, related to the alignment of the agricultural policies with the EU is linked to capacity building and the institutional set-up in the public administration responsible for managing and implementing agricultural support. Functioning administrative, financial, control and information systems are key prerequisites for designing, enforcing and implementing agricultural policies. The implementation of the IPARD programme significantly contributes to the preparation and development of the capacities in this direction.

#### ACKNOWLEDGEMENT

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#### REFERENCES

- Erjavec, E., Volk, T., Rednak, M., Ciaian, P., & Lazdinis, M. (2021). Agricultural policies and European Union accession processes in the Western Balkans: aspirations versus reality. *Eurasian Geography and Economics*, 62(1): 46-75.
- Martinovska Stojcheska, A., Kotevska, A., Stamenkovska, I.J., Dimitrievski, D., Zhllima, E., Vaško, Ž., Bajramović, S., Kerolli-Mustafa, M., Spahić, M., Kovacević, V., Ali Koç, A., and Ciaian, P. (2021). *Recent agricultural policy developments in the context of the EU approximation process in the pre-accession countries*. EUR 30687 EN, Luxembourg: Publications Office of the European Union, 139 p.
- Rednak, M., Volk, T. and Erjavec, E. (2013), A tool for uniform classification and analyses of budgetary support to agriculture for the EU accession countries' *Agricultural Economics Review*, 14(1): 76-96.

# Knowledge deficits and challenges for climate action in Austrian agriculture: The Key Policy Questions

Elisabeth Jost, Martin Schönhart, Franz Sinabell and Erwin Schmid<sup>1</sup>

**Abstract** –The Austrian agricultural sector is stipulated with the European Union’s target for climate neutrality by 2050. Furthermore, the Common Agricultural Policy (CAP) is currently under reform. Hence, we explore the prevalent knowledge deficits and challenges for national policymakers, farmers and scientists. We draw from the outputs of an online survey and a successive workshop with experts involved in national climate and agricultural policy-making. The aim was to identify and prioritise Key Policy Questions (KPQs) associated with policy measures and targets for climate action in Austrian agriculture. Research findings illustrate the challenges for increasing acceptance and knowledge transfer among the different societal spheres. Overall, the KPQ with respect to the effectiveness of the current CAP strategic plan and whether the therein proposed measures suffice to attain the targets is seen most pressing for the experts. Secondly, experts also highlighted the KPQ with respect to certification and monitoring in context of the European Commission’s plan to combine the forestry and agriculture sectors for greenhouse gas emissions accounting. The derived KPQs mirror well the currently ongoing policy processes and debates.

## INTRODUCTION

Within its recently passed climate legislation, the European Union’s (EU) member states have committed to reach climate neutrality by 2050. In July 2021, the European Commission further presented the “fit for 55” package. Including 12 legislative proposals, this package aims to lead the way towards the 2030 interim goal to reduce the EU’s greenhouse gas (GHG) emissions by 55% compared to 1990. One of these proposals aims for amending the current Land Use, Land Use Change and Forestry Regulation. Accordingly, the agriculture and forestry sectors shall be combined into a joint land sector for purposes of GHG emissions accounting. The regulation foresees climate neutrality obligations for the newly created land sector by 2035 and sets a yearly carbon sequestration target of 310 million tons of CO<sub>2</sub> equivalents in the EU. These ambitions together with the current ongoing reform of the Common Agricultural Policy (CAP) challenges national policymakers with an urgent need for climate action framed by other challenges, perceived lock-ins and knowledge deficits.

We build on the results of a survey and a successive workshop with experts of the agricultural sector in Austria. Our research reveals the most

pressing Key Policy Questions (KPQs) in the field of climate change mitigation and adaptation in the Austrian agricultural sector. This serves the scientific community and funding agencies to better target their activities towards increasing impact and relevance, to create a comprehensive research agenda, and to foster science-policy interaction (cf. Turnheim et al., 2020).

## MATERIAL AND METHODS

In December 2021, we conducted an online survey among 40 experts from ten Austrian organisations involved in climate and agricultural policy-making. Using a questionnaire, we aimed to gather information regarding the most important challenges and associated knowledge deficits with respect to the suite of existing and envisaged legislative and regulatory frameworks for climate action in Austrian agriculture. The experts could choose from 16 policy documents related to Austria to formulate their perceived knowledge deficits and important challenges associated with measures and targets for climate action raised in the individual policy documents. The experts were asked to answer from the perspective of farmers, policymakers and scientists, respectively. The online survey yielded 350 responses given by a total of 38 experts. The survey analysis was conducted following the principles of Mayring’s qualitative content analysis (Mayring, 2015). The survey data was analysed with a developed inductive category system. The derived categories, assigned to each response in the questionnaire, were then synthesised and translated into eight overarching KPQs. Survey results were used as input for an online workshop with the same experts on December 14th 2021. During the workshop, experts were again confronted with the suite of responses given in the online-survey and asked to prioritise by voting for a maximum of three of all the previously given answers. This research design enabled the formulation and prioritisation of KPQs expressed by the experts.

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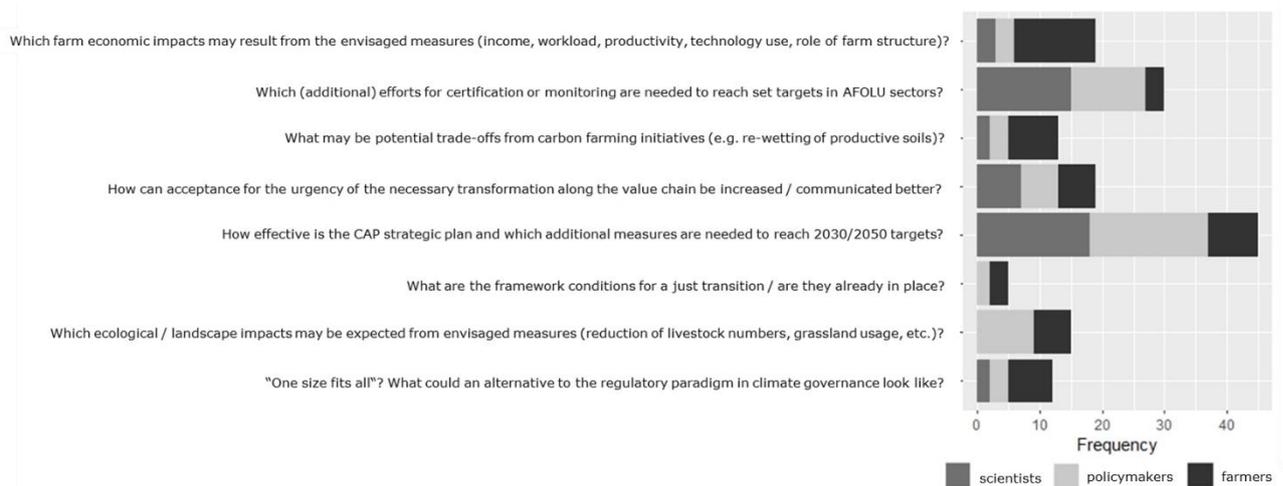


Figure 1. Key Policy Questions (KPQs) from three perspectives (scientists, policymakers, farmers): Bars indicate the number of votes given to each KPQ by the experts.

## RESULTS

Survey answers about the specific knowledge deficits prevalent in relation to climate policy targets, depict different thematic foci and perspectives. Arguing from the farmers' perspective, experts mentioned a perceived lack of site-specific best-practice recommendations for mitigation and adaptation measures as well as uncertainty regarding funding and practicability of proposed measures. Arguing from the perspective of scientists, experts mentioned improved data availability and information flows to close a persistent gap in efficiency assessments for the proposed mitigation and adaptation measures. Arguing from the policymakers' perspective, experts mentioned knowledge deficits about potential interactions and trade-offs among the different policies.

In terms of the greatest challenges associated with imposed measures for climate action, the experts highlighted potential losses of income and higher workloads by arguing from the farmers' perspective. From the scientists' perspective, experts highlighted challenges associated with good and effective knowledge transfer. From the policymakers' perspective, experts identified the key challenge of creating acceptance for the envisaged measures among the relevant societal spheres and stakeholder groups.

The synthesis of the results yielded in eight KPQs, which were prioritised by the experts in the workshop (Fig. 1). We see that highest priority from a farmers' perspective was put on KPQ "Which farm economic impacts may result from the envisaged measures?". From a scientists' and policymakers' perspective, the prioritised KPQ is "How effective is the CAP strategic plan and which additional measures are needed to reach 2030/2050 targets?". This KPQ with a total number of votes of 45 is the most pressing according to the experts. Second most important KPQ is "Which (additional) efforts for certification and monitoring are needed to reach set targets in the sectors of agriculture, forestry, and other land use?".

## DISCUSSION AND CONCLUSIONS

The resulting KPQs represent well the currently ongoing policy processes and debates. The research was conducted at the same time as the national strategic plan for the CAP was being finalised. The given policymakers' perspective corresponds well to Plank et al. (2021), who state that policymakers' inaction regarding climate policy implementation are due to unpopularity of measures and that new communication formats are needed to bridge policymakers' knowledge gaps. Concerning the robustness of produced results, we are aware that derived KPQs may not fully cover the range of farmers', policymakers' and scientists' perspectives in the Austrian agricultural sector. However, we are confident that the group of experts was able to address and prioritise KPQs acknowledging different perspectives. These research results, especially the two most highlighted KPQs, will drive our subsequent research activities over the remaining MACSUR SciPol Pilot project period. We expect that this will increase impact and relevance of conducted research.

## ACKNOWLEDGEMENT

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## REFERENCES

- Mayring, P. (2015). *Qualitative Inhaltsanalyse - Grundlagen und Techniken*, 12th ed. Weinheim, Basel: Beltz Verlag.
- Plank, C., Hass, W., Schreuer, A., Irshaid, J., Barben, D. and Grög, C. (2021). Climate policy integration viewed through the stakeholder's eyes: A co-production of knowledge in social-ecological transformation research. *Environmental Policy and Governance* 31(4). 387-399.
- Turnheim, B., Asquith, M. and Geels, FW. (2020). Making sustainability transitions research policy-relevant: Challenges at the science-policy interface. *Environmental Innovation and Societal Transitions* 34. 116-120.

# Slovenian agri-food trade with Ukraine and Russia

Sara Bele and Tanja Travnikar<sup>1</sup>

**Abstract** – War in Ukraine brings many social implications and challenges for policymakers. Among other things, the war will also affect the global food security and functioning of food systems. In this paper, we wanted to investigate how extensive the impacts on food chains will be in Slovenia. For this purpose, we analysed the trade in agri-food products between Slovenia and the two countries, involved in the war, as well as purchase prices. The analysis shows that the import of agricultural commodities from Ukraine and Russia to Slovenia is not significant. However, this does not imply that there are no negative impacts on food chains in Slovenia. The negative impacts of war are mainly indirect, through rising prices of energy and other production inputs, rising prices of agricultural commodities, as well as uncertain political and economic developments, which affect all stakeholders of the food chains.

## INTRODUCTION

It is clear that the war in Ukraine will negatively impact the global agricultural markets (FAO, 2022; Geijer, 2022). Ukraine and Russia together are among the largest producers and exporters of several important grains, sunflower oil, fertilisers, and fuel (Emedieqwu, 2022; UNCTAD, 2022). Ukraine ranks first in sunflower oil production, while Russia ranks second. Together they contribute to more than half of global exports of this commodity. Russia is the world's second largest producer of barley, fourth largest producer of wheat, and tenth largest producer of maize. The two countries are responsible for around one quarter of global wheat exports. Russia is also the world's third largest producer of fuel and fourth largest producer of mineral fertilisers. Due to war, the agricultural production in Ukraine will be limited and will even be terminated in some regions of the country, while exports will be hindered. Many sanctions have been levied on Russia, which will undoubtedly lead to turbulences and restrictions on trade with agri-food products. Shortages and rising prices of food and agricultural inputs as a consequence of war will affect global food security (Emedieqwu, 2022).



Figure 1. Possible effects of the war in Ukraine on the food system (adapted from Geijer, 2022).

Agricultural markets across the world will be affected in multiple ways and by different magnitudes (Geijer, 2022). The highest magnitude of those effects will be felt in the highly import-dependent countries,

especially developing and lower income countries. For example, in some African countries (e.g. Benin, Somalia), almost all of the imported wheat originates either from Ukraine or Russia and those countries will face the largest direct effects of war (e.g. food scarcity, even hunger) (UNCTAD, 2022). On the other hand, the countries that are self-sufficient with above mentioned agricultural commodities, will face indirect effects, such as the rising prices of agricultural inputs (e.g. fuel and fertilisers), which will in turn lead to higher costs of food production (Emedieqwu, 2022).

The European Union (EU) countries, including Slovenia, are among the group of countries that will undoubtedly feel the consequences of the war, mainly through indirect effects. It should be noted, that food shortage is currently not a problem in EU countries, as the EU is a net food exporter and top agri-food producer and as such is largely self-sufficient in many agricultural products (EC, 2022a). This is especially true for cereals, but not so for sunflower oil. In recent years, the EU was among the top importers of Ukrainian sunflower oil (Emedieqwu, 2022). As already said, the biggest threat to European farmers is the rising prices of the main production inputs, that are imported from Russia, such as energy and mineral fertilisers. The increase in prices of those inputs already began in the second half of 2021, and these increases continue with the war. It is expected that the rising prices of agricultural commodities (at the producer level) will probably not follow the rising prices of production inputs, which will shake the economic stability of farmers.

The purpose of this paper was to answer the question of Slovenia's dependency on some of the Ukraine's and Russia's important export commodities: wheat, maize, and sunflower oil, as well as the country's self-sufficiency in those commodities. At the same time, the rest of the agri-food commodities that are part of the trade flow between the countries were determined. Additionally, the movement of prices of the relevant commodities was analysed, namely on foreign markets and the Slovenian market.

## METHODS

For the purpose of analysing the trade in agri-food products, we analysed the SORS (2022a) foreign trade data by 8-digit code of the combined nomenclature and by countries. We analysed in detail the regional structure of wheat, maize, and sunflower oil imports to Slovenia. Additionally, we analysed the structure of imports of agri-food commodities from Ukraine and Russia.

The self-sufficiency data that were analyzed in the paper were obtained from the national supply and use balance sheets of agricultural products, which are prepared annually by the Agricultural Institute of Slovenia (SORS, 2022b).

In the analysis of purchase prices of the relevant agricultural commodities on foreign and domestic markets, the data obtained from EC reports (2022b)

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and AAMRD reports (2022) were used. Data were analyzed on a weekly, monthly and annual basis.

#### RESULTS

The results show that trade in wheat, maize and sunflower between Slovenia and Ukraine or Russia is very low and in some years nonexistent.

Slovenia produces about three quarters of the total domestic cereals demand, which means that the production of cereals in Slovenia is lower than domestic consumption. According to the latest data for 2020, Slovenia's self-sufficiency rate for cereals is 88%, with the highest self-sufficiency rate for maize (average of 2015–2019: 92% self-sufficiency rate) and the lowest self-sufficiency rate for wheat (average of 2015–2019: 49% self-sufficiency rate). Slovenia meets the rest of its cereal needs through imports. More than 80% of cereal imports originate from neighboring countries: Hungary, Austria and Croatia, with Hungary being the main trading partner.

Sunflower oil is also not imported from Ukraine and Russia. The majority of imports come from Hungary, Serbia, and Croatia (average of 2015–2019: almost 70% of total sunflower oil imports, 2020: 82% of total imports).

Imports of other agri-food products from Ukraine and Russia were also examined. In 2020, imports from Russia accounted for 0.02% of total agri-food imports, while imports from Ukraine accounted for 0.11%. In comparison with a five-year average (2015–2019), imports from Russia accounted for 0.11% of total agri-food imports, and imports from Ukraine accounted for 0.09%. The majority of imported commodities from Ukraine in the years 2015–2019 were nuts (60% of total imports from Ukraine), which in the structure accounted for about 7% of all nuts imports.

According to SORS data, purchase prices in Slovenia have already increased sharply in 2021, with prices of wheat by 27% and grain maize by 66%. Purchase prices were at their highest level since 2012. Oilseed prices also increased sharply, with rapeseed prices by 41%, and soybean prices by 58%. The price growth continues in 2022. According to the market report (AAMRD, 2022), the prices of wheat and maize on European markets and in Slovenia continue to increase. For example, in the first nine weeks of 2022 (compared to the same period in 2021), wheat prices in Slovenia increased by 55% and maize by 80%.

#### DISCUSSION

The results confirm that Slovenia is not dependent on food imports from Ukraine and Russia. Agricultural markets were already in turmoil even before the start of the war in Ukraine (rising prices of inputs and prices of agricultural products), and this war will bring even greater instability and further pressure on prices. Unlike some other countries, the EU and Slovenia will not experience food shortages, but the indirect effects of the war will severely affect stakeholders along the entire food chain (higher commodity prices, higher energy prices, deteriorating economic outlook). Food producers and processors will face an overall increase in production and processing prices, as well as higher prices of transport, storage, etc. Distributors and traders will face new negotiating positions and possibly changing sales channels. Consumers, on the other hand, will feel the effects of this war through much more

expensive food. Rising food prices will push the already vulnerable consumer groups into poverty, even in more developed countries (Emedieqwu, 2022).

Countries will face issues of food independence, opportunities to increase self-sufficiency, providing food to vulnerable consumer groups, etc. In recent decades, in order to take into account the protection of the environment and human health, food production has gone in the direction of achieving quality goals (e.g. organic production), rather than quantitative results. In this situation, higher crop yields will have priority (at least in the short term), which will be a considerable challenge given environmental standards. Changed consumer patterns are also expected. For example, with the significantly higher price of sunflower oil (including the insufficient amount of this type of oil), consumers and industry will be forced to use substitutes, namely other vegetable oils. With the expected high price of livestock products, certain changes in eating habits are also expected (e.g. lower meat consumption). We can conclude that this crisis will undoubtedly bring many changes along the entire food chain, and the extent of these changes depends mainly on the duration of the war.

#### REFERENCES

- AAMRD (2022). Market report. Agency of the Republic of Slovenia for Agricultural Markets and Rural Development.
- EC (2022a). Commission acts for global food security and for supporting EU farmers and consumers. EC, European Commission. ([https://ec.europa.eu/commission/presscorner/detail/en/ip\\_22\\_1963](https://ec.europa.eu/commission/presscorner/detail/en/ip_22_1963)) (April, 2022)
- EC (2022b). Statistic data, crops market observatory. EC, European Commission.
- Emedieqwu, L. (2022). How is the war in Ukraine affecting global food security? *Economics Observatory*. (<https://www.economicsobservatory.com/how-is-the-war-in-ukraine-affecting-global-food-security>) (April, 2022)
- FAO (2022). *Note on the impact of the war on food security in Ukraine*. FAO, Food and agriculture organization of the United Nations. (<https://reliefweb.int/sites/reliefweb.int/files/resources/cb9171en.pdf>) (April, 2022)
- Geijer, T. (2022). The impact of the Ukraine war on food and agriculture is becoming apparent. *Economic and Financial Analysis*. (<https://think.ing.com/articles/the-impact-of-the-war-in-ukraine-on-food-agri-has-only-just-started-to-unravel/>) (April, 2022)
- SORS (2022a). Exports and imports by 8-digit code of the Combined Nomenclature and by countries. SORS, Statistical Office of the Republic of Slovenia.
- SORS (2022b). Self-sufficiency rate (%) by type of agricultural products. SORS, Statistical Office of the Republic of Slovenia.
- UNCTAD (2022). *The impact on trade and development of the war in Ukraine*. UNCTAD, United Nations Conference On Trade and Development. (<https://unctad.org/webflyer/impact-trade-and-development-war-ukraine>) (April, 2022)

PARALLEL SESSION 2

# AGRICULTURAL PRODUCTION AND FARM MANAGEMENT I



# Assessment of alternative plant protection measures by farmers

Alexander Zorn and Solène Clémence<sup>1</sup>

**Abstract** - In the PestiRed resource project, Swiss farmers, advisors and researchers are working together with the aim of reducing the use of plant protection products in a six-year crop rotation in arable farming. This is to be achieved through the consistent use and further development of integrated pest management. Farm managers are surveyed annually to assess the measures used with regard to their effectiveness and economic efficiency. The first results show effective measures to reduce the use of plant protection products. Farmers assess the economic efficiency of the measures implemented mostly also positive.

## INTRODUCTION

The project PestiRed aims to significantly reduce the use of plant protection products (PPP) in arable farming through the consistent implementation and further development of integrated pest management practices. Reducing the risks associated with the use of PPPs is a political goal that is set out in Switzerland's national action plan (Bundesrat 2017) with specific requirements.

In this project, which is mainly funded by the Swiss Federal Office for Agriculture within the framework of the "resource program" (BLW 2022), 68 arable farms from three cantons, the regional agricultural extension services and researchers from various Agroscope departments are working together.

The project works with a co-innovative approach. Knowledge and experience flow from practice and consulting to research and vice versa. The three groups of actors closely exchange information in the project and further develop the project together and optimize the measures.

Through the application of alternative plant protection measures, the use of PPP, measured by the treatment frequency index, is to be reduced by 75%. At the same time, the economic efficiency should not be reduced by more than 10%.

The farms can apply various alternative measures (see Figure 1 and for details on the measures <https://pestired.ch/de/measures>): five basic measures are implemented by all farms and additional measures are selected from 15 specific measures on a regional and farm basis. Each farm uses these measures on a so-called innovative plot to reduce PPP use as far as possible. This plot is compared to a control plot, which is farmed as usual with the same crop. Regionally defined six-year crop rotations will form the framework of the final analysis.

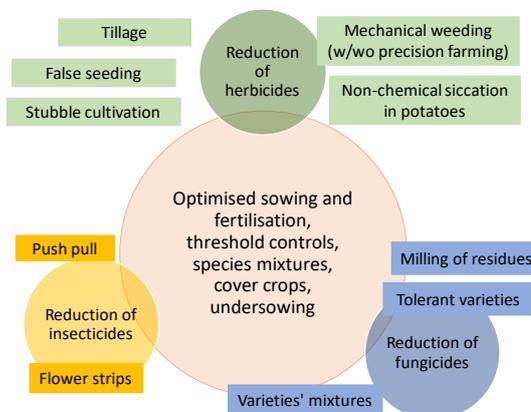


Figure 1. Plant protection measures in the project PestiRed and their expected impact on PPP use.

This article presents first results from the socio-economic research accompanying the project: How do farmers evaluate the measures they apply in terms of their costs, their potential to reduce the use of PPP and their economic efficiency?

## METHODS

Farmers' experiences with the different alternative plant protection measures are collected each autumn via an online questionnaire. The farmers provide information on the crop and select the measures applied.

The measures are evaluated on 7-point Likert scales with regard to costs, economic efficiency, their plant protection effect, their effect on yield quantity and quality, their potential to reduce PPP use and to reduce health and environmental risks. In addition, the question is asked whether experience has already been gained with the measures and how professional colleagues reacted to the implementation of the measures.

For the time being, the data analysis is based on descriptive and rank correlation analyses (Spearman and Kendall); more in-depth statistical analyses are pending.

## DATA

In the two growing seasons 2019-2020 and 2020-2021, a total of 13 crops were grown, in particular wheat (23 farms), rape (18), maize (15), barley (14) and peas (10).<sup>2</sup> The experiences of the farms in the project with the implementation and their assessment of the measures were surveyed annually in autumn or winter online. The response rate was 88% in 2020 and 85% in 2021. Overall, 109 responses are analysed.

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<sup>2</sup>In addition, spelt, sugar beet, sunflower, potatoes, soya, legume mixtures and chickpeas were cultivated. The cultivation of artificial meadows is not recorded in the survey because of the low use of PPPs.

## RESULTS

The presentation of the results from the farmer surveys focuses on the two objectives of the project: the potential of the measures to reduce the use of plant protection products and the economic efficiency of the measures. The nine most frequently applied measures, including the five basic measures, are presented in Table 1.

According to the farmers' evaluation, mechanical weed control is the most effective measure to reduce the use of PPP in the PestiRed project (5.8 is close to the scale value 6 "positive"). The economic efficiency of this measure is rated as almost neutral, but with a slight tendency towards the negative range.

Two basic measures, the consistent application of threshold values (decision rule whether to spray or not to spray relying on pest population levels) and the use of resistant varieties, are assessed quite positively both in terms of PPP reduction and in terms of their economic efficiency. Other basic measures such as optimising sowing (date, density) and fertilisation also contribute to the project's goals.

**Table 1.** Farmers' evaluation<sup>a</sup> of the measures with regard to their potential to reduce PPP and their efficiency.

Measure <sup>b</sup>	PPP reduction	Economic efficiency	N
Mechanical weeding	5.8	3.9	65
<i>Threshold levels</i>	5.3	4.9	100
<i>Tolerant variety</i>	5.3	5.0	105
False seeding	5.2	4.0	44
<i>Drift-reducing techniques</i>	5.0	4.4	97
Stubble cultivation	4.9	4.4	57
Undersowing	4.7	3.9	40
<i>Optimised sowing</i>	4.7	4.6	104
<i>Optimised fertilisation</i>	4.5	4.6	103

<sup>a</sup> Shown are mean values of a 7-scale Likert rating from 1 - very negative... 4 - neutral... 7 - very positive.

<sup>b</sup> Basic (compulsory) measures are in *italics*.

Source: Survey data on the harvest years 2020 and 2021.

Farmers' evaluation of the measures' effect on the yield quantity and the yield quality is mostly neutral with a tendency towards the positive range. Critical evaluations of the economic efficiency (mechanical weeding, undersowing) can be explained by critical evaluations of yield quantity (mechanical weeding, undersowing) and the yield quality (undersowing).

## DISCUSSION AND CONCLUSIONS

Farmers see great reduction potential especially in non-chemical weed control measures, such as mechanical weeding, false seeding and stubble cultivation. Preventive measures are also seen as having a positive effect on the reduction of PPPs, including in particular the choice of resistant varieties and the consistent use of control thresholds and forecasting systems, both of which are basic measures and integral parts of integrated pest management. Other basic measures, such as seed

optimisation or adapted nitrogen use, are rated as less effective but still positively.

Although the past year was very rainy and posed great challenges for crop protection in arable farming (especially protection against fungal diseases), the evaluation of the measures did not vary strongly: The ranking of the measures with regard to PPP reduction and efficiency is quite stable over the years.

The two basic measures, threshold levels and tolerant variety, which scored positively with regard to PPP reduction are also rated well in terms of their efficiency. This result suggests that the approach of the project to improve the implementation of integrated pest management is accurate. This potential to realise PPP reductions at low cost is a challenge for research as well as for extension services (Ramseier, Lebrun et al. 2016): research should develop a sound basis, which then must be communicated to farmers via extension.

The challenges to reduce PPP differ between crops. These challenges are particularly great for crops that are susceptible to insects and fungal diseases, such as potatoes.

When considering the economic evaluation, it should be noted that the farmers receive contributions from the project for the implementation of specific measures in order to compensate for additional costs; these contributions are presumably included in the evaluation and contribute to the rather positive evaluation of the measures' economic efficiency. The project also includes an economic analysis (comparison of two plots on farm and crop level and finally the crop rotation). The linking of the results from the economic analysis with the survey's results is currently pending.

The first results of the PestiRed project provide starting points for upscaling effective measures to reduce the use of PPP in arable farming. These results are also of great relevance for other countries with similar cultivation conditions in their endeavour to improve the sustainability of their crop cultivation systems.

## REFERENCES

- BLW. (2022). "Ressourcenprogramm" Retrieved 22.04.2022, from <https://www.blw.admin.ch/blw/de/home/instrumente/ressourcen--und-gewaeserschutzprogramm/ressourcenprogramm.html>.
- Bundesrat (2017). *Aktionsplan zur Risikoreduktion und nachhaltigen Anwendung von Pflanzenschutzmitteln – Bericht des Bundesrates*. Bern, Schweizerischer Bundesrat.
- Ramseier, H., Lebrun M. and Steinger T. (2016). Anwendung der Bekämpfungsschwellen und Warndienste in der Schweiz. *Agrarforschung Schweiz* 7(2): 98–103.

# Evaluating the relation between crop diversity and productivity of Austrian crop farms

Simon Pröll, Klaus Salhofer and Andreas Eder<sup>1</sup>

**Abstract – Crop diversity in agriculture is essential for sustainable and resilient agroecosystems. However, empirical evidence on the impact of crop diversity on farm performance for Europe is sparse. Using accounting data, we recover farm productivity from a production function utilizing semiparametric estimation techniques and relate it to various crop diversity indices derived from Integrated Administration and Control System (IACS) data. On average, we find that farms providing higher levels of crop diversity are associated with lower levels of productivity. Our findings highlight the need to incentivize farmers to provide public benefits associated with higher crop diversity.**

## INTRODUCTION

Sustaining a high level of crop diversity in agriculture is essential for sustainable and resilient agroecosystems. Empirical evidence on the benefits of crop diversity can be found on several levels. On the global level, crop diversity is found to prevent population from diseases and foster food security. On the biological level, natural biodiversity can be increased through a high level of crop diversity providing the base for healthy soil, species complementarities and more efficient use of natural resources (Altieri, 1999). At the farm level, crop diversification reduces input- and output price risk, serves as a natural insurance against crop failure and allows for economies of scope.

Over the last decades, crop diversity decreased in most developed countries with farmers concentrating production on a few profitable crops entailing heavy use of chemicals and negative impacts on water, soil quality, wildlife and human health (Bellora et al., 2017). Diversification of crops allows pest reduction and suppression of diseases without applying chemical pesticides (He et al., 2019). Hence, in the last decades several measures to increase crop diversity have been introduced under the Common Agricultural Policy (CAP). Two examples are the greening measure 'crop diversification' and the Austrian agri-environmental scheme (ÖPUL) 'environmental friendly and biodiversity improving farming practices' (Umweltgerechte und biodiversitätsfördernde Bewirtschaftung). Therefore, for both farmers and policy makers it is crucial to know whether crop diversification translates into productivity gains.

Most existing studies focus on areas that differ considerably from Central European countries in terms of landscape and structure of agriculture (e.g. studies from Ethiopia or South Africa). We add to the literature by providing new evidence on the relation between crop diversity and productivity for Central Europe with Austria as a case study. In contrast to the

widely used Fixed Effects (FE) estimator, our estimation procedure controls for unobserved and time-varying heterogeneity in production.

## EMPIRICAL MODEL

Following Solow (1957), we consider productivity as the variation in output that cannot be explained by variation in inputs

$$\ln TFP_{it} = y_{it} - f(x_{it}; \beta). \quad (1)$$

Hereby,  $TFP_{it}$  denotes productivity of farm  $i$  in period  $t$ , output is captured by  $y_{it}$  and the function  $f(x_{it}; \beta)$  describes the transformation of inputs  $x_{it}$  into output  $y_{it}$  governed by a set of common technology parameters  $\beta$ . We specify  $f(x_{it}; \beta)$  as translogarithmic and estimate  $\beta$  using the Akerberg, Caves and Frazer (2015) (ACF) procedure. To avoid biased estimates of  $\beta$  that translate into biased estimates of  $TFP_{it}$ , the estimation procedure must control for any unobserved shocks that might be correlated to the level of input use. As a major advantage over the FE estimator, the ACF procedure does not only allow to control for time-invariant unobserved heterogeneity, but also for time-varying unobserved factors that might be known to the farmer but not to the econometrician.

Next, we relate productivity to crop diversity applying a semilogarithmic regression model in the second stage

$$\ln TFP_{it} = \gamma + \varphi div_{it} + \delta b_{it} + d_t + v_{it}, \quad (2)$$

where  $div_{it}$  captures farm  $i$ 's crop diversity in year  $t$ . Control variables are collected in the vector  $b_{it}$  and time fixed effects are captured by  $d_t$ . The composite error  $v_{it} = \alpha_i + \epsilon_{it}$  consists of farm fixed effects  $\alpha_i$ , that are uncorrelated to the regressors, and the i.i.d. error  $\epsilon_{it}$ . We estimate the model using the feasible generalized least squares estimator to appropriately control for the error structure in equation (2) when identifying the parameter of interest  $\varphi$ .

## DATA

The data is drawn from the Austrian fraction of the Farm Accountancy Data Network (FADN). We use an unbalanced panel of 395 crop farms covering the period 2003 to 2019 whereas we only include agricultural holdings with a share of revenue from crops in total revenue larger or equal to 65.5%.

Farm output is measured as the sum of revenues from all agricultural activities net of all subsidies. Labor includes family labor and hired labor, and is measured in agricultural working units per year (AWU). Capital measures the average of a farm's capital stock at the beginning and at the end of the

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year. Material includes the sum of all expenses on intermediate inputs. Land captures the utilized agricultural area in hectares and includes own and rented land. We normalize all input and output variables around the sample mean and deflate all variables in monetary terms by appropriate price indices.

The vector of controls  $b_{it}$  in equation (2) includes altitude in meters, a land quality index and farm location (dummy variables for main agricultural production areas). We calculate a Herfindahl-Hirschman index using seven categories of revenues (revenues from land use, livestock farming, forestry, renting out machinery and services to other farms, direct sales, subsidiary agricultural enterprises and agri-tourism) to control for farm specialization. Since much attention has been drawn to the effects of subsidies on productivity, we finally control for the level of subsidization. A drawback of measuring subsidies per hectare of UAA, as is common practice, is the potential lack of variation in this variable. Therefore, we include first- and second pillar CAP-payments per AWU.

Table 1 shows descriptive statistics of TFP and four different measures of crop diversity that are calculated using IACS data: the Simpson diversity index and the Pielou evenness index, both measured on a scale between 0 and 100; the Shannon-Weaver diversity index, theoretically taking on values between zero and infinity; and the number of crops.

**Table 1.** Descriptive statistics.

	Mean	Std. Dev	Percentile	
			5%	95%
TFP	1.027	0.344	0.574	1.624
Simpson diversity index (0-100)	73.70	8.592	57.54	84.38
Shannon-Weaver diversity index	1.549	0.296	1.038	2.015
Pielou evenness index (0-100)	57.09	6.129	46.64	65.33
Number of crops	6.873	2.083	4	11

### RESULTS

Table 2 depicts parameter estimates of  $\varphi$  from equation (2) using different proxy variables for crop diversity  $div_{it}$ . We find negative coefficients for all crop diversity proxies. On average, a one-point increase in the Simpson diversity index translates into a 0.17% ceteris paribus (c.p.) decrease in TFP. Crop diversity coefficients are found to be significantly different from zero on a 10% level for the Simpson diversity index and Pielou's evenness index but insignificant for the Shannon diversity index or the number of crops planted.

To compare the c.p. impact of crop diversity on TFP, we compute the predicted difference in TFP between the 95<sup>th</sup> and the 5<sup>th</sup> percentile for our four diversity proxies. Using the Simpson diversity index and Pielou's evenness index, we hereby estimate values of -4.56% and -3.36% respectively. Using the Shannon-Weaver index and the number of crops as proxies, we estimate predicted differences in TFP

between their 95<sup>th</sup> and the 5<sup>th</sup> percentile of -3.87% and -2.45% respectively.

**Table 2.** Relating TFP to crop diversity.

	Coeff.	R <sup>2</sup>	Impact
Simpson diversity index (0-100)	-0.0017* (0.0009)	0.175	-4.56%
Shannon-Weaver diversity index	-0.0396 (0.0264)	0.173	-3.87%
Pielou evenness index (0-100)	-0.0018* (0.0011)	0.172	-3.36%
Number of crops	-0.0035 (0.0034)	0.172	-2.45%
Observations	4,151		

Heteroscedasticity robust standard errors in parentheses.

\* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01

### CONCLUSION

On average, we find that farms providing higher levels of crop diversity are associated with lower levels of TFP. Though, the estimated impacts are not statistically significant, the magnitudes may be relevant for farmers. The results are relatively robust to various measures of crop diversity. Our measure of TFP does not include any public benefits from higher crop diversity, such as enhanced biodiversity and ecosystem services. To the extent that these public benefits exceed TFP losses, compensations for crop diversity measures are justified. The results further show that the largest part of variation in productivity is explained by farms' natural conditions and the degree of subsidization.

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### REFERENCES

- Ackerberg, D., Caves, K., and Frazer, G. (2015). Identification properties of recent production function estimators. *Econometrica*, 83(6): 2411–2451.
- Altieri, M.A. (1999). The ecological role of biodiversity in agroecosystems. *Agriculture, Ecosystems & Environment*, 74(1): 19–31.
- Bellora, C., Blanc, É., Bourgeon, J.-M., and Strobl, E. (2017). Estimating the Impact of Crop Diversity on Agricultural Productivity in South Africa. *NBER Working Paper*, 23496.
- He, H., Li-na, L., Shahzad, M., Bashir N.H., Yi, W., Yang J., and Cheng-yun, L. (2019). Crop Diversity and Pest Management in Sustainable Agriculture. *Journal of Integrative Agriculture*, 18,(9): 1945–52
- Solow, R.M. (1957). Technical Change and the Aggregate Production Function. *The Review of Economics and Statistics*, 39(3): 312–320.

# Exploring farmers' reasons for drought adaptation

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**Abstract – Understanding farmers' reasons for drought adaptation is essential to develop tailored policy measures that encourage adaptation. We qualitatively explore farmers' drought adaptation behaviour in the Austrian case study region Seewinkel. The qualitative content analysis reveals that farmers implement incremental measures such as shifting toward drought-tolerant crops and varieties, irrigating or adopting conservation tillage practices. Transformative measures are implemented such as additional water reservoirs or specializing in production activities. Drought adaptation is not only influenced by reasons referring to perceived self-efficacy, costs and effects, but also to farmers' economic, environmental, social, legal and technical contexts. The results will be graphically depicted in a behavioural systems map, which provides the basis for further analysis and the development of tailored policy measures.**

## INTRODUCTION

Climate change is likely to increase frequency and severity of agricultural droughts. Thus, farmers need to adapt in order to reduce or avoid potential adverse impacts. Farmers' adaptation to agricultural droughts is not only essential to ensure their incomes through agricultural production, but also to preserve food security and related economic and social stability (IPCC, 2022).

Researchers and practitioners deal with and continually enhance the knowledge on a plethora of incremental and transformative drought adaptation measures. However, their implementation is still limited, and sometimes lacks effectiveness or leads to adverse trade-offs (Iglesias and Garrote, 2015). Explanations include, for example, cognitive biases of individuals, such as maintaining the already known (Kahneman, 2011). With respect to policy measures, the overemphasis on informational measures and the disregard of economic, environmental, social and technical contexts on farmers' behaviour impede adaptation (Hanger-Kopp and Palka, 2021; Mitter et al., 2019; Wheeler et al., 2013).

Despite an increase in scientific investigations into farmers' drought adaptation, the interaction between individual and contextual information is often disregarded and the application of quantitative methods is prioritized (Hanger-Kopp and Palka, 2021).

We use a qualitative approach to analyse farmers' drought adaptation behaviour in the semi-arid case study region Seewinkel, located in eastern Austria. In particular, we aim to reveal drought adaptation measures, farmers' reasons for their implementation, as well as contexts encouraging adaptation behaviour.

The case study region Seewinkel is characterized as a semi-arid agricultural production region with an individual groundwater body. The Pannonian climate (annual precipitation sums below 600 mm and mean annual temperatures around 10 °C) and the opportunity to use groundwater for irrigation offer favourable conditions for agricultural production (Blaschke et al., 2015). However, agricultural droughts increasingly threaten regional agricultural production (Kropf et al., 2021).

## METHOD

We conducted qualitative, semi-structured interviews with farmers operating in the Seewinkel region, aiming to collect farmers' perceptions of droughts and their reasons for drought adaptation. An emphasis was put on irrigation, which is of particular relevance within the Seewinkel region. The Model of Private Proactive Adaptation to Climate Change (MPPACC) informed the development of the interview-guideline (Mitter et al., 2019).

Interviewees were selected according to the maximum variation principle with regard to farm characteristics (e.g. farm type, location of the farm, main production activity, farm size, cultivation system) and farmer characteristics (e.g. age, gender). Potential interviewees were searched online. Additional interviewees were initially contacted via gatekeepers who informed them about the interview and were thereafter contacted by the interviewer.

One interviewer conducted 21 face-to-face interviews (with 24 interviewees) between November 2019 and February 2020. The interviewed farmers (17 men, 7 women, aged between 24-71 years) follow diverse production activities (multiple answers were possible) such as cropland (13), viticulture (10), livestock (8), vegetables (6), fruit (5), grassland (4), forestry (2), other (2) on their farms with a size between 2 to 2100 ha. The interviews lasted between 25 and 125 minutes and were conducted either at the interviewer or interviewees homes. The transcribed interviews were analysed by means of a qualitative content analysis following Mayring, (2014). Using the text analysis software Atlas.ti, we applied a deductive-inductive coding scheme. Deductive codes were derived from the MPPACC (e.g. perceptions of droughts and drought adaptation measures including self-efficacy, adaptation efficacy and costs). Inductive codes resulted from the interviewees' statements and were used to further refine deductive codes. For the present analysis we exclusively focus on statements referring to drought adaptation and underlying reasons. Reasons are specified as adverbs, conjunctions or prepositions which introduce conditions for drought adaptation measures (e.g., if

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... then, when), purposes (e.g., that) or reasons (e.g., because, as).

## RESULTS

The results show that an increasing number of agricultural droughts and accompanying decreasing soil water availability necessitate farmers to implement drought adaptation measures. These measures were categorized based on Wheeler et al. (2013) and include incremental (e.g. irrigate, switch to drought-tolerant crops and varieties, soil conservation, drought insurance) and transformative adaptation measures (e.g. build water reservoirs, farm specialization, abandon certain production activities).

Irrigation including capacity increases and efficiency improvements are central for farmers in the Seewinkel region. Reasons that motivate farmers to irrigate include their expectations for improved crop yields and product quality. However, the expected costs (including labour) depend on field size and spatial distribution of fields and impede irrigation or force farmers to pro-actively switch to drought-tolerant crops and varieties. *"If we had to purchase an irrigation system now, it would be intensive. We would have to cultivate certain crops or fields, so that it is at least profitable – Seew\_16"*. Expectations to increase irrigation efficiency (i.e.-water- and energy-use per unit of crop yield) through reduced evapotranspiration motivates farmers to shift irrigation to night-times.

Farmers' choice of cultivated crops also influences irrigation water quantity. They argue with irrigation costs, expected yields, and related income to ensure the viability of their farms, but also to economic contexts such the market demand. Farmers perceived self-efficacy also influences the choice of cultivated crops. On the one hand, self-efficacy is perceived low due to limited knowledge about the cultivation and marked potential of new plants. On the other hand, it is perceived high based on already gained experiences with new plants on their farms, or vicarious experiences of farmers in drier European regions, who also cultivate crops profitably.

Farmers also point to the social context, such as prevailing narratives within farming communities, which influence the implementation of drought adaptation measures. For example, prevailing narratives on conventional tillage impede the shift to conservation tillage practices, which are currently only implemented by few farmers.

## CONCLUSION AND OUTLOOK

Reasons for farmers to adapt to droughts are related to the perceived costs, perceived effectiveness or their personal capacity to implement respective measures. Additionally, farmers' perceptions of the economic, environmental, social, legal and technical context influence their drought adaptation. These results support the development of tailored policy measures, such as initiatives to develop new narratives or the provision of financial incentives to decrease irrigation water use and preserve the regional groundwater body. In a next step, the results will be graphically summarized in a behavioural

systems map (Hale et al., 2022) to depict causal relationships of drought adaptation and the reasons for it.

## ACKNOWLEDGEMENT

This work was supported by the Austrian Climate and Energy Fund within the Austrian Climate Research Program, research projects FARMERengage (grant number KR18AC0K14641) and Build Back Better (grant number KR20AC0K18173). Furthermore, we would like to thank Tina Achs for conducting and transcribing the interviews as well as Carina Auzinger and Julia Vihanek for their support in transcribing interviews.

## REFERENCES

- Blaschke, A.P., Reiner, Philipp, Gschöpf, Christine, 2015. Studie zum Grundwasserbewirtschaftungsplan für den Seewinkel. TU Wien, Wien.
- Hale, J., Jofeh, C., Chadwick, P., 2022. Decarbonising Existing Homes in Wales: A Participatory Behavioural Systems Mapping Approach (preprint).
- Hanger-Kopp, S., Palka, M., 2021. Decision spaces in agricultural risk management: a mental model study of Austrian crop farmers. *Environ Dev Sustain*.
- Iglesias, A., Garrote, L., 2015. Adaptation strategies for agricultural water management under climate change in Europe. *Agricultural Water Management* 155, 113–124.
- IPCC, 2022. Climate Change 2022. Impacts, Adaptation and Vulnerability. (Working Group II contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change).
- Kahneman, D., 2011. *Thinking, Fast and Slow*. Penguin Random House UK, Great Britain.
- Kropf, B., Schmid, E., Mitter, H., 2021. Multi-step cognitive mapping of perceived nexus relationships in the Seewinkel region in Austria. *Environmental Science & Policy* 124, 604–615.
- Mayring, P., 2014. *Qualitative content analysis: theoretical foundation, basic procedures and software solution*. Klagenfurt.
- Mitter, H., Larcher, M., Schönhart, M., Stöttinger, M., Schmid, E., 2019. Exploring Farmers' Climate Change Perceptions and Adaptation Intentions: Empirical Evidence from Austria. *Environmental Management*.
- Wheeler, S., Zuo, A., Bjornlund, H., 2013. Farmers' climate change beliefs and adaptation strategies for a water scarce future in Australia. *Global Environmental Change* 23, 537–547.

# Factors influencing young farmers' intention to adopt organic farming

Marius Michels, Vanessa Bonke and Oliver Musshoff<sup>1</sup>

**Abstract** – The main goals of the European Union's agricultural policy are to promote young farmers ( $\leq 40$  years) and organic farming. The promotion of young farmers and organic farming are among the main goals in the agricultural policy of the European Union. Yet, no study has exclusively focused on young farmers' attitudes and perceptions towards organic farming. Hence, the aim of this study is to investigate factors influencing young farmers' intention to adopt organic farming in an extended Unified Theory of Acceptance and Use of Technology (UTAUT) framework. The study is based on a data set with 359 young German farmers collected in 2021. The UTAUT model explains 60 % of the variation in young farmers' intention to adopt organic farming. The results imply that ecological and economic expectations have a statistically significant effect on young farmers' intention to adopt organic farming. Surprisingly, the influence of policy measures was not statistically significant.

## INTRODUCTION

The main goals of the European Union's agricultural policy are to promote young farmers ( $\leq 40$  years) and organic farming. Subsidy programs to promote both of these objectives have been in place for several years, however the set goal in Germany of reaching 25% by 2030 is far from being reached. Considering the relatively long-time availability of financial incentives and the empirical literature that shows the importance of farmers' attitudes and perceptions with respect to the adoption of more sustainable practices, focusing on (young) farmers behavioral factors can offer additional insights to promote the conversion to organic farming. A technology adoption model which exclusively focusses on farmers' perceptions, motives and attitudes is the (UTAUT) (Venkatesh et al., 2003). The UTAUT considers four core constructs: performance expectancy, effort expectancy, social norm and facilitating conditions which influence an individuals' behavioral intention (Int) to adopt a technology. Hence, the aim of this study is to investigate farmers' intention to adopt organic farming by applying the UTAUT framework. Furthermore, this study focusses on young farmers, as the conversion to organic farming is associated with high (learning) costs. As younger farmers have longer business horizons, it is worthwhile to focus on their attitudes and motives to promote the adoption of organic farming. This study contributes to literature by expanding the understanding of factors influencing farmers' adoption of organic farming by focusing explicitly on young farmers. The results are therefore of interest for policy makers and extension services.

## MATERIAL AND METHODS

The online survey was conducted from June 2021 to July 2021. Farmers were invited to take part in the survey via social-media, agricultural online newspapers and websites dedicated to agriculture. The survey can be divided into three parts. In the first part, farmers were asked to provide socio-demographic and farm-related information. In the second part, they were asked to state what they believe motivates or keeps other farmers to or from switching to organic agriculture. In the last question of the second part, farmers were asked if they have seriously considered switching to organic farming in the last 5 years. If they answered the dichotomous question with "yes", they were forwarded to the third part of the survey. In this part, the farmers were asked to evaluate 19 randomized indicator statements on a 5-point Likert scale. The indicator evaluations are then used to estimate the proposed extended adaptation of the UTAUT model (Figure 1) via partial least squares structural equation modelling (PLS-SEM) (Hair et al., 2021).

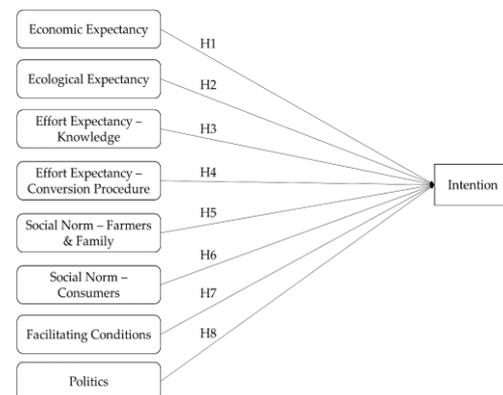


Figure 2: Proposed UTAUT model

## RESULTS, DISCUSSION AND CONCLUSIONS

### Descriptive Results

498 farmers participated of which 139 farmers were deleted or excluded due to being older than 40 years of age or provided unreasonable or incomplete answers. Hence, 359 young farmers remain for the analysis. 42 % of the farmers in the sample answered the question if they have seriously considered switching to organic farming in the last 5 years with "yes" (N = 150). Based on this variable we have subdivided the sample. The average farmers in the sub-sample of interest are 25 years old. 74 % of the farmers work as full-time farmers and 75 % of the farmers are male. The average farmer cultivates 172 hectares of arable land and 33 % hold a university

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degree. The majority of farmers in the subsample (42 %) reside in the southern region of Germany. The average farmer in the sub-sample is slightly risk-seeking (mean = 6.01) based on a 11-point scale (Dohmen et al., 2011). Lastly, the sub-samples differ statistically significantly in terms of several characteristics. Farmers who have seriously considered to adopt organic farming are relatively better educated, more risk-seeking, have a higher proportion of rented arable land and have their farm located mainly in the eastern or southern region of Germany.

#### Estimation Results

Models estimated using PLS-SEM are evaluated in two steps. In the first step, indicator loadings ( $\lambda$ ), internal consistency via composite reliability (CR), convergent validity via average variance extracted (AVE) and discriminant validity via Heterotrait-Monotrait (HTMT) ratios are assessed. Values for  $\lambda$  and CR should be above 0.7. The value for AVE should exceed 0.5, while HTMT ratios should not exceed 0.9 (Hair et al., 2021). The lowest values for  $\lambda$  and CR in the model are 0.571 and 0.728, respectively. Hair et al. (2021) recommends that indicators with a loading below the threshold of 0.7 can remain in the model due to adverse impacts on further model results and content validity. Furthermore, bootstrapping results reveal that all indicator loadings are statistically significant. Henceforth, we decided to leave all indicators in the model as the current model met the recommendations of the literature. 0.536 is the lowest value estimated for AVE. The highest HTMT ratio amounts to 0.787. To conclude, all quality criteria of the first step are met (Hair et al., 2021).

In the second step, the relationship between the constructs as displayed in Figure 1 is evaluated by estimating path coefficients ( $\beta$ ) and t-statistics using a bootstrapping procedure with 10,000 subsamples. Table 1 shows the estimation results for the UTAUT model via PLS-SEM. The model explains approximately 60 % of the variation in young farmers' intention to adopt organic farming. Hence, the results indicate that the proposed UTAUT is able to capture a large amount of latent information in young farmers' intention to adopt organic farming.

The results confirm existing literature (e. g. Läßle, 2013) that ecological as well as economic factors (H1 and H2) play a role in the decision process. Hence, convincing information provided to young farmers to switch should focus on both. Considering the increasing restrictions for conventional farming to enhance environmental goals, educating farmers on the additional ecological advantages of organic farming can be an important lever to facilitate adoption. Perceived efforts with respect to the agronomic knowledge and bureaucratic procedures do not play a (statistical) significant role (H3 and H4). To enhance the findings regarding H1 to H4, one could also consider including organic farming and conversion more in depth into young farmers' education. Social norms with respect to expectations from family, befriended farmers and consumers have a statistically significant influence on the intention, whereby the effect of the former is far larger (H5 and

H6). Facilitating conditions in terms of market access and technical equipment also play a statistically significant role (H7). Hence, sale channels for organic products should be strengthened and expanded by policy makers. In this context, the finding that subsidies and certification programs in the model did not have a statistically significant effect on young farmers' intention should also be considered (H8). Instead of additional programs and further subsidies, rather the market for organic products should be strengthened.

**Table 1.** Estimation results of the UTAUT model (N=150) <sup>a</sup>

Path	H	$\beta$	t <sup>b</sup>	p-value
EcolExp → Int	H1	0.311***	4.798	< 0.001
EconExp → Int	H2	0.152*	1.947	0.052
EffortKnow → Int	H3	0.014	0.244	0.807
EffortProced → Int	H4	0.072	1.278	0.201
SocNoFF → Int	H5	0.261***	4.929	< 0.001
SocNoCons → Int	H6	0.092*	1.741	0.084
FaCo → Int	H7	0.256***	4.127	< 0.001
Politics → Int	H8	-0.023	0.387	0.699

<sup>a</sup> H = Hypothesis, EcolExp = Ecological Expectancy; EconExp = Economic Expectancy; EffortKnow = Effort Expectancy Knowledge; EffortProc = Effort Expectancy Conversion Procedure; SocNoCons = Social Norm Consumers; SocNoFF = Social Norm Farmers & Family; FaCo = Facilitating Conditions; Int = Intention

<sup>b</sup> Bootstrapping results with 10,000 subsamples.

R<sup>2</sup>(Int) = 0.599; Adjusted R<sup>2</sup>(Int) = 0.576

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#### REFERENCES

- Venkatesh, V., Morris, M.G., Davis, G.B. and Davis, F.D. (2003). User acceptance of information technology: Toward a unified view. *MIS quarterly*: 27(3):425–478.
- Dohmen, T., Falk, A., Huffman, D., Sunde, U., Schupp, J. and Wagner, G. G. (2011). Individual risk attitudes: Measurement, determinants, and behavioral consequences. *Journal of the European Economic Association* 9(3):522-550.
- Hair, J.F., Hult, G.T.M., Ringle, C.M. and Sarstedt, M. (2021). A primer on partial least squares structural equation modeling (PLS-SEM), 3rd ed. Thousand Oaks: Sage publications.
- Läßle, D. (2013). Comparing attitude and characteristics of organic, former organic and conventional farmers: Evidence from Ireland. *Renewable Agriculture and Food Systems* 28(4):329-337.

# PARALLEL SESSION 3

# CONSUMER

# BEHAVIOR



# Awareness of Geographical Indications in Baden-Württemberg, Germany

Luisa Schurr and Alexander Wirsig<sup>1</sup>

**Abstract** - For 30 years, geographical indications are a major pillar of the Common European Agricultural Policy. The objective of this study is to assess the awareness of geographical indications and traditional specialities guaranteed in Baden-Württemberg – both: in terms of the EU logos and the names of native specialities registered by the EU. A quantitative consumer survey in Baden-Württemberg was conducted online. Results show that awareness of the PGI, PDO and TSG logos in Baden-Württemberg are significant higher than for consumers on national or European level. There is a varying awareness of names of geographical indications and traditional specialities guaranteed from Baden-Württemberg, whereby they are particularly well known in their region of origin. In general there is also a tendency to increase awareness of GIs with net household income. The results obtained in the study comply with results of a former survey in Baden-Württemberg.

## INTRODUCTION

For 30 years, geographical indications (GIs) are a major pillar of the Common European Agricultural Policy. Within this framework many names of food and agricultural foodstuff, wines and spirit drinks are protected as protected geographical indications (PGIs) and protected designations of origin (PDOs). The European Union also protects traditional specialities guaranteed (TSGs).

Whereas GIs and to a lesser amount TSGs have a long tradition in Mediterranean EU Member States, for example in France, Italy and Spain, including the legal protection and financial support by the state, no such legal tradition exists in Central EU Member States such as Germany (Profeta et al., 2010).

Baden-Württemberg encompasses a rich culinary heritage of 17 food products, five spirit drinks e.g. 'Schwarzwälder Kirschwasser' GI and eight wines e.g. 'Württemberg' PDO protected as GIs under the EU quality scheme. Furthermore six food products such as 'Württembergischer Lamm' or 'Fruit from the Lake Constance' are applied as PDO; PGI or TSG.

The objective of this study is to assess the awareness of GIs and TSGs in Baden-Württemberg – both: in terms of the EU logos and the names of native specialities registered by the EU.

## METHODS

A quantitative consumer survey in Baden-Württemberg (n = 1035) was conducted online. The survey included consumers in Baden-Württemberg aged between 18 and 75 years. Furthermore people who stated that they pay at least some attention to the origin of a food item when purchasing it were screened out. To determine the awareness of the EU-logos (PGI, PDO, TSG) in Baden-Württemberg

multiple-choice question were used. The data obtained was evaluated using the statistical software program IBM SPSS Statistics. After the data had been cleaned up, individual, socio-demographically relevant variable groups, such as age and postal code, were combined.

## RESULTS

### *Awareness of the EU-Logos PGI, PDO and TSG in Baden-Württemberg*

The EU-logos of GIs and TSGs are known differently. Our results show that people aged between 60 and 75 years are less familiar with EU-quality labels than younger people. Further the EU-logos are less known by housewives and pensioners (Table 1).

**Table 1.** Awareness of EU-logos in Baden-Württemberg\*.

EU-Quality logo	Ø	< 60 years	>= 60 years
PGI	26.6	29.3	17.9
PDO	21.2	23.3	13.8
TSG	10.1	11.4	5.8

\* n = 950. Methodology: online questionnaire.

### *Awareness of names of GIs from Baden-Württemberg*

There is a varying awareness of GIs from Baden-Württemberg. The most famous ones are "Schwarzwälder Schinken" PGI (89.3%), "Schwäbische Maultasche" PGI (88.3%), "Schwäbische Spätzle/ Knöpfle" PGI (85.5%). Followed by "Württembergischer Wein" PDO (75.1%) and "Badischer Wein" PDO (73.9%). "Heumilch" TSG (36.9), "Tettlinger Hopfen" PGI (23.4%), "Fränkischer Grünkern" PDO (11.9%), "Höri Bülle" PGI (7.1%), "Weideochse vom Limpurger Rind" PDO (6.8%) and "Allgäuer Weißlacker" PDO (6.7 %) are less known by consumers.

While male consumers are more familiar with "Schwäbisch-Hällisches Qualitätsschweinefleisch" PGI and "Tettlinger Hopfen" PGI, female consumers are more familiar with "Allgäuer Bergkäse" PDO and "Heumilch" TSG. Awareness of the GIs is highest among retirees and lower among students and unemployed consumers - the only exception being the TSG "Heumilch". Concerning this people over 60 years of age are less familiar with this specialty than people under 60 years of age. In general there is also a tendency to increase awareness of GIs with net household income. Furthermore results show that certain specialties are better known depending on which region of Baden-Württemberg consumers live in. This is especially true for "Filderkraut" PGI, "Schwäbisch-Hällisches Qualitätsschweinefleisch" PGI, "Weideochse vom Limpurger Rind" PDO,

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"Schwarzwaldforelle" PGI, black forest spirit drinks GI, "Tettlinger Hopfen" PGI, vegetables from the Isle Reichenau, "Württembergischer Wein" PDO and "Badischer Wein" PDO. It can therefore be assumed that these protected specialties are particularly well known in their region of origin.

#### DISCUSSION & CONCLUSION

##### *Awareness of the EU-Logos*

Despite the high number of names of wine, spirit drinks and agricultural products registered, awareness of the EU-Logos to European consumers are generally low in absolute numbers as for the PDO (14%), PGI (20) and TSG (14%) logos, hitherto (European Commission, 2020). Apart from low consumer awareness, in particular for the TSG logo, European consumers do not fully understand their meaning (European Commission, 2021). On national level awareness of the EU-Logos to German consumers are even lower for the PDO (12%), PGI (12) and TSG (12%) logos (European Commission, 2020).

In comparison consumers in Baden-Württemberg perceive a significant higher awareness of GIs than on national or European level. Awareness of GIs in the federal state of Hessen determined by Henkel in 2014 for the PGI logo (17.8%) and the PDO logo (5.5%) confirms the success of the promotional activities in Baden-Württemberg (Henkel 2017, p. 47). It also becomes clear that in Baden-Württemberg the PGI logo is by far the most well-known of the three EU-wide protected indications of origin. The higher level of awareness in a Germany-wide comparison could be related to the fact that a particularly large number of specialties in Baden-Württemberg are registered as GIs. Furthermore, the increased awareness of the PGI logo in Baden-Württemberg could also be justified by the strong promotional activities of the regional government and the above average participation of producer bodies in EU promotional programs.

In contrast to this, however, the traditional specialties guaranteed (TSG) is not much better known to the people of Baden-Württemberg than to the Germans as a whole (European Commission, 2020, p. 174). Basically, the level of awareness of the TSG logo is lowest compared to the other EU logos. The general unfamiliarity with the logo could be due to the fact that hay milk is currently the only product from Baden-Württemberg that bears the logo.

##### *Awareness of names of GIs from Baden-Württemberg*

The results obtained on the supported awareness of all specialties are similar to the results of a former survey on the awareness of specialties and typical products from Baden-Württemberg (Marketing Research Office, 2009). Although the comparison should be viewed critically due to the different study designs.

The higher level of awareness of the specialties among middle-aged and older people, and above all pensioners, can explain the higher level of awareness among consumers which pay at least some attention to the origin of a food item when purchasing it, as this mainly includes such people. Furthermore, a greater affinity among the older generation for traditional

dishes and foods from the region could be assumed. This was already confirmed by an earlier study (Marketing Research Office, 2009), which showed that people over 50 years of age are more familiar with the examined GIs "Schwäbische Maultaschen" PGI, "Schwarzwälder Schinken" PGI, "Allgäuer Emmentaler" PDO and "Filderkraut" PGI than younger consumers. The difference to consumers between the ages of 18 and 29 is particularly large.

The fact that people up to the age of 60 are more familiar with the traditional specialty of hay milk than older consumers can be explained by the greater awareness of the TSG logo in these age groups.

#### ACKNOWLEDGEMENT

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#### REFERENCES

- European Commission (2020). *Special Eurobarometer 504. Europeans, Agriculture and the CAP*. Brussel, European Commission.
- European Commission (2021). *Evaluation support study on geographical indications and traditional specialties guaranteed protected in the EU: executive summary*, Directorate-General for Agriculture and Rural Development. Brussels, Publications Office. URL: <https://data.europa.eu/doi/10.2762/708630>
- Henkel, T. (2017). *Erfolgskontrolle des Qualitäts- und Herkunftssicherungssystems "Geprüfte Qualität - Hessen" unter besonderer Berücksichtigung der Vertragsregelungen*. Dissertation. Göttingen: Cuvillier Publishing.
- Marketing Research Office (2009). *Spezialitäten aus Baden-Württemberg*. Report on behalf of the food promotion agency (MBW) from the state of Baden-Württemberg, Stuttgart. Nürnberg: Marketing Research Office Edeltraud Schmid.
- Profeta A., Balling, R., Schoene, V., Wirsig, A. (2010). Protected Geographical Indications and Designations of Origin: An Overview of the Status Quo and the Development of the Use of Regulation (EC) 510/06 in Europe, With Special Consideration of the German Situation. *Journal of International Food & Agribusiness Marketing* 22: 1, 179 – 198.

# Communication needs of consumers regarding trust in organic food

Nina Di Guida, Christin Schipmann-Schwarze and Inken Christoph-Schulz<sup>1</sup>

**Abstract - This paper addresses the question of how information influences the perception and trust of consumers in organic food. Focus groups were conducted to identify what type of information persuades consumers and whether and how it can impact trust. The information and communication channels already in use by retailers were obtained through expert interviews. It turns out that retailers underestimate consumers' need for information and, in particular, do not yet exploit the potential of QR codes.**

## INTRODUCTION

Organic food is characterized by credence qualities (Darby and Karni, 1973). Thus, it is not possible for consumers to check whether these foods were actually produced organically. Different studies show that trust is a decisive factor for consumers to make a positive purchase decision in favour of organic food (e. g. Sobhanifard, 2017). However, consumers often do not trust organic products. Among other reasons, doubts about organic production or certification and a lack of knowledge about the meaning of organic labels (e. g. Kushwah et al., 2019) or generally about organic agriculture hinder trust building. To overcome these purchase barriers, providing information about and establishing transparency in regard to organic production could play a critical role (e. g. Tang and Wang, 2013). However, it is a challenge to build up a communication strategy as the need for and perception of information differs widely between individuals (Vega-Zamora et al., 2019). Moreover, an information overload has to be avoided (Terlau and Hirsch, 2015). Therefore, on the one hand, the objective of this paper is to find out whether information can influence the perception of and trust in organic food. On the other hand, it is to be determined which information and communication channels organic retailers are already using. The overall objective is to provide recommendations for action to optimize consumer communication.

## METHODS

The consumer perspective was obtained through ten guided focus groups. One goal of focus groups may be to gather information or explore opinions and attitudes (Lamnek, 2010). The focus groups were conducted in February 2021 with six participants each from Göttingen (rural area) and Duisburg (urban area) in an online format. It was discussed which aspects increase or decrease consumers trust and which trust expectations the participants have. One focus was also on information and communication possibilities. For this purpose, some information was given by the moderator after half of the discussion time. The participants were told what organic food is,

that legal requirements for production and processing exist and that the food is controlled and certified, and the basics of organic farming were explained. In a first step, the participants were asked whether some of the information was new to them and what information was convincing. In a second step, the participants were asked how the information influenced their perception of and trust in organic food and how this knowledge should be communicated.

To find out which information is currently provided by organic retail traders expert interviews were conducted in February and March 2020 in different organic shopping locations (e. g. organic stores and supermarkets or organic butchers). The interviews were conducted with the persons in the company responsible for marketing.

Both the focus groups and the expert interviews were recorded and analysed using qualitative content analysis.

## RESULTS

Although, to some participants none of this information was new, others mentioned very different aspects. In particular, the preservation of diversity as a goal of organic farming or details on animal-friendly husbandry were convincing most.

This information does not lead to a change in the perception of organic food for all the discussants. Among other things, this is due to the fact that the information corresponds to the pre-existing expectations of some participants. In terms of trust, opinions are also mixed as to whether (this) information helps to strengthen trust. For some, however, it can, while others want even more information. The trust of well-informed consumers can be strengthened by information as this confirms their already existing knowledge. Non-informed consumers need information first in order to even be able to trust.

Many different ideas were discussed on how the information should be conveyed, but online-based information options (especially QR codes, but also links to homepages on product packages) as well as information in the shopping places are desired most.

Expert interviews revealed that information at the point of sale need to be brief and rather in a headline modus. Complex information about e. g. principles of organic farming are not grasped during shopping. Moreover, the experts expressed doubts about the extent to which consumers are at all interested in such details. Nevertheless, some retailers established various communication channels, such as mail distribution lists, a well-designed homepage or social media accounts to provide information for interested

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customers. At the time of the interviews (2020) QR Codes were not assessed as a practical communication tool. However, this view might have changed as QR codes became very popular during the Corona pandemic.

#### DISCUSSION

Consumers express a need for information, especially about the aspects they cannot verify themselves, such as organic animal husbandry and thus also organic production.

Regarding trust, the need for information confirms the findings of Kushwah et al. (2019), as consumers mainly have doubts regarding organic production, the meaning of organic labels, and are also partly unaware of what "organic" even means. They ask for information that presents complex interrelationships, circular economy and biodiversity. This presents a challenge for communication as there should be no overload either (Terlau and Hirsch, 2015). Therefore, information in shopping places should be focused on the most important things. Consumers can obtain further information through online-based information options. A mix of communication channels should be used to communicate the positive attributes of organic food (Sultan et al., 2020). However, even if these are perceived by consumers and improve their attitude towards organic food, this does not automatically result into trust. Meijboom et al. (2006) argue that trustworthiness of the food sector is a relevant precondition for trust. This is supported by Thorsøe (2015) who discusses the role of credibility of the food sector in regard to trust. Both conclude that information and transparency are important aspects in gaining consumers trust, however, communicating values and exploring the motivation of actors in the organic sector might be even more important.

Critically, however, it must be considered that this is not a representative study due to the low number of participants. In addition, regarding focus groups, it cannot be ruled out that the participants gave socially desirable answers.

#### CONCLUSION

In terms of content, the organic industry and organic trade should focus primarily on communicating the special features of organic farming and organic animal husbandry. This includes the process of organic production but also the other goals like the preservation of diversity. Particularly convincing were the goal of maintaining diversity, the information on circular economy and animal husbandry. Furthermore, the meaning of the labels must be communicated. Online-based communication options should be used for this – with QR codes being particularly attractive – and information directly in the shopping places, e. g. through signs/boards next to the organic food, flyers or even videos. Overall, a variety of communication channels must be used to reach as many consumers as possible. The organic sector and organic retailers should align themselves with consumer wishes to strengthen not only consumer trust but also sales.

#### ACKNOWLEDGEMENT

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#### REFERENCES

- Darby, M. R. and Karni, E. (1973). Free Competition and the Optimal Amount of Fraud. *The Journal of Law and Economics* 16(1): 67-88.
- Kushwah, S., Dhir, A., Sagar, M. and Gupta, B. (2019). Determinants of organic food consumption. A systematic literature review on motives and barriers. *Appetite* 143(2019): 104402.
- Lamnek, S. (2010). *Qualitative Sozialforschung*, 5th ed. Weinheim/Basel: Beltz Verlag.
- Meijboom, F. L. B., Visak, T. and Brom, F.W.A. (2006). From Trust to Trustworthiness: Why Information is not Enough in the Food Sector. *Journal of Agricultural and Environmental Ethics* 19: 427-442.
- Sobhanifard, Y. (2017). Hybrid modelling of the consumption of organic foods in Iran using explanatory factor analysis and an artificial neural network. *British Food Journal* 120(1): 44-58.
- Sultan, P., Tarafder, T., Pearson, D. and Henryks, J. (2020). Intention-behaviour gap and perceived behavioural control-behaviour gap in theory of planned behaviour: moderating roles of communication, satisfaction and trust in organic food consumption. *Food Quality and Preference* 81(2020): 103838.
- Teng, C.-C. and Wang, Y.-M. (2015). Decisional factors driving organic food consumption: Generation of consumer purchase intentions. *British Food Journal* 117(3): 1066-1081.
- Terlau, W. and Hirsch, D. (2015). Sustainable Consumption and the Attitude-Behaviour-Gap Phenomenon – Causes and Measurements towards a Sustainable Development. *International Journal on Food System Dynamics* 6(3): 159–174.
- Thorsøe, M. H. (2015). Maintaining Trust and Credibility in a Continuously Evolving Organic Food System. *Journal of Agricultural and Environmental Ethics* 28: 767-787.
- Vega-Zamora, M., Torres-Ruiz, F. J. and Parras-Rosa, M. (2019). Towards sustainable consumption: Keys to communication for improving trust in organic foods. *Journal of Cleaner Production* 216: 511-519.

# Motives and Information-based Clustering of German Plant-based Meat Consumers

Laura Hellstern and Beate Gebhardt<sup>1</sup>

**Abstract** - The aim of this study is to segment consumers of plant-based meat products into heterogeneous groups based on their motives and their information behaviour. The four resulting clusters are more heterogeneous in their characteristics than a segmentation based on dietary styles. They can be better addressed by tailored information content and communication channels.

## INTRODUCTION

The number of people who classify themselves as vegetarians or meat avoiders is rising. However, in 2020 the number of vegetarians (5%) and vegans (2%) keep smaller than the new group of flexitarians (27%) (veganz, 2021). According to the ENSA definition (2014: 44), plant-based foods are consumed at the same times and in the same ways as meat and dairy products. Therefore, flexitarians who actively reduce animal-derived food products are considered to have a high growth potential and economic value in the booming market of vegan products – also known as “plant-based (PB) foods” (Gebhardt & Hadwiger, 2021). But who are these flexitarians? It is crucial to characterize target groups as precisely as possible for companies aiming to withstand competition in the saturated German food market and to respond to current developments in consumer behaviour (Nitzko & Spiller, 2014). Regarding the consumption or the abandonment of meat, segmentations of consumers are often based on their dietary style (e.g. Dagevos, 2021). While vegetarian and omnivore dietary styles are clearly defined and distinguished from each other by consistent characteristics, flexitarianism is not (Peuker, 2016). The flexitarian group includes individuals whose consumption is similar to that of the omnivores, but animal products are actively reduced or whose diet is similar to that of vegetarians. Furthermore, there are different forms of flexitarianism, e.g. conscious flexitarians, unconscious flexitarians or extravert flexitarians (Dagevos & Voordouw, 2013).

This paper addresses the question of how consumers of PB meat products can be better segmented and how they can be best addressed according to their motives and information behaviour.

## METHODOLOGY

To answer the research question, the analyses were based on a data set of the two-staged empirical European study “The V-Place – Enabling consumer choice in Vegan or Vegetarian Food Products”. The study was carried out 2020 in France, Italy, Spain, Denmark, Poland, and Germany. Ultimately online responses of German consumers (in total n=448)

were chosen for the analyses using SPSS 27. In the first step, motives for consuming PB meat products were grouped into five dimensions using categorical principal component analysis (CATPCA) (see Table 1). In the second step, the object values resulting from the CATPCA were clustered using the k-means method, resulting in two clusters. These two clusters, in combination with the dummy variables of the information interest, were analysed by applying the two-step cluster analysis.

**Table 1.** Framework of plant-based food consumption motives.

Product orientation	Attitude orientation	Health orientation	Sustainability orientation	Openness orientation
Taste/flavour experience	Family/friends/peers diet	Health benefits	Environmental consciousness	Add variety to my diet
Texture/mouthfeel	Food related intolerances	Health concerns	Social consciousness	Like to try out new products
Convenience in usage	Religious reasons	Beneficial for well-being	Animal welfare	
Price	Trend/lifestyle/popularity	Naturalness		
Availability market/shops/restaurants				

Source: Own estimation results.

## RESULTS

The result of the analysis are four segments of consumers of PB meat products (see Table 2). The smallest segment A “Low interested economists” (10.4%) comprises exclusively disinterested consumers, who are never searching for information about PB diets and food products. The share of self-proclaimed omnivores is highest and the replacement frequency of conventional with PB meat (25.6%) as well as the share of organic foods in the diet is lowest compared to the other clusters. This group is most strongly reflected in the product orientation dimension. To encourage this group to purchase PB food products, the availability and taste of the products should be more communicated above all. This consumer group prefers product tests, followed by documentaries as formats when seeking information about food. The formats should be accessible online and provided best by public or governmental organizations.

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**Table 2.** Characteristics and informational needs of the new segments of plant-based meat consumers.

	A	B	C	D
<b>n (%)</b>	46 (10.4%)	127 (28.6%)	188 (42.1%)	83 (18.7%)
<b>Plant-based dietary style</b>				
Omnivorous	76.1%	45.7%	55.9%	38.6%
Flexitarian	19.6%	41.7%	28.2%	41%
Pescetarian	2.2%	4.7%	5.9%	13.3%
Vegetarian	2.2%	7.1%	8.5%	3.6%
Vegan	0%	0.8%	1.6%	3.6%
<b>Share of organic<sup>a</sup></b>				
0%	15.2%	1.6%	2.1%	0%
Up to 25%	60.9%	42.5%	45.2%	34.9%
26 to 50%	15.2%	43.3%	39.4%	37.3%
51 to 75%	8.7%	12.6%	12.2%	21.7%
76 to 100%	0%	0%	1.1%	6.0%
<b>Meat substitution frequency<sup>b</sup></b>	∅	25.6%	57.1%	45.2%
<b>Information behaviour<sup>c</sup></b>	Disinterested	Medium interested	Medium interested	Highly interested
<b>Information content need</b>				
TOP 1	Market availability			
TOP 2	Taste	Health, Sustainability	Sustainability, Taste	Sustainability, Ingredients
<b>Information formats<sup>d</sup></b>				
TOP 1	Product tests			
TOP 2	Documentaries		Labels / Nutrient info on packaging	
<b>Procurement channel<sup>e</sup></b>				
TOP 1	Online, e.g. internet; websites			
TOP 2	Personal conversations			TV
<b>Trustworthy sources<sup>f</sup></b>				
TOP 1	Public / Governmental organizations	Independent consumer organizations	Scientists / research centres	Nutritional professionals (Dietitians); Vegan/vegetarian organizations

<sup>a</sup> What is the share of organic food products in your diet?  
<sup>b</sup> To what extent are you using/choosing plant-based alternatives over conventional meat products, e.g. plant-protein burger patties over beef burger patties; plant-protein nuggets over chicken nuggets? (Slider 0 – 100%) 0% = I am always using/ choosing conventional meat products, 100% = I am always using/ choosing plant-based alternative products  
<sup>c</sup> Are you searching for information about plant-based diets and products? Often (=highly interested consumers), sometimes (=medium interested consumers), never (=disinterested consumers)  
<sup>d</sup> When it comes to acquiring food related information, what are the most attractive formats for you? Please select max 5 answers.  
<sup>e</sup> When it comes to acquiring food related information, where are you most likely to search for it? Please select max 3 answers.  
<sup>f</sup> Which of the following information sources, do you consider the most trustworthy ones, when acquiring food related information? Please select max 5 answers.

Source: Own estimation results.

In segment B “Medium interested well-bees” (28.6%) the top motives for consuming PB meat products are well-being and expected health benefits. The cluster comprises medium interested consumers – who are sometimes searching for information about PB diets and food products. It is dominated by self-proclaimed omnivores and flexitarians. The replacement frequency of conventional with PB meat is about 57 percent. The target group communication should include information about availability, health value and sustainability of the products. Just like the previously described segment, segment B prefers product tests, followed by documentaries as formats when searching for information about food. The formats should be available online and be delivered by independent consumer organizations.

The largest segment C “Medium interested naturalists” (42.1%) likewise exclusively comprises medium interested consumers. However, the replacement frequency is lower (45.2%) than for the “Medium interested well-bees” and the motives also differ – in this segment, naturalness and animal welfare are the most important ones. The share of self-proclaimed vegetarians is highest in this segment. In addition to the offer, the target group approach should also include sustainability and taste. Segment C prefers product tests, followed by labels or nutritional information on the packaging as information formats about food. The formats should be accessible online and provided by scientists or research centres.

The “Highly interested sustainablists” (segment D) comprising interested consumers – who are often searching for information about PB diets and products – shows the highest replacement frequency (67.5%) and the highest share of pescetarians and vegans. This segment is reflected above all in the sustainability orientation dimension. The shares of organic food were the highest compared to the other clusters. The target group approach should focus on the offer, sustainability and ingredients of PB meat products. Segment D as well prefers product tests,

followed by labels or nutritional information on the packaging as information formats. The formats should be available online and best delivered by nutritionists (dietitians) and vegan or vegetarian organizations.

## CONCLUSION

The clustering designed in this paper provides four heterogeneous consumer segments, which enables target group-specific communication schemes with respect to PB meat products and considering the aspirations of the target groups (Nitzko & Spiller, 2014). More details on sustainability issues of PB meat products seemed to be the relevant topic in communication across the board for all target groups (Gebhardt & Hadwiger, 2021), but different focal points are necessary. It is evident across all new segments that scientists, governmental organizations and independent consumer organizations in particular are assessed as trustworthy, despite of differences in the perceived trustworthiness of various sources of information. Companies can adapt the provision and type of information to the target groups in order to address them in the best possible way. Although the segmentation concept in this chapter relates to Germany, it can be adapted to other countries. Additional, further research on non-consumers of PB foods is recommended.

## ACKNOWLEDGEMENT

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## REFERENCES

- Dagevos, H. (2021). Finding flexitarians: Current studies on meat eaters and meat reducers. *Trends in Food Science & Technology* 114: 530-539.
- Dagevos, H. and Voordouw, J. (2013). Sustainability and meat consumption: is reduction realistic? *Sustainability: Science, Practice and Policy* 9(2): 60-69.
- ENSA (2014). Growing appetite for a healthy and sustainable diet: Soyfood production and consumption in Europe.
- Gebhardt, B. & Hadwiger, K. (2021). Plant-based foods – The product-related potential and challenges to the European food industry. In: Proceedings of Conference on Food Reformulation – Regulation and Marketing. June 18, 2021.
- Nitzko, S. and Spiller, A. (2014). Zielgruppenansätze in der Lebensmittelvermarktung. In: M. Halfmann (Ed.): *Zielgruppen im Konsumentenmarketing*, Wiesbaden: Springer Fachmedien, 315-332.
- Peuker, B. (2016). Das eklektische Verbraucherverhalten – einen Verbrauchertypus neu denken? *Haushalt in Bildung & Forschung* 5(3): 47-58.
- Veganz (2021). Ernährungsreport Zahlen 2021. Berlin.

# Less healthy foods for the poor! - Russia-Ukraine War and its aftermath on vulnerable households groups in Germany

Clara Mehlhose and Adriano Profeta<sup>1</sup>

**Abstract - The Russia-Ukraine war has dominated the daily lives of people in Germany since February 2022. Different age groups are affected to a very different extent. Against this background, this article examines the extent to which changes in dietary and food shopping behaviour and stress perception can be observed in different (age) cohorts. Based on an online survey 1.473 subjects were interviewed about their dietary and health behaviour, anxiety and everyday stress. It is hypothesized that lower-income households and vulnerable populations (e.g. families with children) are significantly more impacted by the effects of the war regarding dietary and purchasing behaviour.**

## INTRODUCTION

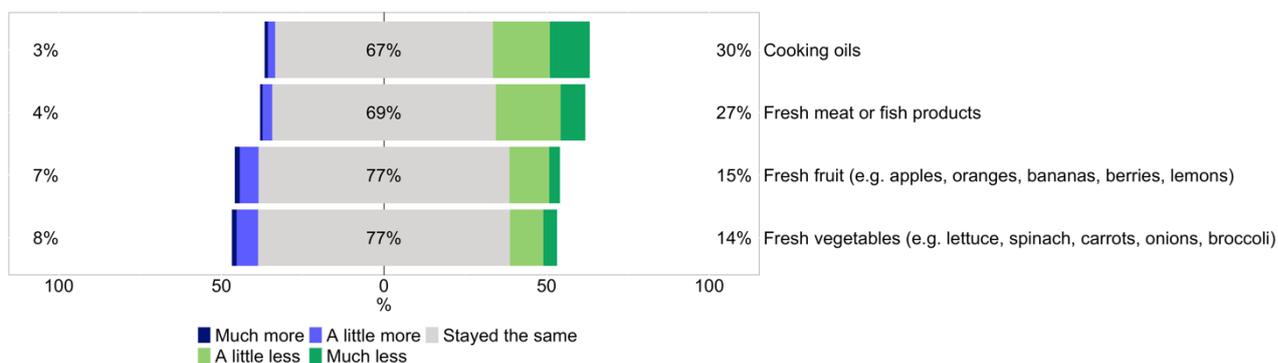
Since the end of February 2022, news about the war between Russia and Ukraine has dominated the daily lives of people in Germany. Many people are concerned not only by the shock of an actual armed conflict in Europe but also by the associated economic and social consequences. Now that the consequences of the Corona pandemic have not yet been overcome, the war is again presenting people with major challenges in many respects. During the Corona pandemic, for example, it was noticed that the perception of "feeling alone" and the sense of stress increased for many people. Younger people, in particular, felt very stressed and additionally also significantly more stressed than in the first lockdown at the beginning of 2020 (Busch et al., 2021). At the same time, it was observed that people's dietary behaviour has also changed.

On the one hand, more fruit and vegetables were consumed, but at the same time, the proportion of people consuming more snacks and junk food also increased (Busch et al., 2021). Against the background of the war and the resulting price increases for energy and food products, it is questionable to what extent these developments will continue or perhaps even develop in the opposite direction. Therefore, this article examines the current war's impact on the emotional state and the purchasing and dietary behaviour of German consumers. Since it became apparent during the Corona pandemic that young people felt burdened and stressed (Busch et al., 2021), we would like to focus in particular on the extent to which possible changes in food and eating behaviour are becoming visible depending on age group.

## METHODS

The study was conducted in April 2022, 8 weeks after the start of the war. 1.473 people were interviewed. The subjects were recruited via an online access panel provider (gapfish). The sample is representative of the German population in terms of age, gender, education, income and regional distribution. In the questionnaire, the respondent was asked about the change in food consumption that is due to the Russia-Ukraine conflict. The concrete question was: "To what extent has your \_\_consumption\_\_ of food changed compared to before the outbreak of the Russia-Ukraine conflict? Which of the following foods do you currently consume more or less of than before the war began?". In this contribution, we present the descriptive results for different consumer segments that were categorized according to income, age, and the number of kids in the household. The change in consumption was measured on a five-point-scale from much less, a little less, stayed the same, a little more, to much more.

Figure 1: Changes in food consumption due to war



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Figure 2: Change in consumption according to income

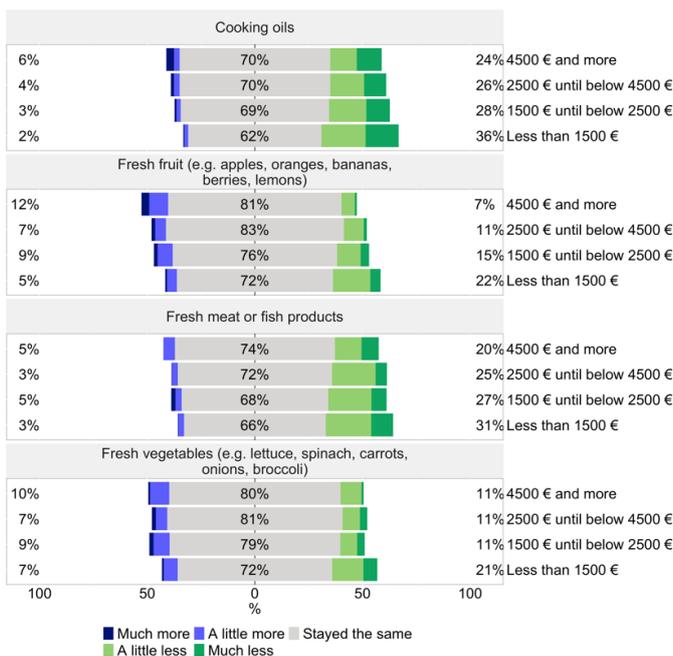
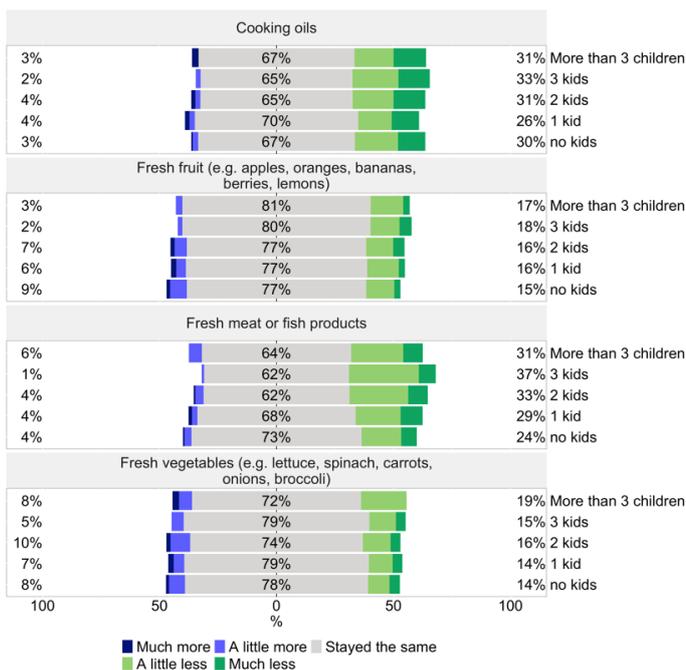


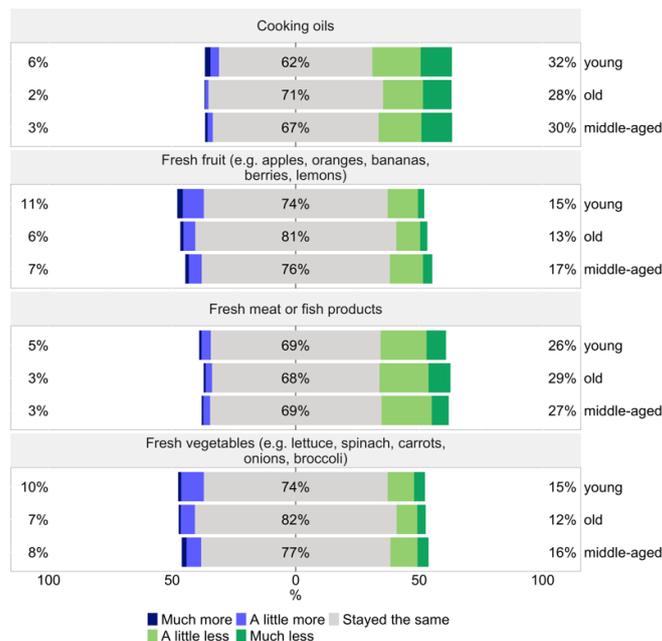
Figure 3: Change in consumption according to the number of kids in the household



**RESULTS**

The findings clearly show that there is, in particular, reduced consumption of edible oils, fresh meat, fresh fruits and vegetables (see Figure 1). Concerning consumer segments, it can be found that lower incomes and a higher number of children in the household lead to lower consumption of healthy product categories, such as fresh fruits and vegetables (see Figures 2 and 3). Similarly, it can be found in meat consumption. Interestingly, only minor differences across age groups can be identified for age.

Figure 4: Change in consumption according to age



The reasons for the changes can be found in increasing prices respectively. Thus, the war caused shock waves that even influenced the diet health in industrialized countries like Germany with all its consequences.

**DISCUSSION & CONCLUSION**

In consumer research, it is known that key moments or drastic experiences can be triggers for long-term behavioural changes. The Russia-Ukraine conflict has led to an economic crisis that affects, in particular, the diet in poor households and households with children. The reduced consumption of healthy product categories can be considered severe and political measures must be taken (e.g. reduced taxes on fresh fruits or vegetables) to counteract this negative effect.

**REFERENCES**

Busch, G., Bayer, E., Iweala, S., Mehlhose, C., Rubach, C., Schütz, A., Ullmann, A., Spiller, A. (2021): Einkaufs- und Ernährungsverhalten sowie Resilienz des Ernährungssystems aus Sicht der Bevölkerung: Eine Studie während der Corona-Pandemie im November 2020. Ergebnisse der dritten Befragungswelle, Diskussionsbeitrag Nr. 2102 des Departments für Agrarökonomie und Rurale Entwicklung der Georg-August-Universität Göttingen, Göttingen, April 2021.

Herber, K. (2014). Auslöser und Modifikation emotionalen Essverhaltens – Feldstudien zum emotionalen Essverhalten und seiner Veränderung durch ein achtsamkeitsbasiertes Training. Julius-Maximilians-Universität Würzburg, Würzburg.

# PARALLEL SESSION 4

# REGIONAL DEVELOPMENT AND VALUE CHAINS



# Adaptation strategies of stakeholders in a region with concentrated livestock production during accelerated structural change

Verena Beck, Josef Efken and Anne Margarian<sup>1</sup>

**Abstract - Livestock density in Germany is most highly concentrated in the north-west of Germany. It is also associated with serious environmental problems due to land, air and water pollution. The enforcement of regulations targeting a reduction of livestock will particularly affect intensive livestock regions (BMU 2016; BMEL 2019). We present first results of a qualitative study on the adaptation strategies of regional actors in the livestock value chain facing the potential reduction of livestock in north-west Germany. The analyses are based on data from interviews with stakeholders. The theory of Strategic Action Fields (SAF) provides the analytical framework. Our preliminary findings indicate that in the face of declining livestock numbers, change is taking place in the field of the old production system. However, the behaviour of some incumbents also favours path dependence, making more radical change difficult. The likelihood of drastic field transformation depends on the strength of the incumbent groups as well as the attitude of relevant state actors.**

## INTRODUCTION

High livestock density in Germany is mainly concentrated in north-west Germany. Nine of the ten districts with the highest livestock densities per agriculturally used area are located in Lower Saxony and North Rhine-Westphalia. The case study region focuses on the districts of Cloppenburg, Emsland, Grafschaft Bentheim, Osnabrück and Vechta in Lower Saxony and the districts of Borken, Coesfeld, Steinfurt and Warendorf in North Rhine-Westphalia. Pig and poultry farming are particularly strong in the case study region. The high production levels not only contribute to economic prosperity, but also cause serious environmental problems. In general, the reduction of livestock is considered inevitable if standards for the protection of land, air and water are to be upheld (BMU 2016; BMEL 2019). If this reduction occurs, the region's livestock production as well as its upstream and downstream sectors will have to deal with strong changes. The adaptation to these changes depends strongly on individual and corporate agents' willingness to develop and implement new solutions in the context of new challenges. Therefore, we analyse the region's adaptability to possible livestock reduction from an actor-centred perspective to answer the following research question: What are the adaptation strategies of different stakeholders in the regional livestock value chain in the face of accelerated structural change?

## METHODS

Conceptually, we refer to the theory of Strategic Action Fields (SAF) by Fligstein and McAdam (2011, 2015). Fligstein and McAdam define SAFs as "the fundamental units of collective action in society" (Fligstein and McAdam 2011, p. 3) that are "comprised of *incumbents*, *challengers*, and, sometimes, *governance units*" (Fligstein and McAdam 2011, p. 5). The participants in an SAF depend on the definition of the situation and the issue at stake. Examples for SAF are value chains, social movements, or governmental systems. The authors assume that SAFs are typically destabilized by exogenous shocks, such as "(1) invasion by outside groups, (2) changes in fields upon which the strategic action field in question is dependent, and (3) those rare macro events (e.g., war, depression) that serve to destabilize the broader social/political context in which the field is embedded" (Fligstein and McAdam 2015, p. 99). The transformation of a field is linked to the successful realization of innovations that have the potential to disrupt the ways things are done in the field. Potentially disruptive changes are often driven forward by "outside challengers", that means groups that had previously not been active "players" in the field (Fligstein and McAdam 2011, p. 15). The possibility for transformation increases if state actors will not protect the incumbents' social order.

Our analyses are based on information from stakeholder interviews.<sup>2</sup> The main criterion for the selection of the stakeholder interview partners is their regional and industrial link to the pig and poultry value chain within the region. The pig and poultry sector in the region is very heterogeneous. Therefore, the spectrum of stakeholders included in the study is wide. Stakeholder interviews are utilised to identify key actors' strategies and to assess their individual and collective networks. 35 stakeholder interviews with actors from the private sector who are directly or indirectly affected by livestock farming were conducted between January and May 2021. The interviews are evaluated using the qualitative content analysis according to Mayring (2010).

## PRELIMINARY RESULTS

In this paper, we define the pig and poultry value chains (pig, poultry, and egg production) in the case study region as an SAF. They include the upstream, the midstream and the downstream sector. Its stakeholders are classified as incumbents. The incumbents differ significantly in terms of their use of

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<sup>2</sup> In addition, 21 expert interviews were conducted. This paper provides first insights from interviews with stakeholders from the livestock value chain in the region. The analyses we present here are part of a larger project. In the project, qualitative analyses are complemented by a second, quantitative approach.

capital and technology and their employee profiles. Stakeholders operating in the alternative protein market segment are seen as potential challengers. There are few challengers located in the region. For example, a fast-growing producer of plant-based products from North Rhine-Westphalia who began producing tofu in the 1980s. The company does not position itself as a manufacturer of meat substitutes but rather highlights the benefits of plant-based products as well as plant-based nutrition. Pioneers with potentially disruptive innovations like the development of cultured in-vitro meat, for example, are stakeholders located in the Netherlands, the USA and Israel, meaning from outside the region.

So far, a general finding from the interviews is that the stakeholders in the pig and poultry value chains in the case study region have mostly experienced stable growth in recent years which was rarely seriously threatened by exogenous shocks. The incumbents pursue typical strategies to defend themselves against external risks that range from increasing their market share within existing market segments to expanding into new markets and/or developing new, but related products to diversify into new market and/or product segments that are no longer related to their core businesses.

The area of plant-based proteins offers growth potential in niches. Following the development of vegetarian and vegan product lines by a traditional meat processor in 2013, many other regional sausage and cold meats producers are now processing plant-based proteins. Some traditional meat processors started calling themselves "suppliers of protein products". Even a large slaughter company has expanded vertically into the plant-based market segment and produces vegetarian and vegan products. A leading poultry breeder and processor established a vegan product brand in 2015 to enter the alternative protein business. In addition, the company is focusing on strategic investments. These are the acquisition of distribution rights for the European market (e.g., for a U.S. company producing plant-based egg products), venture capital investments in start-ups operating in promising markets (e.g. start-ups active in cell-cultured meat, vegan fish products, insect-based burgers, and plant-based products) and the creation of a joint venture with a global fund that invests in companies in the plant-based food sector (the new company is expected to become its production and distribution arm in the European market). However, the other "big players" of the poultry industry have not gone down this path so far but rather focus on growth within the segment. Moreover, the mentioned investments of the company are mainly made outside the region.

## CONCLUSIONS

Environmental problems require a reduction of regional livestock densities. The adaptation strategies of stakeholders offer opportunities to transform the field of the old production regime and, besides, to meet environmental standards. Applying the Theory of SAF, the success of transforming the field depends, among other things, on the realization of disruptive innovations and the attitude of state actors.

Our preliminary findings show so far that there are challengers to the old production regime. For example, within the protein-related nutrition market the incumbents from the classical meat sector are challenged by new offers of insect-, plant- and cell-based substitution products. Potentially disruptive innovations like the development of cultured in-vitro meat are not driven forward by the incumbent actors in the field but by challenger groups from outside the field. If, in the long-term, these new products replace large fractions of the traditional meat markets, risk-averse incumbents of the case study region would be in danger of falling behind. An example of a risk-taking incumbent of the case study region is a poultry meat production enterprise. It is actively investing in cell-based meat. Since the enterprise lacks internal know-how in these new fields, it acquires market segments by investing in start-ups, for example, in order to realize growth opportunities in the future. However, these investments are mainly made outside the region. In the area of plant-based proteins we observe more activity in the region. The spatial linkage and the upstream integration of the meat processors to livestock production is weaker than in the preceding stages. It is possible that this relative independence from the regional production regime and its development explains the greater willingness of these enterprises to experiment. This is because their future importance depends to a lesser extent on the development of the local livestock, slaughter and meat industry.

Concerns about environmental problems have made the reduction of livestock density a prominent political question. At the same time, state actors have an interest in keeping capital and labour in the region. Therefore, policy makers should try to motivate the adapting incumbents as well as the existing challengers to keep their investments in the region.

## REFERENCES

- BMEL (Ed.). (2019). *Nutztierstrategie: Zukunftsfähige Tierhaltung in Deutschland*. Berlin.
- BMU (Ed.). (2016). *Klimaschutzplan 2050: Klimaschutzpolitische Grundsätze und Ziele der Bundesregierung*. Berlin.
- Fligstein, N., & McAdam, D. (2011). Toward a General Theory of Strategic Action Fields. *Sociological Theory*, 29(1), 1–26.
- Fligstein, N., & McAdam, D. (2015). *A theory of fields*. Oxford: Oxford Univ. Press.
- Mayring, P. (2010). *Qualitative Inhaltsanalyse: Grundlagen und Techniken*. Weinheim Basel: Beltz Verlagsgruppe.

# Agrivoltaics in regional planning - an integrated assessment framework

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**Abstract** – The expansion of renewable energies often faces trade-offs with other objectives such as food security and biodiversity. Agrivoltaics (APV) is a dual-land use system mitigating this trilemma by allowing for the production of electricity and agriculture on the same location. Yet, while it is politically desired it requires adequate regional planning. Using the Stuttgart Region as a case study, we developed an integrated assessment framework to identify potential priority APV sites on arable land. Agricultural income, nature conservation, landscape aesthetics and power feed-in are used as weighted criteria in an optimization model. Especially the agricultural income decreases with increasing expansion of APV. Also prioritising landscape aesthetics leads to higher income losses for agriculture. The framework is useful for subsequent research like scenario analysis with relevant stakeholders.

## INTRODUCTION

The transformation towards a carbon neutral energy supply is particularly relevant to mitigate climate change and reducing the dependency of fossil resources, which also requires a considerable expansion of photovoltaics. Ground-mounted photovoltaics are often related with farmland consumption and associated conflicts, for instance with agriculture (Trommsdorff et al., 2020). In this context, agrivoltaics (APV) could be one solution to overcome conflicts of interest and to improve land use efficiency (Schindele et al., 2020). Although, the technology is rarely implemented in Germany (Trommsdorff et al., 2020), it is politically desired on arable land in particular, however, not on grassland for nature conservation reasons (Die Bundesregierung, 2022). APV thus must be also addressed in regional planning, which requires consideration of conflicting goals, e. g. nature conservation objectives or acceptance by society, i. e., impacts on landscape aesthetics (Trommsdorff et al., 2020). In this context, we provide an integrated assessment framework to support the consideration of APV in regional planning at the example of arable land in the Stuttgart Region in Germany. Grassland is excluded. We aim to identify priority APV sites and to show potential conflicts between four different criteria for regional APV expansion.

## MATERIAL AND METHODS

For analysis we use the system design of the research APV plant in Heggelbach (Germany) with an installed capacity of 0.52 MWp per ha as example (Schindele et al., 2020). In the first step we identified areas that disable implementation of APV in cooperation with the regional planning unit ("Verband Region Stuttgart"), a catalogue of criteria for ground-mounted solar

systems by LUBW (2021a) and we excluded areas with an average slope above 7% (oral information from Mr. Schindele, BayWa AG, 15.11.2021). 37% of arable land were considered as not suitable for APV at all (LUBW, 2021b; BKG, 2021a; BKG, 2021b).

All remaining arable field plots (n=49,492) were then assigned a score between 1 and 10 for the criteria: agricultural income, nature conservation, landscape aesthetics and power feed-in possibility. In case of agricultural income, the region was divided into pixels of 100 ha and each plot within a pixel was assigned the observed crop share of the pixel from the Integrated Administration and Control System 2021 as well as a yield capacity (low, medium, high) according to LGRB (2015). Annual gross margin changes (GM) were calculated by plot for implementing APV (LEL, 2021; LfL, 2021; KTBL, 2021). Therefore, assumptions were made about changes in crop yields due to shading (e. g. -33.4% in winter wheat) and crop management costs (+2% variable machine costs), as well as a 8% area loss of 8% caused by APV (Laub et al., 2021; Artru et al., 2018; Trommsdorff et al., 2016). Finally, plots with no GM reduction were given a score of 1, plots with a reduction of more than 800 € per ha were given a score of 10, i. e. increase of 1 per 100 € GM loss. For nature conservation, we used a map showing areas with particularly high values for extensive arable farming, thus having a high suitability for nature conservation. (Sponagel et al., 2021). We have assumed that land suitability for APV decreases with increasing nature conservation value. For this criteria the plots received a value between 1 (lowest value) and 10 (highest value). To assess landscape aesthetics we used the map from Roser (2014), which assigns field plots a value from 0 to 10, where 0 and 1 were aggregated to the score 1. To evaluate the possibility for power feed-in, the distance between plots and the closest commercial area was calculated (BKG 2021a). Scores were assigned from 1 to 10 in steps of 500 m. The scores by criteria and plot were summed with equal weights. In the objective function of a linear programming model, the APV area per plot was multiplied by the total plot score. For a given APV capacity the sum over all plots was minimised. In addition, food production was assessed in cereal units.

## RESULTS

Figure 1 shows the development of the average scores by criteria of the APV plots with increasing installed capacity. Up to an installed capacity of 10 GWp (27% of arable land in the region), the average score for power feed-in remains rather low up to 1.75 (< 1 km distance). The average scores for landscape aesthetics and nature conservation seem to be rather close to each other between 3 and 3.6. The

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development of the score for agriculture is worth highlighting. Up to a capacity of 3 GWp, this increases sharply to a score of around 6, which means GM reductions between 400 and 500 € per ha. Only up to an expansion of about 0.2 GWp the score for agriculture is up to 2, which would mean GM changes up -100 € per ha-. The implementation of APV also impacts food supply: from -0.8% for 1 GWp up to -9% for 10 GWp.

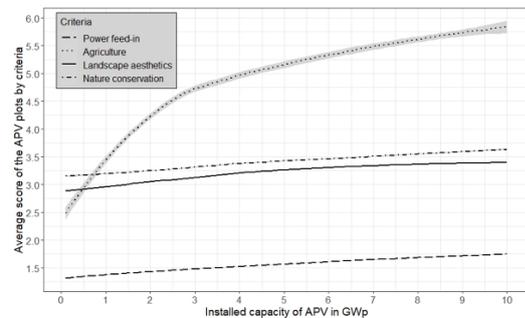


Figure 1. Development of the average score per subject with increasing installed capacity of APV.

If plots with a score greater than 2 for landscape aesthetics are not considered for APV, the expansion of APV is limited to 2 GWp and the average score for agriculture increases up to 7.4 (+70%), which means about 300 € higher average GM losses per ha. The average scores for nature conservation and energy feed-in just increase by 26% and 33%. In addition, a change in spatial distribution of the APV areas can be observed as shown for 1 GWp APV in Figure 2.

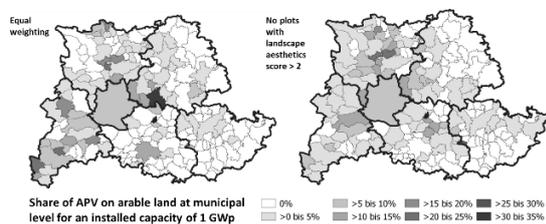


Figure 2. Share of arable land with APV at municipal level with and without landscape aesthetics prioritisation (BKG, 2022).

#### DISCUSSION AND CONCLUSIONS

We provided a framework for an integrated assessment of arable land for the implementation of APV. Under the assumption of equal criteria weighting average scores for nature conservation and landscape aesthetics are rather on a moderate level up to 10 GWp installed capacity. In particular, agricultural income declines with increasing expansion of APV. When interpreting the results, however, some limitations of the applied approach should be kept in mind. This refers to selected criteria and score assignment. Changes in GMs were calculated in a simplified manner, i. e. crop rotation adjustments were not considered. This should be done in a next step. Our results are particular relevant for decision makers in the field of regional planning and help to identify priority areas for APV. Subsequent research

should refine the approach, in particular with formation of scenarios with the relevant stakeholders or transfer to other regions.

#### REFERENCES

- Artru, S., Lassois, L., Vancutsem, F., Reubens, B., Garré, S. (2018). Sugar beet development under dynamic shade environments in temperate conditions. *European Journal of Agronomy* 97:38–47.
- BKG (2021a). CORINE Land Cover 5 ha, Stand 2018. URL: [bit.ly/3oRR8yG](https://bit.ly/3oRR8yG) (31.01.2022).
- BKG (2021b). *Digitales Geländemodell Gitterweite 200 m*. URL: [bit.ly/3sJnzAC](https://bit.ly/3sJnzAC) (31.01.2022).
- BKG (2022). VG250. URL: [bit.ly/38f6doM](https://bit.ly/38f6doM) (24.02.2022).
- Die Bundesregierung (2022): *Eckpunktepapier BMWK, BMUV und BMEL*. URL: [bit.ly/37v7sAc](https://bit.ly/37v7sAc) (22.04.2022).
- KTBL (2021). *Leistungs-Kostenrechnung-Pflanzenbau*. URL: [bit.ly/3rSMwKx](https://bit.ly/3rSMwKx) (31.01.2022).
- Laub, M., Pataczek, L., Feuerbacher, A., Zikeli, S.; Högy, P. (2021). Contrasting yield responses at varying levels of shade suggest different suitability of crops for dual land-use systems. A meta-analysis.
- LEL (2021). *Kalkulationsdaten Marktfrüchte*. URL: [bit.ly/3rSPNJW](https://bit.ly/3rSPNJW) (28.01.2022).
- LfL (2021). *LfL Deckungsbeiträge und Kalkulationsdaten*. URL: [bit.ly/3HODQdP](https://bit.ly/3HODQdP) (31.01.2022).
- LGRB (2015). *Bodenkarte von Baden-Württemberg 1: 50 000* URL: <https://bit.ly/3LBvOap> (24.01.2021).
- LUBW (2021a). *Kriterienkatalog für die Potenzialerhebung für Freiflächen-Photovoltaikanlagen*. URL: <https://bit.ly/33uyUfm> (31.01.2022).
- LUBW (2021b). *Daten- und Kartendienst*. URL: <https://bit.ly/34OOAdP> (31.01.2022).
- Roser, F. (2014). GIS-Daten und Landschaftsbild-Karte URL: [bit.ly/386bLBM](https://bit.ly/386bLBM) (13.11.2020).
- Schindele, S., Trommsdorff, M.; Schlaak, A., Oberfell, T., Bopp, G., Reise, C. et al. (2020): Implementation of agrophotovoltaics: Techno-economic analysis of the price-performance ratio and its policy implications. *Applied Energy* 265:114737.
- Sponagel, C., Raichle, A., Maier, M., Zhuber-Okrog, S., Greifenhagen-Kauffmann, U., Angenendt, E., Bahrs, E. (2021). Expert based maps as a regional planning tool supporting nature conservation and production-integrated compensation – A German case study on biodiversity offsets. *Land* 10(8):808.
- Trommsdorff, M. (2016): *An economic analysis of agrophotovoltaics: Opportunities, risks and strategies towards a more efficient land use*. [bit.ly/3BwPc3L](https://bit.ly/3BwPc3L) (28.01.2022).
- Trommsdorff, M., Gruber, S.; Keinath, T., Hopf, M., Hermann, C.; Schönberger, F. et al. (2020): *Agri-Photovoltaik: Chance für Landwirtschaft und Energiewende*. [bit.ly/3uQmytb](https://bit.ly/3uQmytb) (31.01.2022).

# Assessing diversity and changes of European farming structure

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**Abstract – Land systems in Europe face increasing challenges by societal demands for securing ecological quality and socio-economic development of farming as well as rural vitality. We present main findings from a study, carried out recently for the European Parliament, that aimed to assess the effect of the decline in the number of farms across the EU. It reviews the role of the European Farming Model (EFM), which builds on the notion of multifunctionality and provision of public goods. As such it is not a sectoral target but seeks to enhance beneficial land systems adapted to the diverse types of rural regions in Europe, thus fostering sustainability and resilience of farming activities. The findings of our study underscore that policy must embrace the emerging diversity of farmers' profiles and stimulate socially desirable adaptive strategies that preserve the social and ecological beneficial outcomes of farming.<sup>1</sup>**

## INTRODUCTION

Even if the original objectives of the Common Agricultural Policy (CAP) focused on food security and farm income, the broad concern for food systems has included aspects of ecological, social and territorial impact, as well as quality aspects, for a long time. This widely shared perspective has been incorporated in the notion of the "European Farming Model" (EFM), a term elaborated at the end of the 1990s to capture the specificity of farming practice in European regions, as compared to large-scale structures of land management in other farming systems of the industrialized world.

However, long-term technological, socio-economic and institutional changes have contributed to concentration of land management and markets that put strong pressure on this idealized picture of European farming. The relevance of the model is hence more and more questioned. As this trend is discerned primarily through the decline of its key characteristics (diversity of management features, benefits due to provision of multifunctional tasks, including highly valued public goods, and positive implications for socially and territorially balanced development of rural regions), concern about future structural development is rising.

This paper draws on the study "The Future of the European Farming Model", carried out by the authors for the European Parliament's Committee on Agriculture and Rural Development (Schuh et al. 2022). The project was committed to analysing the main socio-economic and territorial impacts of structural changes and adjustments on the EFM.

Research methods included classical quantitative synthesis work (desk and literature review, cluster and GIS analyses of structural trends over the last 20-30 years), as well as qualitative investigation of main drivers, inspired by five regional case studies and supplemented by risk analysis and forecasting as well as scenario building. The synthesis of findings builds upon expert contributions by external experts, triangulation of the quantitative and qualitative methods and results in recommendations for mitigating EU policies, both within and outside the remit of the Common Agricultural Policy.

## COMPLEXITY AND DYNAMICS OF LAND SYSTEMS

The paper focuses on the high complexity of drivers and the adverse trends of land management in social-ecological systems of European regions. Against the backdrop of the primacy of technological changes, an increasingly neoliberal policy framework, stifling climate change adaptation and short-term stakeholder interests, adapted policy responses are demanded. However, in this context of uncertainty, particularly aggravated by the recent multiple crises (financial, ecological, pandemic, and conflicts and wars), far-reaching scenarios have to be considered.

The dynamics of structural development point to a high geographical specificity and particular influence of national/regional regulation systems. According to location of agricultural areas and land systems specificities (Meyfroidt et al. 2021), the adaptation of EU regions is variable, with long-term structural change in farming, visible through a steady increase in average farm sizes and a concentration of production on fewer and larger farms. However, farmers of the future are not expected to be uniform but could differentiate into many distinct groups (Bock et al. 2020). These future "types" of farmers will have to respond to substantial changes of the social-ecological systems and imminent needs to foster sustainability and resilience. Many of these emerging profiles of farmers go beyond a simple small—large, or disadvantaged—competitive dichotomy, as they address specific functions and combine styles and activities with inter-relations to non-farming activities, different use of technologies and digital opportunities, as well as different product mixes and quality development benchmarks.

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#### CHALLENGES TO THE EUROPEAN FARMING MODEL

The study assessed the expected changes of farming practices not just in their quantitative effects on farm structure development but also in their ability to fulfil the core functions of the EFM. The outcomes will not only be observed in a decline of farm numbers, but will entail implications on landscape, ecology, value chain development, quality products, food system resilience, as well as through rural vitality issues. What makes the analysis of farm structural change particularly urgent is that effects are often hidden or visible only after a time lag, and changes are typically difficult to influence due to path dependency and irreversible effects.

First tentative scenarios discussed in this study highlight that irritating trends of structural development might be even exacerbated by current crises and increasing strain put on social-ecological systems. The heavy effects looming in a mid-term perspective due to climate change imply an intensified engagement with future farm structure options and adaptations.

To cope with these challenges, it seems important to be aware of the different characteristics of a set of drivers:

- The first group of factors relates to the general socio-economic context and thus is external to agriculture, but might have a strong impact, in particular on its value chains.
- The second group includes triggers for farms adaptation, like technological change and digitisation, input/output prices, agri-food chains and market organisation, as well as obstacles to agricultural productivity, access and land market regulation etc.
- The third group relates to public interventions, with an emphasis on CAP instruments.

#### DESIGNING APPROPRIATE POLICY RESPONSES

In seeking effective policy responses, we have to acknowledge that the first two sets of factors explain much more the adaptation decisions of farmers than drivers affected by direct policy implementation. Nevertheless, it is crucial to shape the policy framework so that it enhances the objectives of the EFM and contributes to socio-cultural shifts. This implies a more explicit focus on specific structural challenges and a deliberate orientation towards small- and medium-sized structures aiming to sustain their important functions (Guarín et al. 2020). In view of the transition to sustainable food systems, CAP measures require a thorough overhaul, also in terms of addressing structural objectives. The future CAP needs to be more open to new forms and types of agriculture, if the EFM is seen as a commonly shared model.

In view of the complex framework underpinning policy development and change in land system management, policy adaptation is not conceived as a primarily rational planning task. It is basically dependent on a host of assumptions of continuity or change, theoretical conceptions and creativity for change (Dax and Copus 2021). Given the current

universal challenges of climate change, resource depletion and interrelated food system resilience, as well as mobility effects and scenarios on future development, it is a contentious issue which pathway future policy should take and who, where and how reorientations towards social-ecological resilience should take place.

#### CONCLUSION

Multiple functions of agricultural activities have been perceived as a core framework for a common perception of land systems across European regions. This widely shared view found expression in policy design and the various reforms of CAP in the past. However, analysis of implementation found limited effectiveness and observed an ongoing farm decline throughout all areas. The main deficiencies are seen in the only partial orientation of the CAP towards the EFM's objectives and long-disproven misconceptions of land systems effects. Basically, the fundamental objectives of growth have not been altered to adjust towards an orientation on resilient farm systems and sustainable development pathways. Particularly due to rising global crises the relevance of the EFM and the urgency to turn towards supporting the inherent objectives is more and more justified.

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#### REFERENCES

- Bock, A.K., Krzysztofowicz, M., Rudkin, J. and Winthagen, V. (2020). *Farmers of the Future*. Publications Office of the European Union, Luxembourg.
- Dax, T. and Copus, A. (2020). *Final Report, Annex 13. How to achieve a transformation framework for Shrinking Rural Regions*. ESPON 2020 project ESCAPE. ESPON EGTC, Luxembourg. <https://www.espon.eu/escape>
- Guarín, A., Rivera, M., Pinto-Correia, T., Guiomar, N., Šūmane, S. and Moreno-Pérez, O.M. (2020). A new typology of small farms in Europe. *Global Food Security*, 26, 100389. DOI:10.1016/j.gfs.2020.100389
- Meyfroidt, P. et al. (2021). Ten facts about land systems for sustainability. *PNAS* 119(7), 1-12. Doi:10.1073/pnas.2109217118
- Schuh, B., Gaupp-Berghausen, M., Münch, A., Badouix, M., Hat, K., Brkanovic, S., Dax, T., Machold, I., Schroll, K., Juvančič, L., Erjavec, E., Rac, I. and Novak, A. (2022). *Research for AGRI Committee – The Future of the European Farming Model: Socio-economic and territorial implications of the decline in the number of farms and farmers in the EU*, European Parliament, Policy Department for Structural and Cohesion Policies, Brussels. <https://bit.ly/699-620>

# The Impact of IP on Agricultural Markets – Case Study in the Hop Industry

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**Abstract** - The rapid rise in the popularity of craft beer between 2010 and 2020, which resulted in global hop acreage growth, was known as the "Craft Revolution" by members of the U.S. hop and brewing industries. Craft beer brewing methods contrasted with the traditional recipes and practices of the macro breweries. In the quest for new flavors, craft brewers increasingly relied upon intellectual property (IP) in the form of proprietary hop varieties. As they incorporated the names of proprietary varieties into their marketing efforts, brewers relied upon access to these new varieties for their success. We calculated the increased market share for proprietary varieties relative to public varieties in the U.S., and the market share of the five largest companies that owned proprietary hop varieties. The latter revealed that one company owned varieties planted on 50% of U.S. acreage. Using these data and the Herfindahl-Hirschman Index (HHI), we analyzed the change in industry competitiveness between 2000-2020 and its result on pricing.

## INTRODUCTION

The companies developing proprietary hop varieties benefited from the unprecedented and rapid rise of the U.S. craft beer industry between 2010 and 2020. They could not have foreseen such a development when they began their programs. They were, however, well positioned to take advantage of the change and benefited from a first mover advantage. Licensing agreements of intellectual property (IP) facilitated the management of supply by a concentrated group of individuals. It would be unreasonable to assume these individuals would manage production of their IP in a way that would be financially disadvantageous to them or the companies they own. These individuals own entities that produce hops and those that market hops in addition to the entities that develop new varieties. Their production and marketing entities have benefitted from sustained high prices as have the third-party growers who produce them on contract. It is reasonable to assume IP owners would manage their IP in a way to encourage sustained premium pricing, and lower price variance. Due to the inelasticity of hop demand, a deficit would produce such conditions while creating the urgency to contract.

## MATERIAL AND METHODS

Using U.S. hop industry data and the Herfindahl-Hirschman Index (HHI), we were able to calculate the change in competitiveness over time as the proportion of proprietary varieties grew relative to the quantity of public varieties. The HHI is useful for evaluating changes in the competitiveness within a single industry over time or comparisons of one industry to another since it can be interpreted as a

number equivalent (Calkins, 1983). It decreases as the number of firms in the market increases (Depken, 1999). The HHI is responsive to asymmetry of market shares. For any number of participants in a market, the HHI will be lowest when market shares were equal, and highest when one firm has an extremely large share of the market (Calkins, 1983).

We proposed that by calculating the market share for each variety and by grouping those varieties together by ownership the market share of the entities involved in variety development could be calculated. The market share of these entities could then be calculated using the HHI to determine the degree of competitiveness within the proprietary market. We took this calculation one step further to consolidate the effect on competitiveness of branded proprietary varieties as a whole relative to public varieties. Branded proprietary varieties were products enjoyed monopoly control. They were governed by few individuals. Public varieties were available for any grower to produce. The contrast was stark enough to warrant a calculation comparing the two and that that calculation was representative of the direction of competitiveness within the market.

A potential drawback of the HHI according to Calkins (1983) is that small errors in estimating a firm's market share can produce large errors in the HHI. It was essential to keep this in mind when designing the parameters of any analysis.

The formula for the HHI is as follows:

The HHI Formula  $HHI = S_1^2 + S_2^2 + S_3^2 + \dots S_n^2$

Where:

N refers to the number of firms in the market

S1, S2, etc.... - refers to the percent market share each firm holds.

## RESULTS

We determined the market share of acreage in production an individual or entity could influence to be of greater impact on the market than the market share of sales of an individual or merchant. Concentration of control over a volume of hops, referred to as "one-desk selling" when it pertained to sales to breweries, was of equal or greater value when applied to production. This concentration combined with the complex monopoly structure of the industry reduced price competition between independent producers and sellers via licensing agreements.

Acreage, and the infrastructure necessary to harvest that acreage, was a more scarce and valuable resource in the hop industry in 2020 than the hops themselves. It was the asset for which there was the greatest competition. The primary method for harvesting hops was via fixed picking machine facilities. Yields of hops for the most popular

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proprietary varieties of 2020 were not higher than public aroma varieties. Their alpha acid yields, however, were significantly higher than public aroma varieties making them dual-use varieties – which is a designation meaning that a variety may be used for its aroma or its alpha characteristics.

Increased alpha acid levels also enables more cost-efficient extraction of surplus proprietary aroma hop production.

The calculations produced an HHI value for each public variety acreage relative to the total U.S. acreage for the years 2000 through 2020. Another calculation produced an HHI for each public variety production relative to total production for the years 2000 through 2020. There were calculations for each proprietary variety acreage relative to total U.S. proprietary acreage for the years 2000 through 2020. The sum of U.S. branded proprietary varieties relative to the sum of U.S. public varieties was calculated and graphed for the years 2000 through 2020 for acreage (Figure 1).

**DISCUSSION**

The HHI calculations made in this research offered a glimpse of potential company market share with regards to branded proprietary varieties. Those same companies used their position to leverage demand for proprietary to encourage sales of public varieties. It was beyond the scope of this research to evaluate whether this type of behavior existed, but anecdotal evidence we gathered suggested it existed. The extent to which such behavior existed could not be confirmed and was beyond the scope of this research. Influence extends beyond the branded proprietary varieties themselves. It was reasonable to extrapolate the market share of the merchant companies that share ownership with the entities that developed branded proprietary variety market share and assume that same level of influence applied to public variety market share.

The results of such analyses can yield useful insights into the reasons for industry behavior concluded Rhoades (1995) who stated that markets with relatively high levels of the HHI, market share inequality, and the presence of major firms were imperfectly competitive and that market imperfections were ultimately exploited.

Competitiveness and the level of concentration within an industry have obvious impacts upon price. Price cost margins were lower in markets with lower concentrations.

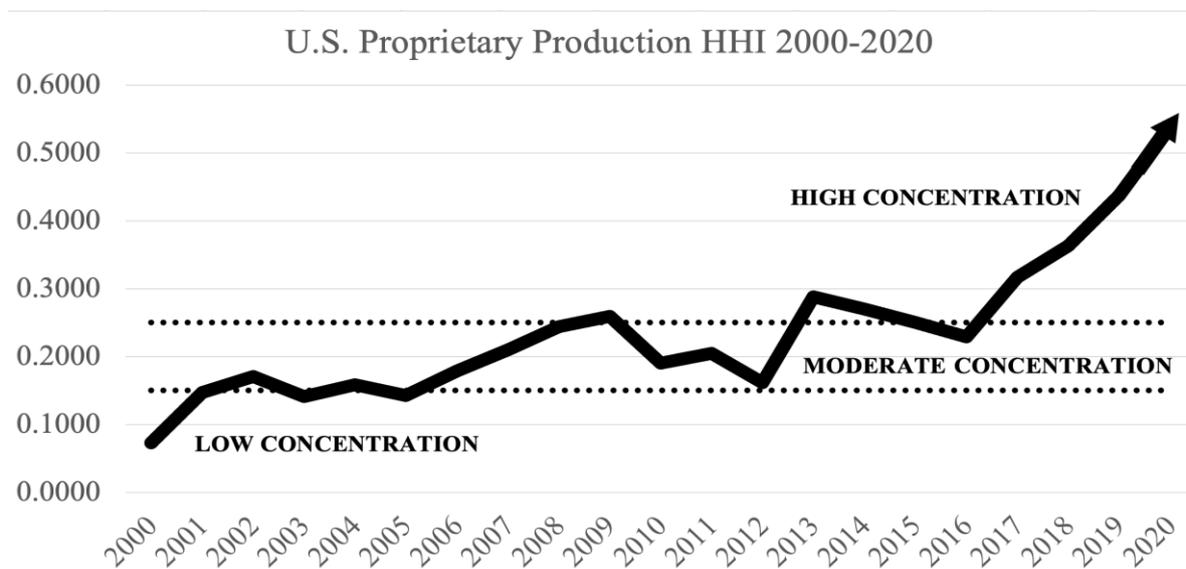


Figure 1: HHI for U.S. proprietary variety acreage 2000-2020.

**REFERENCES**

Calkins, S. (1983). The New Merger Guidelines and the Herfindahl-Hirschman Index. *California Law Review*. 71(2): 402-429.  
 Depken, C. (1999). Free-Agency and the Competitiveness of Major League Baseball.

Review of Industrial Organization. 14(3): 205-217.  
 Rhoades, S. (1995). Market Share Inequality, the HHI, and Other Measures of the Firm-Composition of a Market. *Review of Industrial Organization*. 10(6): 657-674.

**PARALLEL SESSION 5**

**AGRICULTURAL  
PRODUCTION AND  
FARM  
MANAGEMENT II**



# Farm model and analysis at aggregate level, case of beef sector in Slovenia

Jaka Žgajnar and Stane Kavčič<sup>1</sup>

**Abstract** - In this paper farm model applied to analyse beef sector in Slovenia is presented. Approach is prepared to support national Strategic plan of the CAP and to support further simulations of reform scenarios. It is based on bottom-up approach, enabling analysis from the level of the production plan at the farm level to the aggregate sector level. Mathematical programming with limited optimization is applied. The analysis includes 12 typical representative farms for cattle sector, defined using statistical and other available data. According to the results, 7% of beef fattening farms contribute only 4.4% of the total revenue generated in Slovenian agriculture. The results show that these farms on average achieve poor economic results, mainly due to low prices and high costs. In terms of labour input they are not very demanding. Average beef farm achieve only 5.9 € gross margin per working hour involved and on 84% farms even less than 4 €. The importance of subsidies is also pronounced, reaching more than 80% of GM at the aggregate level, and even exceeding the achieved GM on many smaller farms.

## INTRODUCTION

Recently there has been an increasing emphasis on models that allow simulation at the level of agricultural holdings or at the level of selected aggregate. It is a type of micro-simulation models, commonly referred to as farm models. Such models allow us to better understand decision-making and management at the level of agricultural holdings, and on the other hand give policy makers a better insight into what is happening on individual types of agricultural holdings, thus enabling them to make better fact-based decisions (Langrell et al., 2013).

As the policy impacts vary between types of agricultural holdings, the application of models that provide more reliable estimates is very important. It should be emphasized that both the possibility and the reasonableness of analysis carried out at individual farm level are practically impossible. Instead, it makes sense to classify agricultural holdings into groups with common characteristics, referred to as typical agricultural holdings (TAH).

Until recently, general and partial equilibrium models were used for sectoral and aggregate analyses, but in the last years more and more attempts have been made with farm models, as the approach presented in this paper.

## MATERIAL AND METHODS

### *Farm model*

The Farm model applied in this study is a tool based on a mathematical programming and allows for diverse analyses at the level of the farm's production plan and also aggregate analysis at the sector level. It is based on a modular approach in the form of spreadsheets in MS Excel and linked with a complex system of Model calculations prepared by Agricultural institute of Slovenia (AIS, 2021) as a key reference source of analytical and economic data at the level of production activities. It is a tool that follows modern trends in agro-economic analysis in this area and allows analysis at the TAH level (Žgajnar et al., 2022).

In the given model version, deterministic linear programming is used. The developed matrix of production possibilities is an example of production planning in which we focus on finding the optimum GM considering different production constraints, attempting to reflect the situation in the field. The price-cost ratio refers to the period 2018-2020.

### *Typical beef agricultural holdings*

The analysis for beef sector was performed on 12 typical beef farms, which are representatives for different numbers of farms in each size group in Slovenia (Table 1). They were determined on the basis of an in-depth analysis of available statistical data, SO analysis, and other sources on workshops with different experts (Žgajnar et al., 2022). According to national data, there are 3,630 predominantly beef farms in Slovenia, without those breeding also suckler cows and without the part of fattening that is carried out on dairy farms.

It is a fairly diverse group of farms, both in terms of size (No of beef), natural resources (available land and share of fields and permanent grassland), intensity and quality of forage produced, as well as intensity of breeding (with daily gain ranging from 850 g/day up to 1,400 g/day). Most of them (97%) are small agricultural holdings, where a part time labour input is required (<0.5 FTE). With the exception of the last farm (TAH12), where in addition to fattening cattle they have also hops production, all other farms are typical fattening farms.

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**Table 1.** Typical agricultural holdings specialised in beef farming in Slovenia

TAHs	Farms (No)	Beef (No)	FTE (1800 h)	Arable land (ha)	Grass/Lucerne mixtures (ha)	Barley (ha)	Corn (ha)	Permanent grass (ha)
TAH1	600	1	0.13	0.00				1.00 <sup>e</sup>
TAH2	600	2	0.15	0.00				1.54 <sup>c</sup>
TAH3	600	3	0.17	0.00				2.02 <sup>c</sup>
TAH4	400	6	0.20	1.27	0.25 <sup>a</sup>	0.25	0.76	1.84 <sup>c</sup>
TAH5	400	8	0.22	2.38	0.48 <sup>a</sup>		1.90	0.92 <sup>c</sup>
TAH6	450	12	0.24	3.49	0.70 <sup>a</sup>		2.79	0.92 <sup>c</sup>
TAH7	250	17	0.32	5.29	1.06 <sup>a</sup>		4.23	0.92 <sup>c</sup>
TAH8	250	25	0.41	6.91	1.38 <sup>b</sup>		5.53	1.38 <sup>d</sup>
TAH9	30	60	0.54	6.13		2.45	3.68	9.90 <sup>d</sup>
TAH10	30	75	0.82	19.54	3.91 <sup>b</sup>	4.88	10.75	3.68 <sup>d</sup>
TAH11	18	150	1.33	42.00	8.40 <sup>b</sup>	6.57	27.03	5.52 <sup>d</sup>
TAH12 <sup>e</sup>	2	150	1.85	42.00	8.40 <sup>b</sup>	6.57	27.03	5.52 <sup>d</sup>
<b>Total</b>	<b>3,630</b>	<b>32,145</b>	<b>796</b>	<b>7,689</b>	<b>1,501</b>	<b>453</b>	<b>5,735</b>	<b>5,341</b>

<sup>a</sup>Three-cut silage-bale, <sup>b</sup>Four-cut silage-silo and bale <sup>c</sup>Three-cut grass (silage bale, hay bale), <sup>d</sup>Four-cut grass (silage bale & silo, hay bale), <sup>e</sup>Includes also 5 ha of hops production.

### RESULTS AND DISCUSSION

90% beef farms are smaller than average Slovenian farm in terms of available land. Small herds predominate. Therefore, poor economic results on these farms were expected. As illustrated in table 2, only farms with more than 25 beef achieve GM better than 10 €/h. On very small farms (accounting for 84% Slovenian beef farms), with less than 0.3 FTE GM is usually below 4 €/h (Fig.1). According to the results achieved, the last farm producing also hops, stands out in all economic indicators. This is a type of farm typical for one region in Slovenia. The rest we can find all over Slovenia.

**Table 2.** Selected economic indicators by each TAH.

	TR <sup>a</sup> (EUR)	BP <sup>b</sup> (EUR)	VC <sup>c</sup> (EUR)	GM (EUR)	GM/h <sup>a</sup> (EUR)	GM/FT <sup>e</sup> (EUR)	GM/h (EUR)
TAH1	1,688	309	1,426	262	262	1,978	1.1
TAH2	3,344	537	2,461	883	575	5,802	3.2
TAH3	4,970	809	3,626	1,344	667	8,055	4.5
TAH4	9,749	1,478	8,634	1,115	358	5,599	3.1
TAH5	12,736	1,833	11,015	1,721	522	7,958	4.4
TAH6	18,250	2,520	15,704	2,546	578	10,579	5.9
TAH7	27,754	3,826	22,822	4,933	794	15,378	8.5
TAH8	40,347	5,258	32,211	8,136	982	20,022	11.1
TAH9	94,512	7,779	88,539	5,973	373	11,031	6.1
TAH10	122,710	14,143	104,905	17,810	767	21,730	12.1
TAH11	244,351	27,985	210,852	33,504	705	25,251	14.0
TAH12	318,432	30,086	243,035	75,401	1,436	40,802	22.7

<sup>a</sup>TR – total revenue, <sup>b</sup>BP – budgetary payments, <sup>c</sup>VC – variable costs

According to the results obtained, farms with arable land achieve better GM per ha. On average it exceeds 826 €/ha. At the same time, especially smaller farms, where all or most of the fodder is produced on permanent grassland, achieve significantly lower GM per ha (446 €/ha). As a result, there is also more intensive fattening with higher daily weight gains (over 1000 g per day) on farms with arable land producing maize silage. This ratio can also be clearly seen in the Fig. 1, where the share of utilized arable land (39.4%) is significantly lower compared to grassland (79.6%) on TAH's with FTE below 0.3.

The importance of subsidies is pronounced on beef farms. Budgetary payments present more than 80% of GM at the aggregate level, and even exceeding the achieved GM on many small farms (Table 2). The amount of budgetary payments per hectare usually increases with increasing herd. This is on larger farms especially a result of historical payments and higher payments for arable land compared to permanent grassland, and can achieve twice the payments on smaller farms. This indicates also expected negative forecasts with the planned abolition of payment entitlements.

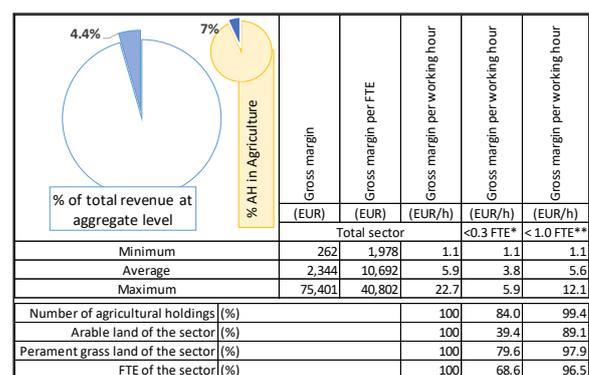


Figure 1. Summary of selected indicators for the beef sector

### CONCLUSIONS

The approach used has proven to be effective, as it allows simulations both at the TAH's level and at the sector level. Both physical aggregates and key economic indicators show satisfactory coverage with comparable values in national statistics. Therefore, we can conclude that the model can be applied for monitoring development trends in Slovenian beef sector. This also makes it possible to support a CAP strategic plan and further simulations of different CAP scenarios for beef sector.

In the case of analysed sector, the importance of budgetary payments is significant. Not so much in terms of revenue as in terms of GM. The latter reflects the extremely high share of variable costs in fattening, based on the purchase of calves.

### ACKNOWLEDGEMENT

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### REFERENCES

- AIS (2021). Model calculations. Agricultural Institute of Slovenia, Ljubljana.
- Langrell, S., Ciaian, P., Espinosa, M., Gomez Paloma, S., Heckeley, T., Louhichi, K., Sckokai, P., Thomas, A., Vard, T. (2013). Farm level modelling of CAP: a methodological overview. Joint Research Centre Scientific and Policy Reports. Luxembourg: European Union.
- Žgajnar J., Kavčič S., Tomšič M., Zagorc B., Brečko J., Hiti Dvoršak A., Moljk B., Verbič J., Bedrač M., Kožar M., Cunder T., Jerič D. (2022). Development of a model for systematic monitoring of the economic situation and analysis of the impact of agricultural policy at the level of typical agricultural: final report. Ljubljana: Biotechnical faculty, 437 p. (in Slovene)

# Modelling crop management adaptation to scenarios of declining precipitation sums in Upper Austria

Katharina Falkner<sup>1</sup>, Hermine Mitter<sup>1</sup> and Erwin Schmid<sup>1</sup>

**Abstract – Changing climate conditions and declining precipitation sums can severely affect agricultural production and crop management adaptation. Moreover, crop management adaptation affects the agro-environment, such as groundwater availability and nutrient loads. We model effects of precipitation scenarios on agricultural production and crop management adaptation in Upper Austria. We employ regional precipitation scenarios, the bio-physical process model EPIC, and the bottom-up land use optimisation model BiomAT. The EPIC results show large regional differences in the effects of precipitation scenarios on crop yields, irrigation amounts and nutrient loads. Efficient crop management adaptation is modelled with BiomAT, which also allows to identify regional hotspots of effects and adaptation in Upper Austria. The model results inform regional land and water management planning under precipitation scenarios in Upper Austria.**

## INTRODUCTION

In agriculture, rising temperatures and changing precipitation patterns combined with more frequent, longer lasting and more intense extreme weather events (e.g., droughts, dry spells, heat waves, late frosts) are already a challenge in many European regions including Upper Austria. This is evident by the events in the years 2017 to 2019. In Upper Austria, fruit and field vegetable production were particularly affected with yield losses of up to 30% compared to a long-term average (Grüner Bericht OÖ, 2020). Currently, crop management adaptation to changing and declining precipitation sums, such as the installation of irrigation systems, is only discussed for a few crops and in a few regions in Upper Austria (Statistik Austria, 2018). However, crop management adaptation is expected to gain in importance in the upcoming decades, even in regions where production conditions are comparably favourable, for example due to deep and fertile soils with large water holding capacities.

Previous studies for Upper Austria mainly focussed on the future availability of (ground)water resources for irrigation, but disregarded alternative crop management adaptation options to precipitation scenarios. Therefore, we aim to (i) model the regional impact of scenarios with declining precipitation sums on crop production and crop management adaptation, and (ii) inform land and water management planning in Upper Austria.

## METHOD

We applied an integrated modelling framework (IMF) consisting of the agronomic model CropRota (Schönhart et al., 2011), the bio-physical process

model EPIC (Williams, 1995), and the bottom-up land use optimisation model BiomAT (Stürmer et al., 2013) at 1 km spatial resolution in Upper Austria. The IMF is employed in context of three precipitation scenarios (Strauss et al., 2013), which are: a reference scenario (SDRY1) where precipitation sums and distribution resemble the past, a moderate (SDRY2) and extreme (SDRY3) scenario with declining annual precipitation sums and more frequent and longer lasting drought periods. CropRota is applied to derive typical crop rotations using IACS (Integrated Administration and Control System) land use data at municipality level. The typical crop rotations per municipality are allocated to the 1 km cropland pixels according to their relative shares. The typical crop rotations, climate, soil, topographical, and crop management data are used in the bio-physical process model EPIC to simulate many agro-ecological processes (e.g., crop growth, evapotranspiration, runoff, nitrification, mineralisation, soil erosion). In particular, rain-fed and irrigated crop management with conventional and reduced tillage are simulated with and without cover crops. EPIC calculates daily stress indices for water, temperature, nitrogen, phosphorus, aluminium toxicity, and aeration using the most limiting value to reduce actual plant growth and crop yield. Irrigation is automatically triggered in EPIC such that 90% of the crop growth period is water-stress free until a total limit of 250 mm per annum is reached. A single irrigation activity is limited to 20 and 50 mm. EPIC is used to calculate – inter alia – crop yields, crop water stress days (i.e., the number of days on which water stress occurs in a crop growth period), irrigation amounts, and nutrient loads for each crop and crop management practice per precipitation scenario at 1 km spatial resolution and a 30 year period. The EPIC outputs are used in BiomAT to model efficient crop management adaptation strategies by precipitation scenario including changes in irrigation, tillage, and crop rotations at 1 km spatial resolution. Moreover, BiomAT accounts for revenues and costs of crop production. Therefore, EPIC output (i.e., dry matter crop yield) and data on crop commodity prices, variable crop production costs, annuities of irrigation equipment costs, and CAP (Common Agricultural Policy) payments are used in the calculation of the revenues and costs of crop production in Upper Austria. Hence, cropland qualities and endowments at 1 km spatial resolution are considered in BiomAT.

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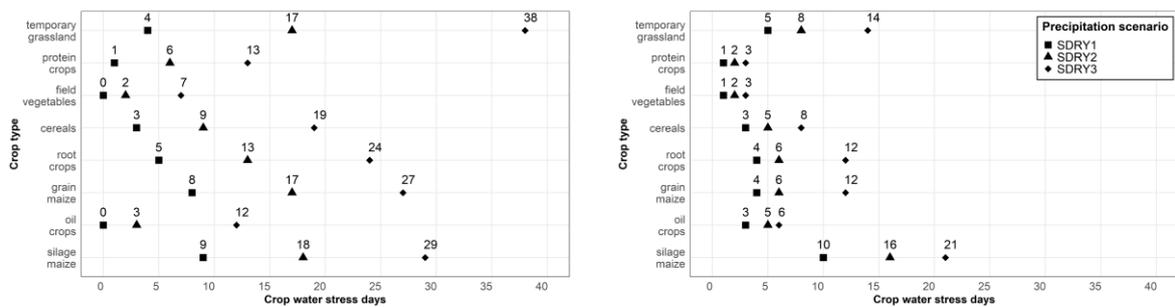


Fig. 1: Crop water stress days by crop type for cropland in the region a) Machland and b) Welser Heide under rain-fed crop production conditions with conventional tillage for three modelled precipitation scenarios

## RESULTS

We present selected EPIC results on the different effects of crop management strategies and precipitation scenarios on crop water stress days (WS), irrigation amounts, and dry matter crop yields (DM) by crop type and regions, which are delineated on the basis of groundwater bodies.

The precipitation scenarios differ in the mean annual precipitation sum (PRCP) using a 30 year period. In SDRY1, PRCP amounts to 969 mm on cropland in Upper Austria. However, it varies spatially from 519 mm to 2,068 mm, and is between 815 mm (25%-quantile) and 1,101 mm (75%-quantile) for 50% of the cropland. In SDRY2, PRCP decreases by 16.9% to 805 mm, with a spatial variability from 455 mm to 1,681 mm. In SDRY3, PRCP decreases by 30.4% to 675 mm, with a spatial variability from 401 mm to 1,384 mm.

The effects of decreasing PRCP vary between regions and crop types. For example, in SDRY1 for cereals, 3 WS occur under rain-fed production conditions with conventional tillage in the regions Machland and Welser Heide (Fig 1). With an increase to 9 (19) days, the SDRY2 (SDRY3) has a greater effect on WS in the Machland compared to Welser Heide, where WS increase to 5 (8) days. Similar effects are seen for the other crop types. In SDRY3, the effect on WS is greatest for temporary grassland in Machland, while it is greatest for silage maize in the Welser Heide.

Maintaining rain-fed production but changing from conventional to reduced tillage has little effect on the regional, crop type-specific WS, i.e., WS decrease by a maximum of 1 day, regardless of the precipitation scenario. However, conventional or reduced tillage with cover crops can reduce WS by up to 3 days.

Irrigation can reduce WS for all crop types and regions below the WS level in SDRY1 under rain-fed production conditions, regardless of the precipitation scenario. Irrigation amounts increase with declining mean annual precipitation sums (SDRY2 and SDRY3) but vary considerably among crop types and regions. For example, in Machland, the annual irrigation amount for cereals is 87 mm in SDRY3 and almost twice as high for silage maize (167 mm). However, the annual irrigation amount for silage maize is 70 mm in the region Westliches Mühlviertel. A change in tillage has little effect on the irrigation amount.

Irrigation also results in higher regional DM for all crop types. For cereals, the increase in DM is highest (lowest) in the region Welser Heide (Zwischen Krems

und Moosbachl) with +7.0% (+1.8%) in SDRY2 and +9.7% (4.1%) in SDRY3, respectively.

## CONCLUSIONS

Changing climate conditions increase the need for informing regional land and water management planning, even in regions with currently comparably favourable cropping conditions. Our analysis shows the effects of precipitation scenarios on crop production, informing efficient crop management adaptation.

## ACKNOWLEDGEMENT

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## REFERENCES

- Amt der Oö. Landesregierung. (2020). Grüner Bericht 2020 über die wirtschaftliche und soziale Lage der oberösterreichischen Land- und Forstwirtschaft in den Jahren 2017-2019. Linz, Oberösterreich.
- Schönhart, M., Schmid, E. and Schneider U.A. (2011). CropRota – A crop rotation model to support integrated land use assessments. *European Journal of Agronomy* 34: 263–277.
- Statistik Austria. (2018). Agrarstrukturhebung 2016 – Betriebsstruktur. Wien, Österreich.
- Strauss, F., Moltchanova, E., Schmid, E. (2013). Spatially Explicit Modeling of Long-Term Drought Impacts on Crop Production in Austria. *American Journal of Climate Change* 02: 1–11.
- Stürmer, B., Schmidt, J., Schmid, E., Sinabell, F. (2013). Implications of agricultural bioenergy crop production in a land constrained economy – The example of Austria. *Land Use Policy* 30: 570–581.
- Williams, J.R. (1995). The EPIC Model. *Computer Models of Watershed Hydrology*: 909-1000.

# Nutrient import at the farm level within an urban-regional context of Eastern Austria

Fritz Wittmann and Michael Eder<sup>1</sup>

**Abstract** – The objective of this study is to compare the nutrient import of farms in eastern Austria in the context of scenarios towards changed, more sustainable, urban food consumption patterns. We use a farm model to calculate changes in farm management – especially changed shares of organic farming in the region – and determine the impacts of these changes on plant nutrient import. The results show that organic farming has a low reliance on external nitrogen and is thus more resilient to price shocks than conventional farming. However, a complete conversion to organic farming of farms in a region would lead to critically low soil nitrogen levels.

## INTRODUCTION

Farmers' behaviour plays a crucial role in the distribution of crops grown and livestock kept of a region. If societal demand for sustainable food changes, farmers face the decision to adapt their farm activities to ensure an efficient allocation of scarce resources under the given circumstances and to enable a flexible response to unforeseen changes (Darnhofer 2014). To assess resource use of farms and changes in the regional food system under changing farming conditions, farmers responses play an important role. The objective of this study is to assess plant nutrient imports at the farm level on the basis of different scenarios in which the demand of consumers in Vienna changes in the context of the metropolitan region of Vienna. Plant nutrient imports are particularly relevant to agriculture in light of the fertilizer price shock due to the 2022 Russian invasion of Ukraine.

## METHOD

This study investigated the farms in the metropolitan region of Vienna, i.e. the region 100 km around Vienna demarcated at the municipal level within Austria, see Figure 1. This region is diverse enough to include a broad range of farm practices, e.g. arable farming and grazing livestock.

We investigated scenarios towards more sustainable food consumption patterns of the Viennese population. To develop the scenarios, three general and commonly suggested factors that can improve the environmental quality of the food system were varied. These factors relate to the food consumption patterns of the Viennese population and concern: 1) Primarily regional food consumption, 2) exclusively organic food consumption, and 3) two thirds less meat consumption.

More precisely, we considered the following scenarios: Regional (Reg), Regional Meat (RegMeat), Regional Organic (RegOrg), and Organic Only (OrgOnly). So, these scenarios use either one or two of the described factors.

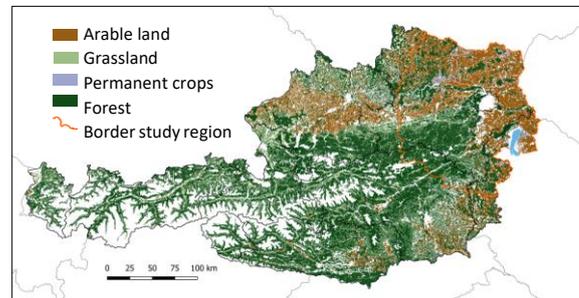


Figure 3. Location of the study region (see orange border).  
Source: Own drawing, based on data from Copernicus Land Monitoring Service (2020) and Statistik Austria (2020).

The factor of "primarily regional food consumption" establishes a connection between agricultural production in the study region and food consumption in Vienna.

We used farm level data with respect to crop and livestock production from the database of the Integrated Administration and Control System (BMNT 2015) to generate the relevant farm types present in the study region. After farm types were generated (with rule-based classification, inter alia cluster analysis), they were included in a farm model to calculate the Baseline, i.e. the agricultural structure of the year 2015.

This farm model uses linear programming and maximizes total gross margin of the farm in calculating the baseline, i.e. allocates scarce resources among activities in order to obtain the outputs that maximize their utility (Blanco, 2016). The model ensures compliance with the first and second pillar of the common agricultural policy. Technical coefficients and nutrient balances (nutrient offtake and supply) have been included from the Federal Institute of Agricultural Economics and the Bavarian State Institute of Agriculture.

The outlined scenarios were calculated by switches of farms from one farm type to another underpinned by data from a survey in the region, conducted in 2019. This was done without involving linear programming. Based on survey data, we assigned each farm of the same farm type preferential weights to apply a change in production orientation (operational focus with respect to crop and livestock production patterns) and production mode (conventional or organic mode of production) in response to the outlined scenarios in order to reflect empirically validated switching patterns among the defined farm

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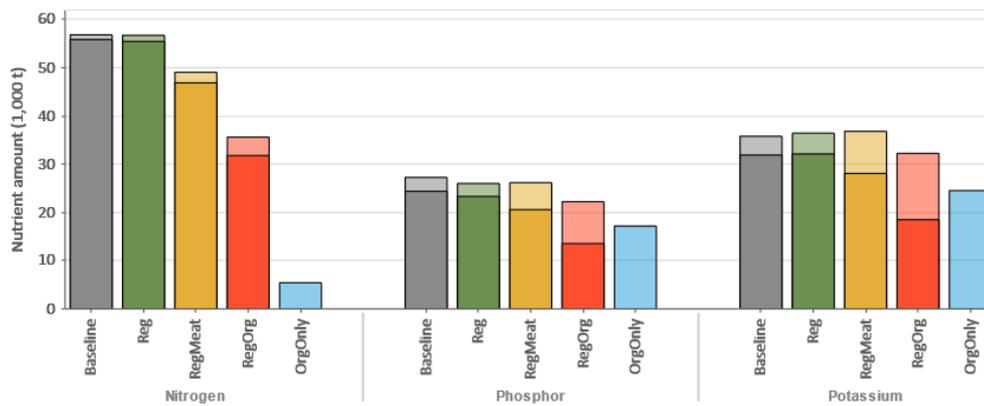


Figure 4. Plant nutrient import at the farm level in the investigated scenarios. Opaque – conventional farms; transparent – organic farms.

types of the study region. Finally, the resulting data were aggregated to the level of the study region.

### RESULTS

The share of organic utilized agricultural area was in the baseline 16% and increased in the scenarios (except in Reg). RegMeat, RegOrg, and OrgOnly exhibited a share of organic utilized agricultural area of 31%, 52%, and 100%, respectively. This increase is attributable to farmers' adaptation behaviour in the scenarios and resulted in changed nutrient imports as shown in Figure 2. Especially in scenario OrgOnly with exclusively organic farming, the nitrogen import decreased by approximately 88%. This is especially due to the largely closed nutrient flows in organic farming with prohibited synthetic nitrogen use. At the same time, the area of legumes (nitrogen-fixing crops) increased by over 3 times in RegOrg and OrgOnly. These results show that organic farming decreased the reliance on external inputs and thus, is more resilient to price shocks than conventional farming. Changes in nutrient imports between the scenarios outlined were more pronounced for nitrogen than for phosphor and potassium.

### DISCUSSION AND CONCLUSIONS

The nitrogen imports presented show that nitrogen import can be reduced, which is also vital to reduce nutrient leaching, greenhouse gas emissions and energy input. Reducing nitrogen import is especially relevant in the context of the farm to fork strategy of the European Union (reduce fertilizer application by 20% by 2030) and a carbon tax on fertilizers because organic farms are usually more energy efficient than conventional farms (Reganold and Wachter 2016). Yet, lower yields in organic farming are associated with lower quantity of produced agricultural goods. However, this can be partially mitigated by changing food consumption patterns (Lauk et al. 2022).

An important aspect to reduce nitrogen import is a more closed nutrient cycle with livestock farming. As organic farms are dependent on manure supply within the farming system, changes in the production orientation towards farm types without livestock are limited without considering nitrogen balances (especially with an increasing share of organic farming). Such an extreme scenario of exclusively

organic farming (OrgOnly) might lead to critically low nitrogen levels in organic agriculture (Muller et al. 2017) and would, therefore, need to be accompanied

by more flexible approaches for the supply of nitrogen to improve food supply.

### ACKNOWLEDGEMENTS

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### REFERENCES

- Blanco, M. (2016) Policy Impact Assessment. In: Shrestha, S.; Barnes, A.P. and Vosough Ahmadi, B. (eds), *Farm-level modelling: techniques, applications and policy*. CAB International: Wallingford, Boston, 1–13.
- BMNT (2015) INVEKOS-Datenpool 2015. BMNT (unpublished data), Vienna
- Copernicus Land Monitoring Service (2020) CLC 2018 – Corine Land Cover (with funding by the European Union). <https://land.copernicus.eu/pan-european/corine-land-cover/clc2018>. Accessed 6 May 2022.
- Darnhofer I (2014) Resilience and why it matters for farm management. *European Review of Agricultural Economics* 41:461–484. <https://doi.org/10.1093/erae/jbu012>
- Lauk C, Kaufmann L, Theurl MC, et al (2022) Demand side options to reduce greenhouse gas emissions and the land footprint of urban food systems: A scenario analysis for the City of Vienna. *Journal of Cleaner Production* 359: 132064.
- Muller A, Schader C, El-Hage Scialabba N, et al (2017) Strategies for feeding the world more sustainably with organic agriculture. *Nature Communications* 8:1290. <https://doi.org/10.1038/s41467-017-01410-w>
- Reganold JP, Wachter JM (2016) Organic agriculture in the twenty-first century. *Nature Plants* 2:1–8.
- Statistik Austria (2020) Geodaten der STATISTIK AUSTRIA. [https://www.statistik.at/web\\_de/services/geodaten/index.html](https://www.statistik.at/web_de/services/geodaten/index.html). Accessed 6 May 2022.

# Project PestiRed: reducing pesticide use while maintaining profitability

Solène Clémence, Sandie Masson and Alexander Zorn<sup>1</sup>

**Abstract-** The PestiRed project aims to significantly reduce the use of plant protection products (PPP) in arable farming through consistent implementation and further development of integrated pest management. In this project, participating farms try to reduce their use of PPP by 75% on a so-called "innovative" plot, while cultivating a control plot as usual. The farmers follow a diversified crop rotation and use a combination of alternative methods to control weeds, pests and diseases. Profitability should not decrease by more than 10%. Agronomic and economic monitoring is carried out during the six years of the project. This article presents the PPP reduction and economic results of the first year of the project (2020). The PPP reduction goal is reached for almost all crops, except for potatoes and sugar beets. The economic target is not reached for potatoes and spelt, and is missed for feed barley. 1

## INTRODUCTION

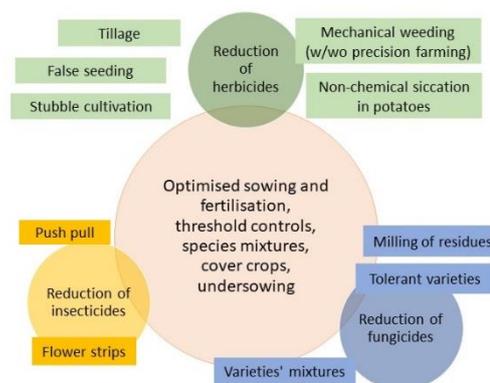
The awareness of the various problems caused by the use of plant protection products (PPP), like pest resistance, contamination of ecosystems and health problems encouraged the development of new instruments for risk reduction and sustainable use of PPP in Switzerland. For this purpose, an action plan was implemented in 2017 (Bundesrat, 2017). One of the measures enacted is the "Development of alternatives to chemical plant protection". It is in this context that the project PestiRed was set up (Wirth et al., 2020). Funded mainly by the Swiss Federal Office of Agriculture, the PestiRed Resource Project aims to reduce the use of PPP by 75% and to evaluate the practical on-farm implementation of alternative plant protection strategies.

However, replacing the use of PPP by alternative control measures is not without risk for the profitability of the farms. It may result in a reduced quality and quantity of agricultural output as well as in increased costs, which may both lead to a decrease in profitability. Therefore, second-order condition of the PestiRed project is to avoid a reduction in profitability of more than 10% when replacing PPP by alternative measures. In parallel, socio-economic research accompanies the project and looks at the assessment of alternative plant protection measures by the farmers regarding their potential for decreasing PPP and their economic efficiency.

This article presents the first year results of the project and aims to discuss the main objective of PestiRed: is it possible to reduce PPP use by 75%, while avoiding a higher than 10% drop in economic profitability?

## METHODS

A total of 68 farmers were recruited in three Swiss cantons. Five diversified six-year crop rotations were designed, adapted to the pedo-climatic and economic context, with the help of advisors and scientists. On a so-called "innovative" plot, the PestiRed farmers implement a combination of multiple management measures to reduce their use of PPP (see fig. 1). At the same time, they cultivate a "control" plot in the usual way. Both plots follow the same crop rotation.



**Figure 1.** Plant protection measures expected to impact PPP use in the project PestiRed. In the middle circle: measures with combined effect on several categories of pests.

The participants record all the actions carried out per plot, control and innovative, in a computerised "field book" each year. For each action carried out, the farmers report the type of action (sowing, tillage, etc.), the date of the action, the plot (innovative/control), the machinery used, the quantity and cost of the products used, the surface treated, the cost of an agricultural contractor, as well as the working time. Apart from filling the "field book", farmers also report the selling prices, the yields of the plots and the direct payments obtained.

The treatment frequency index (TFI) for each product application was used as indicator for the evaluation of the reduction of PPP use. This indicator includes the quantity of each product applied comparing to its standard dose for the target and crop considered, and the treated area compared to the plot area (Gravesen, 2003). Summing the TFI for each product application gives the treatment frequency index of a plot (all PPP categories together).

The preparation of the data for the economic evaluation consisted of assigning a standard cost to the machines/tractors, which is then converted into Swiss francs per hectare. Product, contractor and labour costs are also considered. The analysis of the economic return is based on a calculation of the

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variable contribution margin (VCM). The VCM is composed of the benefits of the plot (sales revenue and direct payments but without project contributions), from which direct costs (seeds, fertilisers, PPP, etc.) and the costs of carrying out the work (machinery, labour and contractor costs) are subtracted. Differentiation of costs and benefits types allows identifying reasons for higher or lower profitability between the two plots of each farm.

### RESULTS

Table 1 summarises the average treatment frequency index for each crop, of innovative and control plots in the first year of the project (2020). For all crops, except sugar beets, potatoes and sunflower, the TFI reduction between the innovative plot and the control plot was over 75%. In potatoes, the reduction was only 30% (mainly due to the high PPP requirements to secure the yield and quality of this crop) and 45% in sugar beets (mainly due to the use of herbicides). The reduction in sunflower is low (31%), however, the TFI is already low on the control parcel.

The provisional economic results for the year 2020 can be seen in Table 2. The objective of a maximum profitability drop of 10% was achieved for wheat, sunflower and rapeseed. For fodder barley, the goal was narrowly missed. For spelt and potato, the objective was not reached. In general, the decrease in the variable contribution margin (VCM) of the innovative plots is related to the decrease in yields and the increase in costs of carrying out the work. Farms with a higher VCM on the innovative plot have in some cases higher yields and/or lower costs on the innovative plot. Additional direct payments as well as premiums can improve the VCM. The trends in the preliminary results for 2020 are not identical for all farms and very variable.

### DISCUSSION & CONCLUSION

The objective of reducing PPP use while maintaining economic profitability is not reached for all crops. Fungicides in potatoes and herbicides in sugar beets

**Table 1.** Treatment frequency index and difference between plots for the first project year (2020).

Crops <sup>a</sup>	Number of farms	TFI innovative	TFI control	Reduction
Wheat	17	0.15	1.22	88%
Barley	10	0.21	2.01	89%
Rapeseed	8	0.13	1.42	91%
Maize silage	7	0.19	1.68	89%
Potato	4	9.72	13.91	30%
Sunflower	4	0.50	0.72	31% <sup>b</sup>
Grain maize	3	0.06	1.59	96%
Spelt	3	0.00	0.00	-
Sugar beet	3	1.60	2.94	45%
Peas and barley	2	0.00	0.16	100%

<sup>a</sup>Artificial grassland (no PPP use) and soybean (only one observation) are not represented.

<sup>b</sup>For sunflower, the objective is not reached, however, the TFI is already very low on the control plot.

**Table 2.** Variable cost margin (VCM) differences: ≈ +/- 10%, < -10 - -20%, << -20 - -30%; <<< -30%. Flower strips were included in the final VCM in Fr./ha.

Culture <sup>a</sup>	Number of farms <sup>b</sup>	Innovative plot (I)	Difference in VCM	Control plot (C)
Wheat	13	I	≈	C
Fodder barley <sup>c</sup>	4	I	<	C
Rapeseed	4	I	≈	C
Potato	4	I	<<<	C
Spelt	3	I	<<<	C
Sunflower	3	I	≈	C

<sup>a</sup>Artificial grassland, grain and silage maize, pea-barley mixtures and sugar beet are not represented.

<sup>b</sup>Only farms that provided final prices were considered.

<sup>c</sup>Malting barley and seed barley were not taken into account (different sales prices).

seemed difficult to reduce. Economic results vary considerably between farms. For example, not all innovative plots were linked to lower yields, and higher machine and labour costs. However, the data is scarce (only one year) and the economic results highly variable. The accumulation of data over the course of the project will make it possible to discern (or not) a trend, if for example machine and labour costs are increasing systematically, and if yields are frequently lower when reducing PPP.

In the PestiRed project, farmers receive contributions for the extra administrative work, the additional costs of the measures and the risk of crop losses. These contributions can be of interest to compensate for the partly lower economic profitability of innovative plots for certain crops. The analysis of the VCM with the PestiRed contributions is expected to provide valuable inputs for future agri-political decisions in the framework of the national action project to reduce PPP risks.

### REFERENCES

- Bundesrat (2017). Aktionsplan zur Risikoreduktion und nachhaltigen Anwendung von Pflanzenschutzmitteln – Bericht des Bundesrates. Bern, Bundesrat.
- Gravesen, L. (2003). The Treatment Frequency Index: an indicator for pesticide use and dependency as well as overall load on the environment. Copenhagen, Pesticides Action Network Europe (PAN), Pure Conference.
- Wirth, J., Steinger, T., Vogelgsang, S., Zorn, A., & Jeanneret, P. (2020). PestiRed: A Swiss on-farm approach to reduce pesticide use in arable crops. Deutsche Arbeitsbesprechung über Fragen der Unkrautbiologie und -bekämpfung. Julius-Kühn-Institut, Braunschweig, 290-294.

# PARALLEL SESSION 6

# MARKETING AND

# CONSUMER

# ATTITUDES



# Are most Germans already vegetarians?

Inken Christoph-Schulz and Martin Banse<sup>1</sup>

**Abstract** - Animal products have recently been discussed more critically than 30 years ago due to various negative effects, e.g. on the climate. Plant-based alternatives to meat and dairy products, on the other hand, seem to be experiencing a veritable triumph. To what extent this perception corresponds to reality or whether the real market situation differs from what some reports suggest, is examined in this paper using data from a panel of private households of the Gesellschaft für Konsumgüterforschung (GfK). The results show clear differences in the quantitative importance of alternative (plant-based) products. While alternative products are demanded in comparatively small quantities for meat products, they are in much higher demand for dairy products. The buyer reach and repurchase rates are significantly lower for plant-based alternative products, while the average price is significantly higher than for the animal-based "originals".

## INTRODUCTION

Nutrition in Germany has undergone a significant change in recent decades, particularly with regard to the consumption of animal products. While in the early 1990s the average per capita consumption for meat products, e.g., was over 100 kg per year (BMEL, 2021), this in the meantime seems to have changed significantly and meat as well as dairy products are regularly "on the index" for various reasons: Different negative effects on the climate and the environment are discussed but also on animal welfare (WBAE, 2020).

Various surveys indicate that consumer behaviour in Germany is changing to the effect that more and more people are giving up meat or even all animal protein sources (ProVeg international, 2021b). With the increasing proportion of people following a plant-based diet, a growing demand for plant-based protein sources and alternative products to traditional animal products can be observed.

Against this background, the aim of this paper is to examine the extent to which the appearance is true that more and more plant-based alternative products are being bought and that these substitute animal products. In this context, the following research questions (RQ) are answered:

RQ 1: How has private demand for alternatives to meat and dairy products changed between 2017 and 2021 compared to the demand for meat and dairy products?

RQ 2: How high are the buyers' reach and repurchase rates and average prices of the alternative products compared to the animal "originals"?

## DATA AND METHOD

The data comes from the GfK household panel collecting representative data of 13,000 German households and in this case focusing on demand for meat, dairy products, and their plant-based alternatives between 2017 to 2021.

The advantage of the present data set is that it is based on real purchase data and not on survey results which often exhibit biases. A disadvantage is that the present data set only represents purchases by private households excluding out-of-home consumption.

The dataset covers highly aggregated data about product categories but without statements about specific products. For example, in the category of drinking milk, no differentiation is made according to fat content, and in the case of drinking milk alternatives, there is no differentiation at all between the various types such as almond milk, oat milk, etc.. In addition, purchase decisions of individual households are not considered, but rather the purchased quantities.

Due to this high level of aggregation of the data set, only descriptive calculations are possible.

## RESULTS

The results of the demanded quantity for the main product groups are shown in Table 1.

**Table 1.** Quantitative household demand for meat products, dairy products and their alternatives in 1000 tons.

Product	2017	2018	2019	2020	2021
Meat c.	3148	3058	2935	3172	3002
Meat bio	51	52	57	84	96
Meat alt. c.	13	13	17	31	45
Meat alt. b.	9	10	12	16	17
Dairy c.	5701	5529	5473	5780	5614
Dairy bio	418	421	480	530	566
Dairy alt. c.	63	69	78	122	166
Dairy alt. b.	77	81	108	154	196

b = biological production; alt. = alternative; c. = conventionally produced  
Source: Own calculation based on GfK, 2022.

Dairy products account for 60% of demand for animal products. Table 1 shows the dominance of conventionally produced animal products. However, the requirement for these products has declined in 2018 and 2019. In 2020 demand for animal products increased again, probably due to the restrictions on eating out of home as a result of the Covid-19 pandemic. In the year 2021, private demand for conventional animal products fell again. In contrast, demand for organically produced animal products increased steadily for both meat and dairy products. However, this growth can only partially compensate for the decline in conventional meat products but compensates for the decline of dairy.

Plant-based alternative products have also shown steady growth over the years. In terms of share, however, they are of secondary importance compared to animal products. Thus, the alternatives (both conventional and organic) to meat account for 2% of the total meat products and meat alternatives in

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2021. For alternatives to dairy products, the figure was 5.5%.

If only alternative products are considered, the dominance of alternatives for dairy products becomes clear. In 2017, organically produced dairy alternatives had the largest share of all alternative products at 47.5%. This slightly declined to 46.2% in 2021. In contrast, the share of conventionally produced dairy alternatives increased a little bit from 38.8% to 39.2%. The alternatives to meat products showed significantly lower shares: Organically produced alternatives had shares of 5.7% in 2017 and 4.0% in 2021, conventionally produced meat alternatives had shares of 8.0% in 2017 and 10.5% in 2021. Consequently, meat alternatives have a higher proportion of conventionally produced products whereas dairy alternatives have a higher share of organically produced ones.

Table 2 shows the dominance of drinking milk and plant-based milk over the remaining dairy products. The substitutes for drinking milk dominate the other dairy alternatives with 85% in 2021.

**Table 2.** Quantitative household demand for drinking milk and their alternatives in 1000 tons.

Product	2017	2018	2019	2020	2021
Milk con.	3265	3187	3125	3260	3167
Milk bio	298	302	349	379	416
Milk alt. con	44	49	55	83	119
Milk alt. b.	72	77	103	147	189

bio/b. = biological; con. = conventional; alt. = alternative; oth dai = other dairy  
 Source: Own calculation based on GfK, 2022.

Table 3 shows that conventional drinking milk has a very constant buyer reach of about 95%. In contrast, organically produced drinking milk increased its reach from 24% in 2017 to 33% in 2021.

The alternative products have significantly lower buyer reaches, which, however, also increased significantly during the observed period: Conventionally produced products had a reach of 13% in 2017, and 26% in 2021. Organically produced drinking milk alternatives were able to increase their share from 12% in 2017 to 25% in 2021.

Conventional drinking milk has an annual repurchase rate of around 97%, i.e. in 2017-2021 around 97% of consumers who bought conventional milk once will do so at least a second time. The repurchase rate of organic milk was around 70% in 2017 with a slight upward trend (2021: 73%).

The repurchase rate also developed positively for plant-based milk and was 62% in 2017, and 65% in 2021 for conventional milk alternatives. There was an even more significant increase in the rate for organic milk alternatives. This was 63% in 2017, and 70% in 2021. In the case of plant-based milk, there is a clear positive trend towards higher repurchase rates with a simultaneous significant increase in buyer reach. Nevertheless, the relatively high proportion of 'mystery' shoppers who buy plant-based drinks only once or at relatively long intervals is evident.

**Table 3.** Purchaser reach, re-purchase rate and mean price

Product	Drinking Milk				Alternatives			
	2017		2021		2017		2021	
Year	con	bio	con	bio	Con	bio	con	bio
Production	95	24	94	33	13	12	26	25
Pur. reach %	95	24	94	33	13	12	26	25
Re-purchase rate/year %	98	70	98	73	62	63	65	70
Mean price	84	118	99	118	203	139	198	124

con = conventional production; bio = biological production, Mean price in EUR-Cents

Source: Own calculation based on GfK, 2022.

Conventionally produced plant-based drinks have by far the highest average price at around two EUR. In contrast, organically produced plant-based drinks cost on average less than 1.30 EUR in 2021, organic milk about 1.20 EUR and conventionally produced milk about 1 EUR.

## DISCUSSION

The quantity of plant-based alternative products for meat and dairy required by private households rose continuously and has more than doubled in the period from 2017 to 2021. Nevertheless, with a share of 4.2% of the total quantity, alternative products still play a subordinate role compared to animal products. This is particularly true of alternatives for meat products whose share is 1.4% while alternatives to dairy already account for 5.5%. More important than the quantities demanded in this context, however, are variables such as buyers reach and repurchase rate. The buyers reach of drinking milk alternatives has doubled during the observation period. In 2021 the repurchase rate has also increased and is only slightly below that of organic milk. The positive trend towards higher repurchase rates of milk alternatives shows that progressively a larger buyer base is developing.

Even though the results clearly show that Germany is certainly not on the road to vegetarianism, the data show that plant-based alternatives are clearly gaining in importance. In this context, it would be important to explore which types of consumers primarily buy plant-based alternative products: are they really vegetarians and vegans or rather omnivores who try to reduce their consumption of animal products with the help of these products?

## REFERENCES

- BMEL – Bundesministerium für Ernährung und Landwirtschaft (2021). *Statistisches Jahrbuch über Ernährung, Landwirtschaft und Forsten* (Jahrgänge 1956 – 2012). Entwicklung des Nahrungsverbrauchs in kg je Kopf und Jahr.
- ProVeg international (2021). *What consumers want: A survey on European consumer attitudes towards plant-based foods*. Country specific insights.
- WBAE – Wiss. Beirat für Agrarpolitik, Ernährung und gesundheitlichen Verbraucherschutz (2020). *Promoting sustainability in food consumption*.

# Consumers' views on virtual fencing and insights on a multi-level biodiversity labeling scheme for pasture-raised beef

Ekaterina Stampa and Katrin Zander<sup>1</sup>

**Abstract** – Whereas the share of cattle grazing on grassland is decreasing in Europe, innovative grazing management systems applying virtual fencing can optimize and promote grassland use. Cattle grazing supports ecosystem services and biodiversity while providing valuable pasture-raised beef and dairy products. To stimulate consumer demand for such products, communicating the benefits of grazing-based production, e.g. through labeling, is vital. Yet, we know little about consumer perceptions of virtual fencing and of labels designed to certify the biodiversity benefits of cattle products. Thus, we aimed to explore consumer perceptions, understanding, and acceptance of virtual fencing in cattle pasturing and of a multi-level labeling system for beef from biodiverse grazing systems. We conducted two qualitative studies with 60 German consumers. Think-aloud protocols demonstrated the participants' general support of pasturing, scepticism about virtual fencing and doubts about the advantages from a specific grazing management practice. Online focus groups revealed significant challenges to the implementation of biodiversity labeling, yet highlighted consumers' appreciation for biodiversity conservation at local level, hinting at perspectives for selling local beef, and the need for policy action to encourage livestock practitioners to conserve and promote biodiversity.

## INTRODUCTION

In view of continuous biodiversity loss in Europe, a downward trend in the share of cattle grazing on pasture is alarming (Van den Pol-van Dasselaar et al., 2020). In attempt to counteract this development and to promote cattle pasturing, an innovative grazing management technology of virtual fencing (VF) is currently being tested in Germany. Grazing management using VF can optimize grassland use to reduce the food-feed competition and enhance biodiversity on pastures and in environmentally sensitive areas (Campbell et al., 2020). Consumer demand for pasture-raised beef and dairy products can encourage farmers to adopt or expand cattle pasturing and depends on consumer perceptions of the VF technology as well as its benefits for animal welfare, biodiversity conservation and for consumers personally, e.g., product taste and quality (Gassler et al., 2018, Tinch et al., 2018).

In earlier studies, experts were concerned about the public perception of digital technologies in farming (Eastwood et al., 2017). However, since VF is novel in Germany, we lack consumer perspective on this technology. This fact urged us to instigate a study and answer the following questions: What do consumers think about VF? Would they support grazing systems

applying VF? Considering consumers' unawareness about the environmental benefits of VF, informing them may be useful for its further implementation.

To inform consumers about the environmental benefits of food products, eco-labeling is commonly used. Whereas many eco-labels are binary (e.g. organic certification), multi-level labeling systems with different levels of provision (e.g. the EU egg labeling) maybe more suitable for continuous attributes like biodiversity. Although eco-labeling has been addressed in earlier research, little is known about consumer perception of multi-level biodiversity labeling. The closest example is a study on the development of a meat guide, in which a multi-level indication of biodiversity conservation and three other attributes were tested with interested Swedish consumers (Spendrup et al. 2017). The proposed indication of the attributes was perceived too complex for regular consumers.

Against this background, we conducted our second study, which addressed the following questions: How do consumers understand grazing, biodiversity, and pasture-raised products? How do consumers perceive a multi-level biodiversity labeling system? In the following, we provide a brief overview of the methods used and the results obtained.

## METHODS

To address our research questions, we conducted two qualitative studies with German buyers of beef. In both studies we used age- and sex-based quota sampling and thematic text analysis (Kuckartz, 2014) to extract the meaning from the data.

The first study took place in three German cities in Fall 2019. Using think aloud protocols with 20 participants in person, we tested four information brochures about VF and the effect of grazing on biodiversity, landscapes, animal welfare and product quality.

In the second study, in Fall 2020, we conducted six audio-only online focus groups with 40 participants. A three-level biodiversity labeling scheme (fig. 1) was presented to the participants with a brief explanatory information regarding the conservation measures corresponding to each level.

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Figure 1. Multi-level labeling scheme tested in online focus groups.

## RESULTS

### *Perception of virtual fencing in cattle grazing*

Think aloud protocols demonstrated the participants' positive perception of pasturing. Whereas a few participants appreciated VF, most showed scepticism and concern about its effect on animal welfare and human safety. Our major finding was the difficulty in communicating to consumers the complex subject of VF technology and its benefits in a concise, engaging manner accessible for a layperson.

### *Perception of a multi-level biodiversity labeling scheme*

Although consumers associate pasture grazing with high-quality beef and with valuable animal welfare and environmental attributes, they were rarely aware of the benefits of pasture-grazing for biodiversity. Participants found important that the conservation measures take place in their home regions. However, biodiversity was not a priority for most participants in their beef-purchasing decisions, often made under time pressure and based on heuristic clues. Participants reported difficulties differentiating between the levels of a label and perceived a multi-level approach excessive. Many participants expressed distrust related to the label's unfamiliarity and suspicions of greenwashing in the context of the abundance of eco-labels. In participants' words, pasture grazing itself stands for all its benefits and a simple "pasture-raised" label would suffice.

## DISCUSSION AND CONCLUSIONS

Consumers do not generally appreciate VF due to the complexity of the subject. Considering the difficulties in communicating VF to consumers, the focus should be placed on the positive associations with pasture grazing that are of greater personal relevance for and higher valued by consumers, such as better taste, healthiness, and improved animal welfare (Gassler et al., 2018).

Communicating biodiversity benefits through a multi-level label and gaining consumer appreciation is challenging, given the low levels of involvement and knowledge about biodiversity, and time pressure. We found that the multi-level biodiversity labeling scheme confused the participants rather than being perceived as a decision-making aid. Thus, a multi-level biodiversity labeling scheme would likely have little to no success in engaging consumers currently uninvolved in eco-labeling. However, such labeling may well be appreciated by consumers already conscious of the effects of food consumption on biodiversity.

Since consumers desire biodiversity conservation measures at local level, there might be a perspective

for selling local beef from biodiverse farms. Promising marketing of "biodiverse beef" and the expansion of biodiversity-friendly cattle pasturing should concentrate on the attributes highly valued by consumers. These are improved animal welfare and high quality rather than biodiversity. The results also indicate that biodiversity conservation will be difficult to ensure by changes in consumers' food purchase behavior alone. Compensation schemes are needed to encourage and remunerate farmers for adopting biodiversity-friendly methods and thereby increase the share of ethically produced meat on the market while reducing the decision-making load on consumers.

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## REFERENCES

- Campbell, D.L.M., Ouzman, J., Mowat, D., Lea, J.M., Lee, C. and Llewellyn, R.S. (2020). Virtual fencing technology excludes beef cattle from an environmentally sensitive area. *Animals* 10:1069.
- Eastwood, C.; Klerkx, L.; Ayre, M.; Dela Rue, B. (2017). Managing socio-ethical challenges in the development of smart farming: From a fragmented to a comprehensive approach for responsible research and innovation. *Journal of Agricultural and Environmental Ethics* 32:741–768.
- Gassler, B.; Xiao, Q.; Kühl, S.; Spiller, A. (2018). Keep on grazing: Factors driving the pasture-raised milk market in Germany. *British Food Journal* 120:452–467.
- Kuckartz, U. (2014). *Qualitative text analysis: A guide to methods, practice and using software*. SAGE Publications.
- Spendrup, S., Rööös, E. and Schütt, E. (2017). Evaluating consumer understanding of the Swedish meat guide: A multi-layered environmental information tool communicating trade-offs when choosing food. *Environmental Communication* 13(1):87–103.
- Tinch, R.; Bugter, R.; Blicharska, M., et al. (2018). Arguments for biodiversity conservation: Factors influencing their observed effectiveness in European case studies. *Biodiversity and Conservation* 27:1763–1788.
- Van den Pol-van Dasselaar, A., Hennessy, D. and Isselstein, J. (2020). Grazing of dairy cows in Europe—An in-depth analysis based on the perception of grassland experts. *Sustainability*, 12:1098.

# Does the origin matter? Results from a cross-national study with poultry meat consumers

Cathleen Lehmann and Inken Christoph-Schulz<sup>1</sup>

**Abstract** - Purchasing domestic and particularly locally produced food is gaining growing interest among consumers within many EU countries. Focus groups were conducted in Denmark, France, the Netherlands and the United Kingdom to assess the importance that consumers put onto the country of origin (COO) of poultry meat and consumers' reasons for their preferences regarding the COO. Especially French consumers seem to put great importance on the COO of poultry meat, whereas Danish, Dutch and British consumers do not seem to care as much about that aspect. However, consumers from all study countries preferred primarily domestic or even locally sourced products. This was mainly due to the perception that stricter regulations are applied in the home country and consumers having more confidence in the domestic production process, environmental issues, meat freshness and support of the domestic economy.

## INTRODUCTION

In the European Union unprocessed and pre-packaged poultry meat must always be labelled with the country of rearing and the country of slaughter of the animal (Regulation (EU) No 1169/2011). But do European consumers actually care about this information? Only 34% of surveyed EU citizens stated that the geographical origin of food is very important and 27% even indicated that it is totally unimportant. Quality and price, however, seem to be far more deciding criteria for food purchases of consumers from the EU (European Commission, 2012). In another more recent survey, the response category "where the food comes from" seemed - among the other categories cost, food safety, taste, nutrient content, personal ethics and beliefs and others - to be the EU citizens' most important food purchasing criteria (EFSA & European Commission, 2019).

This paper deals with the attitudes of consumers from Denmark, France, the Netherlands and the United Kingdom regarding the COO of poultry meat. Besides the importance of the COO, the reasons for consumers' preferences regarding domestic or imported poultry meat will be assessed.

## METHOD

Online focus group discussions were conducted in Denmark, France, the Netherlands and the United Kingdom in August and September 2021. This method can be used to explore the opinions and attitudes of individual participants and capture the diversity of consumer opinions (Flick, 2009).

In each study country, five online focus group discussions were carried out with six poultry meat consumers in each group. Participants were recruited via a market research institute. The sample

was selected according to specific characteristics in order to create heterogeneous groups of consumers. Focus groups were set for a maximum of 120 minutes and were guided by a qualified moderator (native speaker) who followed a given structured series of questions. For the evaluation, a qualitative content analysis was applied.

## RESULTS

Discussants from **Denmark** mainly stated that the COO of poultry meat is not of great importance to them. Many claimed that they do not care or "*never thought about checking where the chicken is from*". In the opinion of some consumers, "*it doesn't make any difference where the poultry meat comes from*", at least if it comes from neighbouring countries. The participants also revealed not knowing if and where the COO is indicated on the product packaging. Some consumers mentioned that they assume that the purchased poultry meat is of Danish origin due to a high domestic production volume. Others declared that "*what matters is the quality*". Despite that, it was mentioned that the COO can be decisive for the purchase of poultry meat primarily due to environmental reasons. Others claimed to have more confidence in domestic meat, inter alia because of the perception of stricter and more trusted regulations and product freshness due to shorter transportation (see table 1). Also, the support of domestic economy and agriculture as well as food safety in general were mentioned motives for purchasing domestic poultry meat. Besides these, price was stated to be important which can lead to buying imported poultry meat.

For most **French** participants, however, the COO of poultry meat is (very) important. Very few consumers stated that they do not pay attention to the origin or that they might buy imported products "*if the price is more within [their] range*". Nevertheless, the vast majority of consumers declared that they prefer domestic, at best locally produced poultry meat. Reasons for that preference were, besides the perception of stricter regulations in France and more confidence in domestic meat products, the quality of French poultry meat. Further motives were "*giving work to local traders and farmers*" as well as to "*support Made in France*", environmental issues (carbon footprint), food safety which is related to domestic regulations, and price.

The majority of **Dutch** discussants, on the other hand, stated that they do not care about the country of origin of poultry meat or "*have never looked at that*". It was claimed that this is due to time reasons, because "*it is always a hassle to look where*

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it comes from". Furthermore, it was mentioned that if the meat is domestic or imported "does not matter much as long as it is good". However, few participants find it "very important where the meat is from". The main reason for preferring domestic poultry meat seemed to be confidence in domestic production as well as regulations and "that you are not being swindled". Other motives were meat freshness, support of the Dutch economy, transportation costs, environmental reasons and food safety.

In the discussions with **British** consumers, many participants also claimed not being interested in the COO of poultry meat. Some have never thought about the origin of meat and "would just have thought chicken was from here". Since "pretty much all of the EU have got the same standards anyway" and since "it's not making a difference [...] as long as it tastes good", consumers tend not to pay attention to the COO. Participants from the United Kingdom often referred to eating out, e.g. in a restaurant, and mentioned that they have never asked about or checked the COO of poultry meat. They assumed it was good quality as well as probably locally sourced meat. However, a considerable number of participants claimed that COO is important to them and that they prefer domestic, specifically locally produced meat. It was also explicitly mentioned that the COO just matters when it comes to fresh and raw meat, but not regarding frozen meat. Reasons for preferring domestic or even local poultry meat were again domestic regulations and confidence in domestic products, environmental motives, freshness, support of domestic economy and agriculture as well as animal welfare aspects.

#### DISCUSSION

The importance of the COO for consumers seems to differ between the study countries and also between the consumers within the countries. The vast majority of French participants of the focus groups classified the COO for poultry meat as (very) important, which goes in line with the findings of an EU wide study about food in general. According to that study, the importance of the COO of food was among French consumers above the EU average with 75% of consumers claiming it to be totally important and 24% totally not important (European Commission, 2012). The results of this paper suggest that consumers from Denmark, the Netherlands and the United Kingdom do not place as much importance on COO as French consumers and often do not even look at it. This can also be confirmed by the EU wide study, in which the importance of the geographical

origin of food was lowest in the Netherlands, followed by the United Kingdom and with Denmark ranked in fourth last place of the 27 countries studied (European Commission, 2012). Nevertheless, if consumers have to choose, they would mostly prefer domestic or even locally produced poultry meat.

Consumers from all study countries primarily prefer domestically produced poultry meat due to perceived stricter regulations in the home country and confidence in domestic production as well as in information given on the product. This goes along with food safety issues. Environmental reasons, product quality as well as freshness and support of the local economy and agriculture also play a major role for the preference of domestic or even local poultry meat. Feldmann & Hamm (2015) reviewed 73 publications on local food from the consumer's perspective and also found better quality, taste and freshness as well as greater trust, support of the local economy, environmental friendliness and animal welfare to be decisive factors for purchasing local food.

#### ACKNOWLEDGEMENT

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#### REFERENCES

- Regulation (EU) No 1169/2011 of the European Parliament and of the Council of 25 October 2011 on the provision of food information to consumers.
- EFSA, European Commission (2019). Special Eurobarometer Wave EB91.3. Food safety in the EU.
- European Commission (2012). Special Eurobarometer 389. Europeans' attitudes towards food security, food quality and the countryside.
- Feldmann, C., Hamm, U. (2015). Consumers' perceptions and preferences for local food: A review. *Food Quality and Preference* (40): 152-164.
- Flick, U. (2009). *An Introduction to Qualitative Research*, 4th ed. SAGE Publications.

**Table 1.** Consumers' reasons for preferring domestically/locally produced poultry meat (sorted by frequency of mention)

Denmark	France	Netherlands	United Kingdom
Transportation	Regulations/confidence	Regulations/confidence	Regulations/confidence
Environmental reasons	Meat quality	Meat freshness	Environmental reasons
Regulations/confidence	Support of economy	Support of economy	Meat freshness
Meat freshness	Environmental reasons	Cost of transportation	Support of economy
Support of economy	Food safety	Environmental reasons	Animal welfare
Food safety	Price	Food safety	

# Purchasing behaviour and motives of consumers of zero-waste shops in Vienna by means-end-chain analysis

Christof Falkenberg, Alice Thürr and Siegfried Pöchtrager<sup>1</sup>

**Abstract - Consumers are becoming increasingly aware of the negative consequences of consumption. The aim of this paper is to analyse consumers through Means-End-Chain-Analysis to find the underlying values and purchase motives when shopping in zero-waste shops compared to conventional supermarkets. The results of this study show significant differences as well as similarities (ecological sustainability, time for family/oneself) in the values of consumers. In addition, there are insights for the implementation of zero-waste concepts, whereby, from the consumer's point of view, attention must be paid to hygiene, cleaning, and process flow.**

## INTRODUCTION AND PROBLEM

For decades, plastic was considered a cheap, lightweight, and durable option for packaging and transporting food. As a result of the development towards a throw-away society, packaging and plastic bags for food are being released into the environment, which, in turn, requires several hundred years for the degradation of many of these substances (Su et al., 2021).

In 2015, a total of 4.16 million tonnes of municipal waste was generated in Austria, i.e. 482 kg per capita (Federal Ministry for Sustainability and Tourism, 2017). Through various governmental and non-governmental measures, the impact of plastic on the environment is supposed to be reduced (Nielsen et al., 2019). At the same time, however, there is also a growing environmental awareness among broad sections of the population. Awareness is reflected, among other things, in consumer behaviour and manifests itself both in the choice of food and its packaging (Lindh et al., 2016). As a result of this change in behaviour, there is a trend in consumption that shows an increased willingness to pay for ecologically, sustainably produced products or products that are not or at least less harmful to the environment (Lindh et al., 2016; Su et al., 2021).

Consequently, as interest in sustainable lifestyles has grown, so has the sustainable business sector. Due to the increased demand for packaging-free food in recent years, the concept of zero-waste shops has become established in the market. Consumers buy or bring their own packaging such as jars or cans and fill them with food directly in the store (van Herpen et al., 2016). Meanwhile, large supermarket chains have also become aware of this trend and are in the process of integrating similar systems into their stores.

In order to analyse the future development of this economic sector, attitudes towards ecological

sustainability as well as the consumption behaviour and motives of consumers of zero-waste stores and consumers of conventional supermarkets will be investigated and compared. Due to the research gap regarding consumer behaviour in zero-waste shops in Austria, Vienna was used as a case study in order to generate in-depth insights by means of qualitative research.

## METHOD AND APPROACH

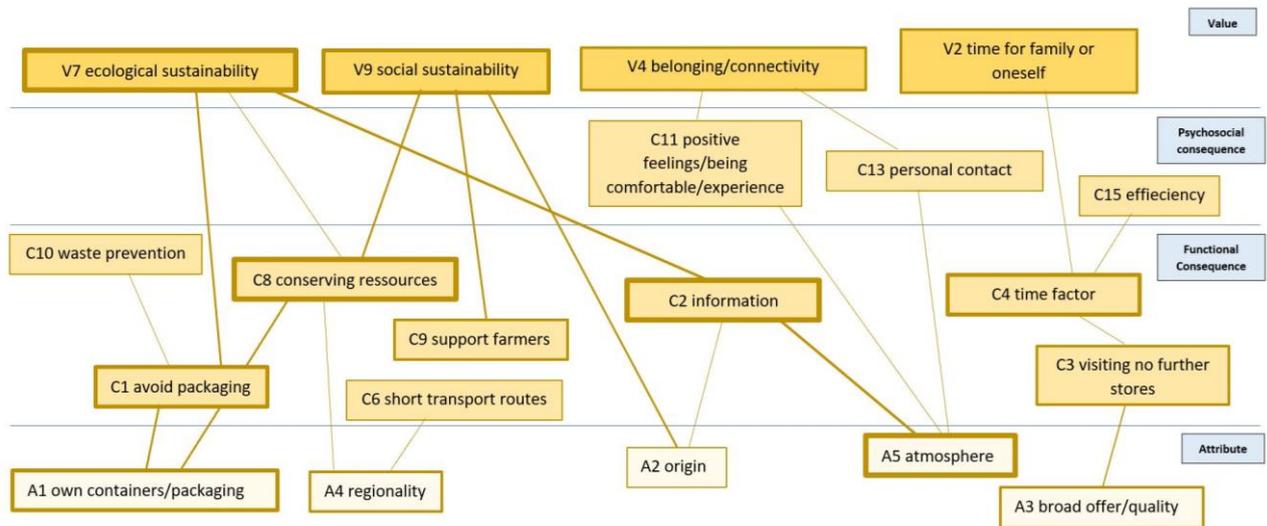
The understanding of sustainable consumption patterns and the reasons for or against sustainable consumption serve as foundation to be able to derive the consumption behaviour of consumers of zero-waste shops as well as conventional supermarkets. A suitable model for this is the Means-End-Chain model (MEC) in combination with the (soft) laddering approach. The MEC serves to explain cognitive structures in hierarchically arranged levels of abstracting (attributes → consequences → values) (Grunert & Grunert, 1995). Laddering involves semi-structured in-depth interviews that allow for a natural flow of speech (Reynolds & Olson, 2001).

After the interviews, they are coded and an implication matrix is created using these codes. Based on the implication matrix, a Hierarchical Value Map (HVM) is generated (Reynolds & Olson, 2001). Furthermore, the most significant relationships between the elements can be represented in the HVM. For this work, a total of 20 people were interviewed, ten per group. In the course of the interviews, attention was paid to theoretical saturation. This was noticeable at interview number eight in each group. Subsequently, two more interviews were conducted per group in order to determine the theoretical saturation with certainty.

## RESULTS

From the results of the qualitative interviews, the HVM shows that there are similarities, but also fundamental differences in the values of consumers of these two types of shopping. In conventional markets, ecological sustainability (14 mentionings) dominated at the deepest level of abstraction (values), followed by health (7) and time for family/oneself (4). For consumers of zero-waste shops (see Figure 1), ecological sustainability (11), social sustainability (9), belonging/connectivity (7), and time for family/oneself (3) dominated the consumption motives.

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**Figure 1: Hierarchical Value Map for consumers of zero-waste shops**

Even though the shopping behaviour of the two groups is different in terms of duration, planning, and frequency, common values such as ecological sustainability and time for family/oneself could be identified. However, the two groups differ in other values, whereby the value structure of the consumers of zero-waste shops appears more differentiated and intrinsically values social factors more strongly. Both groups are positive about the implementation of the concept of zero-waste shops in general. However, there are concerns about hygiene and a possible increase in the number of containers consumed and thus an increase in the consumption of resources by inexperienced consumers.

#### DISCUSSION AND CONCLUSION

Ecological sustainability means acting in a way that preserves the essential characteristics of the environment so that future generations can find them in comparable condition (Pufé 2012). As can be seen in both groups of consumers (zero-waste vs. conventional stores), ecological sustainability is the strongest value in both HVM, with resource conservation and waste avoidance being important to either group in terms of their individual consumption patterns. Consumers of zero-waste shops differentiate the concept of sustainability more strongly and also consider the dimension of social sustainability to be crucial. The fact that consumers of zero-waste shops take on the extra effort is due, among other things, to their greater involvement in these issues and their more intensive engagement with environmental problems, which requires a greater depth of cognitive processing for this group (Kroeber-Riel & Gröppel, 2019).

In the practical implementation of the concept, particular attention should be paid to hygiene standards, regular cleaning, and regulated procedures for filling the collection containers, as well as to monitoring and optimising the collection procedure. The results can be used to further develop products or services from a consumer perspective and to derive further communication and advertising strategies.

#### LITERATURE

- Federal Ministry for Sustainability and Tourism. (2017). Waste Prevention Programme 2017.
- Grunert, K. G., & Grunert, S. C. (1995). Measuring subjective meaning structures by the laddering method: Theoretical considerations and methodological problems. *International Journal of Research in Marketing*, 12(3), 209–225.
- Kroeber-Riel, W., & Gröppel, A. (2019). *Konsumentenverhalten* (11.). München: Verlag Franz Vahlen.
- Lindh, H., Olsson, A., & Williams, H. (2016). Consumer Perceptions of Food Packaging: Contributing to or Counteracting Environmentally Sustainable Development? *Packaging Technology and Science*, 29(1), 3–23.
- Nielsen, T. D., Holmberg, K., & Stripple, J. (2019). Need a bag? A review of public policies on plastic carrier bags – Where, how and to what effect? *Waste Management*, 87, 428–440. 29(1), 3–23.
- Pufé, I. (2012). *Nachhaltigkeit*. Konstanz: UVK Verlagsgesellschaft mbH.
- Reynolds, T. J., & Olson, J. C. (2001). *Understanding consumer decision making: the means-end approach to marketing and advertising strategy*. Mahwah, NJ & London: Lawrence Erlbaum Associates, Inc.
- Su, D. N., Duong, T. H., Thanh Tran Dinh, M., Nguyen-Phuoc, D. Q., & Johnson, L. W. (2021). Behavior towards shopping at retailers practicing sustainable grocery packaging: The influences of intra-personal and retailer-based contextual factors. *Journal of Cleaner Production*, 279, 123683.
- van Herpen, E., Immink, V., & van den Puttelaar, J. (2016). Organics unpacked: The influence of packaging on the choice for organic fruits and vegetables. *Food Quality and Preference*, 53, 90–96.

# PARALLEL SESSION 7

# RURAL SOCIAL

# RESEARCH



# Integration pathways of forced migrants in rural settings. Access to resources and agency

Ingrid Machold, Lisa Bauchinger and Thomas Dax<sup>1</sup>

**Abstract** – During the last refugee movements numerous municipalities and small cities in rural regions gained experience with receiving and integrating international migrants and increased intercultural co-existence in daily life. To better analyse the social and economic effects of international immigration in rural and mountain areas the EU research project MATILDE was initiated. This paper focusses on social integration aspects of forced migrants in three rural municipalities in Vorarlberg (AT) and how these might lead to more permanent settlement. It is concluded that building social relationships during the asylum procedure provides an important starting advantage when it comes to find employment and housing after recognition, enabling permanent settlement in a rural municipality.

## INTRODUCTION

The following analysis of integration pathways of asylum seekers and refugees (hereafter referred to as forced migrants) is based on research conducted within the EU funded project MATILDE (Horizon 2020 programme, grant agreement No 870831).

Although migration and integration have been studied for a long time, particularly in urban contexts, there is now increasing interest on international migration in remote and mountain regions areas (see for an overview: Kordel and Weidinger 2020). Based on the conceptual discussion by Ager and Strang (2008), this paper focusses on the importance of social relationships for all kinds of integration aspects (e.g. housing, employment, education or health), concentrating on the perceptions of forced migrants and the meaning of social relationships for their life in rural areas. Hereby the role of local structures, such as associations, volunteer networks and communal offers, is analysed, with a focus on their contribution to social integration, enabling and establishing social relationships between forced migrants and the local population. Questions about how forced migrants perceive their life worlds, relationships within the community, access to resources and sustaining migrants' agency should give some insights how these activities impacted on a more permanent settlement of forced migrants in rural municipalities (Herslund 2021).

## METHODS

Social mapping is a participative method and suitable for research questions with regard to life perceptions, community involvement and agency, and access to resources (Kumar 2002). To gain deeper knowledge of the perceptions of forced migrants 16 social mappings (each with one or two persons, in sum 25

forced migrants, 14 female and 11 male) were conducted in three rural municipalities of different sizes, territorial features and distinct socio-economic characteristics in the Federal State of Vorarlberg (AT). Within the scope of using the method of social mapping the aim was to find patterns of (un-)successful social integration of forced migrants by exploring their activities and detecting important contact persons since their arrival in Vorarlberg. By mapping the content of the interviews through presenting icons for activity fields, the method adds visibility and allows the relationships of the interviewees to be shown more clearly. Social mappings were transcribed and analysed according to the main principles of the Grounded Theory (Strauss and Corbin 1996).

## RESULTS

Local structures of social integration offer a variety of challenges and opportunities to promote social contacts and exchange between forced migrants and the local population. However, these processes are heavily influenced by timing and the status of the asylum procedure. *Living conditions, needs and demands differ considerably between the period of asylum application and the time after receiving first recognition and right of abode.*

Many interviewees in the three municipalities arrived during the high influx of migration in 2015 and 2016. At that time municipalities were highly alert to the needs of incomers and voluntary aid was offered. Thus, forced migrants found a mostly open and welcoming attitude by locals and many offerings for social integration at that time (Machold and Dax 2017). With regard to the needs and demands of forced migrants during the asylum process the following aspects were of high importance.

### *Learning of the German language*

Due to the large number of new arrivals in 2015 and 2016 official learning structures were overwhelmed with the acute demand for German classes. Therefore, many low-threshold courses were established immediately after the arrival. Volunteers, many of them retired language teachers, supported forced migrants by teaching a basic set of the German language. In other cases, language learning happened to be on a more individual basis, others preferred to visit an even more informal setting, such as language cafés. Depending on the intensity of the support for language learning, close relationships between forced migrants and locals were established.

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*Coping with affluent amount of spare time during this period of waiting*

To have plenty of time and literally nothing to do but waiting for the application interview and recognition is a difficult psychological challenge. It is even harder if forced migrants arrive without family, which was the case for many (young) men. Offerings by local volunteers, such as sports activities or get togethers were a welcome distraction for migrants. During all these activities personal relationships may be developed and maintained. Forced migrants were also looking for some kind of work or employment to make some sense of their time and be of use for the local society. Many of the interviewees were engaged in temporary job opportunities with the program "neighbourhood aid". These activities offered appropriate possibilities to be active in the local community, especially when forced migrants were not (yet) in paid employment.

*Attaining status of recognised refugee*

In some cases, the asylum procedure was exceedingly difficult and a right to abode could only be achieved through high supportive efforts of volunteers, either with regard to legal advice, or accompaniment and support at interviews and other activities that put forward the asylum process. Moreover, volunteers enabled forced migrants the link to local activities and to build bridges to the receiving society in many aspects of integration.

*Educational success of children*

Many forced migrants came as families and naturally the educational success of their children play a major role for their quality of life in the new surroundings. Again, informal and individual voluntary work was of crucial importance, as well as the support of primary and secondary school teachers.

*When forced migrants get their right of abode needs and demands of social integration gradually change.* As an immediate task they have to look for some kind of livelihood and housing as basic care provisions come to an end. In this regard relationships cultivated and elaborated during their asylum process were of crucial importance. Particularly individual support by volunteers was often decisive when it came to job placement, finding an apprenticeship placement and also when looking for a new apartment. However, focus of forced migrants increasingly changed from meeting basic needs to general well-being of the whole family. This included particularly a socially attractive neighbourhood, possibly with access to common meeting places, where neighbours can meet at an equal footing, as well as good support in school and local integration opportunities for children. While male migrants tended to develop some command of the German language, women often lacked contacts and language exposure due to child care, child birth, limited skills and employment integration and illness periods. Most of them were not employed and had little contact opportunities with locals. Thus, particularly for women community offers like language cafés, sewing cafés or any other low threshold offer are an

important possibility to socialize and practice German language acquisition.

#### DISCUSSION AND CONCLUSION

Social relationships are an important aspect of integration and local structures offer a variety of opportunities to promote the establishment of social contacts between forced migrants and the local population. Even if the contacts loose in relevance over time, the social network built during the asylum procedure happen to exist also beyond official recognition. Those contacts can be reactivated when needed and reveal to be relevant for many aspects of daily life (job or apprenticeship placement, housing, health treatment, etc.). Thus, it can be concluded that a diversified social network consisting of local and regional gatekeepers, volunteers, neighbours, friends, etc. is an "anchor" for permanent settlement of forced migrants in rural municipalities as these often build bridges and links to local and regional offerings.

A thorough knowledge of the diversity and relevance of local structures of social integration strengthens awareness building of regional stakeholders who coordinate and manage coordination activities. This might be of particular relevance when it comes to the current increase of migrants – be it refugees from Ukraine or asylum seekers from other destinations.

#### REFERENCES

- Ager, A. and Strang, A. (2008). Understanding Integration: A Conceptual Framework. *Journal of Refugee Studies* 21(2):166-191.
- Herslund, L. (2021). Everyday life as a refugee in a rural setting – What determines a sense of belonging and what role can the local community play in generation it? *Journal of Rural Studies* 82:233-241 <https://doi.org/10.1016/j.jrurstud.2021.01.031>
- Kordel, S. and Weidinger, T. (2020). Migration processes in European rural and mountain areas. In: S. Kordel and A. Membretti (eds.). Classification on spatial specificities and third country nationals distribution in MATILDE regions. Deliverable 2.1. URL: <https://matilde-migration.eu/reports/>
- Kumar, S. (2002). *Methods for community participation: a complete guide for practitioners*. London: ITDG Publishing.
- Machold, I. and Dax, T. (2017). Migration und Integration: Anstoß zur sozio-kulturellen Veränderung ländlicher Regionen durch internationale Migration. *Europa Regional* 24(3-4):62-76.
- Strauss, A. and Corbin, J. (1996). *Grundlagen qualitativer Sozialforschung*. Weinheim: Psychologie Verlags Union.

# Sustainability in Times of Crisis: Consumer Perceptions on Sustainability Aspects and Resilience of Food Production Systems in Germany during the Russia-Ukraine War

Clara Mehlhose and Adriano Profeta<sup>1</sup>

**Abstract** - The Russia-Ukraine war dominates the daily lives of people in Germany since February 2022, the economic and social impacts are not yet clear but expected to be far-reaching. Against the background of the multiple ongoing crises, one could expect that sustainability aspects lose importance for people. However, during the corona pandemic, sustainability aspects have become even more important for parts of the society. Therefore, this article examines the impact of the current war on consumer attitudes towards sustainability aspects as well as the perceived crisis resistance and resilience of national food production systems in Germany. Based on an online survey, 1470 subjects were interviewed. It can be seen that regional food systems are more strongly supported even though a high number of respondents do not see German agriculture as well positioned for times of crisis. Low food prices are currently the most important aspect for people when buying food, with sustainability aspects being currently the priority for fewer people.

## INTRODUCTION

While the consequences of the Corona pandemic have not yet been overcome and the climate crisis is more relevant than ever, a third big crisis - the Russia-Ukraine conflict - dominates the daily lives of people in Germany and worldwide. Many people are concerned not only by the shock of an actual armed conflict in Europe but also by the associated economic and social consequences. During the corona pandemic, it became clear that sustainability issues are very important to many people, even in times of crisis (Busch et al. 2021). Aspects such as regionality, healthy food, as well as climate and environmental protection have even become more important to parts of the population (Busch et al. 2021; Dangelico et al., 2022). However, against the background of the war and the resulting price increases for energy, but also for food products, it is questionable to what extent these developments will continue or perhaps even develop in the opposite direction. Therefore, this article examines the impact of the current war on consumer attitudes towards sustainability aspects and the perceived crisis resistance and resilience of national food production systems in Germany.

## METHODS

The study was conducted in April 2022, 8 weeks after the start of the war. 1470 people were interviewed. The subjects were recruited via an online access panel provider (gapfish). The sample is representative of the German population in terms of age, gender, education and regional distribution. The questionnaire

was adapted from Busch et al. 2021 to compare current consumer behaviour with that during the Corona pandemic. This paper will focus on the questions about sustainability aspects regarding food purchase behaviour, as well as on perceived resilience of food production systems and crisis resistance of the German agricultural system.

## RESULTS

By now, data analysis is not completely finished. We focus at this point on the descriptive results of the data.

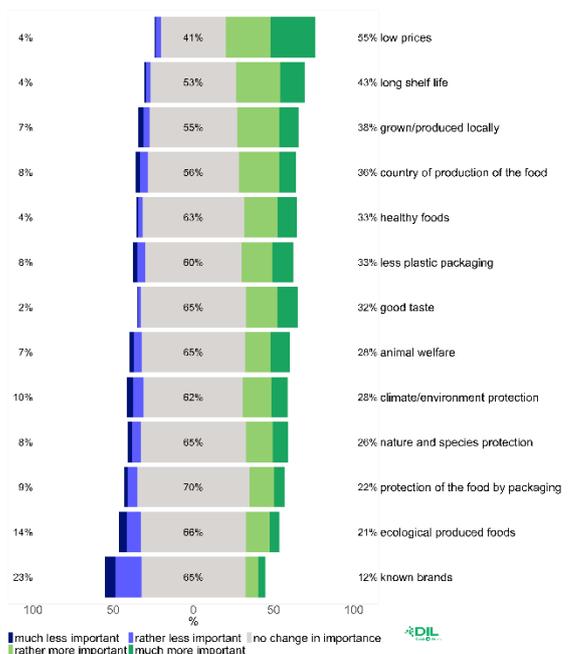


Figure 1: Change in the importance of different aspects of food purchase due to the Russia-Ukraine conflict.

When it comes to different aspects that have become more important or less important to people when buying food due to the outbreak of the war, it can be seen that for all aspects except the "low price" aspect, more than half of the subjects answered that the importance had not changed (see Figure 1). The aspects that have gained importance for a part of the respondents are "low prices" (56%), "long shelf life" (43%), "regionality" (39%) and "country of origin of the food" (36%). Sustainability aspects such as "climate and environment protection" (28%), "animal welfare" (28%) "nature and species protection" (26%) have gained in importance for almost one-third of the respondents and only for just about 10% have

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these aspects become less important. The aspects that have the largest share of decreasing importance are "brands" (23%) and "organically produced food" (14%) (all Figure 1).

When it comes to balancing economics and sustainability, 34% of the respondents agree with the statement that supporting the economy in times of crisis takes priority over climate and environmental protection. However, this is also contrasted by 43% of respondents concerned that environmental and climate protection and animal welfare (38%) will become less important in society due to the outbreak of war.

In addition, the respondents were asked about their assessments of the resilience of national, regional and global food systems to crises in order to see whether these might change under the impression of the war. The results showed a high amount of support for strong regional food supply chains in general. Respondents agreed relatively strongly that Germany should cover its demand for basic foodstuffs through its own agriculture (84%) and that a minimum quantity of these should always be covered by national agriculture (84%). 79% also agreed with the statement that policy should provide incentives for a diverse agriculture system. However, when it comes to the resilience and resistance of the German food production system 42% of the respondents think that German agriculture is not well positioned for times of crisis, and 34% also disagree that the agricultural sector will emerge stronger from the current crisis.

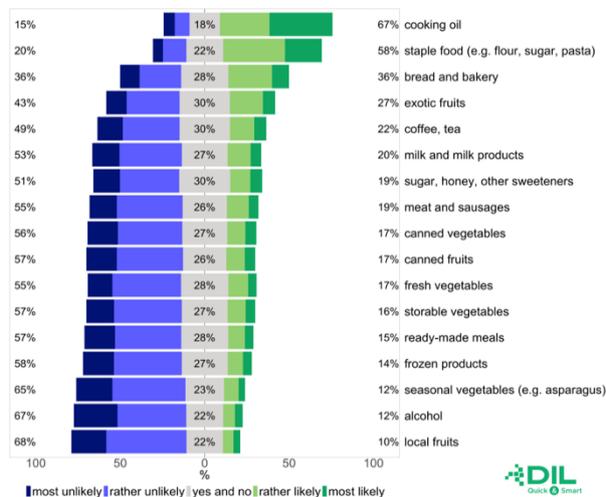


Figure 2: Expected food shortages in the near future due to the outbreak of war

The likelihood of food shortages in the supermarket in the near future is considered most likely by over half of respondents for cooking oils (67%) and staples such as flour, sugar and noodles (58%). The majority of respondents, on the other hand, consider this most unlikely for domestic fruits as strawberries (68%), alcohol (67%) and seasonal vegetables such as asparagus (65%) (see Figure 2). Those who expect food shortages see as the main reasons for this panic buying of others (86%), restricted agricultural production in Ukraine (83%) as well as increased food prices (83%).

## DISCUSSION & CONCLUSION

The Corona pandemic made the global and multi-layered effects of human activity more visible and thus boosted many people's awareness of sustainability. Compared to the results that we found in this study, in November 2020 a significantly larger proportion of respondents indicated that sustainability issues (e.g. "nature and species protection" (48.8%), "animal welfare" (47.7%), "climate and environment protection" (45.3%)) have become more important to them as a result of the pandemic (Busch et al., 2021). It seems that due to the high prices for food caused by the high inflation and the resulting price increases since the outbreak of the war, sustainability aspects have at least partially receded into the background. Concerns about food shortages are in this study also rated more likely in individual product groups than during the pandemic (November 2021 e.g. staples (21.6%), bread and bakery (9.0%)) (Busch et al. 2021). This can be seen in relation to the reasons where hoarding purchases are mentioned as the main reason for shortages, and oil and basic foodstuffs can be stored well.

When it comes to the resilience of food systems, we can see considerable support among the population for a high level of regional food supply, with, compared to the Corona pandemic, a simultaneous increase in the proportion of those who do not see German agriculture as well positioned for times of crisis (Busch et al. 2021). In summary, it can be seen that food prices are currently the most important aspect for people when buying food, with sustainability aspects taking a back seat. It remains to be seen how this will develop in the long term.

## REFERENCES

Busch, G., Bayer, E., Iweala, S., Mehlhose, C., Rubach, C., Schütz, A., Ullmann, A., Spiller, A. (2021): Einkaufs- und Ernährungsverhalten sowie Resilienz des Ernährungssystems aus Sicht der Bevölkerung: Eine Studie während der Corona-Pandemie im November 2020. Ergebnisse der dritten Befragungswelle, *Diskussionsbeitrag* Nr. 2102 des Departments für Agrarökonomie und Rurale Entwicklung der Georg-August-Universität Göttingen, Göttingen, April 2021.

Dangelico, R. M., Schiaroli, V., & Fraccascia, L. (2022). Is Covid-19 changing sustainable consumer behavior? A survey of Italian consumers. *Sustainable Development*, 1–20. <https://doi.org/10.1002/sd.2322>

# The role of Local Action Groups in identifying and resolving rural conflicts in Slovenia

Janja Rudolf<sup>1</sup> and Andrej Udovč<sup>2</sup>

**Abstract** - Researchers hypothesized that Local Action Groups (LAGs) could play an important role in resolving rural conflicts due to their unique networking status. Namely, they are the only actor in the field that offers tenders for networking projects with fair involvement of the public, private and non-governmental sectors. Through their Local Development Strategies of LEADER program, they provide a professional basis for connecting various municipalities, regional and development agencies, farmers, entrepreneurs, and the non-governmental sector. Their basic mission could be described to be a sub-actor between municipalities and to guide the local inter-municipal development of their region through targeted project financing. With the help of e-surveys among LAGs in Slovenia and in-depth interviews, we explored how the LAGs see their role in resolving inter-municipal spatial conflicts in rural areas. Results suggest that most of LAGs are aware of their capability to perceive rural conflicts and also see themselves as a vital mediator for solving these conflicts. They are aware of their specific networking status that enables them to build a space where an open direct communication with fair involvement of the private, public and non-governmental sector is build.

## INTRODUCTION

Rural development in the European Union (EU) countries has been supported by various policy measures and initiatives. One of them is mainstreaming the LEADER approach into development policies in establishing and supporting the local development partnerships in rural development projects in autonomous regional development (Pylkkanen and Hyyrylainen, 2005). The LEADER approach aims at encouraging establishing and supporting local development partnerships between three groups of local actors – civil society, public administration, and private sector – organized as the Local Action Groups (LAGs). These groups are expected to possess a relatively high degree of various intangible forms of capital, especially networking and social capital, which is believed to be the most important for the LAGs (Loštak and Hudečkova 2008).

The countryside is a place of important changes and functions and a space/place for diverse interests. Where areas of different interests overlap, conflicts arise, but on the other hand there can also be mutual benefits. Identifying and coordinating interests is a task of spatial planning and relevant sectoral policies, which necessarily requires cross-sectoral coordination (Golobič et al., 2003).

However, the functions of the rural areas cannot be considered in isolation. There are also interconnected actors who live, work, or just visit the countryside. This in turn leads to interactions that are often perceived as conflicts due to conflicting perceptions and interests (Potočnik Slavič, 2010).

Researchers hypothesized that LAGs could play an important role in resolving rural conflicts due to their unique networking status. Namely, they are the only actor in the field that offers tenders for networking projects with a fair involvement of the public, private and non-governmental sectors. Through their Local

Development Strategies (LDS), they provide a professional basis for connecting various municipalities, regional and development agencies, farmers, entrepreneurs, and the non-governmental sector.

With the help of e-surveys among LAGs in Slovenia and in-depth interviews, we tried to understand if and how the LAG sees its role in resolving inter-municipal spatial conflicts in rural areas.

## METHODS

We used quantitative technique – an e-survey and a qualitative technique – in-depth semi-structured interviews with representatives of LAGs in Slovenia. The e-survey was sent to all 37 LAGs in Slovenia, and we received complete answers from 18 LAGs.

With further quantitative analysis of these surveys, we defined four criteria by which we identified nine LAGs that would be suitable for an in-depth interview. These criteria were:

- a perception of specific areas/locations where conflicts occur or may occur in the future;
- an experience in adapting the LDS due to expressed actual or potential conflicts;
- an experience in mediating conflicts between members of LAG
- a presence of one's own participation in the conflict as an actor.

Due to COVID restrictions and health issues of certain representatives of LAGs we successfully conducted six in-depth interviews in November 2021, recorded and analysed them with Silverman's method (2001) of interpreting qualitative data using coding technique. We have interviewed LAG Gorenjska košarica (9.11.2021), LAG Loško pogorje (10.11.2021), LAG Dolenjska in Bela krajina (16.11.2021), LAG Haloze (18.11.2021), LAG UE Ormož (19.11.2021) and LAG Notranjska (18.11.2021).

In the interviews, we set eight topics:

- The role of the LAG now and in the future,
- How can a weak communication be a source of conflict?,
- Conflict resolution and the role of LAGs,
- Mediation process,
- Concrete areas and participants in the conflict,
- 'Troublemaker' or a driver of conflict,
- Are potential areas of conflict reflected through changes in local development strategies?,
- Changes in the demographic (D), economic (G) and spatial (P) areas over the last 10 years.

The idea was to get a first-hand views, experiences, and expectations regarding the past, present, and future role of the LAG in its area. We sensibly moved between the topics according to the course of the conversation and deepened the discussion with thematic sub-questions. The interviews ranged from 40 minutes to 1 hour and 20 minutes, with no time limitations.

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RESULTS AND DISCUSSION

We found that 14 out of 18 respondents have perceived at least one form of conflict. A qualitative analysis of the results of the e-survey showed that LAGs most often identify a group of conflicts that arise due to *lack of communication* (between residents and municipalities, between natives and newcomers; 10 out of 18 respondents answered YES) and *lack or abolition of public service shops, post offices, ATMs*; (9 out of 18 respondents answered YES). Six LAGs say they also perceive conflicts due to *problems with access to drinking water* and due to *leisure, recreational and sports activities* (mushrooming, cycling, hiking, horseback riding). Other groups of conflicts are identified by LAGs in less than one third of cases. Only three LAGs identify rural conflicts due to *agricultural production*.



Figure 5: Perception of LAGs on the presence of individual groups of conflicts in rural areas (n=18)

All LAGs in the survey expressed the need for assistance in identifying and resolving conflicts, the most (50%) identified *the need for assistance from lawmakers* and *the need for financial assistance*. 39% of LAGs want *help from decision makers*.

With further in-depth interviews we identified that LAGs perceive themselves as a key mediator of rural conflicts, because of their capability to seek synergies between conflicting interests and expectations. This consists with their main purpose - to use local endogenous rural potential for authentic local rural development (Volk and Bojnec, 2014).

LAG's representatives observe that the assemblies of LAG members are usually a catalyst for conflicts, as all members have an equal opportunity to communicate directly with each other. Therefore, most of conflicts are also successfully resolved there. In rural areas in Slovenia, it is expected that with increasing changes and an increasing number of diverse actors, there will be more and more interactions in the future, as also the need to coordinate diverse interests and resolve conflicts grows (Guštin and Potočnik Slavič, 2015). Therefore, an open direct communication on LAG's assemblies with different stakeholders equally represented could become vital for successful local rural management. According to the in-depth interviews, LAGs want to devote more time and resources to direct contact with the local environment, as this contributes to earlier involvement in resolving pre-conflict situations. Also, they observe, that the level of interaction (verbal and in writing) between LAG stakeholders declines greatly when the tenders are closed. However, according to their opinion, this is the ideal time to talk with stakeholders about their expectations for the next

LDS. LAGs wish they would receive a financial assistance, primarily intended for more field visits during a period when there is a stagnation of resources and communication between members is reduced.

Results of the e-survey and the in-depth interviews suggest that a LAG has a good insight into the spatial, demographic, and economic development of its region over time.

More, based on the results of the e-survey and interviews, LAGs could have a real opportunity to identify conflicts in rural areas and predict with a program of measures how they could be resolved. Results suggest that their role in this topic is more as a mediator and not so much as an actor. However, not all LAGs are aware of this possibility, so decision-makers could draw their attention to this aspect when preparing LDS.

CONCLUSION

Results suggest that most of LAGs are aware of their capability to perceive rural conflicts and also see themselves as a key mediators for solving these conflicts. They are aware of their specific networking status that enables them to build a space where an open direct communication with fair involvement of the private, public, and non-governmental sector is build. For collaboration to be possible at all, a certain degree of trust is needed between actors (Gubbins and MacCurtain, 2008), which the LAGs seem to produce. For the Slovene rural environment this means that LAGs could have the role of a mediator recognized by the state in inter-municipal conflicts.

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REFERENCES

Golobič, M., Marušič, J., Kovačič, M. (2003). Možnosti za usklajevanje razvoja kmetijstva z drugimi družbenimi interesi na slovenskem podeželju, primer občine Komenda. *Zbornik Biotehniške fakultete Univerze v Ljubljani*, Kmetijstvo. 81(2):389-409.

Gubbins, C., MacCurtain, S. (2008). Understanding the dynamics of collective learning: The role of trust and social capital. *Advances in Developing Human Resources*, 10(4):578-599.

Guštin, Š., Potočnik Slavič, I. (2015). Prepoznavanje in prostorska razmestitev konfliktov na podeželju. *Geografski vestnik*, 87(1):81-101.

Loštak M., Hudečkova H. (2008). Agricultural and farming related activities: their actors and position in the LEADER approach. *Agricultural Economics - Czech*, 54 (6):245-262.

Potočnik Slavič, I. (2010). *Endogeni razvojni potenciali slovenskega podeželja*. GeograFF 7. Ljubljana.

Pylkkanen P., Hyyrylainen T. (2005). Mainstreaming the LEADER method into rural development policies in Finland. *Finnish Journal of Rural Research and Policy*, 4:22-32.

# The State of Development of the Agriculture Knowledge and Innovation System in North Macedonia

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**Abstract** – This paper investigates the level of development of the AKIS in North Macedonia through seven key functions. Semi-structured questionnaire following the AKIS theoretical archetype was used in interviewing the key representatives of the national AKIS. The results revealed that the AKIS in the country is incomplete, partly functional, and disintegrated. New structures are necessary to enter the system and interconnections need to be established so to build a functional and integrated system for research, innovation, and technology transfer (RITT) in agriculture.

## INTRODUCTION

The agricultural sector in North Macedonia is technologically behind developments in the EU countries. Innovation does not occur in isolation, but several factors play a key role, such as policy, legislation, infrastructure, funding, and market developments (Fieldsen et al. 2021). Understanding the setting of the Agriculture Knowledge and Innovation System (AKIS), including identification of the AKIS actors, their organisation(s), and the knowledge flows between them, is an important step to understanding constraints and opportunities in the transfer of RITT (Knierim et al. 2015) to and in the agricultural sector in the country.

The main aim of the research is to identify the level of development of the national AKIS. Better understanding and improvement of constraints and opportunities in the RITT, would allow the development and application of methods and tools to increase the performance of the agricultural sector.

## THEORETICAL FRAMEWORK AND METHOD

Following the analytical AKIS framework, we study seven interlinked key functions required to improve the uptake of knowledge and technologies for innovation in AKIS (SCAR AKIS, 2013) as presented in Table 1, upon which the questionnaire was composed.

**Table 1.** Theoretical framework and questionnaire composition (SCAR AKIS, 2013)

Creation of knowledge	Fundamental knowledge transfer processes are the learning processes related to developing and utilising new knowledge, technology, or a set of practices. The development of new knowledge can occur through formal education, and in the private sector.
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Knowledge diffusion	The exchange of information through networks, where research and development meet government and markets. Policy decisions should be guided by the latest technological research and agendas should be adapted to changing environmental, market and social conditions.
Development of an AKIS vision	Creation of a vision for the AKIS and mobilisation of incentive structures to promote that vision. Incentive structures may change in response to factor prices and regulatory pressures, expectations in market growth potential, new knowledge, expression of interest by customers, cultural changes and external events, etc.
Entrepreneurial	Turn the potential of new knowledge, networks and markets into concrete actions to develop and capitalise business opportunities.
Market formation	Creating demand for the outputs of the development process. New technologies or practices often have difficulty competing with the status quo, so a market must be created via institutional change.
Creation of legitimacy	Necessary to overcome resistance to a new technology or set of practices from the existing production, trade and consumption systems.
Resource mobilisation	Closely linked to the creation of legitimacy and concerns financing investments, investments in human and social capital and the development of complementary products, services, infrastructures, etc.

The semi-structured interviews were conducted with representatives of the key institutions that are part of the (in)formal AKIS: i) Ministry of Agriculture, Forestry and Water Management: The Head of IPARD Managing Authority; ii) National Federation of Farmers: The Executive Director; iii) National Extension Agency: The Deputy Head of Sector; iv) The Agricultural Institute: A Research Assistant, and v) The Faculty of Agricultural Sciences and Food: University professors.

The data were summarised in a descriptive manner, enriched with analysis based on the researchers' analytic and integrative skills to examine the collected data, in line with the synthesis method.

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## RESULTS

*Creation of knowledge in the AKIS* - The first step in enhancing RITT is providing solid ground for the AKIS system, starting with the enhancement of the education, research, and advisory systems. Improvement of the education and creation of training curricula tailored to the changing market and circumstances are necessary for creating a sound knowledge base in agriculture. The research community plays an important role in developing innovations and the relations between the education and other relevant stakeholders should be formalised so as to enable the smooth transfer of knowledge and technology. Research investments in the country need to be increased in line with the market demand. The country has a public advisory service (the National Extension Agency - NEA) and a limited number of informal private advisors. The existing advisory service needs to be strengthened and other possibilities to involve new advisory structures i.e. private advisory providers should be explored.

*Knowledge diffusion in the AKIS* - Certain cooperation between different stakeholders in the agricultural sector exists in regard to innovation and technology development, however still not at a satisfactory level. The cooperation is mostly based on an individual and informal network basis, thus establishing a formal network for active collaboration of all stakeholders in the agri-food sector is urgent. The results confirm that innovations are mostly adopted from abroad i.e. importing the technology etc. or 'imitating' the process, and very rarely, there are innovations invented in the country.

*Development of an AKIS vision* - The national AKIS system contains almost all elements and institutions in the visualization of the conceptual framework. But, the system is partial and mostly informal and weak. The main problems occur in the undefined roles, positions and links among the stakeholders. The system as a whole is not functional and integrated due to the lack of facilities, finances, technical preparedness, and legislation. The links between different actors involved need to be strengthened and formalised, and new structures to be established.

*Entrepreneurial activities* - The domestic private sector is the leader in innovations and usually, innovation is market-driven, although they are far less innovative than the other European companies. Large farm companies and processors predominantly adopt innovations from abroad. Most companies, especially those of a small scale, are not motivated to develop innovation because of the high-risk levels in the sector. With few exceptions, small-scale farmers adopt innovations slowly. The private sector should be the key factor in the technology transfer and innovation due to their business interest.

*Market formation* - The external factors (i.e. the economic situation, EU accession, current pandemic crisis, etc.) are thought to be key to enhancing RITT in the agri-food sector. The national economic situation and the current crises have a negative effect, while the EU accession has a positive effect on enhancing RITT. Interviewees agree that demand is partially driven by private requests. In most instances, the supply-side factors for RITT are market-driven or dependent upon the available support programmes and finances.

*Creation of legitimacy* - The identified incentives or disincentives present in the system (i.e. market incentives, regulations, financial instruments, and support for investment and transfer initiatives) are mostly characterized as impediments in terms of limited access to credits, concentrated markets on the demand side, problems in sustainability of innovation

processes (monitoring), implementation of laws, programs, strategies, etc.

*Resource mobilisation* - The governance arrangements (i.e. coordination arrangements, interest of different actors, rules in place) for transferring RITT into practical applications are characterised as weak. There is a certain legal framework that needs to be adjusted and upgraded. In terms of modes of governance (i.e. regulatory, market-based), a market-based model is not incorporated into the regulatory model. Coordination is even weaker on a local level. IPARD program is one of the most important and stable instruments for promoting innovation and technology transfer. IPARD is a potential booster of innovation and new technologies in the agricultural sector.

## CONCLUSION

This research gives a representation of the internal and external factors which influence the AKIS system and provides conclusions for using the opportunities and bypassing the gaps in the transfer of RITT in the sector.

It can be concluded that the AKIS system in North Macedonia contains almost all elements and institutions but is based on informal relations and undefined roles and positions of the existing stakeholders. There is a large number of institutions with the same or similar competencies, making their coordination process difficult. There is also weak cooperation and competitive relations among the education and research institutions. One of the main deficiencies of the system is the lack of infrastructure and finance to support contemporary research that would solve real problems and introduce innovative solutions in the agricultural sector.

What is needed is an improvement of the regulations, an increase in the budget allocations and inter-sectoral coordination, along with the consistent implementation of comprehensive measures in a number of areas to create competitive products, and investment in RITT. The Government should put the RITT issue on the top of their policy agendas.

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## REFERENCES

- EU SCAR, 2013, Agricultural Knowledge and Innovation Systems Towards 2020 - An Orientation Paper on Linking Innovation and Research. European Commission, Brussels (Be), [http://ec.europa.eu/research/agriculture/scar/group\\_s\\_en.htm](http://ec.europa.eu/research/agriculture/scar/group_s_en.htm).
- Fieldsen, FA., Cronin, E., Varga, E., Biró, S., Rogge, E., 2021, 'Sharing the space' in the agricultural knowledge and innovation system: multi-actor innovation partnerships with farmers and foresters in Europe, *Journal of Agricultural Education and Extension, Competence for Rural Innovation and Transformation*, 27(4): 423-442.
- Knierim, A., Boenning, K., Caggiano, M., Cristóvão, A., Dirimanova, V., Koehnen, T., Labarthe, P., Prager, K., 2015, The AKIS Concept and its Relevance in Selected EU Member States. *Outlook on Agriculture*, 44(1): 29-36.

**PARALLEL SESSION 8**

**LAND**

**MANAGEMENT**



# Inheritance tradition and farm land fragmentation: evidence from Austria

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**Abstract** – Farm inheritance traditions may have long-term impacts on farmland use and ownership fragmentation. However, empirical evidence on the existence and magnitude of such impacts is rare. We use matching methods and regression analysis to compare nine indicators of fragmentation between farms in regions with partible and impartible inheritance. We combine plot-level land use data, land ownership information and historical information on inheritance traditions. We find that 50 years after impartible inheritance became the default by law, farmland in areas with a historically partible inheritance tradition is significantly more fragmented than farmland in areas with an impartible inheritance tradition. However, land renting contributes to reducing these differences in land fragmentation.

## INTRODUCTION

There is comprehensive empirical evidence that agricultural land fragmentation (LF) has a negative impact on farm performance. This is due to, among others, higher transport costs, lower field efficiency of machinery and harvest loss along field boundaries and corners (Latruffe & Piet, 2014).

LF can vary significantly between regions and there are numerous reasons for these variations. One commonly hypothesized cause of LF is partible inheritance, where farmland is split between several heirs (e.g., Thapa & Niroula 2008 for Nepal; Sklenicka et al. 2017 for Czechia). However, actual empirical evidence of the impact of different inheritance traditions of LF is scarce, in particular for European countries.

We address this lack of empirical evidence and investigate the impacts of inheritance traditions on LF in Austria. We focus on the North-Eastern Lowlands and Hills production area, where historically both partible and impartible inheritance prevailed in different municipalities. For the farms in this production area, we investigate whether the magnitudes of several indicators of farmland use fragmentation and farmland ownership fragmentation differ between different inheritance traditions.

## INHERITANCE TRADITION IN AUSTRIA

In general, there are two common practices of how agricultural land is inherited. Impartible inheritance (“*Anerbenrecht*”) traditionally transfers the whole (or most of the) farm, including its land, to the oldest (primogeniture) or youngest (ultimogeniture) heir. In contrast, in partible inheritance (“*Realteilung*”) or multiple succession), the farm and/or land is apportioned (equally) among heirs. In most parts of Austria, impartible inheritance traditionally was the norm (Khera, 1973); except some regions in Vorarlberg, Tyrol, Burgenland and Lower Austria,

where partible inheritance was applied. In 1959 (Vorarlberg: 1990), impartible inheritance was made mandatory by law to encourage larger farm sizes. However, with the exception of Tyrol, this legislation can be invalidated by a testator’s last will or by an agreement of the coheirs (Bäck, 2012). Since most farms in Austria are handed over through a “farm transfer contract” and not via statutory inheritance (Bäck, 2012), the traditions of partible inheritance may still be echoed in actual behaviour (Khera, 1973). Moreover, given that a farm is usually only inherited about three times in a century, effects of partible inheritance may be relatively long-term and therefore still visible today.

## DATA

We combine three different data sets for our analysis. First, we use plot-level data from the Austrian section of the EU’s Integrated Administration and Control System (IACS) to calculate the following fragmentation descriptors for each farm: farm size, average plot size, average plot-farm distance, and normalized average nearest neighbor distance between plots. We calculate these fragmentation measures for the total utilized agricultural area (UAA) of a farm, and separately only for the land owned (and not rented) by the farm. We also use this data set to derive exogenous control variables for each farm, including average altitude, slope, and soil productivity. Second, we use land ownership information from the Austrian cadastre to calculate the number of landowners for each farm. Third, we take historical data on inheritance traditions from the Austrian Ethnological Atlas (Österreichischer Volkskundatlas) to map the occurrence of different inheritance traditions to municipalities (Kretschmer and Pieglar, 1965) and to assign each farm to an inheritance tradition, based on its location.

## METHODOLOGY

We use multiple regression analyses to estimate the impact of partible inheritance on each of the nine fragmentation descriptors. We specify each model as

$$\log LF_i = \alpha + \beta D_i + \gamma X_i + \varepsilon_i$$

where  $LF_i$  is one of the different measures of LF calculated for farm  $i$ ,  $D_i$  is a dummy variable equal to 1 if the farm is located in a municipality with historically partible inheritance and 0 otherwise,  $X_i$  is a vector of control variables,  $\varepsilon_i$  is an error term and  $\alpha, \beta$  and  $\gamma$  are coefficients to be estimated.

As inheritance traditions are not distributed randomly and LF may be influenced by factors not observable but correlated to the explanatory variables, estimated coefficients may be biased. To

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avoid this, we pre-process the dataset using coarsened exact matching (CEM). The main task of CEM is to eliminate all imbalances in control variables between treated (partible inheritance) and control (impartible inheritance) groups above an ex-ante chosen level (Iacus et al., 2012). We use average altitude, average slope, average soil productivity, and farming type as control variables. In a first step, control variables are coarsened. For example, instead of assigning a particular altitude to each farm, we group farms into four categories (<200, >200 but <300, >300 but <400, and >400 meters). Second, these coarsened variables are used to match farms that are equal in regard to the control variables, but different in regard to the inheritance tradition. We drop farms that have no counterpart. Last, each farm gets a weighting, based on the number observations in their assigned category. This procedure decreases the imbalances and helps to identify the causal effect of our treatment variable, the partible inheritance (Iacus et al., 2012).

#### RESULTS AND DISCUSSION

Table 1 presents regression results and shows that when considering total UAA, farms in municipalities with traditionally partible inheritance have a significantly smaller average plot size, a larger average plot-farm distance, and a higher number of landowners. Average farm size is larger, but not statistically significant. The normalized average nearest neighbor distance between plots is smaller (contrary to expectations) but statistically not significant. Considering only owned UAA, the impact of partible inheritance is generally stronger than for total UAA, with all coefficients having the expected sign: farm size and average plot sizes are smaller than for farms with impartible inheritance, and average plot-farm distances and the normalized average nearest neighbor distances are larger.

**Table 1.** Coefficients and significance levels of the inheritance tradition variable for all models. Each coefficient describes the difference in the logged fragmentation descriptor of farms with partible inheritance tradition compared to farms with impartible inheritance tradition.

Fragmentation descriptor	Total UAA	Owned UAA
log (farm size)	0,016	-0,181***
log (average plot size)	-0,140***	-0,160***
log (average plot-farm distance)	0,090***	0,152***
log (normalized average nearest neighbor distance)	-0,058	0,135**
log (number of landowners)	0,355***	-

\*\*\*, \*\*, or \* denote statistical significance at 0.1%, 1% and 5% level, respectively.

#### CONCLUSIONS

After 50 years of impartible inheritance being the legal "default", farms in areas with a historically partible inheritance tradition are still significantly more fragmented than farms in areas with an impartible inheritance tradition. Thus, traditional inheritance customs are either still applied, at least to some extent, and/or it takes a lot of time to reverse the effects of past partible inheritance on LF. Hence, farms in partible inheritance areas still suffer some structural disadvantages. Smaller plots and longer distances increase production costs. However, renting land considerably helps to circumvent the differences in LF, stressing the importance of efficient land rental markets.

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#### REFERENCES

- Bäck, E. (2012). Anerben- und Höferecht. In: Norer, R. (ed.). *Handbuch des Agrarrechts*. Wien: Verlag Österreich.
- Iacus, S. M., King, G., & Porro, G. (2012). Causal Inference without Balance Checking: Coarsened Exact Matching. *Political Analysis*, 20(1), 1–24.
- Khera, S. (1973). Social Stratification and Land Inheritance among Austrian Peasants. *American Anthropologist*, 75(3), 814–823.
- Kretschmer, I. & Piegler, J. (1965): Bäuerliches Erbrecht. In: *Wissenschaftliche Kommission für den Volkskundeatlas: Kommentar zum Österreichischen Volkskundeatlas*, 2. Lieferung, Bl.17, Wien: Böhlau, 1-18.
- Latruffe, L., & Piet, L. (2014). Does land fragmentation affect farm performance? A case study from Brittany, France. *Agricultural Systems*, 129, 68–80.
- Sklenicka, P., Zouhar, J., Trpáková, I., & Vlasák, J. (2017). Trends in land ownership fragmentation during the last 230 years in Czechia, and a projection of future developments. *Land Use Policy*, 67, 640–651.
- Thapa, G. B., & Niroula, G. S. (2008). Alternative options of land consolidation in the mountains of Nepal: An analysis based on stakeholders' opinions. *Land Use Policy*, 25(3), 338–350.

# Land management paths for alpine pastures and mountain meadows in the Eisenwurzen region

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**Abstract - Due to the traditional cultivation by farmers and their unique flora and fauna, alpine pastures and mountain meadows can be considered as highly valuable but at first glance contradictory cultural and natural assets for the region and people who live there and visit it. The aim of this analysis is to gain a better understanding of the societal preferences of managing alpine pastures and mountain meadows and identify utilization strategies and framework conditions in order to develop an optimum of both, the cultural and natural asset and also consider recreational aspects. Therefore, we combine different methods of participatory research as well as a discrete choice experiment (DCE). This process identified six crucial attributes, having all positive preferences, in particular with regard to an increase in the diversity of plant and insect species. Based on final model results and further interactions with stakeholders, we aim to outline alternative land management paths for alpine pastures and mountain meadows in the Eisenwurzen region.**

## INTRODUCTION

Austria's landscape has been shaped by agriculture for centuries. Agriculture is thus instrumental in shaping the living space in rural regions and the resulting cultural landscape. In alpine regions cultural landscape extends up to high altitudes in the form of alpine pastures and mountain meadows. Due to the traditional cultivation of these alpine areas by farmers, alpine pastures and mountain meadows can be considered as a highly valuable cultural asset for the region and people who live there (Pötsch, 2010). Additionally, they form a habitat for a unique flora and fauna and can therefore be considered as natural asset (Hilpold et al. 2018). With the aim of preserving these habitats, some alpine pastures and mountain meadows in Austria have been included in the zones of Natura 2000 areas, nature reserves and national parks.

However, the clash of different interests with regard to conservation and future development of cultural and natural assets can lead to conflicts of use. In particular such conflicts occur between agriculture and nature conservation. Since both alpine agriculture and nature conservation are of great societal relevance and these alpine areas are a point of attraction for recreation, societal expectations play a crucial role in the future development of cultural and natural assets.

The aim of this analysis is to gain a better understanding of societal preferences for managing alpine pastures and mountain meadows within the

Eisenwurzen region and its surrounding areas. The results will be used to shape utilization strategies and framework conditions of such areas in order to achieve an optimum of both - at first glance contradictory - cultural and natural assets and also consider recreational aspects.

## METHODOLOGICAL APPROACH

We apply a participatory approach combining qualitative and quantitative methods of social research. Firstly, we elicit local expert knowledge by means of stakeholder interviews and conduct a literature review to identify the crucial features (attributes) of the design of alpine pastures and mountain meadows. Secondly, we organized workshops with local experts in order to identify the most crucial attributes in terms of their natural and cultural assets. Within the workshops we apply different methods of participatory research which can help to facilitate processes in which all stakeholder groups are on an equal footing. These include the method "Personas", which aims to motivate stakeholders to look at the problem from different perspectives.

Thirdly, different configurations of these attributes are combined to land use scenarios and assessed by the local population through a discrete choice experiment (DCE). DCEs are increasingly applied to analyse preferences of individuals with respect to non-market goods and services connected to agriculture. The key advantage of such a stated preference approach is that it can be used to value non-market outputs, for which no market values can be derived. DCEs are based on the rationale that people do not derive utility from goods and services directly, but from their attributes. In a DCE, choice data is generated through the construction of a hypothetical market by using a survey, where respondents are presented with several choice sets, each consisting of at least two alternatives, which are marked by a set of attributes with varying outcomes (i.e. levels). By choosing their preferred alternative in each choice set, they make trade-offs between the levels of the attributes of the respective alternatives in each choice set, from which their preferences for the good/service of interest can be derived. We analyse the choice data of the DCE with a Multinomial Logit Model (Train, 2009) and estimate the parameters reflecting preference weights for the attribute levels using a maximum likelihood estimation.

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CASE STUDY REGION

The Eisenwurzen region, which is located in the border region of Upper Austria, Lower Austria and Styria, serves as a case study region for the present analysis. Being part of the international network of Long-Term Socio-Ecological Research (LTSER), the region offers a regionally and internationally networked field of research. Small scale agriculture has been of great importance in this region for a long time and contributes to the preservation of the cultural landscape to a very large extent. So far, the touristic activities within the region are relatively low, but the region has a high potential for sustainable tourism. Two national parks, low population density and an attractive and diverse alpine landscape all have the potential to be appreciated by people from nearby urban centres who look for outdoor activities, both in summer and winter.

PRELIMINARY RESULTS

Through the participatory approach we developed 6 attributes for the DCE, which are shown in Table 1. In the survey, respondents were presented with 6 different choice sets, each consisting of 3 alternatives. One of these three alternatives was always identical, referring to a reference scenario, which described the possible status of alpine pastures and mountain meadows in the case study region in around 10 years in a business-as-usual scenario. The other two alternatives were varied based on a d-optimal experimental design (Street et al. 2005).

**Table 1.** Attributes and levels used in the DCE.

Attribute	Levels (number of level) <sup>a</sup>
Mountain hut function	<i>Resting place (1)</i> ; food and drinks (2); accomodation (3)
Scenery	<i>Forest dominated (1)</i> ; grassland and forest balanced (2); grassland dominated (3)
Share of regional food	<i>Low (1)</i> ; medium (2); high (3)
Diversity of plants and insect species	<i>Low (1)</i> ; medium (2); high (3)
Knowledge transfer	<i>None (1)</i> ; information signs (2); guided tours and courses (3)
Price (€/household and year in additional taxes)	0, 60, 120, 180, 240

<sup>a</sup>reference level in *italic*. n = 360 respondents  
 360 respondents from Eisenwurzen and surrounding areas with complete and valid responses were included in the econometric analysis. First preliminary results of a basic Multinomial Logit Model are shown in Table 2. The model was specified, so that all the parameter estimates describe the difference in utility with respect to the business-as-usual scenario. Results indicate overall positive preferences for all non-monetary attributes, in particular regarding an increase in the diversity of plant and insect species, and a negative preference for the price attribute, reflecting disutility for an increase in taxes for scenarios other than the reference scenario.

**Table 2.** Preliminary results of Multinomial Logit Model

Variable	Estimate	Std. Err.	Sign.
Alternative 1	0.642	0.140	***
Alternative 2	0.983	0.133	***
Mountain hut function (2)	0.440	0.074	***
Mountain hut function (3)	0.234	0.076	**
Scenery (2)	0.222	0.077	**
Scenery (3)	0.164	0.076	*
Share of regional food (2)	0.359	0.077	***
Share of regional food (3)	0.360	0.075	***
Diversity of plants and insects (2)	0.544	0.076	***
Diversity of plants and insects (3)	0.773	0.080	***
Knowledge transfer (2)	0.528	0.074	***
Knowledge transfer (3)	0.306	0.077	***
Price	-0.009	0.001	***

Note: \*\*\*, \*\*, \* and . indicate significance at the 0.1%, 1%, 5% and 10% level, respectively. Level numbers of the respective attributes are in brackets.

DISCUSSION AND OUTLOOK

The results of the DCE are currently further analysed with econometric models (latent class models) to better reflect heterogeneity in preferences, between different segments of respondents in the sample (Train, 2009), using several of the socio-demographic variables of the respondents. Based on final model results and further interactions with stakeholders, we aim to outline how alternative land management paths for alpine pastures and mountain meadows in the Eisenwurzen region could look like. The recommendations to be derived from this analysis should increase both, the (agri)cultural value as well as the natural value of such alpine areas, support policy in the development of appropriate strategies and avoid future conflicts between agriculture, nature conservation and tourism.

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REFERENCES

Hilpold, A., Seeber, J., Fontana, V., Niedrist, G., Rief, A., Steinwandter, M., Tasser, E., Tappeiner, U. (2018). Decline of rare and specialist species across multiple taxonomic groups after grassland intensification and abandonment. *Biodiversity and Conservation*, 27, 3729–3744

Pötsch E.M. (2010). Multifunktionalität und Bewirtschaftungsvielfalt im österreichischen Grünland. 16. *Alpenländisches Expertenforum 2010. Raumberg-Gumpenstein*

Street, D.J., Burgess, L., Louviere, J.J. (2005). Quick and easy choice sets: Constructing optimal and nearly optimal stated choice experiments. *International Journal of Research in Marketing* 22 (4), 459–470.

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

# Land use fragmentation and technical efficiency of Austrian crop farms

Andreas Eder, Klaus Salhofer<sup>1</sup>

**Abstract - For developing countries, a vast literature on the effects of land use fragmentation (LUF) on farm performance and its implications for land consolidation programs exists. However, little is known about the relationship between LUF and farm performance in Western and Central European countries. We use plot-level data from the Austrian Integrated Administration and Control System to derive a set of LUF indices at the farm-level. We explore the relationship between these LUF indices and technical efficiency of Austrian crop farms. We find statistically significant, though moderate efficiency-decreasing effects of a higher number of plots, lower average plot size and a larger distance from the farmstead to the most remote plot on technical efficiency. At the same time our results indicate no statistically significant effect of the scattering of plots and the average farmstead-plot distance on technical efficiency. Land consolidation programs should not only consider the efficiency losses from LUF incurred by farmers, but also the potential public costs and benefits of LUF.**

## INTRODUCTION

Agricultural LUF encompasses many different dimensions including: 1.) (average) plot size; 2.) number of plots farmed; 3.) shape of plots; 4.) distance of plots from farmstead; and 5.) distances between plots (or plot scattering) (Latruffe and Piet, 2014). LUF can have different costs and benefits for farmers: i.) higher transportation costs for inputs and outputs; ii.) higher labour requirements due to travelling time and organizational issues; iii.) less possibilities to exploit economies of scale (e.g., reduced field-efficiency of machinery and limited uptake of innovations); and iv.) harvest loss along field boundaries and at corners. While costs subsumed in i.) and ii.) are more related to dimensions 3.), 4.) and 5.), costs described in iii.) and iv.) are related to dimensions 1.) and 2.). However, there are also possible positive effects of LUF, which are mainly connected to the number of plots, including: cropping pattern optimization by better matching crops and plot attributes (e.g., soil); reduced production risk (e.g., from flood and hail); and reduced price risk (due to product diversification). The aim of this article is to investigate if LUF has a positive or negative impact on the technical efficiency of Austrian crop farms. A solid body of empirical literature on the effects of LUF on different dimensions of economic performance exists. However, most of these studies focus on developing or transition countries (e.g., Albania, Bulgaria, Estonia, North Macedonia). To the best of our knowledge the only studies investigating the effect of LUF on farm performance in Western European countries are Latruffe and Piet (2014) for Brittany,

France, Olsen et al. (2017) for Denmark, and Heinrichs et al. (2021) for Germany. While Heinrichs et al. (2021) provide a case study for three farms located in Western Germany, Latruffe and Piet (2014) and Olsen et al. (2017) offer large-scale analyses. For most LUF indices, except for indices measuring the shape and scattering of plots, Latruffe and Piet (2014) find a significant negative relationship between LUF and technical efficiency. Olsen et al. (2017) find that the shape of fields has no statistically significant effect, while smaller field sizes and longer distances significantly reduce farm performance.

## DATA AND METHODS

We merge two datasets: First, we use farm bookkeeping data from the Austrian section of the FADN to calculate production input and output variables, i.e., capital (in 2009 Euros), land (utilized agricultural area in ha), labour (annual working units), intermediate inputs including expenditures for fertilizer, pesticides, energy and others (in 2009 Euros), and revenues (in 2009 Euros). We use the four inputs and the single output to estimate technical efficiency scores with a standard radial Data Envelopment Analysis model (Charnes et al., 1978). We allow production frontiers to vary across time. The technical efficiency measures take values between 0 and 1, where 1 indicates that a farm is efficient. Second, we use plot-level data of the Integrated Administration and Control System to calculate a) the number of plots per farm, b) a farm's average plot size (in ha) and c) the Euclidian distance between the farmstead and the most remote plot (in km). The sample for our analysis consists of farms generating more than 50 % of annual revenues with crops and is restricted to the years 2009-2012. We regress each LUF index separately on the technical efficiency scores and control for average farm-plot characteristics (avg. altitude, avg. slope, avg. soil quality), farmer characteristics (age, gender, education), farm size and time fixed effects. We estimate pooled regression models with Ordinary Least Squares (OLS) and standard errors cluster at the farm-identifier. **Table 1** provides summary statistics of technical efficiency estimates and the LUF indices.

**Table 1.** Data used in analysis

LUF index	Mean	SD	Min	Max
Technical efficiency	.58	.20	.03	1.00
Number of plots	41	30	6	320
Average plot size (ha)	1.5	0.7	0.2	5.3
Max. farmstead-plot dist. (km)	5.6	4.6	0.2	34.5

Based on ~ 1260 obs. for the years 2009-2012.

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The average technical efficiency is 0.58. On average, a farm has 41 plots with a size of 1.5 ha, and the most remote plot being located 5.6 km from the farmstead.

#### RESULTS

**Table 2** shows the results of the pooled-OLS regression models. To save space, we do not report coefficient estimates and standard errors of control variables. The coefficient estimates of the LUF indices indicate that more fragmented farms tend to be less technically efficient: Model (1) reveals that one additional plot decreases technical efficiency by 0.001. The effect is statistically significant at the 1 % level. Model (2) shows that an increase of the average plot size by one hectare is associated with an increase of technical efficiency by 0.037. Finally, model (3) suggests that if the distance from the most remote plot to the farmstead increases by one km, the technical efficiency declines by 0.003. The statistical significance of this effect is weaker than for the LUF indices tested in Model (1) and (2) but we can reject the hypothesis that this effect is equal to zero at the 10 % significance level. LUF indices tested but not reported in **Table 1** and **Table 2** include the weighted (by plot size) average farmstead-plot distance and an index capturing the scattering of plots (average nearest neighbour distance). While the estimated coefficients are negative for both measures, our analysis suggests that these effects are statistically insignificant.

**Table 2.** Pooled-OLS regression results

LUF index	(1)	(2)	(3)
Number of plots	-.001*** (.0003)		
Average plot size (ha)		.037*** (.0112)	
Max. farmstead-plot dist. (km)			-.003* (.0016)
Observations	1252	1252	1251
Number for farms	374	374	373
Adjusted R <sup>2</sup>	0.23	0.23	0.22

\*\*\* p<0.01, \*\* p<0.05, \*p<0.10. Dependent variable is technical efficiency. Coefficient estimates are reported with standard errors clustered at farm-identifier in parenthesis.

Note that our results should be interpreted with caution and might not represent a causal relationship, especially if more efficient farmers are more likely to reduce fragmentation. Other methodological limitations are: First, little within variation for most of our variables makes it difficult to apply farm-fixed effects that control for time-invariant, farm-specific heterogeneity beyond the control variables included in our models, leaving some chance for omitted variable bias. Second, we do not control for regional time-variant effects such as (extreme) weather (events). Third, recent literature argues that LUF could be endogenous (see e.g. Knippenberg et al., 2020) and determined by, e.g., farmers' ability or conscious choices of farmers, both potentially affecting farm performance.

#### CONCLUSION

Regarding the efficiency-decreasing effects of a larger number of plots, lower plot size, and (to a certain extent) larger farmstead-plot distances, our findings are in line with Latruffe and Piet (2014) and Olsen et al. (2017). However, policy recommendations for land consolidation programs should not only take into account the private costs of LUF for farmers, but also public costs and benefits associated with LUF. On the one hand, additional and longer trips by farmers may result in additional traffic, road safety issues, and CO<sub>2</sub> emissions. On the other hand, smaller fields, in particular those with hedges or other landscape components between plots, may increase ecosystem services, biodiversity, and landscape characteristics. Moreover, fragmented plots may increase crop diversity, which in turn may strengthen the ecosystem.

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#### REFERENCES

- Charnes, A., Cooper, W.W., Rhodes, E. (1978). Measuring the efficiency of decision making units. *European Journal of Operational Research* 2(6):429-444.
- Heinrichs, J., Kuhn, T., Pahmeyer, C., Britz, W. (2021). Economic effects of plot sizes and farm-plot distances in organic and conventional farming systems: A farm-level analysis for Germany. *Agricultural Systems* 187:102992.
- Knippenberg, E., Joliffe, D., Hoddinott, J. (2020). Land fragmentation and food insecurity in Ethiopia. *American Journal of Agricultural Economics* 102(5):1557-1577.
- Latruffe, L., Piet, L. (2014). Does land fragmentation affect farm performance? A case study from Brittany, France. *Agricultural Systems* 129:68-80.
- Olsen, J.V., Czekaj T.G., Henningsen, A., Schou, J.S. (2017). The effect of land fragmentation on farm performance: A comprehensive farm-level study from Denmark. [Available at: <https://ageconsearch.umn.edu/record/260900>]

# Using the Integrated Administration and Control System's plot-level data: A proposed scoping review and pilot analysis

Heidi Leonhardt, Tobia Lakes, Silke Hüttel, Maximilian Wesemeyer and Saskia Wolff<sup>1</sup>

**Abstract** - In recent years, data from the EU's Integrated Administration and Control System (IACS) containing farmed plots' location and cultivation have become increasingly available for research purposes. While researchers from a broad range of disciplines rely on this data for their work, there is no complete and structured overview of use cases. To address this gap, we plan to conduct a systematic scoping review for identifying and analysing publications using plot-level IACS data from Austria, Czechia, France, Germany, and Sweden. To illustrate our intentions, we conduct a pilot analysis of 12 selected academic publications and present the results here. The pilot analysis demonstrates that IACS data serve to address a variety of research questions from disciplines including economics, ecology, and remote sensing. The analysed publications derive and apply 26 different indicators from IACS data to indicate landscape or farm configuration, composition, and management outcomes. We find a lack of a common terminology in the analysed papers and an apparent lack of data (access) harmonization between countries. Nevertheless, the results suggest that IACS plot-level data provide reliable, comprehensive and highly disaggregated information that facilitates scientific work.

## INTRODUCTION

To administer and control subsidies to farmers under the Common Agricultural Policy, European Union (EU) member states operate an Integrated Administration and Control System (IACS). IACS contains a land parcel identification system in which authorities provide georeferenced information on the agricultural plots eligible for subsidies and collect information on the crops grown on each plot (European Commission, n.d.). Since most farmers in the EU apply for subsidies and declare their farmed land and cultivated crops to IACS each year, the final dataset covers the vast majority of farmland in most EU countries.

Recently, authorities increasingly provide IACS data for scientific use. Researchers from various disciplines use the data, but there is little exchange of ideas, data handling strategies, or solutions to common problems between data users. We are also unaware of efforts to systematically collect and analyse published uses of IACS data.

To address this lack of knowledge collection and sharing, we plan to conduct a systematic scoping review (Munn et al., 2018) of scientific work that uses plot-level IACS data from five selected countries: Austria, Czechia, France, Germany, and Sweden. In

this conference paper we present a pilot analysis to explain our research aims and planned analysis.

We address the following research questions (RQs) in both the planned review and the pilot analysis: (1) Who has used IACS plot-level data, in which disciplines and time periods? (2) What research questions have been answered by using the data? (3) For which purposes have IACS data been used? (4) What information from IACS data has been used at which spatial and temporal levels? (5) What indicators have been derived from the data and for what purposes? (6) What other datasets have been linked to IACS data and how? (7) What critical evaluations and suggestions for using and improving the IACS datasets have been made?

## THE PILOT ANALYSIS

To guide our proposed scoping review, we rely on the methodology suggested by James et al. (2016) and follow a pre-registered protocol (in preparation) that details the 5 stages of the review process: (1) Searching publications, (2) Screening and selecting publications, (3) Extracting information, (4) Analysing and synthesizing information, and (5) Reporting.

To test stages (3)-(5) of the review protocol, we conduct a pilot analysis of 12 selected publications that cover different disciplines, journals, publishers, and all countries included in the review. From each of these publications we extract information needed to address RQ2 – RQ7, and analyse this information, e.g., by means of creating wordclouds, coding and grouping content, etc. The following sections present and discuss selected results of the pilot analysis.

## RESULTS

Figure 1 presents a wordcloud of the sample papers' abstracts, illustrating the *research topics* (RQ2) addressed in the papers. Note that land (use) and farming feature prominently, next to fragmentation. We identify and group the *methodological purposes* (RQ3) of IACS data use into indicator derivation, use as metric(s), site selection and grouping, typology creation, and reference data for remote sensing applications. We identify and group *content-related purposes* (also RQ3) into describing landscape and farm structure in terms of configuration and composition, describing farmer management activities, and conceptual discussions of IACS data.

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**PARALLEL SESSION 9**

**AGRI-FOOD  
BUSINESS**



# Fruit and vegetable producer organisations in Austria from an evaluator's perspective

Josef Hambrusch, Lisa Bauchinger, Lisa Eller, Sophie Pfusterschmid, Tobias Plankensteiner, Christoph Stelzer, Oliver Tamme and Christoph Tribl<sup>1</sup>

**Abstract – Based on a National Strategy, fruits and vegetables producer organizations (POs) of the member states can develop operational programs (OPs) and apply for EU funding. We present selected results of the evaluation of the National Strategy for sustainable Operational Programmes of Austrian fruits and vegetables producer organisations (POs) for the period 2013-18. Based on statistical analyses of annual reports of the POs as well as on qualitative interviews with various stakeholders we discuss the relevance of this strategy for the POs and the overall sector. Aligned to the six main guidelines of the National Strategy the results provide some useful insights for policy makers, POs and for future research.**

## INTRODUCTION

Since 2001, the Common Agricultural Policy (CAP) of the European Union (EU) supports co-operations between farmers in the fruits and vegetable sector via recognised producer organizations (POs). This policy action is also motivated by the ongoing concentration processes of downstream and upstream industries within the food chain affecting the bargaining position of farmers. In the fruits and vegetables sector National Strategies can be approved by the respective member states and provide then the basis for the Operational Programmes (OPs) and financial support of the POs. The main objectives of the National Strategy are stipulated in six strategic guidelines including an increasing competitiveness, a better production planning and the consolidation of structures of the farms.

The existing literature covers the topic of POs from different perspectives. For instance, using the example of fruit and vegetables POs, Fałkowski and Chlebicka (2018) discuss the POs product mix and marketing channels they use. Other papers discuss the role of POs with respect to farmers' bargaining power within the food chain (e.g. Fałkowski and Ciaian, 2016). Michalek et al. (2018) estimate the farm level impact of PO membership by employing propensity score matching and a difference-in-differences approach.

This paper presents selected results of the evaluation of the Austrian National Strategy for the fruit and vegetable sector (BMLFUW 2013; Hambrusch et al. 2021). Focussing on the period 2013-18 we discuss the relevance and objectives of the National Strategy for the fruit and vegetable sector. Furthermore, we address some general problems and shortcomings identified by the interviewed stakeholders.

## METHOD

The evaluation is based on statistical analyses of the submitted data and reports of the POs, a literature review and qualitative impact analyses of 14 guideline-based expert interviews. Seven managing directors of the POs could be interviewed, for the remaining POs no interview partners were available for various reasons. In addition, seven further interviews were conducted with persons from the chambers of agriculture (LKÖ), the paying agency (AMA), the ministry as the programming authority (BMLRT) and an advisory institution. The interviews proved to be crucial to the evaluation, as there were some information gaps and inconsistencies in the data and annual reports of the POs. Quantitative methods (e.g. before-after and with-without comparisons or difference-in-difference method; e.g. Kirchweger and Kantelhardt, 2015) were not applicable due to the lack of data on control groups (similar non-subsidised POs).

## RESULTS

There is only a small number of recognised POs in the fruits and vegetables sector in Austria, however we found a great heterogeneity characterising the POs as regards to their product mix and established marketing channels. Despite of these differences the patterns of provided support measures were similar.

Between 2013 and 2018, eleven POs were accredited in Austria but not all of them submitted OPs over the entire evaluation period. In these six years the total expenditures (i.e. eligible costs) of the OPs amount to approximately 92.7 million €. About 83% of all eligible costs are related to measures improving marketing performances (34%), production planning (30%) and improving and maintaining product quality (19%). Environmental measures (around 13%) are also of importance, not least because of their mandatory nature. However, the impact of individual measures can hardly be deduced solely on the basis of the allocations of measures to groups carried out by the POs. Hence, the amount of funds allocated among measures gives no indication of their impact per se, but does provide information on the need for certain measures.

The objective of increasing the Value of Products Marketed (VPM) and Quantity of Products Marketed (QPM) has not been achieved: both the total VPM of the POs for fruits and vegetables (-27%) and the total QPM (-16%) decreased from 2013 to 2018. However, there are considerable differences between the POs: while four POs (including three vegetable producers) were able to increase their VPM, seven POs (including

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four fruit producers) recorded decreases. Massive late frost events in 2016 and 2017 impaired the production of apples and contributed to the decrease of the Unit Value (VPM/QPM) from 0.93€/kg to 0.81€/kg.

As indicator for the organisation rate of POs in a country we used the ratio between the VPM of POs and the VPM of the total fruit and vegetable sector in the country (Fig. 1). After a period of quite stable values between 42% and 49% the organisation rate decreased to roughly 30%. Main reasons were production losses due to late frost events, varietal conversion programmes in apple production and a decreasing membership in POs.

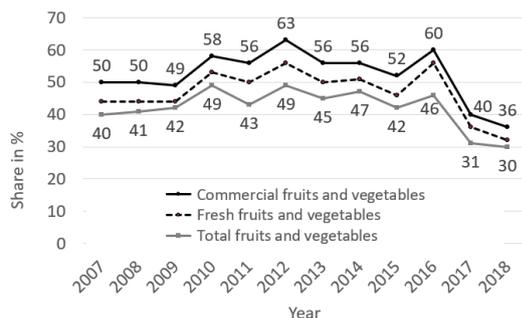


Figure 1. Organisation rate of Austrian POs (fruit and vegetable production, 2007-2018); Ratio of the VPM of POs vs. aggregated production values of fruit and vegetables.

#### DISCUSSION AND CONCLUSION

With respect to the period under review 2013-18 and the six guidelines pursued in the National Strategy, we can summarise the following:

A direct effect on the competitiveness and the concentration of supply cannot be derived from the available data. However, similar to the results of Dirksmeyer et al. (2012) it can be assumed that support to the recognised POs contributed to an overall improved competitiveness of these POs and their members. At the same time the support of recognised POs has impacts on other producers, packers and traders on the market. But POs compete also with other POs to attract members by deciding which strategies to pursue and which measures to promote within their OPs. On the one hand, investments in the modernisation of the POs' infrastructure or on the members' farms, access to quality programmes, to high cost varieties or advisory services are incentives for a membership in a PO. On the other hand, the POs often pursue the strategies of professionalisation, uniformity and high productivity of their members. These strategies attract primarily high-performance farms and lead to a certain selection process. All in all, the total number of PO farms decreased within the six years by 26%.

The expert interviews revealed problems regarding the implementation of OPs and related issues of legal clarity. At EU level, the EU regulation has to cover the entire, extremely heterogeneous sector of fruit and vegetable production across different EU countries, thus leaving some room for interpretation of the national implementation. This led to disagreements between the EU and Austria in the past. The interviewees also mentioned ambiguities in the specifications at the national level, e.g. with regard to

the control of the production marketed by PO members, the recognition/withdrawal of the status of a PO or the handling of reclaims. Both at EU and national level, POs experienced a lack of information and advice on funding modalities.

As a result of the lack of data, we were not able to draw empirically verifiable conclusions or to evaluate the efficiency of specific measures. In order to improve the overall significance of the evaluation results more accurate data and indicators are needed. For this reason, we suggest the change of the application process to a digital system. To shed more light in detail on individual measures and the overall impact and significance of the National Strategy for the POs, their members, the sector and consumers we suggest the assignment of further studies.

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#### REFERENCES

- BMLFUW (2013). *Nationale Strategie, Operationelle Programme Obst und Gemüse*. 2014-18. Wien.
- Dirksmeyer, W., Garming, H. und Fluck K. (2012). *Bewertung der nationalen Strategie für nachhaltige operationelle Programme im Obst- und Gemüsesektor in Deutschland (2012)*. Institut für Betriebswirtschaft, Johann Heinrich von Thünen-Institut. Braunschweig.
- Fałkowski, J. and Ciaian, P. (2016). *Factors Supporting the Development of Producer Organizations and their Impacts in the Light of Ongoing Changes in Food Supply Chains*; EUR 27929 EN; doi:10.2791/21346.
- Fałkowski, J. and Chlebicka, A. (2018). *Fruit and vegetables producer organisations – some insights on their functioning based on data from Poland*. European Commission, Joint Research Centre, doi:10.2760/758545.
- Hambrusch, J., Bauchinger, L., Eller, L., Pfusterschmid, S., Plankensteiner, T., Stelzer C., Tamme, O. und Tribl, C. (2021). *Bewertung der Nationalen Strategie für nachhaltige Operationelle Programme im Obst- und Gemüsesektor (2013-2018)* Österreich. Studie im Auftrag des BMLRT.
- Kirchweger, S. und Kantelhardt, J. (2015). The dynamic effects of government-supported farm-investment activities on structural change in Austrian agriculture. *Land Use Policy* 48, 73–93.
- Michalek, J., Ciaian, P. und Pokrivacák, J. (2018). The impact of producer organizations on farm performance: The case study of large farms from Slovakia. *Food Policy*, 75 (2018): 80-92.

# Identifying key causes of food waste generation in the Slovenian food supply chain

Teja Pogorevc, Ilona Rac, Mojca Korošec and Ilja Gasan Osojnik Črnivec<sup>1</sup>

**Abstract** - The causes of food waste are linked to each link of the food supply chain (production and processing, distribution and retail, HoReCa and other food service, final consumption) resulting in complex financial, social and environmental consequences. In order to prevent food wastage, it is crucial to understand its causes. Initially, the main causes of food waste in each link in the food supply chain were described. The causes of food waste are relatively well known for the consumer level, but not as well for the rest of the food supply chain. For that reason, additional semi-structured interviews with key stakeholders in the Slovenian food supply chain prior to the consumer phase were conducted. The interviews showed key causes in agriculture, food industry, retail, HoReCa and other types of food serving. The findings were validated with a national expert workshop.

## INTRODUCTION

The amount of food waste (FW) in Slovenia increased from 118 thousand tonnes in 2013 to 143 thousand tonnes in 2020, representing a 19% increase (SI-STAT, 2021). Half of this was from households, a third from the HoReCa sector, one tenth from retail and one tenth from primary production and processing. FW is directly related to food supply, food safety and environmental protection. By shifting to a responsible food culture and linking stakeholders, FW could be reduced throughout the food supply chain. Unconsumed food bears the imprint of all previous processes (from production to final consumption), and has many adverse environmental, social and economic effects. To reduce FW, it is necessary to identify its causes. In order to understand the causes of FW in the Slovenian food supply chain, this study focuses on the generation of FW prior to the consumer level, where the causes of FW generation are less known. For this, a participatory approach with the key stakeholders in the food supply chain was employed.

## METHODS

In the first stage, a review of the available scientific and expert literature in the field of FW was performed, drawing from own and other ongoing project work, as well as several good practices in surplus food reduction.

For the semi-structured interviews, key stakeholders with established engagement in the FW field were identified in coordination with national sectoral institutions and branch organisations. In total, 31 interviews with organisations were conducted, with 20-25 interviewees from each food supply phase. Interviews were conducted simultaneously with several people from the same organization. The first paragraph under each 'phase of food supply' includes 'aggregated' findings from all sources, while the second paragraph only includes findings from interviews.

## RESULTS

### Primary production (n=20)

Primary food production is highly dependent on climatic and seasonal conditions, location and production technology. Furthermore, in agriculture,

both food losses and FW occur. In recent years, there has been increasing FW due to more **frequent extreme weather events**, which destroy the crop to the extent that it is not suitable for the market due to not meeting minimum quality and cosmetic standards (MKGP, 2020). In agriculture, food losses occur due to **inflexible production planning options**, resulting in the production of larger quantities of produce than required, and market fluctuations (Osojnik Črnivec et al., 2021). FW can result from rejection due to quality requirements of the buyer, **order cancellation and unrealistic requirements** regarding visual standards and shelf life. Poorly developed production techniques, seed selection, technical equipment, lack of infrastructure, global trends and the demand for certain products throughout the year increase the amount of FW.

According to interviewees from primary production, more incentives for reducing food losses and for donating surplus food (removal of administrative barriers and minimalizing delivery costs) are needed. For example, the costs for the preparation of the crops are the same when surplus is provided for donation or when the products are sold on the market. Policy incentives and more stakeholder initiatives are important here. Moreover, awareness-raising and cross-chain coordinated actions are needed, such as fairer relations legislation.

### Processing – food industry (n=25)

The causes of FW in the food industry are numerous and often intertwined (MKGP, 2020). FW is generated in three phases of the food processing process - pre-processing, production and packaging, and after the production process (i.e. storage and transport) (Dora et al., 2020). The main reasons for FW in this sector are **underutilized inedible food fractions and by-products**, as well as **inadequate storage** of raw materials impacting the quality and **shelf life** (Dora et al., 2020; MKGP, 2020). Most of the **inedible part** of FW are generated in pre-processing, e.g. due to peeling or bone removal. The proportion of this FW is difficult to reduce; if it was not formed in this part of the food supply chain, it would be generated later on (Gunders, 2012), with a lower separation efficiency (Osojnik Črnivec et al., 2021). FW also can be generated due to **exceptional circumstances and technical issues** (Dora et al., 2020). In addition to generation of FW due to **improper handling** of food during storage and distribution (inappropriate conditions, improper handling) FW is also generated due to specific requirements of the market and customers (Dora et al., 2020; MKGP 2020).

According to the interviewees, general incentives for FW reduction are less effective for the food industry, an immensely diverse sector. They believe that it would be good to financially encourage stakeholders in the food supply chain who are already active and to offer promotion of stakeholders which are not recognisable. Furthermore, FW is regularly monitored at least from the point of financial losses, and used for continual optimization of production. According to

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the representatives of the food industry, these financial losses also occur due to various equipment maintenance, production line start-up, as well as subsequent recalls and withdrawals.

#### *Retail (n=26)*

Retail is the first link in the food supply chain in direct contact with the consumer (Gunders, 2012). Some FW can be generated due to **inadequate inventory management** and **poor ordering strategies**. **Improper storage** in warehouses and on store shelves, damage to packaging due to **improper handling** can lead to deterioration of product quality (MKGP, 2020; Pfeifer et al., 2016). A large quantity of products may be **recalled** due to established health inadequacy when it is already on the shelves and thus FW may be generated (MKGP, 2020). With the increased supply of prepared meals in stores, the amount of discarded food is also increasing. This can be exacerbated by the policy that the shelves should be full at all times, including just before closing (Gunders, 2012). In addition, FW can be caused by **offering a range of similar products** and **internal sales deadlines** that can cause withdrawal of items from shelves before their actual expiration date. (Osojnik Črnivec et al., 2021).

Retail (and other sectors) can also benefit from networking among stakeholders, and own initiative of individual retailers is already showing promising results. According to interviewees, interventions in food surplus prevention need to overcome strict regulations, social responsibility and systemic solutions for food surplus donation, and pose a huge challenge for actors already active in these practices. Disposal of FW in retail represents financial losses, which are partly reduced by food surplus donation and claiming VAT relief on donated quantities.

#### *HoReCa and other types of food serving (n=20)*

FW from the HoReCa and other types of food service is mostly caused by **food business management** and **guest preferences**. Insufficient training of staff can contribute to **poor kitchen practices** resulting in large amounts of FW (Gunders, 2012). **Ordering practices** (adjusting to demand vs. purchasing larger quantities of food in stock) and inadequate **stock planning** (MKGP, 2020) and **stock cooking** importantly affect FW generation. The amount of FW in restaurants can also be affected by the **season** (more FW generated during the off-season) (Filimonau and Sulyok, 2020). **Portion sizes** and **types of service** also increase FW generation (Osojnik Črnivec et al., 2021). E.g. flexible portion sizes and self-service cafeterias in public institutions have shown to lead to smaller amounts of FW (Osojnik Črnivec et al., 2021) as compared to fixed portions.

In this sector, the main challenges lie in organising proportional stock cooking, understanding guest preferences, staff training and guest education. Individual actors have identified practices of financial loss monitoring that can be successfully used in planning for FW reduction. An obstacle in surplus donation is demanding food safety and logistics due to variable quantities.

#### *Households (n=21)*

According to the Statistical Office of Slovenia (SI-STAT, 2021), most FW is generated by final consumers. The main causes of FW here include: (i) the level of awareness and habits of consumers when planning food purchases, (ii) sales promotions and wide ranges of similar products, (iii) lack of consumer knowledge about food preparation and storage, (iv)

insufficient planning of meal preparation, (v) low food culture and the knowledge on how food is produced, (vii) poor knowledge on expiration dates (poor distinguishing of the quality related "best before" and safety related "use by" dates) (Osojnik Črnivec et al., 2021).

#### CONCLUSION

FW is steadily increasing in Slovenia. Its causes differ in each link of the food supply chain: **Production** (poor production planning options, poor crop quality, market fluctuations), **food industry** (quality of raw materials, by-products, inedible parts), **wholesale and retail** (storage, packaging, promotions, expiration dates), **service** (planning and preparation, guest type, portion size), **consumption** (lack of knowledge about food preparation, storage, too much choice). Based on the identified causes of FW, suggestions for reducing or even preventing FW can be made. Cross-cutting factors driving FW reduction along the food supply chain are horizontal and vertical cooperation, involvement of stakeholders in policy making and multi-level education.

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#### REFERENCES

- Dora, M., Wesana, J., Gellynck, X., Seth, N., Dey, B., De Steur, H. (2020). Importance of sustainable operations in food loss: Evidence from the Belgian food processing industry. *Annals of Operations Research*, 290 (3): 47-72.
- Filimonau, V., Sulyok, J. (2020). »Bin it and forget it!«: The challenges of FW management in restaurants of a mid-sized Hungarian city. *Tourism Management Perspectives*, 37: 100759.
- Gunders, D. (2012). *Wasted: How America is losing up to 40 percent of its food from farm to fork to landfill*. New York City, Natural Resources Defense Council, iP:12-06-B.
- Matzembacher, D. E., Brancoli, P., Maia, L. M., Eriksson, M. (2020). Consumer's in different restaurants configuration: A comparison between different levels of incentive and interaction. *Waste Measurement*, 114: 263-273.
- MKGP. (2020). *Predlog strategije za manj izgub in odpadne hrane v verigi preskrbe s hrano*. Ljubljana, Ministrstvo za kmetijstvo, gozdarstvo in prehrano, 1-26.
- Osojnik Črnivec, I. G., Korošec, M., Maček, K., Rac, I., Juvančič, L., Poklar Ulrih, N. (2021). *Analiza stanja in vzrokov nastajanja odpadne hrane v Sloveniji z vlogami ključnih akterjev v Sloveniji v shemi poročanja distribucije presežkov hrane*. Ljubljana, Biotehniška fakulteta, 1-110.
- Pfeifer, C., Jörissen, J., Bräutigam, K. R. (2016). FW prevention in Europe – A cause-driven approach to identify the most relevant leverage points for action. *Resources, Conservation and Recycling*, 109: 155-165.
- SI-STAT. (2021). *Food waste generation by source (tons), Slovenia, annually*. Ljubljana, Statistical office of Slovenia: database.

# Understanding the motivations of individuals and organizations to prevent food waste

Ilona Rac, Nataša Poklar Ulrih and Ilja Gasan Osojnik Črnivec<sup>1</sup>

**Abstract** – Food loss and waste are important environmental and social issues gaining increasing amounts of attention. However, while its causes are relatively well-researched and understood, national research on this topic is relatively scarce for Slovenia. Furthermore, research on motivations and barriers to reduce its amounts is especially lacking. The national research project Food not waste aims to fill this gap and provide information to decisionmakers and practitioners on appropriate points of intervention. Preliminary results show a low level of mutual understanding between actors, a lack of cooperation and a high degree of shifting responsibility onto the 'unconscious' consumer.<sup>1</sup>

## INTRODUCTION

Food loss and waste (FLW) are environmental and social issues that have been gaining increasing amounts of societal, political and scientific attention. Worldwide, an estimated 1.3 billion tonnes of edible food are wasted annually (FAO, 2011). It FLW were a country, its carbon footprint would be third only to the USA and China (FAO, 2013). Furthermore, the food wasted could feed the world's undernourished several times over (WFP, 2020). In light of its environmental and social repercussions, the increasing necessity to curb greenhouse gases, wasteful resource use and food scarcity, FLW represents a field that must be addressed in any endeavours to achieve sustainability. The importance of common action is recognized in the UN's Sustainable development goal 12.3, which sets out to halve per capita global food waste, as well as at the heart of the EU's Green Deal and the Farm to Fork Strategy.

In Slovenia, an estimated 143.570 tonnes of food were wasted in 2020, equalling about 68 kilograms per capita (SORS, 2022). While the distribution and amounts are not yet known precisely, owing to issues in reporting, research shows that generally, about half of food waste can be attributed to households, while the rest happens in the earlier stages of the food chain, with every next stage carrying a bigger environmental footprint due to additional inputs in terms of processing, packaging, transport and labour (Osojnik-Črnivec et al., 2021). The first Slovenian systemic actions to combat food waste is set in the Strategy for less food losses and food waste in the food supply chain (MAFF, 2021).

While the reasons for the occurrence of FLW are now relatively well-known, the motivations of various food chain actors to reduce it are not as well researched, and are hardly researched at all in Slovenia. Here, we present an early attempt at elucidating the motivations of the successive food chain actors (primary production, processing and packaging, retail, food service) to reduce food waste; while the research is still ongoing, we can already present some preliminary results. The end aim of this research is to identify key interventions that are both effective and acceptable to stakeholders.

## METHODOLOGY

When an explicit theoretical framework is employed in FLW motivation research, especially research tackling consumer food waste, it is most often Ajzen's Theory of planned behaviour (1991). Thus, we divided our own research into two main parts, segmenting the food chain into the pre-consumer and consumer stage, first explored using interviews (analysed inductively) and followed by quantitative surveys.

To gain a first insight, we first conducted in-person semi-structured interviews (n=46) with food chain actors (8 in production, 9 in processing, 11 in food service and 11 in final consumption), yielding the preliminary results presented below.

In the subsequent part of the research (still ongoing), the two separate online surveys are being applied to the two distinct segments described above. They include questions on approximate amounts of food lost or wasted, their causes and factors affecting volumes of FLW, actions taken to tackle FLW, awareness of available options for this, readiness to change practices, and attitudinal variables relating to environmental and social effects of FLW. Since the response to the survey has yielded a small sample (n=62; only 41 finished the survey) so far, we only present results for consumers, and this descriptively.

## RESULTS

### Causes of FLW

The main identified causes of FLW in *agriculture* are poor production planning, deliberate production of larger quantities of produce than expected sales, adverse production conditions affecting crop quality, and market fluctuations. In food *processing*, large quantities of food waste (FW) are not cost-effective, so production processes are already streamlined away from edible FW generation, with some leeway in feedstock and product expiration dates, mobilising side-streams and underutilised production lines, input quality control and strategic control point management. In *retail*, FW is generated due to the differences between planned and actual sales, damaged packaging, as well as withdrawals and expirations; partly it is also due to sales practices (internal sales deadlines, constant product availability, large ranges of similar products, and promotions). In food *services*, FW occurs because of: consumer preferences and behaviour, improper handling, stock management, food preparation planning and service type; public institutions also mentioned a need to upgrade the public procurement system (Osojnik Črnivec et al., 2021).

At the consumer level, the most commonly stated reasons by consumer representatives in interviews include a lack of awareness of the food production process and consumer preferences, as well as planning of purchases and food preparation, and lack of knowledge with regard to food reuse, storage and preservation, and on expiration dates (ibid.). On the other hand, the surveyed consumers selected 'unpredictable eating behaviour in the household' and

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'lack of time' as the most important reasons for household FW, followed by the 'wish to provide good nutrition for family' and 'lack of planning'.

### Barriers to reducing FLW

The obstacles to reducing FLW and mobilizing excess food at different stages of production and consumption that were highlighted in interviews can be classified into three broad (interrelated) categories: costs and logistics, awareness and education, and legislative and administrative barriers (including food safety concerns). Another factor spanning the entire food supply chain (as well as public bodies) is a lack of horizontal and vertical cooperation.

**Costs and logistics** are a concern both in terms of harnessing additional financial and labour capacities needed for storing, transporting and/or distributing excess food, both in terms of alternative forms of valorisation and donation of food.

**Awareness and education** mainly refer to the lack of awareness regarding the inputs of resources required to produce food, but also to the lack of skill of staff handling food during storage, transport and production, and of consumers when handling and storing food at home. This also includes reluctance to donate food due to fear of liability and potential misinformation regarding the relevant legislation.

Finally, **legislative and administrative barriers** refer on the one hand to legislation on food safety that is intended to protect consumers from food unfit for consumption and food-borne diseases, but also other aspects (rigidity) of legislation, such as e.g. taxation and regulation of economic entities and NGOs, which hamper the redistribution of excess food.

The consumer survey again contradicts some of these results, showing that limited time and planning, in addition to disposable income and food prices, are considered the most important factors.

### DISCUSSION AND CONCLUSIONS

Results of interviews so far largely confirm research findings published in international journals, as do the suggested practices and points of intervention, such as awareness-building campaigns, stimulating the adoption of novel technologies, social innovation, cooperation between value chain actors and a more favourable and flexible regulatory environment (see e.g. Pfeifer et al., 2016; Canali et al., 2016).

However, something notably missing from the interviewees replies but apparent from the consumer survey, was the precedence to consumers of *convenience* over awareness (cf. Graham-Rowe et al., 2014; Hebrok and Boks, 2017). Research on environmental issues in general shows that there is often misalignment between stated attitudes and actual action, referred as the attitude-behaviour gap (e.g. Schanes et al., 2018). It may follow from this that awareness and other psychological factors, cited many times by interlocutors, while undoubtedly important, may actually be secondary to practical aspects of consumers' everyday lives, such as e.g. time constraints or socio-economic characteristics; at any rate, their importance should not be overlooked.

The issue of FLW is still relatively poorly understood in Slovenia, especially in terms of motivations and contribution of different segments. This is manifested *i.a.* in a lack of understanding of processes at other stages of the food supply chain emanating from the interviews, and, more tangibly, in the paucity of long-term contractual relations and information-sharing. This indicates the need for a higher level of communication and cooperation (cf. e.g. Priefer et al., 2016) between different actors to

tackle the problem in a comprehensive way, while the discrepancy between the results of the interviews and the survey indicates a strong need for further research.

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### REFERENCES

- Canali, M., Amani, P., Aramyan, L., Gheoldus, M., Moates, G., Östergren, K., Silvennoinen, K., Waldron, K., & Vittuari, M. (2016). Food waste drivers in Europe, from identification to possible interventions. *Sustainability*, 9(1), 37.
- Food and Agriculture Organization of the United Nations (FAO). *Food Wastage Footprint. Impacts on Natural Resources; Summary Report*; FAO: Rome, Italy, 2013.
- Graham-Rowe, E., Jessop, D. C., & Sparks, P. (2014). Identifying motivations and barriers to minimising household food waste. *Resources, Conservation and Recycling*, 84, 15–23.
- Gustavsson, J., Cederberg, C., Sonesson, U., van Otterdijk, R., Meybeck, A., (2011). *Global Food Losses and Food Waste: Extent, Cause and Prevention*. Food and Agricultural Organization of the United Nation (FAO)
- Hebrok, M., & Boks, C. (2017). Household food waste: Drivers and potential intervention points for design – An extensive review. *Journal of Cleaner Production*, 151, 380–392.
- MAFF (2021). Strategy for less food losses and food waste in the food supply chain. Available at [https://www.gov.si/assets/ministrstva/MKGP/PODR\\_OCJA/HRANA/Zavrski\\_odpadna\\_hrana/Strategija\\_izg\\_uba\\_hrane\\_odpadna-hrana.pdf](https://www.gov.si/assets/ministrstva/MKGP/PODR_OCJA/HRANA/Zavrski_odpadna_hrana/Strategija_izg_uba_hrane_odpadna-hrana.pdf) (accessed 3.5.2022)
- Priefer, C., Jörissen, J., & Bräutigam, K.-R. (2016). Food waste prevention in Europe – A cause-driven approach to identify the most relevant leverage points for action. *Resources, Conservation and Recycling*, 109, 155–165.
- Osojnik Črnivec, I. G., Korošec, M., Maček, K., Rac, I., Juvančič, L., Poklar Ulrih, N. (2021). Analiza stanja in vzrokov nastajanja odpadne hrane v Sloveniji [Analysis of the situation and causes of food waste generation in Slovenia]. Ljubljana, Biotehniška fakulteta: 110
- SORS (2022). Nastajanje odpadne hrane po izvoru in ravnanje z njo. [Sources of food waste per source and its management]. Available at <https://pxweb.stat.si/SiStatData/pxweb/sl/Data/-/2780705S.px> (accessed 25.4.2022)
- World Food Programme (WFP). (2020). 5 facts about food waste and hunger. Available at <https://www.wfp.org/stories/5-facts-about-food-waste-and-hunger> (accessed 26.4.2022)

# Tipping points in measuring organic trust: Just another food choice experiment?

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**Abstract - Consumer Trust is particularly important in organic food systems because there are only marginal visual and sensory differences between organic and conventionally produced products. In this context, trust is fostered by certain personal and systemic circumstances. However, it also depends on the ability of the food system to meet consumer expectations. As there is a growing gap between consumer expectations and actual behaviour, there is a need to align consumer expectations with the organic food system. To examine the growing expectations gap and potential tipping points for mistrust, our study conducted a choice experiment with four different attributes and three different products, targeting especially groups in doubt of the prescribed intrinsic attributions.**

## INTRODUCTION

Consumers are generally interested in sustainable food quality, but broad acceptance is still lacking. In the food market in Germany as a whole, organic food sales only account for about 7% (BÖLW 2022) indicating an information or trust gap (Janssen and Hamm 2014). Consumer trust is particularly important in sustainable foods, such as organic foods, because of the credence quality it possesses. It can be fostered by certain circumstances, such as the health content of organic food, local production, the organic label, taste, animal welfare, small family farming (Thorsøe 2015) and price premiums (Macready et al. 2020). The overall aim of the project is to understand doubts and tipping points in organic food shopping acquisition. The project targets to understand food choices by respondents, who are not regularly shopping organic – organic doubters. In a qualitative study in May and June 2020 with 39 semi-structured in-depth interviews, interviewees were asked about attributes influencing not only trust, but also mistrust in organic products. The majority of participants had an academic education, were responsible for their own food purchases, and purchased organic food only occasionally. The most interesting result highlighted a lack of systemic trust in reflection of the distribution channel, personal involvement of supermarket personal and the visual appearance of an organic product (own study, in review for publication). It is assumed that systemic-trust may be bound to the systemic quality orientation determined through the distribution channel, personal-involvement of study personal and visual appearance. To determine how sociological origin, distribution channel, appearance of the product and price do influence the likelihood of choosing organic products among 'undecided organic shoppers' and to find any strong determinants (tipping points) for (mis-)trust, we conducted a choice experiment with three different products (animal, plant and processed product), varying not only price and distribution channel, but also visual appearance

and social distance of the selling person as attributions, hence adding soft-attributions as measures for acceptance.

## METHODS

The quantitative representative consumer online survey was conducted from April 09 to 26, 2021. The sample follows the German population in terms of gender, age, level of education and residence size. 1,014 consumers were asked to make a choice between three organic products that varied in the levels of the four product attributes presented or a no-choice. The final design consisted of 5 choice sets for each of the three organic product categories with three different alternatives per choice set. Products shown were organic carrots, eggs and chocolate. Organic carrots were chosen, as vegetable for processing and raw consumption with a short value chain. Fruits and vegetables are also the second most frequently purchased product in organic quality (Bio-Barometer 2020). As a second product, organic eggs were chosen because they are the most frequently consumed organic product among Germans who buy organic food at least occasionally (BMEL 2022) and are an unprocessed organic food with a short value chain. The third product was organic chocolate, which is a highly processed product with a complex value chain. Attributes were the sociological origin (soz1: no information, soz2: I can trace where the product was produced, soz3: There is a photo of the producer on the product, soz4: The sales staff seems sympathetic, soz5: I know the producer of the product personal), the distribution channel (dis1: discounter, dis2: supermarket, dis3: organic supermarket, dis4: farmers market, dis5: natural food store), the appearance of the product (app1: for eggs: size L, for carrots and chocolate: plastic packaging; app2: for eggs: White color (trade class M), for carrots: smaller size, for chocolate: Simple packaging; app3: for eggs: Brown color (trade class M), for carrots: loose package, for chocolate: XL-packaging; app4: for eggs: Size S (commercial class S, brown, white mixed), for carrots: unusual shape, for chocolate: Elaborate packing; app5: for Eggs: eggs directly from the stable (feather, light dirt on the shell), for carrots: Dirty look, for chocolate: Sustainable packaging) and five price levels (for six eggs: 0.75 – 3.49 €; price for carrots: 0.80 – 3.25 €; price for a bar of chocolate: 0.49 – 5.70 €). In order to make the choice experiment as tangible as possible, the attribute levels were visualized using pictures and text. The attributes for soz1 - soz5 as well as for dis1 - dis5 were displayed as text below the corresponding product image. Mixed logit models were applied to represent insights of the importance of the attributes and consumers preferences.

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**RESULTS**

We estimated three models from the survey results, one for each product category with the dependent variables for the choice of the product. Table 1 reports the results for each product category.

**Table 1.** Beta Coefficients of the mixed logistic models on preferences for food choices. Reference value: discounter (dis1), no additional information on the product (soz1), plastic packaging for carrots and chocolate (app1) and size L for eggs (app1).

Choice	Coefficients eggs	Coefficients carrots	Coefficients chocolate
Eggs: trade class S, brown, white mixed; Carrots: unusual shape; Chocolate: Elaborate packing (app4)	5,270***	5,243***	7,177***
Eggs: Eggs directly from the stable (feather or light dirt on the shell); Carrots: Dirty look; chocolate: Sustainable packaging (app5)	4,179***	3,906***	6,321***
I know the producer of the product personally (soz5)	3,581***	2,241***	2,917***
Eggs: White color (trade class M); Carrots: smaller size; Chocolate: Simple packaging (app2)	2,682***	2,688***	4,281***
Eggs: Brown color (trade class M); Carrots: loose package; Chocolate: XL-packaging (app3)	1,831***	2,839***	2,587***
Supermarket (dis2)	1,789***	2,166***	-0,052
Organic supermarket (dis3)	1,639**	1,340**	- 0,844*
Farmers market (dis4)	0,862	0,723	- 2,368***
Natural food store (dis5)	- 0,291**	- 0,535***	- 0,190*
I can trace where the product was produced (soz2)	-0,793	-0,476	- 3,507***
There is a photo of the producer on the product (soz3)	-0,896	-0,539	- 3,505***
Price	- 1,093***	- 1,018***	- 2,368***
The sales staff seems sympathetic (soz4)	- 2,137***	- 1,293***	- 1,778***
Pseudo r <sup>2</sup>	0,122	0,109	0,169

For both organic eggs and carrots, the results show that the retail channels supermarket (dis2) and organic supermarket (dis3) lead to increases in choice probabilities for the shown products compared to shopping at a discounter (dis1). Shopping at a specialized natural food store (dis5) reduces the likelihood of purchase compared to shopping at a discount (dis1). The imprint 'The sales staff seems sympathetic' (soz4) decreases the probability for choosing the product compared to when there was no additional information on the product (soz1). On the other hand, the imprint 'I know the producer of the product personally' (soz5) increased the probability for choosing the product compared to no additional information (soz1). All attributes of the appearance of the products (app2 to app5) significantly increased the probability that the product was chosen, compared to col1 (for eggs: size L, for carrots: plastic packaging). The level of price coefficient was negative, as expected.

For organic chocolate the results show that the retail channels organic supermarket (dis3), farmers market (dis4) and natural food store (dis5) lead to decreases in choice probabilities for the shown products compared to shopping at the discounter (dis1). The imprint 'I can trace where the product was produced' (soz2), 'There is a photo of the producer on the product' (soz3) and 'The sales staff seems sympathetic' (soz4) decreases the probability for choosing the product compared to when there was no additional information on the product (soz1). Knowing the producer of the product personally (soz5) lead to

an increased choice for the presented product compared to when there was no additional information on the product (soz1). All attributes of the appearance of the products (app2 to app5) significantly increased the probability that the product was chosen, compared to plastic packaging (app1). The level of price coefficient was negative as well.

**DISCUSSION**

So far, it is particularly interesting to note that the product attributes like packaging and the appearance of the products influenced the choice and therefore is an overlooked facet of preference (and consequent trust assessment). The results are particularly interesting in the case of eggs with preferences for natural appearance (with a feather or light dirt) on the shell and dirty carrots, as such products are rarely found in stores due to quality controls. Moreover, knowing the producer personally seemed to increase the choice probability for all three products. However, it appeared that it was more likely that carrots or eggs were chosen in a supermarket than in a farmers' market, which may conflict with the personal contact to the farmer, but may be explained through daily life habits and consumer consistent food choice. Hence, it may be enough to know the producer, but the distribution may be professionalized. The imprint 'The sales staff seems sympathetic' (soz4) also seems to reduce the likelihood of purchase. However, the statement was only printed in text on the product and that the sympathetic sales staff were not actually experienced while shopping.

**REFERENCES**

BMEL (2022): Welche Bio-Lebensmittel kaufen Sie am häufigsten? Available online at <https://de.statista.com/statistik/daten/studie/2378/umfrage/biolebensmittel-die-am-haeufigsten-gekauft-werden/>, checked on 1/22/2022.  
 BÖLW (2022). Bio-Branchenreport 2022. Bund Ökologische Lebensmittelwirtschaft. <http://www.boelw.de/>.  
 Janssen, Meike; Hamm, Ulrich (2014): Governmental and private certification labels for organic food. In Food Policy 49, pp. 437–448. DOI: 10.1016/j.foodpol.2014.05.011.  
 Macready, Anna L.; Hieke, Sophie; Klimczuk-Kochańska, Magdalena; Szumiał, Szymon; Vranken, Liesbet; Grunert, Klaus G. (2020): Consumer trust in the food value chain and its impact on consumer confidence. In Food Policy, p. 101880. DOI: 10.1016/j.foodpol.2020.101880.  
 Thorsøe, Martin Hvarregaard (2015): Maintaining Trust and Credibility in a Continuously Evolving Organic Food System. In J Agric Environ Ethics 28 (4), pp. 767–787. DOI: 10.1007/s10806-015-9559-6.

**PARALLEL SESSION 10**

**ECOSYSTEM  
SERVICES AND  
BIODIVERSITY**



# Ecosystem services of protected areas in Slovenia

Ilona Rac, Anže Japelj, Suzana Vurunić and Mateja Šmid Hribar

**Abstract - Protected areas (PAs) provide important and valuable ecosystem services (ESs) to society. The main goals of the project NatGuidES are to prepare a typology of (sub)ecosystems and spatial units for identifying ESs in PAs, establish an ES identification, mapping and evaluation protocol, and test them in selected pilot PAs. So far, a conceptual framework and draft typology have been co-created with experts and stakeholders in a participatory manner.**

## INTRODUCTION

Ecosystem services (ESs) are the benefits that people receive from ecosystems (MEA, 2005). Protected areas (PAs) provide important and valuable ESs to society, such as the binding of atmospheric carbon, retention of pollutants and preventing them from leaching into groundwater, and offering an attractive space for recreation and tourism activities (e.g. Hummel et al., 2019). PAs are also an important generator of local spatial identity (ibid.), which may offer developmental opportunities.

While Slovenia has managed to prevent the degradation its ecosystems to a very high degree, developmental pressures on ecosystems are still great. The project NatGuidES aims to address these threats through identifying, mapping and evaluating the ESs of PAs in an effort to improve the understanding of these issues and raise awareness of the benefits that PAs provides to humans. The project's working hypothesis is that PAs provide a different array and a greater extent of ES to different beneficiaries across all spatial levels as compared to non-protected areas; a confirmation of this hypothesis would help to further substantiate protecting natural areas to both the general public and local inhabitants, helping to mitigate conflicts often associated with PA status.

Scientific research on the ESs of PAs is a relatively new but growing field. To begin with, the underlying theoretical framework of ES research is still developing. Practically, this manifests in a number of different typologies; the three main typologies are the one utilised by the MEA (Millennium Ecosystem assessment, 2005), the TEEB (The economics of ecosystems and biodiversity; TEEB, 2010) and the CICES (Common international classification of ecosystem services; CICES, 2011) typology, of which the latter seems to be gaining ground in international acceptance (Hummel et al., 2019). Furthermore, there are a number of conceptual models describing the relationship and flow of benefits from ecosystems to humans as the final beneficiaries; of these, the cascade model developed (see Fig. 1) by Haines-Young and Potschin (2010) seems to be prevalent in use, though it is far from uncontested (see e.g. Costanza et al., 2017).

An issue in ES research particularly relevant for the management of PAs is the ethical reservation felt by some researchers (e.g. Spash, 2008) and quite often by PA managers (Hummel et al., 2019). Protecting nature as a provider of benefits to humans rather than for its own sake is unpalatable to many in nature conservation; this aversion is even stronger with regard to ES valuation, especially where monetary techniques are applied. This misgiving is rejected by prominent ES researchers such as Costanza et al.

(2017), however, who argue that this is an overly simplistic interpretation of the concept of ESs.

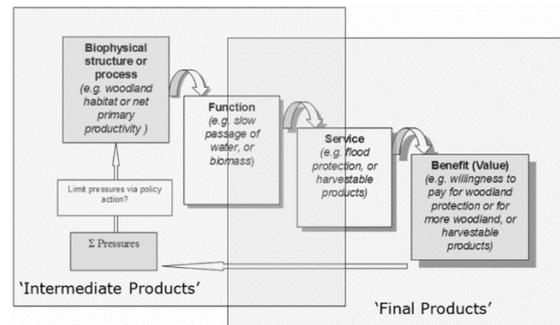


Figure 1: The cascade model of Ecosystem services (Haines-Young and Potschin, 2010)

Finally, despite the increasing interest of both decisionmakers and practitioners in the ESs concept, it is a field that is chronically lacking in reliable data. This issue, which is closely related to the lack of standardised definitions, is currently often addressed through the use of expert opinion, simplifications and proxies, in many cases to the detriment of the transferability of mapping, assessment and valuation exercises.

Despite these shortcomings, an increasing amount of research is attempting to address the ESs of PAs in a comprehensive and transferable way, employing a variety of methods ranging from top-down spatial mapping to bottom-up participatory mapping (see e.g. Hummel et al., 2019, for a review). For example, Eastwood et al. (2016) have shown that PAs consistently provide a higher level of ESs than unprotected ones and that the difference can mainly be attributed to cultural and regulating ESs. Similarly, Spanò et al. (2017) found that ES hotspots generally appear inside PAs. By contrast, Palomo et al. (2013) show that ES hotspots do not necessarily appear in PAs, while areas of *demand* (service-benefitting areas) for the ESs provided by PAs generally appear in adjacent areas.

## METHODOLOGY

The main goals of the project are to prepare a typology of (sub)ecosystems and spatial units for identifying ESs in PAs, establish an ES identification, mapping and evaluation protocol, and test them in selected pilot PAs (5). According to the conceptual framework (see Fig. 2) developed by the project group, the first step in this process is to identify the specific ecosystems and other spatial units in these areas that enable the provision of ESs (cf. Luck et al., 2009). To this end, the MAES (Maes et al., 2013) typology of ecosystems, as well as a number of other land use and land cover typologies such as the Corine Land Cover, are currently being examined in terms of their utility for the needs of the project, as well as data availability at the appropriate scale.

The core project group has employed a participatory approach (Cornwall and Jewkes, 1995) to research since the outset; in practice, this has meant that the relevant experts and stakeholders in conservation science, policy and practice, as well as

ES specialists, were consulted in a workshop (33 attendees) as early as the development of the project's conceptual framework, and have contributed actively (through online meetings) to the currently ongoing identification of (sub)ecosystems and spatial units. The stakeholders themselves were identified through the research group's experience and familiarity with the Slovenian institutional environment, as well as based on further recommendations from those contacted.

## RESULTS

So far, the project has had two main results. Firstly, the co-created conceptual framework has been constructed as an adaptation of the Haines-Young and Potschin cascade model in which the two leftmost elements in the cascade (biophysical structure and function) are merged into one element (ecosystems), while the following elements have been added:

- indicators and methods for the evaluation of ESs,
- the aspect of the natural conditions of PAs and the impact of management,
- (sub)ecosystems and spatial units providing ESs
- a comparison of ESs in PAs and unprotected areas (Fig. 2)

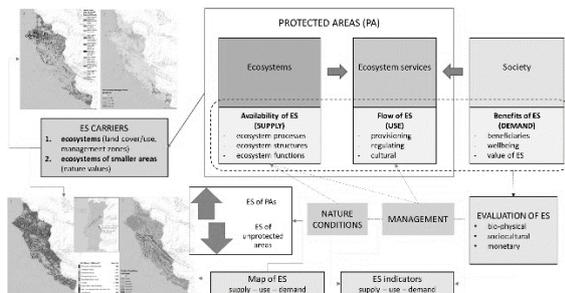


Figure 2: The NatGuidES conceptual framework.

The second result, which we currently regard as preliminary, is the classification of the (sub)ecosystems and spatial units that act as ES providers. It is roughly based on the MAES typology, but includes further subtypes not included in the original classification, as proposed and discussed by the experts attending the workshops and online meetings. For example, the MAES categories 'cropland' and 'grassland' have been merged into agricultural land, but broken down into several subtypes (meadows, pasture, fields and permanent crops), which are broken down to even smaller units.

## DISCUSSION AND CONCLUSION

Regardless of the issues faced by ES researchers and practitioners that we outlined in the introductory section, it is generally accepted that ES research is a field that can contribute to more sustainable land use, as well as to mitigating conflicts between PA managers, landowners and users (Berghöfer and Dudley, 2010). While the field may be experiencing some initial difficulties, we think that exercises such as the one being conducted in NatGuidES are necessary to further develop our understanding of the relationship between ecosystems and the benefits that humans receive from them, with the ultimate goal of fostering the sustainable use of natural resources in the long run. As stated by Costanza et al. (2017), "There is not one right way to assess and value ecosystem services. There is however a wrong way, that is, not to do it at all."

## ACKNOWLEDGEMENT

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## REFERENCES

- Berghöfer, A. and Dudley, N. (2010). Ecosystem services and protected areas. In *TEEB – The Economics of Ecosystems and Biodiversity for Local and Regional Policy Makers*.
- Cornwall, A. and Jewkes, R. (1995). What is participatory research? *Social Science & Medicine*, 41(12), 1667–1676.
- Costanza, R., de Groot, R., Braat, L., Kubiszewski, I., Fioramonti, L., Sutton, P., Farber, S., and Grasso, M. (2017). Twenty years of ecosystem services: How far have we come and how far do we still need to go? *Ecosystem Services*, 28, 1–16.
- Eastwood, A., Brooker, R., Irvine, R. J., Artz, R. R. E., Norton, L. R., Bullock, J. M., Ross, L., Fielding, D., Ramsay, S., Roberts, J., Anderson, W., Dugan, D., Cooksley, S., and Pakeman, R. J. (2016). Does nature conservation enhance ecosystem services delivery? *Ecosystem Services*, 17, 152–162.
- Haines-Young, R. and Potschin, M. (2010). The links between biodiversity, ecosystem services and human well-being. *Ecosystem Ecology: A New Synthesis*, 1, 110–139.
- Hummel, C., Poursanidis, D., Orenstein, D., Elliott, M., Adamescu, M. C., Cazacu, C., Ziv, G., Chrysoulakis, N., van der Meer, J., & Hummel, H. (2019). Protected Area management: Fusion and confusion with the ecosystem services approach. *Science of the Total Environment*, 651, 2432–2443.
- Luck, G. W., Harrington, R., Harrison, P. A., Kremen, C., Berry, P. M., Bugter, R., Dawson, T. P., de Bello, F., Díaz, S., Feld, C. K., Haslett, J. R., Hering, D., Kontogianni, A., Lavorel, S., Rounsevell, M., Samways, M. J., Sandin, L., Settele, J., Sykes, M. T., ... Zobel, M. (2009). Quantifying the Contribution of Organisms to the Provision of Ecosystem Services. *BioScience*, 59(3), 223–235.
- Maes, J., Teller, A., Erhard, M., Liqueste, C., Braat, L., Berry, P., Egoh, B., Puydarrieux, P., Fiorina, C., & Santos, F. (2013). *Mapping and Assessment of Ecosystems and their Services*.
- Millennium Ecosystem Assessment. (2005). *Ecosystems and human well-being: Synthesis*. Island Press.
- Palomo, I., Martín-López, B., Potschin, M., Haines-Young, R., and Montes, C. (2013). National Parks, buffer zones and surrounding lands: Mapping ecosystem service flows. *Ecosystem Services*, 4, 104–116.
- Spanò, M., Leronni, V., Laforteza, R., & Gentile, F. (2017). Are ecosystem service hotspots located in protected areas? Results from a study in Southern Italy. *Environmental Science and Policy*, 73, 52–60.
- Spash, C. L. (2008). How Much is that Ecosystem in the Window? The One with the Bio-diverse Trail. *Environmental Values*, 17(2), 259–284.

# Farmers' perceptions of agro-food system actors in biodiversity-related decision-making

Verena. Scherfranz, Katie Moon, Jochen Kantelhardt and Lena Schaller<sup>1</sup>

**Abstract** – Little is known on how agro-food system actors, e.g. researchers or bulk buyers, influence farmers' biodiversity-related decision-making (*biodivDM*). By understanding these relationships, it becomes possible to use them in informing future pro-biodiversity campaign and policy design. Therefore, we elicited and analyzed farmers' perceptions of these actors across 10 case study regions. Aiming for a comparative approach, we created a Perception Matrix including 12 stakeholder groups to be quantitatively rated against 8 perception statements, complemented by qualitative interviews to discuss findings with local experts. On average, governmental bodies were perceived most negatively and researchers most positively. Additionally, we found perceptions towards stakeholder groups to be nuanced and, partly, divergent. Randomization tests support these findings indicating significant differences in farmers' perceptions across and within stakeholder groups. Overall, this approach helps to reveal highly valued actors and their perceived strengths and weaknesses. This research can facilitate accurate design of broadly-based, potentially more powerful pro-biodiversity initiatives.

## INTRODUCTION

Farmers' social environment is known to affect their pro-environmental decision-making (Dessart et al., 2019). Acting as information sources, farm input suppliers, researchers or peers influence, for example, farmers' decisions, regarding efficient nitrogen input or the adoption of soil innovations (Stuart et al., 2018; Rust et al., 2022). Perceptions towards these stakeholders, such as taking farmers' interests seriously (Rust et al., 2022) or sharing useful knowledge (Stuart et al., 2018) are found to contribute to explaining the influence of, and trust in, stakeholders. However, regarding biodiversity management, a systematic analysis of stakeholder perceptions remains lacking. To identify highly valued stakeholder groups, we analyzed how farmers perceive agro-food system actors in *biodivDM*. This approach could facilitate behavioral change in agriculture through informing more broadly-based pro-environmental initiative design (media campaigns, policies, etc.), as suggested by Dessart et al. (2019) and Stuart et al. (2018).

## DATA AND METHODS

This study is based on mixed methods. Data was, after pre-testing, collected in 49 farmer interviews across case studies in 10 European countries (UK, NL, FR, CH, RO, HU, PT, SE, ES, EE) in autumn/winter 2021/22.

To reveal farmers' implicit perceptions of stakeholders as comparable, quantitative data, we applied Perception Matrices (PMs). PMs, as described by Moon et al. (2017), are based on constructionist Repertory Grid (RG) technique (Kelly, 1955). RGs aim

to portray individuals' views on their environment by systematically identifying and rating "elements" (here: stakeholder groups) against "constructs" (here: perception statements) worded as quantitative scales. For PMs, researchers objectify the rating process by pre-defining elements and constructs, i.e. the matrix, to enable quantitative comparisons between subjects.

For pre-defining the matrix, we applied a multi-actor approach. Project partners (n=12) proposed stakeholder groups and perception statements reflecting the local context of the research areas. To consider practical relevance, we conducted RGs with three farmers revealing their individually relevant elements and constructs. After checks for redundancy and, by means of scientific literature, completeness, we created a matrix including 12 stakeholder groups and 8 perception statements (Table 1). Statements are *biodiversity-specific* (row 1-4) or *general* (row 5-8). Each statement is worded negatively (1-point end) and positively (5-point end) to define scales on which stakeholder groups are rated. Stakeholders include public, market and social actors.

To analyze PM data, besides descriptive statistics, we applied randomization tests (RTs) to detect significant differences in perceptions both *across* and *within* stakeholder groups and between socio-demographically, geographically and management-wise clustered groups of farmers. Non-parametric RTs allow for pairwise comparison of means in within-subject, i.e. non-independent data (Craig and Fisher, 2019). RTs, based on 10.000 repeats, were carried out in R.

To subsequently explain extreme, i.e. most positive and negative, perceptions country-specifically, qualitative interviews with 40 local experts were conducted in winter 2021/22. The sample includes representatives from agricultural administration (14), extension (7), farmers' associations (7), researchers (5), nature organizations (4) and others (3).

## RESULTS

When comparing the overall means across countries, *government* is perceived most negatively (2.54) and *researchers* most positively (3.81). Table 1, the *average matrix* (Moon et al., 2017), visualizes mean ratings across the sample for each perception statement.

This matrix reveals differences in average perceptions, i.e. relative strengths and weaknesses, *across* certain stakeholder groups (e.g. machinery suppliers are viewed as taking on lower responsibility for biodiversity than producer organizations) and uncovers similar as well as divergent perceptions *within* these groups. RTs support these findings.

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Row number	1 -point end	Government national/local	Researchers	Farm advisors	Other farmers	Producer organization(s)	Fertilizer supplier(s)	Crop protection supplier(s)	Machinery supplier(s)	Bulk buyer(s)	Direct buyers /consumers	People in general	People in social environment	5 -point end
1	biodiversity protection in agriculture is <b>not</b> their <b>goal</b> at all	2.94	4.22	3.14	2.83	3.15	2.16	2.13	2.15	3.30	3.63	2.99	3.55	biodiversity protection in agriculture is one of their <b>major goals</b>
2	doesn't take on <b>responsibility</b> re biodiversity	2.72	3.79	2.90	2.86	3.12	2.13	2.21	1.99	2.67	2.86	2.56	3.26	takes on <b>responsibility</b> re biodiversity
3	isn't <b>objective</b> about biodiversity	2.49	3.96	3.02	2.76	3.16	2.53	2.50	2.50	3.03	3.11	2.50	3.27	is <b>objective</b> about biodiversity
4	doesn't treat me as <b>partner</b> re biodiversity	2.36	3.80	3.30	3.06	3.54	2.58	2.64	2.27	2.85	3.24	2.91	3.54	treats me as <b>partner</b> re biodiversity
5	doesn't <b>understand</b> farmers' reality	2.20	3.13	3.93	4.31	3.92	3.49	3.44	3.53	3.00	2.89	2.41	3.41	<b>understands</b> farmers' reality
6	isn't <b>trustworthy</b>	2.59	3.96	3.65	3.57	3.75	3.13	2.97	3.27	3.26	3.41	3.04	3.91	is <b>trustworthy</b>
7	hinders me from farming in a <b>future-proof</b> way	2.71	3.68	3.82	3.71	4.09	3.66	3.58	3.55	3.55	3.55	3.14	3.86	enables me to farm in a <b>future-proof</b> way
8	isn't <b>reliable</b> re medium-/long-term behavior	2.31	3.98	3.75	3.69	3.82	3.34	3.15	3.14	3.01	3.25	3.04	3.79	is <b>reliable</b> re medium-/long-term behavior

**Table 1:** Average matrix (mean perception ratings across countries); darker shading indicates lower ratings. © The authors, 2022.

Biodiversity-specific statements are, on average, rated significantly differently ( $P < 0.01$ ) for most stakeholder groups. They are rated more negatively for actors primarily associated with farming and profit-orientation. Only for researchers, biodiversity-specific perceptions are rated significantly higher ( $P < 0.01$ ). Pairwise comparison of perception statements, e.g. 3 and 6, for one stakeholder group, e.g. farm advisors, showed that aspects initially considered as similar are perceived significantly ( $P < 0.01$ ) differently.

uncovers similar as well as divergent perceptions *within* these groups. RTs support these findings. Biodiversity-specific statements are, on average, rated significantly differently ( $P < 0.01$ ) for most stakeholder groups. They are rated more negatively for actors primarily associated with farming and profit-orientation. Only for researchers, biodiversity-specific perceptions are rated significantly higher ( $P < 0.01$ ). Pairwise comparison of perception statements, e.g. 3 and 6, for one stakeholder group, e.g. farm advisors, showed that aspects initially considered as similar are perceived significantly ( $P < 0.01$ ) differently.

#### DISCUSSION AND CONCLUSION

Additional to identifying researchers as most positively and government as most negatively perceived actors, we show that farmers' perceptions not only differ *across*, but also *within* stakeholder groups. This finding not only indicates potentially low halo effect, i.e. one strong feeling or perception pre-determining several ratings (Thorndike, 1920). It also might affect policy design. Involving stakeholder groups *generally* being perceived positively but weak regarding *biodiversity* aspects, might in consequence also have low, or even negative, influence on farmers' biodivDM. To avoid adverse effects through uninformed involvement of stakeholders, inclusive pro-biodiversity initiatives require a careful selection process. To gain a deeper understanding of farmers' perceptions, we will compare ratings of diverse farmer groups and analyze national differences. For country-specific explanations, we will apply content analysis on the data generated through qualitative follow-up interviews.

Although small sample size and potential selection bias towards farmers with science affinity might limit

generalizability, results show that this approach is powerful in uncovering differences in farmers' perceptions of stakeholder groups. Results can help to promote more inclusive campaign/policy design and, potentially, sustainable farming. To make best use of perceived strengths (e.g. high trustworthiness) and compensate perceived weaknesses (e.g. low understanding), we recommend to test involving multiple actors.

#### ACKNOWLEDGEMENT

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#### REFERENCES

- Craig, A.R. and Fisher, W.W. (2019): Randomization tests as alternative analysis methods for behavior-analytic data. *Journal of the Experimental Analysis of Behavior* 111(2): 309-328.
- Dessart, F.J., Barreiro-Hurlé, J. and van Bavel, R. (2018): Behavioural factors affecting the adoption of sustainable farming practices: a policy-oriented review. *European Review of Agricultural Economics* 46 (3): 417-471.
- Kelly, G.A. (1955): *The psychology of personal constructs*. W. W. Norton: Vol. 1. A theory of personality. Vol. 2. Clinical diagnosis and psychotherapy.
- Moon, K., Blackman, D.A., Adams, V.M. and Kool, J. (2017): Perception matrices: An adaptation of repertory grid technique. *Land Use Policy* 64: 451-460.
- Rust, N.A., Stankovics, P., Jarvis, R.M., Morris-Trainor, Z., de Vries, J.R., Ingram, J., Mills, J., Glickman, J.A., Parkinson, J., Toth, Z., Hansda, R., McMorrnan, R., Glass, J. and Reed, M. (2022): Have farmers had enough of experts? *Environmental Management* 69 (11): 31-44.
- Stuart, D., Denny, R.C.H., Houser, M., Reimer, A.P. and Marquart-Pyatt, S. (2018): Farmer selection of sources of information for nitrogen management in the US Midwest: Implications for environmental programs. *Land Use Policy* 70: 289-297.
- Thorndike, E. (1920): A constant error in psychological ratings. *Journal of Applied Psychology* 4: 25-29.

# Farm-level land use strategies in terms of agricultural production and biodiversity conservation in Switzerland

Pierrick Jan, Franziska Zimmert and Dunja Dux<sup>1</sup>

**Abstract – Understanding farmers’ land use behaviour is a pre-requisite for the design of effective policies aiming at protecting and enhancing biodiversity in agriculture. The aim of the present paper is to develop a typology of Swiss farmers’ land use strategies in terms of agricultural production and biodiversity conservation. We adopt for that purpose a comprehensive perspective encompassing both the Ecological Focus Area (EFA) and the non-EFA. We use K-means cluster analysis to identify the farm types. We consider four clustering variables, namely the agricultural production intensity, the extent of farm’s participation in agri-environmental schemes for biodiversity conservation and the impact of farm agricultural practices on the organismal biodiversity of the EFA and non-EFA. Our results reveal that land use strategies are not only heterogeneous but also complex, going beyond the classical myopic dichotomy of low versus high EFA share.**

## INTRODUCTION

The exceptionally high species extinction rates observed in the last century and induced by the human domination of ecosystems suggest that a sixth mass extinction is under way (Ceballos et al., 2015). Biodiversity plays a major role in sustaining the productivity and stability of earth’s ecosystems and thus human well-being (Cardinale et al., 2012). There is therefore an urgent need to reverse human-induced biodiversity loss (Shivanna, 2020). Agriculture is the main driver of biodiversity loss (Dudley and Alexander, 2017). As a response to growing concerns over the biodiversity loss caused by agriculture, agri-environmental policy instruments aiming at protecting and enhancing biodiversity were introduced in the 1990s in Switzerland. The most important instruments of the current Swiss agricultural policy for biodiversity conservation are the three cumulative area-based direct payments schemes for biodiversity conservation, namely the management-based Ecological Focus Area (EFA) payments, the result-based EFA bonus payments and the EFA-connectivity bonus payments (FOAG, 2020).

Understanding farmers’ land use strategy is a pre-requisite for the design of effective policies aiming at protecting and enhancing biodiversity in agriculture. To the best of our knowledge, the existing socio-economic literature on farmer’s biodiversity preservation and enhancement behaviour focuses mainly on the factors influencing the uptake of agri-environmental schemes for biodiversity conservation (see, for instance, Mack et al., 2020). Even if these investigations provide highly valuable insights into farmers’ attitudes towards biodiversity conservation schemes, they present two shortcomings. First, by

focusing on the EFA, these investigations ignore the remaining farmland (i.e., the non-EFA), which is also of importance in terms of biodiversity preservation, and thus neglect a part of the whole farm biodiversity picture. Secondly, in most of the existing studies, the success/effectiveness of agri-environmental schemes is assessed using indicators of their uptake. Uptake indicators may be particularly inappropriate for evaluating the effectiveness of management-oriented agri-environmental schemes because the link between land management and ecosystem services provision is rather weak and might lack scientific evidence (Rodríguez-Ortega et al., 2018). In the case of result-oriented schemes, uptake indicators may be relatively well appropriate for evaluating the scheme’s effectiveness. One should however be aware that windfall effects might occur with this type of schemes (see, for instance, Fleury et al., 2015).

The aim of the present research is to provide a better understanding of the heterogeneity of land use strategies regarding agricultural production and biodiversity conservation in Swiss agriculture. We adopt for that purpose a comprehensive perspective embracing the whole farm, i.e., encompassing both EFA and non-EFA. We consider thereby not only the extent of participation in agri-environmental schemes for biodiversity conservation, but also the potential biodiversity outcome of farm practices on EFA and non-EFA as well as the farm agricultural production intensity. Our analysis based on a clustering procedure results in a typology of farm strategies regarding agricultural production and biodiversity conservation. We characterize the different farm types regarding their structural, managerial and socio-demographic characteristics as well as with respect to their natural environment (in terms of natural production conditions and biodiversity richness). We conclude on the implications of our findings in terms of an agri-environmental policy design.

## METHODS

Our investigation relies on unbalanced panel data from the Swiss Farm Agri-Environmental Data Network (FAEDN) for the years 2009 to 2018 (Stutz and Blaser, 2010). The sample consists of 2089 farm observations that were matched to the data of the Farm Accountancy Data Network (FADN). It covers the three agricultural regions (plain, hill and mountain) and all farm types as defined in Meier (2000) with the exception of farms with a strong focus on special crops. For the clustering, we consider four variables as described in Table 1 and use the K-means algorithm (see Hastie et al., 2009). To account for

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varying production conditions across the three agricultural regions, we cluster separately for each regional subsample.

**Table 1.** Variables used for the clustering

Variable	Description
EFA share in the UAA	Indicator of the extent of farm's participation in agri-environmental schemes for biodiversity conservation
Biodiversity score of the EFA	Potential impact of farm agricultural practices on the organismal (flora and fauna species) diversity of EFA assessed using the approach developed by Jeanneret et al. (2014)
Biodiversity score of the non-EFA	Potential impact of farm agricultural practices on the organismal (flora and fauna species) diversity of non-EFA assessed using the approach developed by Jeanneret et al. (2014)
Nitrogen output per ha UAA	Nitrogen output per ha UAA as an indicator of agricultural production intensity. It is derived from a soil-surface nitrogen balancing according to the approach described in Spiess (2010).

Meaning of the abbreviations: UAA = Utilised Agricultural Area; EFA = Ecological Focus Area

#### RESULTS

We find four clusters for the plain region and three clusters for the hill and mountain regions. The clusters are all characterised by very different farm strategies in terms of biodiversity conservation and agricultural production. Interestingly, there are strong similarities between clusters across the agricultural regions. In all regions, one cluster, called "the very intensive farms", shows a very high production intensity while the EFA share and the biodiversity scores of the EFA are relatively close to the regional average. This cluster exhibits in all three regions the lowest biodiversity scores of the non-EFA among all clusters. In the plain and hill region, another cluster, referred to as "the middle intensive farms with biodiversity-friendly practices", is characterised by an average or slightly below average production intensity and EFA share, but above average values for both biodiversity scores. These farms have a focus on dairy farming. A quite similar cluster can be found in the mountain region, where the better performance of this cluster in terms of the biodiversity score is restricted to the EFA. Finally, we identify a cluster, called "the specialized EFA producers", with a strong focus on cattle (especially beef) production, and also arable crops in the plain region. The farms of this cluster exhibit an extremely high EFA share while their biodiversity EFA score is among the lowest. The production intensity of this group is far below the respective regional average. The plain region consists of an additional cluster, called the "neither highly intensive nor particularly biodiversity-friendly plain farms with a high arable land share", capturing arable farming as well as dairy and cattle production. These farms show a below average production intensity, but also biodiversity scores (for both EFA and non-EFA) that are lower than the regional average. Only the EFA share of this cluster corresponds to the regional mean.

#### CONCLUSIONS

We conclude from the cluster analysis that land use strategies in terms of agricultural production and biodiversity conservation are not only heterogeneous but also complex, going beyond the classical myopic dichotomy of low versus high EFA share. We find that the highest EFA biodiversity scores were not necessarily observed in clusters with the highest EFA share. Besides, farms with a high production intensity may perform quite good in terms of EFA biodiversity score and even outperform the specialized EFA producers in this regard. The fact that the plain and hill clusters with the highest EFA and non-EFA biodiversity scores show an EFA share very close to the respective regional averages suggests that biodiversity conservation also takes place outside the EFA direct payment programs.

#### REFERENCES

- Cardinale, B.J., Duffy, J.E., Gonzalez, A., Hooper, D.U., Perrings, C., Venail, P., Narwani, A., Mace, G.M., Tilman, D., Wardle, D.A., Kinzig, A.P., Daily, G.C., Loreau, M., Grace, J.B., Larigauderie, A., Srivastava, D.S. and Naeem S. (2012). Biodiversity loss and its impact on humanity. *Nature* 486: 59–67.
- Ceballos, G., Ehrlich, P.R., Barnosky, A.D., Garcia, A., Pringle, R.M. and Palmer T.M. (2015). Accelerated modern human-induced species losses: Entering the sixth mass extinction. *Science Advances* 1: e1400253.
- Dudley, D. and Alexander, S. (2017). Agriculture and biodiversity: a review. *Biodiversity* 18: 45-49.
- Fleury, P., Seres, C., Dobremez, L., Nettièr, B. and Pauthenet, Y. (2015). "Flowering Meadows", a result-oriented agri-environmental measure: Technical and value changes in favour of biodiversity. *Land Use Policy* 46: 103-114.
- FOAG (Swiss Federal Office for Agriculture) (2020). Überblick: Direktzahlungen an Schweizer Ganzjahresbetriebe. Bern, FOAG.
- Hastie, T., Tibshirani, R. and Friedman, J. (2009). The elements of statistical learning, Second Edition. New York: Springer series in statistics.
- Jeanneret, P., Baumgartner, D.U., Freiermuth Knuchel, R., Koch, B. and Gaillard, G. (2014). An expert system for integrating biodiversity into agricultural life-cycle assessment. *Ecological Indicators* 46: 224-231.
- Mack, G., Ritzel, C. and Jan, P. (2020). Determinants for the implementation of action-, result- and multi-actor-oriented agri-environment schemes in Switzerland. *Ecological Economics* 176: 106715.
- Meier, B. (2000). Neue Methodik für die zentrale Auswertung von Buchhaltungsdaten an der FAT. Ettenhausen: Eidgenössische Forschungsanstalt für Agrarwirtschaft und Landtechnik.
- Rodríguez-Ortega, T., Olaiola, A.M. and Bernués, A. (2018). A novel management-based system of payments for ecosystem services for targeted agri-environmental policy. *Ecosystem Services* 34: 74-84.
- Shivanna, K.R. (2020). The sixth mass extinction crisis and its impact on biodiversity and human welfare. *Resonance* 25: 93-109.
- Spiess, E. (2010). Agrar-Umweltindikator "N-Bilanz". Interner Bericht. Zürich: Forschungsanstalt Agroscope Reckenholz-Tänikon ART.
- Stutz, D. and Blaser S. (2010). Regionalised agri-environmental monitoring on a farm-based activity-report data network. In: OECD workshop: agri-environmental indicators: lessons learned and future directions. 23–26 March 2010, Leysin.

# Participatory scenario modelling of ecosystem services and biodiversity in the Wienerwald region

Katrin Karner, Florian Danzinger, Thomas Wrбка and Martin Schönhart<sup>1</sup>

**Abstract** – The biosphere reserve Wienerwald aims to act as a model region for sustainable development. Yet, species-rich habitats were degraded or lost to a large extent due to land use changes in the past decades. Underlying drivers of such land use changes are uncertain. We aim to understand current challenges of sustainable regional development in the Wienerwald, develop regional development pathways and assess the pathways with respect to the impact on land use, ecosystem services and biodiversity under climate change. We develop nested scenarios in a participatory process and apply an integrated modelling framework consisting of bio-economic farm models and models for biodiversity and ecosystem services. First results show the importance of subsidies and market drivers (e.g. input and output prices) for past land use change. The future development pathways, hence, mainly deviate for these drivers. The vicinity to Vienna determined several developments in each scenario.

## INTRODUCTION

Land use change contributes globally to the unprecedented biodiversity loss, deterioration of ecosystems and the climate crises (IPCC 2019, IPBES 2018). The latter poses itself a risk for future agricultural land use, ecosystem functioning and biodiversity. The biosphere reserve Wienerwald (WW) region in Austria aims to act as a model region for sustainable regional development, e.g. halt biodiversity loss while allowing sustainable economic activities in the region. The region is characterized by forests (70%) and grassland (12%). Extensively managed grasslands, i.e. with maximally two annual cuts, provide a valuable habitat and contribute considerably to the high biodiversity in the region. Yet, the area of extensively managed grassland declined from 11,140 ha to 4599 ha during the period of 2015 to 2021. Most of these former extensive grasslands were intensified, others abandoned. Future land use changes are uncertain and generally depend on a multitude of drivers, such as the development of markets or policies. Scenarios allow to account for underlying uncertainties of the development of drivers. Scenarios can also be useful to challenge stakeholder discussions on sustainable regional development pathways and inform policy- and decision-making (Wright et al., 2013). We aim to (i) understand arising challenges related to sustainable regional development characterising the current situation in the WW region, (ii) develop plausible regional development pathways for the WW region for 2050 in a participatory process and (iii)

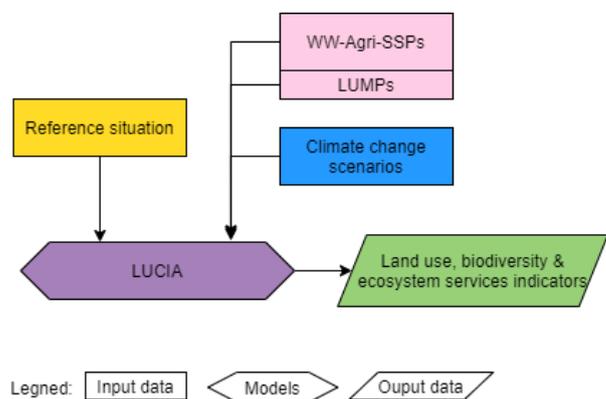
assess the impact of the pathways on agricultural land use, land cover, ecosystem services and biodiversity. The presented research is part of the international research project SALBES, in which scenarios for four European case study regions are developed and assessed.

## METHODS

We conducted interviews in the WW in order to contribute to research aim (i). We have interviewed in total eleven farmers, representatives from farming associations, nature protection NGOs, administration, as well as civil engineers with a background in landscape planning and biodiversity. These interviews and additional statistical data have informed the story of the present, which builds the basis for the participatory scenario development. The following figure 1 gives an overview on the conceptual model for achieving the research aims (iii) – (iii).

Figure 1. Conceptual model of the scenario workflow in SALBES

LUCIA is an integrated modelling framework consisting of bioeconomic farm models and models for ecosystem services and biodiversity available at the entire project consortium. LUCIA will be used to assess first the reference situation informed by the



story of the present and then participatory future regional development pathways, i.e. socioeconomic scenarios, and climate change scenarios until 2050. The socioeconomic scenarios are developed within the SSP logic and are consistent with the larger scale Eur-Agri-SSPs and the AT-Agri-SSPs. The AT-Agri-SSPs describe five scenarios for the Austrian agriculture and food system (AFS), developed along the two axes of challenges for climate change mitigation and

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challenges for climate change adaptation. The AT-Agri-SSPs describe the average Austrian development of 79 drivers of the AFS. We have discussed the framework conditions described in the AT-Agri-SSPs with regional stakeholders from the WW in an online workshop. The stakeholders identified those drivers, that deviate regionally from Austrian averages. LUCIA furthermore requires details not yet provided by the AT-Agri-SSPs, such as the development of arable farms or ruminant farms in the WW. The interview and workshop results were used to build the WW-Agri-SSPs, consisting of a short narrative consistent with each AT-Agri-SSPs and a parameter table. These results are sent to the stakeholders and discussed in a second online workshop in May 2022. In total, three WW-Agri-SSPs were developed (WW-Agri-SSP1, WW-Agri-SSP2 and WW-Agri-SSP5). LUCIA also requires a specification of new land use and management practices (LUMPs) consistent with each WW-Agri-SSP. These LUMPS are discussed in the second online workshop as well. Additionally, two different climate change scenarios are assessed with LUCIA: RCP4.5 and RCP8.5.

LUCIA will then be used to assess the impact of the WW-Agri-SSPs and the climate change scenarios on land management, land cover, landscape composition and selected ecosystem services and biodiversity indicators, based on the interview results. Final quantitative LUCIA results are expected to be available in autumn 2022.

## RESULTS

The interview results, as summarized in table 1, give an overview on the drivers, which are perceived as most relevant for land use change, changes in the provision of ecosystem services and biodiversity loss in the WW region. Mentioned land use changes were, for instance, a reduced density of sheep/cattle on grassland due to climate change, larger field sizes due to larger machinery or an abandonment of grasslands due to an insufficient ratio of input and output prices. Interviewees mentioned the important role of subsidies for agri-environment-climate measures which still enabled an economically efficient yet very extensive management of grasslands (i.e. one cuts). Grasslands with one annual cut increased indeed in the area, while total grassland with two or less cuts annually declined substantially. All interviewees mentioned food production and recreation as important ecosystem services in the region. Soil fertility, protection of habitats and biodiversity were often mentioned as well, however changes thereof were overall rarely perceived.

The WW-Agri-SSPs deviate in particular regarding policies. For instance, in WW-Agri-SSP1 agri-environmental-climate funding increases strongly, while it is abandoned in WW-Agri-SSP5. Stakeholders defined common developments e.g. for land prices, which increase due to the vicinity to Vienna. The framework conditions in WW-Agri-SSP1 describe many opportunities for agricultural production in the WW, while they are less favourable for agricultural production in the WW in WW-Agri-SSP5.

**Table 1.** Key interview results for the WW region

Driver category (description)	Mentioned impact on...		
	Land use	Ecosystem services	Bio-diversity
Climate change (e.g. less/seasonally different precipitation)	●	◐	◑
Technology (e.g. size of tractors, GPS tractors)	◐	◑	◑
Economy (e.g. input and output prices, availability of workers)	●	◑	◑
Politics (e.g. ÖPUL)	●	◑	◑

Legend: ◑ rarely (1-25%), ◐ partly (26-50%), ◑ often (51-75%) and ● very often (76-100% of interviews)

## DISCUSSION AND CONCLUSIONS

The nested scenario approach applied in SALBES allows to maintain comparability among several regional case studies and consistency with larger scale scenarios, while allowing an in-depth analysis of each case study. The scenarios for the WW region revealed the need to account for the sub-national scale as well. In the scenario development process, the vicinity to Vienna appeared to play a major role leading to fewer differences among the scenarios compared to the Austrian or European scale. For instance, recreation in the WW by the inhabitants of Vienna was found to be important in each scenario. The impact of the scenarios on land use, ecosystem services and biodiversity will be revealed with a modelling framework, also accounting for climate change scenarios. The final results will be of particular relevance for regional decision-makers and representatives from the biospheres reserve and administration, who participate during the entire project phase and showed great interest so far.

## ACKNOWLEDGEMENT

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## REFERENCES

- IPBES (2018). *The regional assessment report on biodiversity and ecosystem services for Europe and Central Asia*. Rounsevell, M. et al. (Eds.).
- IPCC (2019). *Climate Change and Land - An IPCC Special Report*.
- Wright, et al. (2013). *Does the intuitive logics method – and its recent enhancements – produce “effective” scenarios?* Technological Forecasting and Social Change, 80, 631–642.

# PARALLEL SESSION 11

# ANIMAL HUSBANDRY AND WELFARE I



# Economic and environmental performance of ecological dairy farming systems in Austria

Andreas Niedermayr, Lena Schaller and Jochen Kantelhardt

**Abstract** - we assess the performance of a range of ecological farming systems, going beyond a comparison of only conventional and organic farms, using a FADN sample of specialized dairy farms in Austria. We identify four different farming systems in our sample (standard farming, integrated/circular farming, organic farming and a combination of integrated/circular and organic farming), using a novel classification system, the LIFT farm typology. Performance comparisons are carried out based on partial performance indicators and efficiency analyses with Data Envelopment Analysis (DEA). We further control for sample selection bias with matching. Our results reveal potential synergies and trade-offs in terms of economic and environmental performance of the identified farming systems and of switching to a more ecological farming system.

## INTRODUCTION

In light of increasing environmental ambitions of the European Union and an associated ecological transition of its farming sector, it is crucial to assess how such a transition, besides potential environmental benefits, affects the economic viability of farms.

While a greater number of studies has investigated differences in economic and/or environmental performance based on well-established ecological classifications such as conventional and organic farming systems (Lakner and Breustedt, 2017), a broader comparison of a variety of ecological farming systems is less common, in particular with a typology that is applicable on a European scale with readily available data (Rega et al., 2021).

The aim of the present study is thus to assess performance of a broader range of ecological dairy farming systems in Austria, going beyond a comparison of only conventional and organic farms.

## METHOD AND DATA

Our methodological approach consists of three steps: (i) identification of different ecological farming systems, (ii) calculation of performance indicators and (iii) comparison of performance.

We identify different ecological farming systems, using the LIFT farm typology (Rega et al. 2021). It allows to identify the following farming systems based on several indicators derived from FADN data: (i) low input farms are characterized by a lower level of use of environmentally detrimental inputs, (ii) integrated/circular farms are characterized by a higher degree of circularity in their input use (e.g. own feed) and organic farms, are farms that are either partially or fully certified as organic. Combinations of these farming system are also possibly. Farms which are not classified to any of these groups form a residual group, referred to as standard farming. Farms in this group do not stand out in any of the above described ecological criteria.

In terms of economic performance, we investigate indicators related to profitability (revenue cost ratios (RCR) including and excluding public payments as well as opportunity costs of own production factors land, labour and capital) and average products (AP) of individual inputs (i.e. monetary output divided by the respective input). With respect to environmental performance indicators, FADN data only provides limited information. We thus mainly use intensities of selected inputs as well as environmental subsidies as proxies for negative and positive environmental externalities from farming, respectively. In order to also assess overall efficiency, we employ an output-orientated Data Envelopment Analysis (DEA), assuming variable returns to scale.

We further control for structural differences between groups (e.g. due to site conditions or farm size) with matching. Specifically, we use direct covariate matching (DCM), which is a non-parametric, straight-forward and flexible matching approach and has been applied in similar contexts (Kirchweiger et al., 2016). After matching, inference in terms of comparison of farm performance between groups is made by computing average treatment effects. Specifically, we calculate the average treatment effect on the treated (ATT).

Our FADN dataset consists of a pooled unbalanced panel of specialized dairy farms (TF14 = 45) with 796 farms in 2014 and 787 farms in 2015. We control for price differences between the years using price indices from Eurostat.

For the definition of a production technology in DEA, we use five inputs land (ha), labour (annual working units - AWU), capital (Euro), intermediate expenses (Euro) and herd size (livestock units - LSU). Further, we use three different output specifications, resulting in three different DEA models. In model one output consists of the overall market revenues, in model two we use two outputs, namely produced milk in kg and other output in Euro. In model three we use the sum of market revenues and agri-environmental as well as organic farming payments as one aggregated output (Renner, 2021).

## PRELIMINARY RESULTS

Within our sample we identified 871 standard farms, 274 integrated/circular farms, 258 organic farms and 180 farms combining integrated/circular and organic farming. We considered farm size (measured by standard output), site conditions (proxied by LFA payments per LSU and the share of permanent grassland) and a dummy for the year 2014 (matched farms had to be from the same year) as matching variables. Farming systems differed significantly according to these indicators before matching, but these differences were eliminated through matching. At the same time, the number of matched farms is lower than the number of treated farms for each of

the three treatments. Table 1 shows the ATTs of performance indicators after matching.

The effects of an uptake of ecological farming systems on profitability is mostly positive. However, if public payments are excluded and opportunity costs of own production factors are included, the effect becomes negative for integrated/circular farms and roughly 0 for the other two farming systems. For productivity, we largely observe negative ATTs of APs of land, labour, capital and livestock, whereas the ATTs are positive for the AP of intermediate expenses. Efficiencies of model 1 are rather similar, whereas negative ATTs are observed for efficiencies of model 2 for organic and organic + integrated/circular farms. The first three environmental indicators show mostly negative ATTs, meaning ecological farming systems have lower livestock densities, lower veterinary expenses and concentrate feed expenses. In turn environmental subsidies as well as efficiencies from model 3 show predominantly statistically significant positive ATTs.

**Table 1.** Average treatment effects on the treated (ATT) based on selected performance indicators, where treatment refers to the uptake of an ecological farming system.

Indicator	Stand. → integrated/ circular (n=76)	Stand. → organic (n=103)	Stand. → integrated/ circular + organic (n=60)
<i>Economic performance</i>			
Pu. RCR no opp. costs	0.20***	0.12***	0.37***
Pr. RCR no opp. costs	0.11***	0.04*	0.18***
Pr. RCR opp costs	-0.03***	0.00	0.00
AP of land	-1,046***	-555***	-1,745***
AP of labour	-6,962***	-253	-1,744.
AP of capital	-0.03***	-0.01.	-0.02***
AP of int. exp.	0.24***	0.10***	0.38***
AP of livestock	-243***	-45	-117*
Efficiency (model 1)	0.00	0.01	0.02***
Efficiency (model 2)	-0.03	-0.07***	-0.07***
<i>Environmental performance</i>			
St. density (LSU/ha)	-0.31***	-0.21***	-0.63***
Vet exp./cow	-39***	-33***	-67***
Conc. feed exp./LSU	-201***	-11	-285***
RD subs./ha (excl. LFA and Inv.)	66***	158***	254***
Efficiency (model 3)	0.00	0.03***	0.07***

Note: \*\*\*, \*\*, \* and . indicate significance at the 0.1%, 1%, 5% and 10% level, respectively. n refers to the number of matched farms. RCR = revenue cost ratio; AP = Average Product; RD = rural development; LFA = less favoured areas

#### DISCUSSION AND OUTLOOK

Our matching results indicate that the identified farming systems differ based on the matching covariates, but that these differences can be eliminated by matching. In terms of performance, our results reveal potential synergies and trade-offs in economic and environmental performance of the identified farming systems and of switching to a more ecological farming system. Both integrated/circular farming systems can be seen as more extensive forms of dairy farming, compared to standard farming and

organic farming. However, the non-organic integrated/circular farming system performs worse compared to the other groups. In contrast, organic and integrated/circular organic farms can compete with standard farms in terms of profitability, especially, if subsidies are included, a result which is not always found in similar literature (Mayen et al., 2010). At the same time, these farming systems also perform better in terms of environmental performance than the standard and integrated/circular farming system.

In a next step we will extend our analysis by testing further matching approaches, since the current reduction of treated observations after matching may lead to attrition bias. Also, we will consider potentially different production technologies of the identified farming systems and will analyse drivers of efficiency with a second stage regression.

#### ACKNOWLEDGEMENT

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#### REFERENCES

- Kirchweger, S., Kantelhardt, J., Leisch, F. (2016). Impacts of the government-supported investments on the economic farm performance in Austria. *Agric. Econ. – Czech* 61(8): 343–355.
- Lakner, S., Breustedt, G. (2017). Efficiency Analysis of Organic Farming Systems: A Review of Concepts, Topics, Results and Conclusions. *German Journal of Agricultural Economics* 66(2): 85–108.
- Mayen, C. d., Balagtas, J. v., Alexander, C.E. (2010). Technology Adoption and Technical Efficiency: Organic and Conventional Dairy Farms in the United States. *American Journal of Agricultural Economics* 92(1): 181–195.
- Rega, C., Thompson, B., D'Alberto, R., Niedermayr, A., Kantelhardt, J., Gouta, P., Konstantidelli, V., Tzouranami, I., Desjeux, Y., Latruffe, L., Billaudet, L., Paracchini, M.L., 2021. LIFT farm typology developed, tested and revised, and recommendations on data needs. EU H2020 project LIFT Low-Input Farming and Territories - Integrating knowledge for improving ecosystem based farming. Deliverable D1.4.
- Renner, S., Sauer, J., El Benni, N. (2021). Why considering technological heterogeneity is important for evaluating farm performance? *European Review of Agriculture Economics* 48(2): 415-445.

# Evaluation of animal welfare outcomes of RDP-Measures for Dairy Cows

Angela Bergschmidt<sup>1</sup> and Stefan Schwarze<sup>1</sup>

**Abstract** – We use German cattle register data to analyse the effect of animal welfare measures for dairy farms in the federal state of North-Rhine Westphalia for the period 2007-2013. To establish causality, we applied a flexible conditional difference-in-differences approach, which has not yet been employed in the context of agricultural policy assessments. While participation in farm investment support did not have substantial effects on mortality as well as longevity, participation in grazing reduced mortality by 0.5 percentage points, corresponding to an effect of -12%. Participation in the measure litter led to a substantial increase in longevity by 142 days, which is equivalent to an increase of about 12%. We conclude, that the use cattle register data offers new possibilities for impact evaluations, but its application is time consuming and restricted to mortality and longevity.

## BACKGROUND

In §13 of the Lisbon Treaty, the European Union (EU) recognises that animals are sentient beings and requires the Member States (MS) to “pay full regard to the welfare requirements of animals”. A specific animal welfare measure was included into the Rural Development Programmes (RDP) of the Common Agricultural Policy (CAP) in the programming period 2007-2013. While it was not taken up by many MS at first, it gained impetus in the 2014-2020 programming period and the expenditures increased from 55 m Euro in 2014 to over 450 m in 2019 (European Commission, 2019). Moreover, animal welfare issues also gained importance in measures, which were originally oriented towards increasing competitiveness such as farm investment support (FIS) or farm advisory measures.

## AIM OF OUR STUDY

According to Fraser (2008) animal welfare comprises the dimensions of health, behaviour (ability to perform normal behaviour) and emotions (e.g. fear, pain, pleasure). Animal welfare is assessed using indicators and a comprehensive animal welfare measurement usually involves a substantial number of indicators. The survey of such indicator sets on farms is very time-consuming (e.g. 6 hours for a Welfare Quality® protocol) and for this reason such approaches have rarely been used for evaluation purposes. In addition, a comparison with non-supported farms, which is necessary for measuring causality, is not feasible with this approach.

In consequence, the evaluation of RDP animal welfare measures has up to now been based on the comparison of the regulations with scientific literature (e.g. BAB 2019), surveys which assess changes in management at the farm level (e.g. Gröner 2019) or the measurement of animal welfare on supported farms (Bergschmidt et al. 2014).

Another possibility for the assessment of animal welfare outcomes is the use of secondary data such as national cattle register data. The HI-Tier (HIT) (www.hi-tier.de) is the German register and we used it to analyse the effect of animal welfare measures for dairy farms in the federal state of North-Rhine Westphalia for the period 2007-2013. We applied a flexible conditional difference-in-differences approach (Dettmann et al. 2020), which has not yet been employed in the context of agricultural policy assessments.

## MATERIALS AND METHODS

The HIT-Data contains information for every cattle in Germany concerning (among others) date of birth and death, sex, breed, calving status, date of entering and exiting the farm as well as the cause of death. In a first step, we identified the milking cows based on sex, breed and calving status. We then aggregated the data on farm level and calculated the animal welfare indicators mortality (The Welfare Quality Consortium® 2009) and longevity (European Food Safety Authority 2009).

North-Rhine Westphalia implemented the following measures in the programming period 2007-2013 to improve animal welfare on dairy farms:

1. The animal welfare measure *Grazing* which requires daily access to pasture for all dairy cows (payment: 30-35 € per cow and year).
2. The animal welfare measure *Litter*, which has requirements for space allowance and litter (30-37 € per cow and year); and
3. *Farm investment support (FIS)* which covered up to 40 % of the building costs for stables through grants.

Farms participating in measures 1, 2 and 3, respectively, form the treatment groups, while all other farms are in the control group. In Table 1, the numbers of participants for the measures are listed.

To establish causality between participation in animal welfare measures and changes in mortality and longevity we applied a flexible conditional difference-in-differences approach (Dettmann et al. 2020). It combines matching with a difference-in-differences approach and further allows for variations in treatment timing and durations.

**Table 1.** treatment group, supported farms

Measure	number of supported farms
1 Grazing	2.043
2 Litter	784
3 FIS	737

## RESULTS

While participation in *FIS* did not have substantial effects on the observed indicators (see Fig. 1 and 2),

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the measure *Grazing* resulted in a reduction in mortality by 0.5 percentage points, corresponding to an effect of -12%. The measure *Litter* led to a substantial increase in longevity by 142 days, which is equivalent to an increase of about 12%.

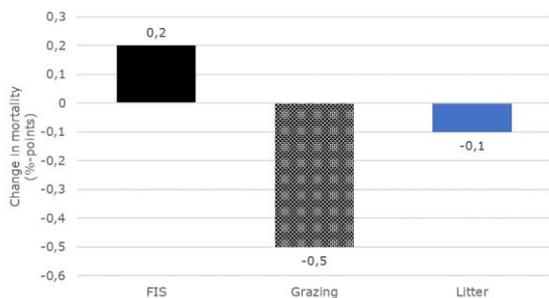


Figure 1. Effects of the support measures on cow mortality

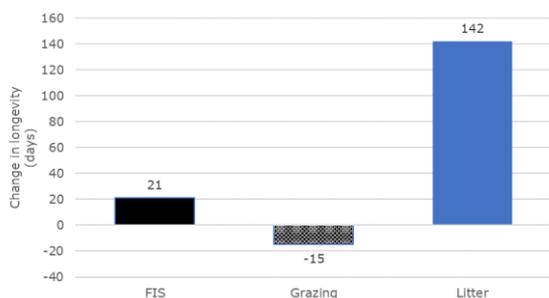


Figure 2. Effects of the support measures on cow longevity

#### DISCUSSION

Due to the low animal welfare requirements of *FIS* in the 2007-2013 programming period, it is no surprise that no substantial effects were found. While the effects of grazing on mortality have already been documented in other studies (Burow et al. 2011), comparable studies for the effects of litter are lacking. One explanation could be that the softer lying conditions lead to a reduction in lameness and joint damage (European Food Safety Authority 2009), which hence increases longevity.

The use of HIT-Data has the advantage of allowing the application of "state of the art" evaluation methodologies, but it also has some disadvantages: Due to different interpretations of the legal framework, the access to HIT-Data was only granted for a few federal states, making a national analysis impossible. Moreover, due to the fact that the information in HIT has to be aggregated to the farm level, data handling is time consuming and complex. And, as a final issue, HIT only contains two indicators, which limits the analysis.

#### CONCLUSIONS & OUTLOOK

Due to these limitations we will use data from milk recording schemes instead of HIT for the evaluation of the programming period 2014-2020. This data has the advantage of containing additional indicators on mastitis and metabolic health, which should facilitate the interpretation of the results and will enable us to provide more concise recommendations for the design of animal welfare support measures. Moreover, its use is much easier, because it is already aggregated at farm level.

Despite its usefulness, German administrative data is yet hardly used for research and evaluation purposes

because access is very restricted. Administrative bodies and managing authorities should hence take measures to facilitate access. Furthermore, it should be made possible to combine different administrative datasets (HIT, IACS, FADN etc.) allowing for more comprehensive evaluations.

#### REFERENCES

- BAB - Bundesanstalt für Agrarwirtschaft und Bergbauernfragen (Ed.) (2019). Evaluierung des Österreichischen Agrar-Umweltprogramms ÖPUL – Nationaler Detailbericht 2019
- Bergschmidt, A.; Renziehausen, C.; Brinkmann, J.; arch, S. (2014): Application of the welfare quality protocols for the evaluation of agricultural policies. In: Veissier I. Mounier L (Hg.): Proceedings of the 6th WAFL Conference. Wageningen Academic Publ, p 201
- Burow, E.; Thomsen, T.; Sørensen, J.; Rousing, T. (2011): The effect of grazing on cow mortality in Danish dairy herds. In: Preventive Veterinary Medicine 2011, S. 2-5
- Dettmann, E.; Giebler, A.; Weyh, A. (2020). Flexpanelid: A Stata toolbox for causal analysis with varying treatment time and duration. Leibniz-Institut für Wirtschaftsforschung Halle (IWH), Halle (Saale) (IWH Discussion Paper 3/2020)
- European Commission (2016). Attitudes of Europeans towards Animal Welfare. Special Eurobarometer 442. Brussels
- European Commission (2019). CAP indicators - Data explorer: <https://agridata.ec.europa.eu/extensions/Dashboard Indicators/DataExplorer.html>
- European Food Safety Authority (2009). Effects of farming systems on dairy cow welfare and disease. Report of the Panel on Animal Health and Welfare 3686.
- Fraser, D. (2008). Understanding animal welfare. In: Acta Veterinaria Scandinavica, 50 (Suppl 1). The 21st Symposium of the Nordic Committee for Veterinary Scientific Cooperation
- Gröner, C. (2019): Tierwohlmaßnahme des PFEIL – Programms 2014 bis 2020 Besonders tiergerechte Haltung von Legehennen (T1). Thünen-Institut. Braunschweig (5-Länder-Evaluation, 4/19)
- The Welfare Quality Consortium® (2009): Welfare Quality® Assessment protocol for cattle. Lelystad, The Netherlands.

# In practice, cow longevity hardly pays off

Daniel Hoop<sup>1</sup>

**Abstract – Based on accountancy data from Switzerland, this study investigates the relationship between the economic performance and the lifespan of dairy cows. Group comparisons and regression analyses do not reveal significant effects of longevity on farm economic performance. It seems challenging to increase both longevity and average milk yield per cow and year. Only those farms that succeed in doing so seem to have an economic advantage. Our findings are in line with another empirical study but in contrast to the findings derived from bio-economic models. This highlights the importance of empirical evidence before recommendations are made to practitioners.**

## INTRODUCTION

For Swiss consumers, animal-friendly husbandry in agriculture is as important as the production of food (gfs, 2018). The Swiss media reported repeatedly about the short lifespan of dairy cows, which could harm the reputation of agriculture (e.g. bioAktuell, 2018). In addition, studies found that an increase in cow longevity could reduce greenhouse gas emissions (Alig et al., 2015; Grandl et al. 2018). This led the Swiss Federal Office for Agriculture to conclude that payments to promote cow longevity could be a useful agricultural policy measure (FOAG, 2020).

With regard to economics, studies based on bio-economic models found that longevity of cows has positive effects on performance (Horn et al. 2012; Kiefer et al. 2019). On the other hand, based on empirical data, Vredenberg et al. (2021) did not find a significant economic impact of longevity on the gross margin per kg milk. Because empirical studies are rare, they are urgently needed to assess with a higher degree of certainty the link between longevity and profitability in agricultural practice.

Based on empirical data, the present study sheds light on the economic impact of longevity in Swiss dairying and discusses the differences between studies based on bio-economic models and empirical data.

## METHODS AND DATA

Based on Swiss FADN data of dairy farms in 2020, the average productive lifespan (from start of 1<sup>st</sup> lactation to culling) of cows in the herd of a farm was calculated as the inverse of the cow replacement rate. Other farm characteristics beyond structural and monetary information were available from a one-time additional survey in the FADN sample in 2020.

The farms were grouped according to the lifespan of dairy cows. Subsequently, their characteristics and economic performance were compared. The same procedure was repeated using the average cow life performance (kg milk production per cow life) as the grouping variable. Significant differences between variables were identified using the non-parametric Wilcoxon rank sum test for numeric, and the Chi-Squared test for binary variables, respectively. In

addition, two separate cross sectional regression models were estimated to evaluate the impact of different farm characteristics on the gross margin per livestock unit (CHF/LU) in the dairy production branch and on the remuneration of family labour on the whole farm (CHF/year of family labour), respectively.

## RESULTS

Table 1 shows the differences between the farms with a cow lifespan above the 75% quantile (except the top 2.5%), and those below the 25% quantile (except the bottom 2.5%). Each groups contains 116 farms. The group with a high average lifespan (HLS) uses less concentrates per cow, but also less concentrates per kg milk; therefore, more milk is produced from roughage. The average milk yield per cow and year is 13% lower in the HLS group. However, because the share of cows in the herd is higher, the milk yield per livestock unit is only 9% lower. With 47,990 kg, the life performance per cow is 83% higher in the HLS group. Nevertheless, neither the gross margin per livestock unit in the dairy production branch, nor the remuneration of family labour on the farm level differ significantly between the two groups.

**Table 1.** Averages of two groups of farms with the lowest and the highest cow lifespan, respectively. Only significantly different variables are shown in the table.

Variable	Low lifespan group	High lifespan group
Lifespan (years)	3.3	6.9
Share of cows in dairy herd (%)	79.9	83.4
g concentrates per kg milk	111.6	89
kg concentrates · cow <sup>-1</sup> ·year <sup>-1</sup>	894.1	619.4
Milk yield · cow <sup>-1</sup> ·year <sup>-1</sup>	8013.4	6955.8
Milk yield · livestock unit <sup>-1</sup> ·year <sup>-1</sup>	6404.4	5802.1
Life performance (kg)	26224.9	47990.2

The same exercise as described above was conducted using life performance as the grouping variable. On average, cows on farms with a high average life performance (HLP) live 6.4 years instead of 3.6 years. Even though they consume 13% more concentrates cow<sup>-1</sup> year<sup>-1</sup> and graze 18% less, 8% less concentrates are used per kg milk produced. This is because the milk yield cow<sup>-1</sup> year<sup>-1</sup> is 23% higher. Therefore, both the gross margin per livestock unit and year and the remuneration of family labour are 19% and 17% higher in the HLP group (significant effect). However, as the share of farms in more favourable production zones is considerably larger in the HLP group, it is probable that these farms did benefit from high quality roughage and therefore had an advantage over the farms in the group with a low average life performance.

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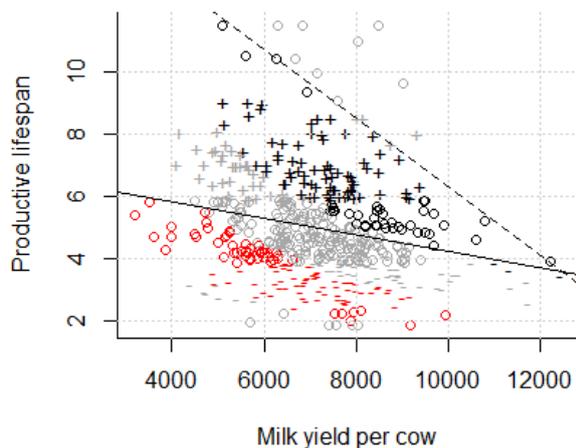


Figure 1. Relationship between productive lifespan and milk yield. Black: farms with highest life performance, red: farms with lowest life performance, "+": farms with highest lifespan, "-": farms with lowest lifespan. The 2.5% top and bottom farms were not included in the mentioned groups. Solid line: coefficient from linear regression (lifespan ~ milk yield). Dashed line: assumed maximum combination of lifespan and milk yield derived from the black group.

The relationship between the cow lifespan and the milk yield per cow, whose multiplication yields the life performance, is depicted in Fig. 1. The correlation coefficient between these two variables is  $-0.22$ , implying a negative overall relationship between them. The dashed line is drawn along the most efficient black coloured observations having the maximum possible life performance (without 2.5% outliers). This seems to mark a boundary of the maximally possible combinations between lifespan and milk yield per cow in the sample.

**Table 2.** Significant coefficients from the regression models explaining the gross margin per livestock unit (GM; left column; CHF/LU) and the remuneration per family labour unit (RFLU; right column; CHF/year of family labour).

Variable	Coef. GM	Coef. RFLU
Livestock units dairy branch	--	930.0
Share of cows in herd (%)	28.5	--
g concentrates per kg milk	-5.6	-131.3
Milk yield per cow [1000 kg]	257.3	--
No. of grazing days year <sup>-1</sup>	3.3	149.9
<i>Dummies:</i>		
Milk for non-pasteurised cheese	413.7	--
Hill zone	--	9074.8
Mountain zone 3	415.8	--
Education: master or higher	--	6832.6

Table 2 shows the coefficients from the linear cross sectional regressions explaining the gross margin per cow and the remuneration per family labour unit by means of different farm characteristics. Only significant coefficients are shown. The only variables that have a consistent effect in both models are the amount of concentrates per kg milk produced and the grazing time of cows. The less concentrates per kg milk, the better the economic performance. The more grazing, the better the economic performance. That is, each additional day of grazing (24 h for all cows in the herd) increases the labour remuneration by 149.9

CHF. Neither the cow lifespan nor the life performance showed a significant effect on the economic figures.

#### DISCUSSION

The results of this study are similar to the empirical findings by Vredenberg et al. (2021). In short: there is no positive effect of the cow lifespan neither on gross margin nor on labour remuneration, which is in contrast to the findings based on bio-economic models (Horn et al. 2012; Kiefer et al., 2019). The analysis showed that the negative correlation between the lifespan and the milk yield is probably the reason for this finding. In practice, it seems difficult to increase both – and therefore only few farms can benefit economically from a longer cow lifespan. However, even though the group with the highest life performance showed superior economic performance, no significant ceteris paribus effect of life performance on neither gross margin nor remuneration of family labour could be shown in the regression analysis. This finding suggests that there is limited synergy between economics, ecology and consumer needs with regard to cow longevity in (real as opposed to modelled) dairy production systems.

#### REFERENCES

Alig, M., Prechsl, U., Schwitter, K., Waldvogel, T., Wolff, V., Wunderlich, A., Zorn, A. and Gaillard, G. (2015). *Ökologische und ökonomische Bewertung von Klimaschutzmassnahmen zur Umsetzung auf landwirtschaftlichen Betrieben in der Schweiz*. Zürich: Agrocope.

bioAktuell (2018). Das Leben vieler Milchkühe ist zu kurz.

gfs (2018). Mitteilung Univox Landwirtschaft 2018.

Grandl, F., Furger, M., Kreuzer, M. and Zehetmeier, M. (2018). Impact of longevity on greenhouse gas emissions and profitability of individual dairy cows analysed with different system boundaries. *Animal* 13(1):198-208.

Horn, M., Knaus, W., Kirner, L. and Steinwider, A. (2012). Economic evaluation of longevity in organic dairy cows. *Org. Agr.* 2:127-143.

Kiefer, A., Sonntag, L. and Bahrs, E. (2019). Ökonomische Bewertung der Nutzungsdauer von Milchkühen im Kontext erwarteter Erkrankungen. *Austrian J. Agr. Econ. And Rural Studies* 28.5: 27-34.

Vredenberg, I., Han, R., Mourits, M., Hogeveen, H. and Steeneveld, W. (2021). An Empirical Analysis on the Longevity of Dairy Cows in Relation to Economic Herd Performance. *Front. Vet. Sci.* 8:646672

# Making animal welfare labelling more transparent - The potential of using virtual reality glasses

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**Abstract** – Intensive pig husbandry has been subject to increasing public criticism including a clear demand for more animal friendly housing systems and transparency. Thereon, various animal welfare labels have been introduced to help consumers making more informed purchasing decisions with regard to animal welfare. However, such labels need to be accompanied by adequate information to reveal full market power. The aim of our study is to investigate whether different information modes influence understanding and evaluation of the 'Haltungsform' label that has been introduced by German retailers in 2019. We thereby investigate the case of a level 3 stable for pigs ("outdoor climate stable") and used a quantitative research approach with 4 experimental groups (n=200). Each group was presented with different modes of information concerning the label: 1) text only, 2) text and stable pictures, 3) 360° stable video via tablet, 4) 360° stable video via virtual reality glasses. Results show that regardless of information mode, participants general understanding of the label improved. Participants rated animal welfare as well as acceptability of the stable higher after information was given. However, amongst all four information treatments virtual reality glasses are particularly promising to transfer information about housing conditions in an entertaining and effective way.

## INTRODUCTION

Over the last decades, intensive livestock production, especially pig husbandry, has been exposed to growing public criticism resulting in a considerable loss of public acceptance (Krystallis et al., 2009; Weible et al., 2018). In this context, animal welfare is a main concern with many people demanding for more nature and species-appropriate housing conditions (Boogaard et al., 2011) and increased transparency in agricultural activities (Caracciolo et al., 2016). In order to comply with citizens' desire, in the last years various front-of-package labels have been developed to inform consumers about housing conditions of animals. Indeed, labels have been shown to help consumers making more ethical buying decisions (Ingenbleek and Immink, 2011), even though little is known about what makes animal welfare labels most effective (Cornish et al., 2020). However, Cornish et al (2020) found, that additional explanatory information about animal welfare standards behind a given label increase purchase intention and thus help consumers translate their personal attitudes into actual behavior. Nowadays consumers are confronted with plenty of labels, which are commonly presented with little information. However, giving more information to consumers may

help revealing the full market power of animal welfare labels due to increased understanding and transparency. In Germany, the 'Haltungsform' label has been introduced by German retailers in 2019 and is widely used for meat and meat products. The label is intended to provide a quick overview of housing conditions by referring to already existing programs and standards and classifying them. It comprises four levels ranging from 1) indoor stables to 4) premium. Against this background, the aim of our study was to analyse how different information modes influence understanding and evaluation of a pig stable corresponding to level 3 of the 'Haltungsform' – an outdoor climate stable. We further analyse, how different modes of information presented are evaluated in terms of utility, user experience and usage potential.

## METHODS

The study was conducted between January and February 2022 at the University of Göttingen with a total of 200 participants, all students without agricultural background and who identify as pork-meat eaters. We used a quantitative research approach with 4 experimental groups (n=50 each) consisting of an online questionnaire and an information treatment (Figure 1).

Part 1: Questionnaire	
<ul style="list-style-type: none"><li>• Sociodemographics, involvement in and evaluation of pig husbandry</li><li>• Meat consumption, buying and information behaviour</li><li>• Affinity for technology, experiences with VR glasses</li><li>• Familiarity with different animal welfare labels</li><li>• Understanding and evaluation of level 3 based on the label only</li></ul>	
Part 2: Information treatment	
<b>Group 1:</b> Information text on level 3 stables	
<b>Group 2:</b> Information text + 2D Pictures of a level 3 stable	
<b>Group 3:</b> Information text + 360° video of a level 3 stable via tablet	
<b>Group 4:</b> Information text + 360° video of a level 3 stable via VR glasses	
Part 3: Questionnaire	
<ul style="list-style-type: none"><li>• Understanding and evaluation of level 3 stables</li><li>• Evaluation of the information mode</li></ul>	

Figure 1. Overview of the study design.

The study also included questions on the willingness to buy and willingness to pay for minced meat from a level 3 stable, both before and after information treatment, which are not discussed in this paper.

The information treatment differed between the four groups in the mode of presenting information about the outdoor climate stable (i.e. level 3) (Figure 1).

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**RESULTS**

The total sample consisted of 55.5% men and 44.5% women with an average age of 23.1 years with similar distribution in all four groups. When it comes to general characteristics of the sample, participants' self-perceived knowledge about ( $\mu=3.3$ ;  $\sigma=1.1$ ) and interest in ( $\mu=3.9$ ;  $\sigma=1.2$ ) German pig husbandry was rather low to medium (Likert scale: 1 = very low to 7 = very high). With regard to the general evaluation of German pig farming, participants rather did not agree that pig husbandry is acceptable ( $\mu=3.2$ ;  $\sigma=1.4$ ) and pigs are kept in a species-appropriate manner ( $\mu=2.6$ ;  $\sigma=1.3$ ) (Likert scale: 1 = not agree at all to 7 = fully agree). Furthermore, more than 60% of the total sample rate information about pig housing conditions provided at the point-of-sale to be insufficiently and would like to receive more information.

Table 1. Understanding and evaluation of an outdoor climate stable (level 3) for pigs before and after presenting information.

Statement	Experimental group				
		1	2	3	4
I can well imagine how animals live in housing systems of level 3.	Before	3.5 (1.6)	2.9 (1.2)	3.2 (1.3)	3.4 (1.4)
	After	5.7 (1.1)	5.5 (1.0)	5.8 (0.9)	5.9 (1.1)
I don't understand what level 3 means.	Before	3.8 (1.9)	4.4 (1.3)	4.3 (1.6)	3.9 (1.7)
	After	2.0 (1.3)	2.1 (1.2)	2.0 (1.3)	1.8 (1.3)
The pigs have more space than legally required.	Before	4.5 (1.9)	4.2 (1.8)	4.7 (2.0)	4.1 (2.0)
	After	6.5 (0.8)	6.6 (0.7)	6.6 (0.6)	6.4 (1.0)
The pigs have an area with straw bedding in their pen.	Before	5.1 (1.9)	5.0 (1.7)	5.4 (1.8)	4.9 (1.7)
	After	6.0 (1.0)	6.1 (0.9)	6.6 (0.7)	6.5 (0.7)
The stable is built in a way that pigs have contact to fresh air, e.g. through windows or open stable.	Before	5.8 (1.3)	5.5 (1.2)	5.8 (1.2)	5.4 (1.5)
	After	6.6 (0.6)	6.7 (0.6)	6.7 (0.6)	6.7 (0.6)
The pigs are healthy.	Before	4.7 (1.8)	4.2 (1.6)	4.4 (1.7)	4.6 (1.6)
	After	5.5 (1.5)	5.2 (1.1)	5.6 (1.2)	5.5 (1.1)
Pigs in housing systems of level 3 are doing well.	Before	3.9 (1.2)	3.7 (1.1)	3.8 (1.1)	3.9 (1.3)
	After	4.8 (1.4)	4.9 (0.8)	4.5 (1.1)	4.7 (1.3)
I consider it acceptable to keep pigs in housing systems of level 3.	Before	4.5 (1.4)	4.1 (1.2)	4.1 (1.3)	4.3 (1.3)
	After	5.2 (1.4)	5.3 (0.9)	5.1 (1.5)	5.0 (1.4)

Displayed are means and standard deviations (n=200). Evaluation on a 7-point Likert scale from 1 = not agree at all to 7 = fully agree.

All information treatments increased participants general understanding of how an outdoor climate stable looks like, including specific key improvements of housing conditions. Furthermore, animal welfare as well as acceptability of the stable was rated higher after information was given (Table 1). With regard to utility, user experience and usage potential, the VR glasses were rated best amongst all four information modes (Figure 2).

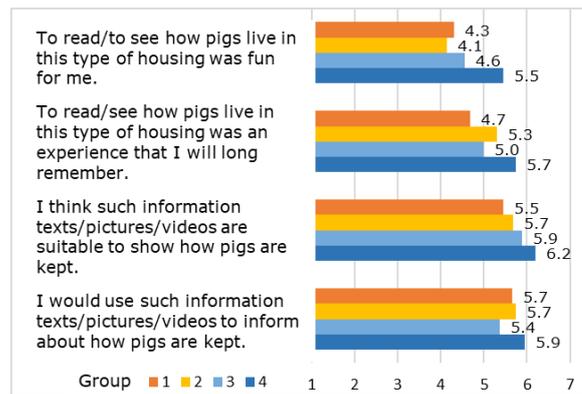


Figure 2. Evaluation of information modes. Evaluation on a 7-point Likert scale from 1 = not agree at all to 7 = fully agree (n=200).

**DISCUSSION & CONCLUSION**

The comprehensibility as well as the acceptability of an outdoor climate stable corresponding to level 3 of the 'Haltungsform' increased after information was given, independent of the way information was provided. Furthermore, results showed that VR devices are advantageous with regard to the viewing experience and perceived utility for information provision compared to text only, text and photos and a 360-degree video presented via tablet.

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**REFERENCES**

Boogaard, B., Boekhorst, L.J.S., Oosting, S., Sørensen, J. (2011). Sociocultural sustainability of pig production: Citizen perceptions in the Netherlands and Denmark. *Livestock Science* (140): 189–200.

Caracciolo F, Cicia G, Del Giudice T, Cembalo L, Krystallis A, Grunert KG, u. a. (2016). Human values and preferences for cleaner livestock production. *Journal of Cleaner Production* (112):121–30.

Cornish A.R., Briley D., Wilson B.J., Raubenheimer D., Schlosberg D. & McGreevy P.D. (2020). The price of good welfare: Does informing consumers about what on-package labels mean for animal welfare influence their purchase intentions? *Appetite* (48):104577

Ingenbleek, P. T. M., & Immink, V. M. (2011). Consumer decision-making for animal-friendly products: synthesis and implications. *Animal Welfare* (20): 11-19.

Krystallis A, de Barcellos MD, Kügler JO, Verbeke W, Grunert KG. (2009). Attitudes of European citizens towards pig production systems. *Livestock Science* 126(1): 46–56.

Weible D, Christoph-Schulz I, Salamon P, Zander K. (2016). Citizens' perception of modern pig production in Germany: a mixed-method research approach. *British Food Journal* 118(8): 2014–32.

# PARALLEL SESSION 12

# DIGITIZATION



# Blockchain technology for sustainable out-of-home consumption: Prospects and barriers

Magdalena Thur<sup>1</sup>, Thomas Wassermann<sup>2</sup>, Helene Doppler<sup>3</sup> and Siegfried Pöchtrager<sup>4</sup>

**Abstract** – Transparency in the food supply chain is understood as a prerequisite to sustainable consumer choices. Still, indicating the provenance and method of production is non-mandatory in most out-of-home eating environments in Austria. Two qualitative studies conducted at the Institute of Marketing and Innovation investigated the feasibility of mandatory labelling of processed eggs in restaurant meals; and the potential of blockchain-technology for food-supply-chain (FSC) tracking in Austria, respectively. Results underpin the prevailing demand for traceability of processed foods, however accompanied by concerns for attaining mutable agreement among stakeholders. Surveyed experts agreed that method of production should be prioritized over origin indication. Compulsory labelling needs to be politically legitimated, controlled by authorities and FSC members should receive support for implementation. A fully digitized, blockchain-based tracking system in the Austrian food supply chain is viewed critically. Even though experts stressed its potential to prevent counterfeit activities, the quality of input data as well as lacking know-how and high implementation costs constitute major barriers. Further research should investigate the potential of blockchain-based consumer applications to nudge sustainable consumption.<sup>1</sup>

## INTRODUCTION

As globalization is forming increasingly sophisticated food supply chains (FSCs), prone to fraud and counterfeit, society expresses growing interest in trust and traceability considering food provenance, safety and sustainability. Therefore, consumer-oriented means for effective monitoring and verification mechanisms gain importance (Treiblmaier & Garaus, 2022).

While mandatory indications have already widely been implemented in retail, Austria just recently sentenced compulsory labelling of primary ingredients in communal food service facilities (Bundesministerium für Soziales Pflege und Konsumentenschutz, 2022). However, plans for implementing such measure for non-communal localities like restaurants are still undetermined. This shortcoming is argued with the costliness of tracing the highly complex FSC of processed foods (Doppler, 2019; Montecchi et al., 2019).

Blockchain-technology (BCT) based systems claim to resolve transparency and traceability issues inexpensively (Montecchi et al., 2019; Treiblmaier & Garaus, 2022). BCT ensures that the genesis and transactions of a product are immutably recorded and can be published to consumers. Agro-food BCT

projects (e.g. by Walmart, Carrefour and Nestlé) are already facilitated by service providers like Hyperledger (open source), Origin Trail (Slovenia) or Ambrosus (Switzerland). According to the EU's "farm to fork"-strategy, BCT will play a vital role for achieving an increase in sustainable consumption and better agricultural practices (European Commission, 2019).

Hence, synthesizing the knowledge about BCT and consumer sciences is required. This short paper summarizes two recent studies conducted at the Institute of Marketing & Innovation, aimed to assess the applicability and limitations of BCT in out-of-home settings in terms of sustainability.

## METHODS

(1) In 2019, an explorative study was conducted by graduate student Helene Doppler, investigating the potential of and barriers to a mandatory labelling system for eggs as an ingredient in restaurant meals in Austria. Four experts were interviewed about the existing origin labelling regulations in Switzerland and France. The results were converted into a guideline questionnaire for interviewing seven Austrian egg industry experts and restaurant industry stakeholders. Results were attained by qualitative content analysis. (2) In 2020, graduate student Thomas Wassermann aimed to describe the potential of BCT for agri-food supply chains in Austria. Five semi-structured interviews with Austrian agri-food system experts were conducted and qualitatively analyzed, resulting in a SWOT-matrix. The results are put into context by in-depth literature analysis.

## RESULTS

(1) Doppler (2019) describes that industrial (liquid and powdered) eggs and grade B eggs with lacking origin and type of farming indication are utilized as ingredients in Austrian restaurant kitchens. Imported goods with unclear origin encompass eggs produced from caged hens. As about 60 percent of all consumed eggs in Austria are eaten in form of processed foods, ensuring complete traceability is urgent. The interviews revealed that the indication of production method is more relevant than the place of origin, especially in the case of processed eggs undergoing many steps, eventually containing eggs from multiple sources. Experts not only agreed that origin should be defined at the primary level of the supply chain, but also that foremost, for effective labelling of processed eggs in gastronomy, a legal regulation is needed. To effectively convey transparency, also non-Austrian produce must carry

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trustworthy labels, which requires international negotiating. Furthermore, elaborating definitions (e.g. "processed") and thresholds (e.g. share of eggs in a meal to be indicated) are prerequisites. Regular controls by authorities are essential and harsh penalties must be issued to prevent fraud. A digital solution for traceability is discussed critically, as experts argue that trading partners along the supply chain might protest being forced to invest into the required digital infrastructure. The presented case of eggs in restaurant meals shows the challenges posed by multiple-step supply chains.

(2) Wassermann (2020) addressed this by outlining the potential of BCT-based systems, operationalized by a SWOT-Matrix. *Strengths*: The intrinsic features of BCT, especially transparency and immutability, are argued to be convincing advantages. "Even with a product recall in the food chain, every member is always up to date". Also, decentralization is seen as a pro, as it could redistribute power in the Austrian retail landscape, where few companies are now constituting a central data oligopol. *Weaknesses*: The most critical boundaries are seen in questionable quality of input data, and in the lacking infrastructure for (automated) data collection. An efficiently running system would require the standardization of inputs, while simultaneously eradicating the possibility to enter manipulated data into the blockchain. Additionally, the missing globally standardized definition of key data points in the FSC, would impede reader's (e.g. consumer's) understanding of information stored in the blockchain. *Opportunities*: All experts emphasized on the potential of BCT to prevent food fraud and counterfeit of labels or certificates. BCT was considered to be especially effective to monitor long food chains with multiple border crossings, as well as animal product chains. With high standards in animal welfare, BCT might further strengthen Austria's image as a high-quality producer. The possibility to enhance food safety and trustworthiness of a product meets consumer trends such as health-orientation and preference for regional produce. *Threats*: The main barriers for implementing BCT are technical, in particular when not met by enough know-how. This is closely linked with the concern of high costs. Especially for smaller companies, implementation poses a big hurdle compared to players with specialized IT resources. This might be aggravated if public authorities miss to counteract duly by supplying adequate support. Another threat is the conflict between competing IT-Service providers that object to the standardization of input data due to individual commercial interest.

#### DISCUSSION

Regarding the results of both studies, experts see the tackling of food fraud and labelling counterfeit as the primary need (Doppler, 2019), and also as the biggest potential (Wassermann, 2020), respectively.

Providing trustworthy labelling information is a crucial step towards supporting consumer trends in favour of sustainable consumption (such as organic and regional). Since there is willingness to pay a higher price for quality and provenance features, thorough labelling could even add value for producers'

revenues (Montecchi et al., 2019; Treiblmaier & Garaus, 2022; Wassermann, 2020).

However, the hypothesized inexpensiveness of BCT is causally tied to enhanced automatization (Treiblmaier & Garaus, 2022), entailing substantial investments. BCT-based digitization of the FSC requests political institutions to craft a framework (Doppler, 2019), which not only implements full transparency, but also supports producer's investment in the required infrastructure. As has been claimed before (Montecchi et al., 2019; Treiblmaier & Garaus, 2022) and supported by Wassermann (2020), BCT might diminish fraud, but the integrity of input data is the precarious pivot point. Moreover, open questions such as data security and sovereignty must be addressed; as well as the environmental costs of running the FSC on BCT.

Last but not least, it is not yet clear to what extent access to information on the blockchain would incentivise consumers to make better choices (Treiblmaier & Garaus, 2022). Currently, a quantitative study is prepared at the Institute of Marketing and Innovation to assess the willingness to consume more sustainable meals, when information is provided through BCT. The results may allow to estimate the effect of BCT to facilitate sustainable consumption. Certainly, it is worthwhile to investigate the intersection of sustainability, consumer sciences and BCT further.

#### REFERENCES

- Bundesministerium für Soziales Pflege und Konsumentenschutz. (2022). Herkunftskennzeichnung bei Lebensmitteln. Accessed 2022-05-05 at <https://www.sozialministerium.at/Services/News-und-Events/herkunftskennzeichnung-lebensmittel.html>
- Doppler, H. (2019). *Potentialabschätzung einer verpflichtenden Herkunftskennzeichnung von Eiern in der Gastronomie*. Master Thesis. Universität für Bodenkultur, Wien.
- European Commission. (2019). From farm to fork: The European Green Deal. *Directorate-General for Communication*. <https://doi.org/https://data.europa.eu/doi/10.2775/691860>
- Montecchi, M., Plangger, K., & Etter, M. (2019). It's real, trust me! Establishing supply chain provenance using blockchain. *Business Horizons*, 62(3), 283–293. <https://doi.org/10.1016/j.bushor.2019.01.008>
- Treiblmaier, H., & Garaus, M. (2022). Using blockchain to signal quality in the food supply chain: The impact on consumer purchase intentions and the moderating effect of brand familiarity. *International Journal of Information Management*, xxxx, 102514. <https://doi.org/10.1016/j.ijinfomgt.2022.102514>
- Wassermann, T. (2020). *Blockchain Technology in the Agri-Food Supply Chain: A SWOT Analysis based on Expert Interviews in Austria*. Master Thesis. University of Natural Resources and Life Sciences, Vienna.

# How digitally competent do German farmers think they are?

Sara Anna Pfaff and Michael Paulus<sup>1</sup>

**Abstract - The progressive digitalisation of agriculture has resulted in new demands on farmers' skills, which is a future challenge for the entire agricultural value chain. So far, relatively few studies have examined the digital competence of farmers in Germany. In order to support the successful on-farm implementation of digital technologies, it is fundamental to better understand farmer's capabilities regarding the use of digital technologies. We surveyed farmers from Baden-Württemberg using an online survey in 2021. 302 farmers took part and provided insight into their digital skills. The results show that farmers see themselves as advanced to professional users in different skill areas, even in more complex skills such as combining different data sources for long-term farm action decisions.**

## INTRODUCTION

The range of digital technologies is increasing constantly. In the same way, the acceptance of digital technologies by farmers in southern Germany is growing as well (Gabriel et al. 2021). Moreover, the increased use of digital technologies may imply shifts in farming skills and labour. So far, research has focused on the potential competence demands and shifts for the workforce along the agricultural value chain (Erickson et al. 2018). Additionally, this applies to farmers as end-users of digital technologies too (Goller et al. 2021). A lack of digital competences can cause social challenges for the farmers in their access to work (Rotz et al. 2019). However, it is still unknown what the level of digital competence in agricultural practice looks like, particularly in Baden-Württemberg. To realize the potential of digital agriculture, having digital competences is necessary to make full use of the benefits of digitalisation (Higgins et al. 2017). The present study contributes to better understanding the implications of digitalisation on farmers' knowledge. Therefore, we have investigated technical and methodological digital competence of farmers in Baden-Württemberg (STALA 2021) as an example for a small-scaled farming system. We have done this by addressing the following research question: Which (self-assessed) digital (technical-methodical) competence level do farmers in Baden-Württemberg have?

## MATERIAL AND METHODS

We collected the data between March and June 2021 by using the online tool Limesurvey based on a convenience sampling procedure. We used two different dissemination strategies. Firstly, the Ministry of Rural Areas and Consumer Protection (MLR) sent an information flyer to all 39.085 (STALA 2021) farmers in Baden-Württemberg. Secondly, we encouraged farmers to participate by advertising in

several publications in agricultural media, by contacting farmers through public mailing lists and agricultural organizations. 749 farmers participated and after we cleansed the dataset from incomplete and inconsistent questionnaires, the sample included 302 participants from Baden-Württemberg. 86% of farmers are male, 14% female, and the average age of farmers is between 40 and 49. When further interpreting the results it needs to be taken into account that the sample is not representative for Baden-Württemberg (STALA 2021) due to the dissemination strategies. It is also possible that self-sampling bias may play a role in the farmers' self-assessments. To investigate farmers' competence situation, the items presented in Table 1 were used. The competences were measured on 3-point scale (1=Professional (Full consent), 2=Advanced (Partial consent), 3=Beginner-no experience (No consent)). The level of competence thus differed between no experience at all to a moderate to high level of experience.

**Table 1.** Surveyed competences (C1-7)

C <sub>x</sub>	Likert Scale Item
C <sub>1</sub>	I can operate IT devices, my smartphone or a tablet so that I can use the essential functions confidently.
C <sub>2</sub>	I use digital data sources as a decision-making tool for my business.
C <sub>3</sub>	I can independently solve technical malfunctions of digital technologies.
C <sub>4</sub>	I can combine different information from digital data sources and use it for decisions in practice in order to work more efficiently and sustainably in the long term.
C <sub>5</sub>	I can manage and protect my data and can determine who uses it.
C <sub>6</sub>	I can inform myself digitally, educate myself effectively and critically evaluate my sources.
C <sub>7</sub>	I can independently create an application map using different data sets (e.g. yield or soil maps).

Based on the surveyed self-assessment of competences, we created a competence index for each farmer using a weighted additive index (Schnell et al. 2014). According to this the index ranges between 5.28 and 15.84. It is assumed that a farmer with a low index value (min. 5.28) is more competent than one with a high index value (max. 15.84). Within this value range, the three competence levels are as follows: Beginner-no experience (B): 12,32-15,84, Advanced (A): 8,8-12,32 and Professional (P): 5,28-8,8.

## RESULTS AND DISCUSSION

72% of the surveyed farmers use at least one digital technology. Moreover, we see clear tendencies regarding the self-assessment of technical-

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methodical digital competences: It is evident that the number of farmers who see themselves in the professional and advanced group predominate, see Figure 1. It is striking that the proportions of professionals are particularly high in the area of more basic skills such as C1 and C6. In this context, 118 farmers state that they can professionally use digital data sources as a decision-making aid (C2) while 134 classified themselves as more advanced in this respect. This is also true for the advanced group. Almost 166 farmers are able to independently solve technical malfunctions (C3). In addition, 155 state that they can partly merge different data sources and use them for long-term decision-making (C4). Regarding the ability to create application maps out of different sources, farmers support the assessments above (C7).

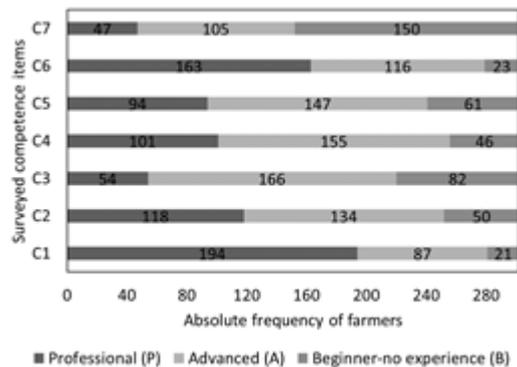


Figure 1. Digital competences of 302 surveyed farmers. The competence index supports our perception above of this digitally competent sample, see Figure 2. 50% of the farmers are advanced and 31.5% professional in technical-methodical digital handling. On average, the competence index is  $10.03 \pm SD 2.63$ , so in the advanced range.

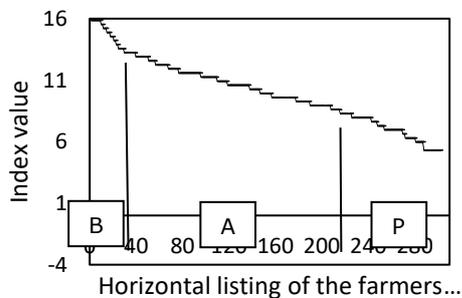


Figure 2. Digital competence index of 302 surveyed farmers. Contrary to Rotz et al. (2019) and Goller et al. (2021), the farmers in our sample assess themselves as rather digitally competent and therefore seem to be prepared for the increasing demands. This advanced level of competence lays a solid foundation for farmers in Baden-Württemberg to participate in further digital progress. It is noteworthy that we cannot exclude farmers' own overestimations. Furthermore, we notice that non-digital farmers were possibly unable to participate in an online survey, which is why their support cannot be taken into account now. In future, however, the level of competence of all users should be examined in more detail by also covering more aspects related to the use of digital technologies.

## CONCLUSION

The results suggest that the farmers surveyed in Baden-Württemberg largely classify themselves as advanced and professional. Moreover, they seem to consider themselves to be well prepared for further development in the agricultural digital future. However, we should consider that the data set is not representative and we need further research to investigate the digital competence on the farms. Nevertheless, this study allows initial insights into the actual situation and the farmer's self-perception.

## FUNDING

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## REFERENCES

- Erickson, Bruce; Fausti, Scott; Clay, David; Clay, Sharon (2018): Knowledge, Skills, and Abilities in the Precision Agriculture Workforce: An Industry Survey. In: *Natural Sciences Education* 47 (1), S. 180010. DOI: 10.4195/nse2018.04.0010.
- Gabriel, Andreas; Gandorfer, Markus; Spykman, Olivia (2021): Nutzung und Hemmnisse digitaler Technologien in der Landwirtschaft. Sichtweisen aus der Praxis und in den Fachmedien. In: *Berichte über Landwirtschaft - Zeitschrift für Agrarpolitik und Landwirtschaft* 99 (1), S. 1-27. DOI: 10.12767/buel.v99i1.328.
- Goller, Michael; Caruso, Carina; Harteis, Christian (2021): Digitalisation in Agriculture: Knowledge and Learning Requirements of German Dairy Farmers. In: *International Journal for Research in Vocational Education and Training* 8 (2), S. 208-223. DOI: 10.13152/IJRVET.8.2.4.
- Higgins, Vaughan; Bryant, Melanie; Howell, Andrea; Battersby, Jane (2017): Ordering adoption: Materiality, knowledge and farmer engagement with precision agriculture technologies. In: *Journal of Rural Studies* 55, S. 193-202. DOI: 10.1016/j.jrurstud.2017.08.011.
- Rotz, Sarah; Duncan, Emily; Small, Matthew; Botschner, Janos; Dara, Rozita; Mosby, Ian; Reed, Mark; Fraser, Evan D.G. (2019): The Politics of Digital Agricultural Technologies: A Preliminary Review. In: *Sociologia Ruralis* 59 (2), S. 203-229. DOI: 10.1111/soru.12233.
- Schnell, Rainer; Hill, Paul B.; Esser, Elke (2014): *Methoden der empirischen Sozialforschung*. 10. Aufl. München: Oldenbourg
- Statistisches Landesamt Baden-Württemberg (STALA) (2021): *Landwirtschaftszählung 2020 in Baden-Württemberg*. In: [https://www.statistik-bw.de/Service/Veroeff/Statistische\\_Daten/221121001.bs](https://www.statistik-bw.de/Service/Veroeff/Statistische_Daten/221121001.bs), retrieved April 21, 2022

# On the Use of Smartphones, Tablets and Drones in German Forestry

Marius Michels, Hendrik Wever and Oliver Musshoff<sup>1</sup>

**Abstract** – Although the use of digital tools such as smartphones, tablets, and drones is expected to have many benefits for forestry, no study has yet evaluated the use of such tools. Hence, this study investigates the use of smartphones, tablets and drones in German forestry. For this purpose, 215 German foresters were surveyed from December 2021 to February 2022. Descriptive data on the use of smartphones, tablets and drones was collected. Furthermore, an extended Technology Acceptance Model (TAM) was estimated to analyze factors influencing foresters' intention to use drones. Despite the proclaimed benefits of digital technologies, not all foresters use a smartphone and/or tablet. Likewise, only a small percentage of foresters use a drone. The TAM explains 44 % of the variation in the intention to use a drone of which perceived usefulness for forest management purposes is the strongest predictor. The results are of interest for policy makers, extension services as well as foresters.

## INTRODUCTION

Although the use of digital tools such as smartphones and drones is expected to have many benefits for forestry (Tomastik et al., 2017, Tang and Shao, 2015), no study has yet investigated the use of such tools. Hence, the aim of the study is to capture the current state of digitization in forestry. The study explicitly focuses on the use of smartphones, tablets and related apps as well as the use of drones. Furthermore, factors influencing the decision to use drones will be investigated within the framework of an extended Technology Acceptance Model (TAM) as proposed by Davis (1989). To the best of the authors' knowledge, this is the first study to address the digitization of forestry from a user perspective with regard to smartphones, tablets and drones.

## THEORETICAL FRAMEWORK

To investigate factors influencing foresters' intentions to adopt drones, the TAM proposed by Davis (1989) was applied and extended. The TAM postulates that an individual's intention to use a technology (*INT*) is determined by the perceived ease of use (*PEOU*) and perceived usefulness (*PU*). Furthermore, the *INT* influences the actual adoption. *PEOU* refers to the degree an individual perceives using a technology as effortless. *PU* is defined as the degree to which an individual perceives that a technology is useful for his or her job performance. Both latent constructs (*PEOU* and *PU*) affect an individuals' *INT*. Furthermore, *PEOU* also affects *PU* since the easier a technology is to use, *ceteris paribus*, the higher the *PU* would be (Davis, 1989). The model was extended by adding the latent construct of perceived ecological benefits (*PEB*) and

adapting the *PU* to the construct perceived usefulness for forest management purposes (*PUFM*), as drones can be used to monitor the health status of the forest stand and accordingly make better management decisions. The derived hypotheses are displayed in Figure 1.

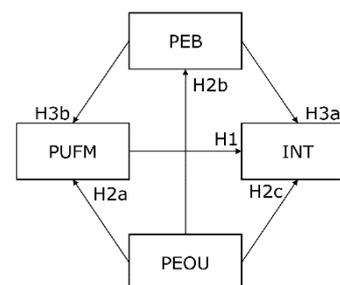


Figure 6. Proposed TAM for the intention to adopt drones in German forestry. H = Hypothesis, PEOU = Perceived Ease of Use, INT = Intention to Use a Technology, PEB = Perceived Ecological Benefit, PUFM = Perceived Usefulness for Forest Management Purposes.

## MATERIAL AND METHODS

An online survey dedicated to German foresters was conducted between December 2021 and February 2022. Foresters were invited to participate by e-mail notifications from professional forestry associations in Germany. The survey was divided into three parts. In the first part, the foresters were asked to provide socio-demographic and forest business-related information. In the second part, foresters were asked if they use a smartphone and/or tablet. Foresters who use a smartphone and/or tablet were asked if they use apps for forestry purposes and, if yes, which types of apps they use. Likewise, foresters were asked if they use a drone and, if yes, for which purpose. In the third part, foresters were asked to evaluate statements to estimate the proposed TAM (Figure 1) on a 5-point Likert scale (1 = strong disagreement; 5 = strong agreement). Before that, foresters who had not heard of the use of drones in forestry received an explanatory text. The TAM is estimated using partial least squares structural equation modelling (PLS-SEM) (Hair et al., 2021).

## RESULTS, DISCUSSION AND CONCLUSIONS

### Descriptive Results

244 fully completed questionnaires were collected, of which 29 were deleted due to unclear answers, resulting in 215 usable records. The average forester in the sample is 48 years old and 47% hold a technical or university degree. 13% of the participants are female. Based on a 11-point scale (0 = risk averse,

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10 = risk seeking) (Dohmen et al., 2011), the average forester in the sample is slightly risk-averse (mean = 4.89). Also based on a 11-point scale (0 = not innovative; 10 = highly innovative), the average foresters can be described as innovative (mean = 7.07). The average forest area in the sample is 10,594 ha. 39% of the participants are also the owners, whereas the rest have indicated that they are employed. 69% of the foresters own a smartphone, of which 62% also use apps related to forestry. A tablet is owned by 43% of the foresters, of which 72% use apps related to forestry. 84% had heard of the use of drones in forestry prior to the survey. A drone is currently used by 10% of the foresters in the sample. Furthermore 6% of the participants indicated that they had already used a drone for forestry purposes in the past. Drone users primarily use drones to inspect tree stands (62%), document storm damage (62%), and determine infestations of pests (43%). They see the advantages of drone use primarily as faster and more accurate data collection (62%) and the ability to respond in a timely manner to calamities such as storm damage (66%). For non-users, arguments against the use of drones include price (48%), lack of technical knowledge in the forestry operation (43%), and lack of technical infrastructure in the forestry operation (52%).

#### Estimation results

Models estimated using PLS-SEM are evaluated in two steps. In the first step, indicator loadings ( $\lambda$ ), internal consistency via composite reliability (CR), convergent validity via average variance extracted (AVE) and discriminant validity via Heterotrait-Monotrait (HTMT) ratios are assessed. Values for  $\lambda$  and CR should be above 0.7. The value for AVE should exceed 0.5, while HTMT ratios should not exceed 0.9 (Hair et al., 2021). The lowest values for  $\lambda$  and CR in the model are 0.746 and 0.885, respectively. 0.620 is the lowest value estimated for AVE. The highest HTMT ratio amounts to 0.723. To conclude, all quality criteria of the first step are met.

In the second step, the relationship between the constructs as displayed in Figure 1 is evaluated by estimating path coefficients ( $\beta$ ) and t-statistics using a bootstrapping procedure with 10,000 subsamples. Furthermore, explained variance ( $R^2$ ) is estimated. Table 1 shows the estimation results for the TAM via PLS-SEM. The model explains 44% of the variation in foresters' intention to adopt a drone. Hence, the results indicate that the proposed TAM is able to capture a large amount of latent information in the adoption process.

As Table 1 indicates, all hypotheses in the model are supported except H3a (PEB  $\rightarrow$  INT). The results show that both the perception that drones or the data collected by drones are useful for forest management decisions and the PEOU have a statistically significant effect on the INT to use a drone. Furthermore, PEOU has a statistically significant impact on PUFM and PEB. In order to promote the use of drones in forestry, extension services and providers of drones should focus on effective communication of the benefits in terms of decision support for management decisions. Likewise, handling of drones and data collected by the

drones for forest purposes should be kept as simple as possible for ease of use.

**Table 1.** Estimation results of the TAM (N=215) <sup>a</sup>

Path	H	$\beta$	t <sup>b</sup>	p-value
PUFM $\rightarrow$ INT	H1	0.451	6.598	<0.001
PEOU $\rightarrow$ PUFM	H2a	0.478	9.454	<0.001
PEOU $\rightarrow$ PEB	H2b	0.244	3.644	<0.001
PEOU $\rightarrow$ INT	H2c	0.281	4.698	<0.001
PEB $\rightarrow$ INT	H3a	0.025	0.399	0.690
PEB $\rightarrow$ PUFM	H3b	0.348	6.598	<0.001

<sup>a</sup> H = Hypothesis, PEOU = Perceived Ease of Use, INT = Intention to Use a Technology, PEB = Perceived Ecological Benefit, PUFM = Perceived Usefulness for Forest Management Purposes

<sup>b</sup> Bootstrapping results with 10,000 subsamples.

$R^2$ (INT) = 0.439;  $R^2$ (PEB) = 0.059;  $R^2$ (PUFM) = 0.431

The current study is focused on the intention to adopt drones. For future research, it could be of interest to investigate foresters' willingness to pay for drone services. Furthermore, this study is based on the TAM by Davis (1989). To further investigate the adoption decision, more sophisticated social-psychological theories should be applied.

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#### REFERENCES

- Davis, F.D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly* 13(3):319-340.
- Dohmen, T., Falk, A., Huffman, D., Sunde, U., Schupp, J. and Wagner, G. G. (2011). Individual risk attitudes: Measurement, determinants, and behavioral consequences. *Journal of the European Economic Association* 9(3):522-550.
- Hair, J.F., Hult, G.T.M., Ringle, C.M. and Sarstedt, M. (2021). A primer on partial least squares structural equation modeling (PLS-SEM), 3rd ed. Thousand Oaks: Sage publications.
- Tomaščík Jr, J., Tomaščík Sr, J., Saloň, Š. and Piroh, R. (2017). Horizontal accuracy and applicability of smartphone GNSS positioning in forests. *Forestry: An International Journal of Forest Research* 90(2):187-198.
- Tang, L. and Shao, G. (2015). Drone remote sensing for forestry research and practices. *Journal of Forestry Research* 26(4):791-797.

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

Michael Paulus, Andrea Knierim and Sara Pfaff<sup>1</sup>

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

## INTRODUCTION

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

## MATERIAL AND METHODS

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

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

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

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

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

## RESULTS

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

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

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

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

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

#### DISCUSSION

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

#### CONCLUSION

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

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#### REFERENCES

- Ammann, J., El Benni, N. (2022). Digitale Technologien in der landwirtschaftlichen Ausbildung. URL: <https://ira.agroscope.ch/de-CH/publication/48880> (20.04.2022).
- Beinert, M. (2017). Fachliche, methodische und persönlich-soziale Anforderungen an landwirtschaftliche Arbeitskräfte vor dem Hintergrund der zunehmenden Technisierung und Digitalisierung in der Landwirtschaft. *Schriftenreihe der Rentenbank* 33: 7-42.
- Birner, R., Daum, T., Pray, C. (2021). Who drives the digital revolution in agriculture? A review of supply-side trends, players and challenges. *Applied Economic Perspectives and Policy* 43(4): 1260-1285.
- Bundesministerium für Ernährung und Landwirtschaft (BMEL) (2020). Arbeitsmarkt Landwirtschaft in Deutschland. URL: <https://www.bildungserveragrار.de/fileadmin/Redaktion/Bildungswege/studie-arbeitsmarkt-landwirtschaft-in-deutschland.pdf> (04.04.2022).
- Kitchen, N.R., Snyder, C.J., Franzen, D.W., Wiebold, W.J. (2002). Educational Needs of Precision Agriculture. *Precision Agric* 3(3): 341 – 351.
- Klerkx, L., Jakku, E., Labarthe, P. (2019). A review of social science on digital agriculture, smart farming and agriculture 4.0: New contributions and a future research agenda. *NJA – Wageningen Journal of Life Sciences* 90-91: 100315.
- Lowenberg-DeBoer, J., Erickson, B. (2019). Setting the Record straight on Precision Agriculture Adoption. *Agronomy Journal* 111(4):1552-1569.
- Mayring, P. (2015). Qualitative Inhaltsanalyse. Grundlagen und Techniken, 12., überarb. Auflage, Weinheim und Basel: Beltz.
- Wolfert, S., Ge, L., Verdouw, C., Bogaardt, M.-J. (2017). Big Data in Smart Farming – A review. *Agricultural Systems* 153: 69-80.

# PARALLEL SESSION 13

# CLIMATE CHANGE



# Farm-level adaptation to climate change

Julian Zeilinger, Andreas Niedermayr and Jochen Kantelhard<sup>1</sup>

**Abstract - Adaptation of agriculture to climate change (CC) is a main goal within the European Union (EU). Therefore, it is crucial to assess the effectiveness of specific farm-level measures. This paper explores the CC adaptation of Austrian farms in arable regions, taking advantage of detailed information on soil conservation practice adoption. By employing an endogenous switching regression model (ESRM) for panel data we investigate the farm-level implementation of CC adaptation and its economic effect. Preliminary regression results suggest a significant effect of climatic conditions on the adoption of soil conservation.**

## INTRODUCTION

Agriculture is going to be strongly influenced by increasing temperature and shifts in precipitation patterns, making it one of the most vulnerable economic sectors to CC in Europe. Consequently, the EU underlines the importance of mitigating its impacts. A key strategy to enhance the CC resilience of agriculture is farm-level implementation of specific CC adaptation measures. One example constitutes soil conservation (e.g. cover crops or reduced tillage), which aims to increase the moisture retention and subsequently yield (stability). This research investigates whether such farm-level CC adaptation decision is indeed economically effective for farms in Austrian arable regions – e.g. allowing them to better adapt to long-term and short-term (e.g. weather extremes) changes associated with CC.

## METHODOLOGY

Implementing farm-level CC adaptation is voluntary, which means that adopters may systematically differ from non-adopters and cannot be seen as a random sample of the farm population. Unobservable characteristics of farms may affect both the CC adaptation decision and agricultural outcomes (Di Falco et al, 2011). A naive comparison of the two groups will thus most likely bias the effect of CC adaptation. To deal with this issue, Murtazashvili and Wooldridge (2016) developed an ESRM for panel data. The two-step model combines the Mundlak-Chamberlain approach to heterogeneity with the control function approach, which we follow hereafter. Firstly, we model the selection variable using a correlated random effect (CRE) Probit model. The selection variable indicates the adoption of CC adaptation, which in our case consists of cover crops and low-impact tillage (i.e. soil conservation). We assume that the decision to adapt is represented by a dichotomous choice model, where the implementation depends on the expected utility of CC adaptation:

$$Pr(Adapt_{it} = 1 | z_{it}) \quad (1)$$

where  $z_{it}$  denotes meteorological conditions (e.g. climate) as well as farm characteristics. These variables are later introduced in the outcome equation too, which is why two-step models have been criticized for potential misspecification due to multi-collinearity. In line with previous studies (Di Falco et al., 2011), we account for this by adding a set of selection instruments solely to the selection equation, affecting the decision to employ CC adaptation but not the outcome. Further, the Mundlak (1978) device ( $z_i$ ) is included, which represents the mean of each time-varying exogenous variable. This is done to control for unobservable characteristics and aims to substitute fixed-effects in nonlinear models. Finally,  $\alpha$  and  $\nu$  denote a time-trend and dummies for regions, respectively. In the second step, we estimate the relationship between the agricultural outcome and the control variables from the selection equation using an OLS estimator. We follow Murtazashvili and Wooldridge (2016) by including the generalized residuals from the Probit model to this outcome equation, in order to account for the endogeneity of the selection variable:

$$y_{it} = \beta_{00} + x_{it}\beta_{01} + \gamma_{10}Adapt_{it} + x_{it} * Adapt_{it}\gamma_{11} + \frac{z_i\boldsymbol{\rho}_0 + z_i * Adapt_{it}\boldsymbol{\rho}_1}{\xi_0\widehat{h}_{it} + \xi_1\widehat{h}_{it} * Adapt_{it}} + \delta_1\alpha + \delta_2\nu + \quad (2)$$

where  $y_{it}$  is the net revenue per hectare of farm  $i$  in year  $t$  and  $x_{it}$  represents a vector of all meteorological and farm variables. Further,  $x_{it}$  is interacted with the selection variable  $Adapt_{it}$ , where  $\gamma_{11}$  denotes the difference between the coefficients of  $x_{it}$  (i.e.  $\beta_{11} - \beta_{01}$ ) in the two regimes (Auci et al., 2021). In addition, the Mundlak device ( $z_i$ ) and the generalized residuals ( $\widehat{h}_{it}$ ) from the Probit model as well as their interaction with the selection variable are included. Using the coefficients of Equation (2), it is possible to denote the treatment effect on the treated (TT) farms (Heckman and 2001). Therefore, the difference between the expected net revenues for those farms that actually implemented the CC adaptation measure and the counterfactual outcome if farms with CC adaptation had decided not to adopt is:

$$TT = E \left( y_{it}^{(1)} \middle| Adapt_{it} = 1 \right) - E \left( y_{it}^{(0)} \middle| Adapt_{it} = 1 \right) \quad (3)$$

This represents the effect of CC adaptation (i.e. soil conservation) on the net revenues of adapted farms.

## DATA

Our calculations are based on an unbalanced panel of individual farms in Austrian arable regions between 2003 and 2016. Data on soil conservation practices is

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obtained from the Integrated Administration and Control System (IACS), which entails information on participation in the Austrian Agri-environmental Programme (ÖPUL). In particular, we account for the measures 'greening of arable land' (i.e. cover crops) and 'direct seeding and seeding on mulch'. Financial indicators, other characteristics and topographic information of individual farms are derived from the Austrian Farm Accountancy Data Network (FADN) data. Net revenue is calculated as the difference between revenues and costs in Euros per hectare. Further, we correct farm profits and subsidies using agricultural price indices from 'Statistics Austria'. Information on daily temperature and precipitation come from the 'Central Institute for Meteorology and Geodynamic' (ZAMG) at a resolution of 1x1km<sup>2</sup>.

#### PRELIMINARY RESULTS

Based on our assertion that farms employing CC adaptation (i.e. soil conservation practices) and those who do not differ systematically, we first explore observable characteristic of both groups in Table 1. Farms with CC adaptation show both, higher net revenues and subsidies. Further, it is visible that adopting farms cultivate more area with a higher share of arable land. These variables might indicate that soil conservation practices are primarily implemented by larger arable farms. This is reinforced when considering topographical and plot-level information, which indicate flatter land with higher soil quality. Corresponding to existing studies, we also find higher temperatures and less precipitation for farms with CC adaptation (Teklewold and Mekonnen, 2017; Auci and Pronti, 2020).

**Table 1.** Descriptive statistics based on soil conservation.

	CC adaptation=1	CC adaptation=0
Farms	547	819
Net revenues (€/ha)	858.97 (559.89)	727.98 (655.67)
Subsidies (€/ha)	442.53 (113.86)	405.54 (149.46)
Farm area (ha)	50.21 (27.03)	33.84 (22.36)
Arable share (%)	78 (18)	45 (24)
Livestock (LU/ha)	0.75 (0.67)	0.89 (0.53)
Tractor (kw/100ha)	182.7 (71.1)	143.4 (61.0)
Education (1-4)*	3.41 (0.84)	2.96 (1.03)
Age (year born)	1962.1 (8.8)	1961.5 (10.0)
Altitude (m)	6.00 (3.87)	9.89 (6.03)
Slope (°)	357.2 (127.3)	484.1 (160.6)
Soil quality (0-100)*	52.37 (17.89)	32.21 (15.87)
Temp <sub>20</sub> <sup>a</sup> (°C)	14.37 (0.88)	13.72 (1.11)
Temp <sub>Dev</sub> <sup>b</sup> (°C)	0.51 (0.13)	0.46 (0.16)
Prec <sub>20</sub> <sup>a</sup> (mm/month)	78.8 (14.6)	86.8 (14.3)
Prec <sub>Dev</sub> <sup>b</sup> (mm/month)	0.7 (4.9)	-0.3 (6.1)

<sup>a</sup>20: 20-year moving average of weather (i.e. climate); <sup>b</sup>Dev: Deviation of annual weather from climate; \*: Lowest value on the left; Standard deviation in parentheses.

Regarding the econometric analysis, we are currently developing a suitable set of variables explaining the implementation of CC adaptation. Based on previous literature (e.g. Hynes and Garvey, 2009; Auci and Pronti, 2020) we mainly focus on farmer, farm and topographic variables, resembling some of the characteristics in Table 1. Further, preliminary results of the CRE Probit model suggest that climatic conditions have a significant effect on the adoption of soil conservation, reinforcing our expectations and previous literature (Teklewold and Mekonnen, 2017).

#### DISCUSSION AND OUTLOOK

Based on the comparison of key characteristics between adopters and non-adopters, we conclude that self-selection bias cannot be excluded and an ESRM has to be conducted. Therefore, our next step entails final specification of the CRE Probit model to uncover drivers and barriers of farm-level CC adaptation. Yet, the choice of selection instruments is not straightforward. While employing a large panel over several years allows us to capture adaptation induced by CC, it does not contain intrinsic characteristics of farmers (e.g. sustainable farming or CC awareness). A potential strategy includes employing proxies by accounting for ÖPUL participation (i.e. sustainable farming) and climate variability (i.e. experience of CC), respectively. First simple falsification tests indicate the validity of these instruments. In a final step, we aim to isolate the direct economic effects of soil conservation, in order to assess how CC adaptation affects the competitiveness of farms.

#### REFERENCES

- Auci, S., Barbieri, N., Coromaldi, M. & Michetti, M. (2021). Climate variability, innovation and firm performance: evidence from the European agricultural sector. *European Review of Agricultural Economics* 48(5):1074-1108.
- Auci, S. & Pronti, A. (2020). Innovation in Irrigation Technologies for Sustainable Agriculture. *Sustainability Environmental Economics and Dynamics Studies* 1220.
- Di Falco, S., Veronesi, M. & Yesuf, M. (2011). Does adaptation to climate change provide food security? A micro-perspective from Ethiopia. *American Journal of Agricultural Economics* 93(3):829-846.
- Heckman, J., Tobias, J. L. & Vytlačil, E. (2001). Four parameters of interest in the evaluation of social programs. *Southern Economic Journal* 68(2):210-223.
- Hynes, S. & Garvey, E. (2009). Modelling farmers' participation in an agri-environmental scheme using panel data: an application to the rural environment protection scheme in Ireland. *Journal of Agricultural Economics* 60(3):546-562.
- Mundlak, Y. (1978). On the pooling of time series and cross section data. *Econometrica: journal of the Econometric Society* 69-85.
- Murtazashvili, I. & Wooldridge, J. M. (2016). A control function approach to estimating switching regression models with endogenous explanatory variables and endogenous switching. *Journal of econometrics* 190(2):252-266.
- Teklewold, H. & Mekonnen, A. (2017). The tilling of land in a changing climate: Empirical evidence from the Nile Basin of Ethiopia. *Land Use Policy* 67:449-459.

# Peat soils from the farmers' perspective: integration, importance and implications in the context of climate change

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**Abstract - Adapting the management of peat soils to reduce greenhouse gas (GHG) emissions is one way in which farmers can contribute to sustainable food production. Yet, climate-friendly management changes might have major economic consequences for affected farmers. In order to assess these for farmers in Austria, our study investigates, for the first time, how farmers in Austria manage peat soils, how they are integrated into the farming systems and what they mean to the farmers. Therefore, a survey of 16 typical farms managing peat soils was conducted. Initial results show that although the management of peat soils poses challenges, the farms' productivity in terms of crop and fodder production largely depend on these areas. Peat soils are also of particular importance with regard to climate change, as they can buffer yield losses on other soils during dry periods.**

## INTRODUCTION

Reducing GHG emissions by adapting management of drained peat soils is one possibility for farmers to contribute to sustainable food production (Joosten et al. 2015). This is also a goal in the new CAP (EC 2019) as well as in Austria's recently published peatland strategy (BMLRT 2022).

Studies from Germany show, that such climate-friendly management alternatives can be associated with high income losses for farmers, which mainly depend on type and intensity of the management (Krimly et al. 2016, Schaller 2014). For the case of Austria, it is not yet known how farmers manage peat soils, how they integrate those soils into their farming systems and how important they are for them. Thus, the economic consequences of climate-friendly management options for farmers cannot be estimated.

Our study therefore aims at analysing how Austrian farmers manage and use peat soils, what role they play for the farms' productivity and what perspectives result from this, also for possible climate-friendly adaptations of management such as extensification or rewetting.

## DATA AND METHODS

Combining the digital soil map of Austria (BFW 2020) and IACS (Integrated Administration and Control System) data on farm level (BMLRT 2021), the structure and types of agricultural use on peat soils and their spatial distribution in Austria were identified. On this basis, three case study regions, representing typical context situations of peatland management in Austria, were selected. By means of

expert consultations, five to six typical farms managing peat soils were identified per region and interviewed personally using a structured questionnaire. The questionnaire included general questions describing the farm as well as specific questions on land use and animal husbandry. The importance of peat soils for the farmers was surveyed by asking them to express their agreement with certain statements on a four-point scale from "strongly disagree" to "strongly agree". Moreover, specifics and importance of peat soils, as well as farmers' attitudes towards possible measures (e.g. extensification or rewetting) for climate-friendly management options were surveyed.

In Flachgau (Salzburg) six dairy farms were interviewed. Their affectedness, i.e. the share of peat soils in their total utilized agricultural area (UAA), is between 46% and 82%. In the Klagenfurt Basin (Carinthia) the sample consists of two arable farms, two pig farms and one dairy farm with an affectedness between 25% and 79%. In the Rhine Valley (Vorarlberg) we interviewed three dairy farms as well as one suckler cow and one ewe farm, who have a share of peat soils from 36% to 86%.

## RESULTS

### *Integration of peat soils into farming systems*

Peat soils are fully integrated into the farming systems in Flachgau, but management and use of forage often differs from that of mineral soils. Four out of six farms manage peat soils partly more extensively. Two farmers state that they do not produce silage on peat soils due to their characteristics, but hay instead. Half of the farmers do not feed the forage from peat soils to dairy cows but rather to their offspring or dry cows.

In the Klagenfurt Basin, too, peat soils are fully integrated into the farming systems, but their management is not so clearly different from other soils. Only one farmer states that he does not cultivate grains and uses conservation tillage especially on peat soils. Although all farmers recognise differences in yields, trafficability and pressure from pests and diseases and adapt their management accordingly, they use the same crop rotation as on other soils.

As four out of the five farms in the Rhine Valley cultivate 80% or more peat soils, they are also fully integrated there. The farmer with only a smaller share of peat soils manages them more extensively and uses the forage only for the offspring. Probably

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because of the limited possibilities due to their high affectedness, other farmers hardly distinguish between peat soils and other soils.

#### *Importance of peat soils for farms*

The cultivated peat soils are of great economic importance for farmers. 13 out of 16 farmers fully agree with the statement, that the management of peat soils provides fodder and yields that they could not do without. 14 farmers agree at least partly, that peat soils contribute significantly to their farm income, but for most not because of the subsidies they receive from these areas but because of yields and fodder. In addition, all farmers at least partially agree, that peat soils are important to buffer losses on other soils in dry years.

Ten out of 15 farmers at least partly agree, that the management of peat soils is also done for traditional or emotional reasons. Only one farmer agrees, that cultivating peat soils is more of a burden.

Nine farmers fully agree with the statement, that they want to keep the landscape open and prevent scrub encroachment by managing peat soils. Twelve agree at least partly, that they also want to contribute to nature conservation on peat soils.

#### *Implications for future management of peat soils*

As mentioned, peat soils are important for farmers to buffer losses on other soils in dry years. Accordingly, when asked whether peat soils play a special role against the background of climate change, a large proportion of farmers said that they will become more important if dry periods become more frequent as a result of climate change. Two farmers in Carinthia even stated, that they would like to lease or buy more areas on peat soil, precisely for this reason. Most farmers are optimistic that peat soils will continue to be cultivable as until now, even if climate change with increasing drought but also heavy rainfall events may lead to challenges in cultivation.

Farmers were also asked whether they could imagine to implement climate-friendly management alternatives to reduce GHG emissions on their peat soils. Likely due to the full integration and great importance, also in relation to climate change, farmers can hardly imagine implementing measures.

#### DISCUSSION AND OUTLOOK

The results show that a dichotomy is emerging: farmers could help to reduce GHG emissions by adapting their management on peat soils. In the meantime, the cultivation of peat soils is an opportunity for them to buffer the impacts of climate change. And while abatement costs for GHG emissions on drained peat soils are comparatively low (Röder and Osterburg 2012), the economic consequences for farmers are likely to be extensive (Krimly et al. 2016, Schaller 2014). Such negative consequences for farmers are confirmed by our results, as similarly observed by Schaller (2014).

Our results are shaped significantly by the fact that the farms in our sample have an above-average proportion of peat soils in their total UAA. On average, farms with peat soils in Austria have a share of about 27% of them, whereas the average in our sample is about 62%. However, the majority of peat soils is

cultivated by farms with a high share of peat soils; thus, these types of farms are therefore particularly relevant.

The external circumstances specific to each region also have an influence on the farmers' perspective. While in the Rhine Valley the massive pressure on land limits the farmers' development opportunities, in Flachgau conflicts with nature conservation are an issue. In Carinthia, on the other hand, some farmers state that there is probably not even enough water available for the rewetting of peat soils. Overall, a complex picture emerges with regard to the management of peat soils in Austria. In order to improve our understanding and to be able to assess the consequences of possible climate-friendly management alternatives, the evaluation of the importance of peat soils in economic figures will be addressed next.

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#### REFERENCES

- BFW – Bundesforschungszentrum für Wald (2020). Digitale Bodenkarte (eBod). Provided by BMLRT.
- BMLRT – Bundesministerium für Landwirtschaft, Regionen und Tourismus (2022). Moorstrategie Österreich 2030+. Vienna: BMRLT.
- BMLRT – Bundesministerium für Landwirtschaft, Regionen und Tourismus (2021). IACS farm level data. Not published.
- EC – European Commission (2019). The Post-2020 Common Agricultural Policy: Environmental Benefits and Simplification.
- Joosten, H., Brust, K., Couwenberg, J. et al. (2015). MoorFutures – Integration of additional ecosystem services (including biodiversity) into carbon credits – standard, methodology and transferability to other regions. *BfN-Skripten* 407.
- Krimly, T., Angenendt, E., Bahrs, E., Dabbert, S. (2016). Global warming potential and abatement costs of different peatland management options: A case study for the Pre-Alpine Hill and Moorland in Germany. *Agricultural Systems* 145: 1-12.
- Röder, N., Osterburg, B. (2012). Reducing GHG emissions by abandoning agricultural land use on organic soils. Selected Paper for presentation at the *IAAE Triennial Conference*, Foz do Iguaçu, Brazil.
- Schaller, L. (2014). Landwirtschaftliche Nutzung von Moorflächen in Deutschland – Sozioökonomische Aspekte einer klimaschonenden Bewirtschaftung. Dissertation: Technische Universität München.

# Technology change and impact on GHG emissions on a dairy farm, farm level modelling approach

Jure Brečko<sup>1</sup> and Jaka Žgajnar<sup>2</sup>

**Abstract** - In this paper a farm model, enabling different analysis at the production plan level is presented. We focus on the influence of changes in manure storage and feeding technology on the environmental-economic impact, which is measured by greenhouse gas (GHG) emissions and selected economic indicators. The applied model is based on linear programming. The approach is presented on a medium-sized dairy farm. The results indicate that a farm can significantly reduce the environmental impact and total GHG emissions generated by livestock production on a farm by changing manure storage technology and feed production technology. These changes also have significant impact on the economic indicators. Results show that by optimizing feed ration and manure storage, farm could increase its gross margin by 14% and at the same time, decrease its total GHG emissions by up to 24%.

## INTRODUCTION

Farm-level modelling has become an important activity of agricultural economists because there is a growing need for data, models, and knowledge products that provide user-friendly data collection and analysis capability for decision makers at different levels (Antle et al., 2017). The farm-level model is primarily based on the growing demand and need for a microsimulation tool that can design and analyse various policies at the farm level to capture farm heterogeneity (Louhichi et al., 2015).

In addition, there is also a growing need to assess the environmental impacts generated by individual farms, as most policies aim to reduce GHG (greenhouse gas) emissions. These attempts are largely based on aggregate-level data without adequately accounting for farm heterogeneity. Recent attempts have been made to obtain also farm-level GHG data (Stetter and Sauer, 2022).

GHG emissions from agriculture account for about one-tenth (10.1% in 2019) of total GHG emissions in Slovenia and is the second largest sector after transport. The main source of GHG emissions in agriculture is methane (68.4%), which is produced during the fermentation of feed in the digestive tract of domestic animals, especially in the rumen of ruminants and during the storage of livestock manure (Verbič, 2021).

Assessing the diversity and typology of farms has become increasingly important. Farm typology is important both for effective agricultural policy planning and for discussion and support in finding appropriate solutions for the development of multifunctional and sustainable agricultural and rural areas. To date, numerous operational models based on different techniques have been developed to answer a variety of questions in agricultural systems (Ciaian et al., 2013). Various approaches have been used for this purpose. The most commonly used is mathematical programming (MP), including linear programming (LP). The nature and quality of the available data, as well as the scope of the research,

usually determine which approach is most appropriate for farm-level modelling.

Reidsma et al. (2018) point out that gross margin (GM) is the most commonly used economic indicator in agricultural analyses, while as environmental indicator GHG emissions are most commonly applied (Verbič, 2021).

## METHODOLOGY

The main objective of this study is to measure the impact of a change in ration structure, manure and harvesting technology on a dairy farm from the perspective of GHG emissions. GHG emissions is an indicator that shows the intensity of greenhouse gas emissions in livestock production, especially in dairy and beef production. It shows emissions of methane released from the gastrointestinal tract and from manure storage, and nitrogen oxides released from manure storage, grazing, and manure application by dairy cows (including indirect emissions). Methane and nitrous oxide are converted to carbon dioxide equivalents and expressed in kg per unit of milk/beef produced or in kg CO<sub>2</sub> equivalent per animal. The reduction in emission intensity is mainly due to improvements in dairy farming efficiency (higher milk yield, improved milk production, reproductive traits, etc.) and partly also due to improved farming practices (e.g., more pasture).

To this end, a farm model based on mathematical programming has been developed. It is an example of a spreadsheet model developed in Microsoft Excel and supported with VBA macros. The farm model is based on mathematical programming and enables the optimization of the production plan. The model allows the integration of different production activities (livestock, crop production and vegetable/fruit products), different production intensities and the modification of technological parameters. For the definition of technological coefficients of individual production activities, the farm model is supported by the system of model calculations developed by the Agricultural Institute of Slovenia (AIS, 2020). The basic set of constraints deals with the available production resources and describes the characteristics of the analysed farm. The basic set of constraints includes labour requirements, tillage area, crop rotation, conservation technologies for permanent grassland, nutrient and ration balance, and barn capacity (number of places for different categories of animals). The developed farm model consists of two main parts.

The first part consists of a set of simple static simulation models that calculate the economic and technical parameters for all production activities that could be included in the production plan. It creates technological cards for each of the production activities and calculates various economic indicators for different states of nature considering different production functions.

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The second part consist of a model based on linear programming (LP). The main purpose of this model is to find the optimal solution that provides the highest expected gross margin (EGM).

$$\mathbf{EGM}_f = \max\{\mathbf{X}_f \mathbf{EGM}_{A,f}\} \quad (1)$$

s.t.

$$\mathbf{X}_f \mathbf{TC}_f \leq \mathbf{R}_f \quad (2)$$

$$\mathbf{X}_f \geq \mathbf{0} \quad (3)$$

On this basis (1) to (3), the optimal production plan is determined, considering the price-cost ratio for the ten-year period (2011-2020). Where  $X_f$  is the decision vector of activities and  $EGM_f$  is the scalar of the expected maximum gross margin per farm.  $TC_f$  presents the matrix of technical coefficients for the production activities.

Analysed farm

For the purpose of this analysis a typical medium-sized dairy farm was selected. It was defined in the study Žgajnar et al. (2022), where you can also find more details. On the farm they breed 35 dairy cows, 9 breeding heifers and 12 bulls for fattening, also there are 15 ha of fields and 3 ha of meadows on a farm. On the fields corn, silage corn and clover-grass mixtures are grown. Grass silage, hay and pastures is produced on the permanent grassland. In different scenarios we tested adjustment to the management strategy, to show on the impact on farm GHG emissions by different planning approaches. In such a manner we analysed how GHG emissions change if the feed ration in a barn is based A) on grass and corn silage year-round and the technology for manure storage is slurry in lagoons, B) if dairy cows were only on pasture for half of the year and the technology in stalls was straw bedding and C) same technology as B with better milk yield produced as a result of improved feed ration.

**Table 1:** Animal activities, scenarios and indicators for the analysed farm

Animal activities	production	Scenario A	Scenario B	Scenario C
Dairy cows		35	35	35
Expected intensity (l/head)		6,200	6,200	7,000
Economic indicators		110,224	109,811	118,492
Total revenue (€)		61,207	58,566	62,554
Total variable costs		49,017	51,255	55,938
EGM (€)		12,0	12,5	13,3
EGM/h (€)				
Environmental indicators		236,523	197,092	202,134
GHG emissions (kg CO <sub>2</sub> eq)		0.81	0.62	0.57
GHG emissions/ l milk (kg CO <sub>2</sub> eq)				

## RESULTS

In the first part, we present the animal production activities, the expected intensity of dairy cows, and the economic and environmental indicators. In scenario A, the farm could obtain a total income of 110,224 €. It breeds 35 dairy cows, 9 heifers and 12 bulls. The feed is produced on grassland. In this scenario, the farm produces 236,523 kg CO<sub>2</sub> eq. and 0.81 kg CO<sub>2</sub> eq. per litter of milk produced. Scenario B shows the results if a farm were to change manure storage technology and its feed rations and keep the animals on pasture for half of the year. With this change in feed technology while maintaining milk yield at the same level, total revenue would remain at the same level, while variable costs would decrease for 4% and gross margin would increase by 5%

respectively. Results show significant GHG emissions decrease in this scenario B, 25% on a farm and 23% per l of milk (0.62). Scenario C shows results of a farm with higher milk yield achieved through better fodder. Farm could increase its gross margin up to 14%. While total GHG emissions would increase by only 3% compared to Scenario B, emissions per l of milk produced would be with 0.57 the lowest.

## CONCLUSIONS

In this paper, we present a farm model to analyze the production plan of a farm considering the impact of different feed ration technologies on GHG emissions. We present the results for a typical medium size dairy farm, as we were interested in seeing what happens to GHG emissions on a farm when feeding technology and the manure storage is changed. Based on the results, we can see that a change in feed ration would have an impact on the total GHG. While the optimization of farm`s potential and its feed ration would result in slightly higher variable costs. However, gross margin increase would be substantial, up to 14 %, while GHG per milk produced is even improved.

## REFERENCES

- AIS. 2020. *Model calculations. Agricultural Institute of Slovenia*  
[https://www.kis.si/Modelne\\_kalkulacije\\_OEK/](https://www.kis.si/Modelne_kalkulacije_OEK/)  
 [Accessed 5/4/2022]
- Antle, J.M., Jones, J.W., Rosenzweig, C. (2017). *Towards a new generation of agricultural system models, data, and knowledge products: introduction. Agricultural Systems*, 155: 186-190
- Ciaian, P., Espinosa, M., Paloma, S. G., Heckelei, T., Langrell, S., Louhichi, K., Sckokai, P., Thomas, A., & Vard, T. (2013). *Farm level modelling of CAP: A methodological overview. In: European Commission. JRC Scientific and Policy Report. EC: Seville, Spain.*
- Louhichi, K., Ciaian, P., Espinosa, M., Colen, L., Perni, A., Gomez y Paloma, S. (2015). *An EU-Wide Individual Farm Model for Common Agricultural Policy Analysis (IFM-CAP). JRC Scientific and policy reports. Luxembourg: Publications Office of the EU.*
- Reidsma P., Sander Janssen, Jacques Jansen, Martin K. van Ittersum. (2018). *On the development and use of farm models for policy impact assessment in the European Union – A review. Agricultural Systems. Volume 159, 111-125*
- Stetter, C., Sauer, J. (2022). *Greenhouse Gas Emissions and Eco-Performance at Farm Level: A Parametric Approach. Environmental and Resource Economics*. 81: 617–647
- Verbič J. (2021). *Zmanjšanje izpustov toplogrednih plinov in amonijaka na kmetijskih gospodarstvih (V4-1816). Zaključno poročilo o izvedbi raziskovalnega projekta ciljnega raziskovalnega programa »Zagotovimo.si hrano za jutri«. Ljubljana, Kmetijski inštitut Slovenije: 67 p. [in Slovene]*
- Žgajnar, J., Kavčič, S., Erjavec, E., Zagorc, B., Brečko, J., Moljk, B., Hiti, A., Jerič, D. (2022). *Razvoj modela za sistematično spremljanje ekonomskega položaja in analizo vpliva kmetijske politike na ravni tipičnih kmetijskih gospodarstev [poročilo]. [in Slovene]*

**PARALLEL SESSION 14**

**ANIMAL  
HUSBANDRY AND  
WELFARE II**



# Profitability of Swiss dairy farms according to different milking systems

Dierk Schmid<sup>1</sup>

**Abstract** – The choice of an investment in a milking system has a long-term influence on the labour organisation and cost structure of dairy farms. Based on farm-level survey data of the year 2020, the farm structure and economic performance between groups of farms with different milking systems are analysed for the Swiss plain region. Results show that farms with bucket or pipeline milking systems are smaller and achieve lower family farm income per family work unit than farms with milking parlours. Farmers' investments in automatic milking systems are more recent, occurring on farms with very large herds (58 dairy cows on average). High depreciation of investments in automatic milking equipment has a negative impact on their farm income.

## INTRODUCTION

Despite an above-average decline in the number of dairy farms since the early 2000s, dairy farming in Switzerland still plays an essential role in grassland use and the production of agricultural commodity for food production, accounting for around 40 % of all farms (Zorn 2020; Agristat, 2021).

The income of dairy farms, however, remains below average compared to other farm types (Hoop et. al, 2021). A large proportion of the working time in the production process of dairy farming is spent on milking. Today, the majority of farms in Switzerland still uses either bucket or pipeline milking systems or milking parlours. Only a small proportion of farms have so far opted for automatic milking systems (Heitkämper et. al., 2021).

An investment in a milking system is made for a long-term time horizon. Usually, it has a significant impact on costs and income. Therefore, the decision needs to be well considered and well planned. On the one hand, farm specific calculations are necessary. On the other hand, research results, e.g. model calculations on profitability (Gazzarin et al., 2014) can support the decision-making process. In the Swiss context however, there is a lack of empirical studies on the profitability of different milking systems. The present analysis aims to close this gap. It examines how farms differ in terms of structures, profitability and non-agricultural activities depending on their milking system.

## METHOD AND DATA

The data of the specialised dairy farms of the Farm Management Sample of the Swiss Farm Accountancy Data Network (Renner et al., 2019) are used as a basis, as well as their key figures on the existing milking system collected for the 2020 accounting year. 80% of these farms answered the supplementary survey on milking systems and, after a plausibility check and adjustment, data from 455 farms were available for the analysis. In the

questionnaire, we distinguished between bucket/pipeline milking system (BPMS), parlour (PMS) and automatic milking system (AMS). Differences in farm and farmers characteristics between these three groups were examined by non-parametrical group comparisons (Wilcoxon rank test, or Chi<sup>2</sup>). To minimise the influence of regional differences on the results, we limit the analysis to farms in the valley region.

## RESULTS

Table 1 presents the characteristics of the different milking system groups in terms of farm structure and profitability. With regard to the absolute **labour input**, the **age of the farm managers**, the farm groups do not differ. Significant differences between groups exist in farm size, both in terms of agricultural area and livestock. Farms with BPMS are the smallest farms, followed by farms with PMS. Farms with AMS are the largest.

The **stocking rate** (animals per utilised agricultural area) and the proportion of silage maize per UUA is higher on AMS and PMS farms than on BPMS farms. AMS farms manage the largest herds per labour input with about 36 **livestock units (LU) per annual work unit (AWU)**, followed by PMS farms with about 23 LU per AWU and farms with BPMS with about 17 LU per AWU.

With about 0.14 CHF/kg milk the use of **concentrate** per kg produced milk is on the same level for BPMS, PMS and AMS. The **milk yield** is higher on AMS farms with 8'800 kg/milk cow and year, than on parlour farms with 7'900 kg/milk cow and year or 7'500 kg/milk cow and year on farms with BPMS.

The main results of the **monetary outputs and inputs** per farm size (dairy cows or UUA) show no differences between the farm groups. However, the resulting key figures for agricultural income and labour earnings differ between farms with BPMS and farms with the other two milking systems. The higher depreciation of investments is remarkable for the AMS farms, whereby the date of investment in the milking system is more recent than for the other two groups. If we try to standardise the (monetary) state of the investments by taking these higher depreciations for fixed installations of around CHF 20'000 into account, the farms with AMS achieve a significantly higher family farm income per family work unit. However, if we relate family farm income to the produced milk, the AMS farms have lower family farm income per kg produced milk than the farms with BPMS and PMS.

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**Table 1.** Characteristics of the three milking system groups in terms of farm structure and profitability (average) in 2020 in the plain Region.

Milking system	BPMS	PMS	AMS
Farms [n]	44	86	15
<b>Farm structure</b>			
Farming system Bio [%]	14	7	0
Year of investment in the milking system	1999 <sup>2,3</sup>	2004 <sup>1,3</sup>	2016 <sup>1,2</sup>
Unpaid (family) labour input [FWU]	1.6	1.53	1.66
Paid labour input [AWU]	0.46	0.75	0.42
Age farm manager	50	47	48
Utilized agricultural area (UAA) [ha]	26.54 <sup>2,3</sup>	30.23 <sup>1*</sup>	40.19 <sup>1</sup>
Silage maize [ha]	2.16 <sup>3</sup>	3.1 <sup>3</sup>	6.46 <sup>1,2</sup>
Total livestock units [LU]	34.74 <sup>2,3</sup>	51.69 <sup>1,3</sup>	74.19 <sup>1,2</sup>
Dairy cows [LU]	26.81 <sup>2,3</sup>	43.00 <sup>1,3</sup>	61.59 <sup>1,2</sup>
Animal stocking (LU/ ha)	1.31 <sup>2,3</sup>	1.71 <sup>1</sup>	1.85 <sup>1</sup>
Livestock per labour input (LU/AWU)	16.86 <sup>2,3</sup>	22.73 <sup>1,3</sup>	35.55 <sup>1,2</sup>
Milkyield [kg per cow & year]	7455 <sup>3</sup>	7899 <sup>3*</sup>	8845 <sup>1,2*</sup>
<b>Output/Input/Income</b>			
Output total per Dairy cow [CHF/GVE]	11'572	10'774	10'360
Output Livestock per Dairy cow [CHF/GVE]	6746	6909	6944
Output milk [CHF/GVE]	4674	5154	5293
Output direct payments per UAA [CHF/Ha]	2322	2404	2211
Input total [CHF] per Dairy cow	8727	8335	8321
Input concentrate per milkyield [CHF/kg]	0.14	0.13	0.15
Depreciation Fixed installations [CHF]	3'576 <sup>2,3</sup>	8'404 <sup>1,3</sup>	33'509 <sup>1,2</sup>
Variable input on total input [%]	39	41	45
Agricultural income [CHF]	76'270 <sup>2,3*</sup>	104'894 <sup>1</sup>	125'611 <sup>1*</sup>
Family farm income per family work unit [CHF/FWU]	47'758 <sup>2,3</sup>	68'740 <sup>1</sup>	75'572 <sup>1</sup>
Farms <sup>4</sup> [n]	204	203	19
Off farm income <sup>4</sup> [CHF]	19'461	21'210	11'323
Share of working days off farm in total working days <sup>4</sup> [%]	8	10	4

<sup>1</sup>Sign. different to BPMS, <sup>2</sup>Sign. different to PMS, <sup>3</sup>Sign. different to AMS. \*Level of significance < 0.05. <sup>4</sup> only available for individual farms, since key figures on non-agricultural activities are not collected for farm associations  
 31.12.2020: 1 Euro = 1.078 CHF

For the analysis of non-agricultural activities, we only use individual farms (i.e. did not consider farm associations), since key figures on non-agricultural activities are not collected for farm associations. In the case of individual farms, we do not observe that the proportion of working days for non-agricultural activities or the absolute figures for non-agricultural income are significantly different between the groups.

#### DISCUSSION

The present study was the first to analyse descriptively the differences between farms in terms of structure and profitability according to their milking system in Switzerland. BPMS and PMS are still the most common milking systems, with more farms in hill and mountain regions using BPMS. The clear differences in livestock per labour input highlight the

great gaps in physical labour productivity between these milking systems. The investment in a more modern milking system is often associated with an increase in farm size. Bigger farms have mostly higher family farm income per family work unit at higher intensities.

AMS tend not to be used on smaller farms in Switzerland. This is likely because these milking systems require a certain size in order to ensure economic profitability. The profitability gap between AMS versus non-AMS farms would be even bigger if we would account for the huge differences in terms of age of the milking system.

From the point of view of the farm manager's family, flexibility through AMS can economically only be achieved on larger farms and despite easing physical labour, these farms still have to cope with a heavy workload. The fact, that the labour efficiency gained with an AMS does not lead to a substitution of agricultural work with non-agricultural work or leisure time, is also related to this.

As the results presented are initial descriptive analyses, we intend our future research to investigate causal effects of the milking system on farm economic performance.

#### REFERENCES

- Gazzarin, C. and Nydegger, F. (2014). *How profitable are robots? Costs and benefits of automated devices in dairy-cow husbandry*. Agroscope Transfer (3). Agroscope, Ettenhausen.
- Heitkämper, K., Mielewicz, M., Bozzolini, G., Groher, T., Umstätter, C. (2021). *Stand der Mechanisierung in der Schweizer Landwirtschaft Teil 2: Tier-haltung*. Agroscope Transfer Nr. 352. Agroscope, Ettenhausen.
- Hoop, D., Schiltknecht, P., Dux-Bruggmann, D., Jan, P., Renner, S., Schmid, D. (2021). *Landwirtschaftliche Einkommensstatistik 2020*. Agroscope, Ettenhausen.
- Renner, S., Pierrick, J., Hoop, D., Schmid, D., Dux, D., Weber, A. and Lips, M. (2019). *Survey system of the Swiss Farm Accountancy Data Network with two samples: Income Situation sample and Farm Management Sample*. Agroscope Science (68).
- Agristat, (2021). *Milchstatistik 2020*. Hrsg. TSM, SMP, SCM, BO Milch, Agristat [https://www.sbv-usp.ch/fileadmin/user\\_upload/MISTA2020\\_def\\_onlin\\_e.pdf](https://www.sbv-usp.ch/fileadmin/user_upload/MISTA2020_def_onlin_e.pdf) (20.4.2022)
- Zorn, A. (2020). *Kennzahlen des Strukturwandels der Schweizer Landwirtschaft auf Basis einzelbetrieblicher Daten*. Agroscope Science 88: 1-58.

# The effect of husbandry system information on consumer willingness to pay for dairy products from cow-calf-contact systems

Lena Eitelberg, Silke Hüttel, Jeanette Klink-Lehmann and Reinhard Uehleke<sup>1</sup>

**Abstract – Demand for dairy products from organic and pasture-based husbandry is increasing and segments of consumers who reject certain practices in animal husbandry are growing. Previous studies explored consumer attitudes towards common practices in conventional dairy husbandry, but consumer willingness to pay (WTP) for avoiding contentious practices has not been established. We investigate WTP for dairy products from cow-calf-contact systems, which avoids the common practice of separating the calve from its mother shortly after birth. We compare the effectiveness of three communication strategies to affect consumption values and hypothetical WTP. We randomly assign 1600 participants to one of the three information treatments and a control group. Respondents then state their WTP for dairy products from cow-calf-contact systems in a contingent valuation scenario. The information treatments are expected to increase WTP via their influence on respondents' epistemic, social and emotional consumption values. Our study offers insights for marketers and policy makers to address consumer concerns on animal welfare and support the choice for animal welfare-oriented husbandry. The results also provide a foundation for exploring product- and target group-specific marketing and may guide profitability analysis of adopting cow-calf-contact systems.**

## INTRODUCTION

In Germany, food retailers are continuously increasing production standards for animal products with the goal to improve animal welfare. Demand for dairy products from organic and pasture-based husbandry systems is growing and reached 11.7% and 4.7%, respectively, in 2020 (MIV, 2021). Still, the dairy sector is subject to public requests to avoid certain production practices. A survey of German supermarket customers revealed that around half of the customers were aware of early cow-calf separation and around 70% of respondents rejected the practice with 25% being undecided (Placzek et al., 2020). A larger online survey found similar rates of rejection of this practice (Busch et al., 2017). The low public acceptance paired with growing evidence on improved calve growth, social competence and stress resilience after late separation (Meagher et al., 2019; Waiblinger et al., 2020) has led to a rising interest in cow-calf-contact (CCC) systems.

So far, consumer studies on the perception of CCC systems have focused on attitudes towards this husbandry system (e.g., Busch et al., 2017; Placzek et al., 2021; Sirovica et al., 2022). However, it remains unknown, whether the unfavorable attitude towards early separation translates into willingness to

pay (WTP) a price mark-up for dairy products from CCC systems to cover increased producer costs. To our knowledge, we are the first to investigate consumer WTP for dairy products from CCC systems.

Therefore, the aim of this study is to develop communication strategies based on the theory of consumption values (Sheth et al., 1991; van Riemsdijk et al., 2017) and test the effectiveness of these strategies for affecting the relevant consumption values and WTP. Since enhancing animal friendly consumption requires large shares of consumers to change their consumption habits, we further examine heterogeneity of responses to the communication strategies by personal values (Sivapalan et al., 2021).

## METHODS

The WTP for dairy products from CCC systems is retrieved using an online contingent valuation (CV) survey. We survey 1600 respondents and randomly assign them to one of four information treatments. The field time is planned for end of May 2022. The CV scenario briefly presents the CCC system (Figure 1).

Imagine that in your local supermarkets that you regularly visit, dairy products are offered for which the milk is obtained from the following alternative husbandry conditions:

Instead of separating the calves from their mothers, the so-called cow-calf-contact husbandry is practiced. In this system, the calves stay together with their mother cows for at least three months.

This husbandry system requires investments for adapting stable structures, changes in management, especially more labour input, and more space for the animals. Additionally, around half of the mother cow's milk cannot be sold as long as she feeds the calf. All this increases production costs for farmers.

Figure 1. Contingent valuation scenario - control treatment

The CV scenario is followed by a cheap talk and the payment vehicle is a circular payment card. We apply the budget approach as suggested by Nocella et al. (2010). This way respondents can indicate their WTP in terms of a mark-up on their regular spending for dairy products.

Respondents are randomly assigned to one of the four treatment groups: a control group and three information treatments that are designed to affect the epistemic, social and emotional consumption values, respectively. For example, the epistemic information

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treatment highlights the innovativeness of the CCC system and thus should increase the epistemic consumption value. The social information treatment highlights the large share of consumers that favour late separation in CCC systems. The emotional treatment highlights the possibility for cow and mother to interact with each other. The control group will receive neutral information about the dairy production system (Figure 1) instead of information tailored to the respective consumption values. The items to measure the respective consumption values are based on Sweeney and Soutar (2001) and Hur et al. (2012). The measures for the personal values are based on de Groot and Steg (2008).

#### RESULTS

We expect the information treatments to affect the respective consumption value and increase WTP. The WTP in the control treatment should be lower than in the information treatments. Comparing the WTP in the three information treatments, it is less clear which treatment yields the largest WTP. Since the cow-calve separation may trigger emotional responses, the emotional treatment could yield the highest WTP. We further may find that the effect of the strategy is moderated by personal values. For example, subjects with pronounced egoistic values may respond stronger to the social information treatment because they may perceive social power and wealth by consuming what others find desirable.

#### DISCUSSION

The comparison of different communication strategies enabled us to identify promising paths to transfer the negative attitude towards early cow-calve separation into willingness to pay price markups for husbandry systems that avoid this practice. This is relevant to the dairy value chain, since additional production costs must be covered when adopting CCC systems. The moderating effect of personal values for the effect of the information treatments opens up opportunities for individual consumer communication, possibly in connection with retailing of regional food products. (Schütz and Mergenthaler, 2019; Charton-Vachet et al., 2020).

#### REFERENCES

Busch, G., Weary, D.M., Spiller, A., Keyserlingk, M.A.G. (2017). American and German attitudes towards cow-calf separation on dairy farms. *PLoS one* 12(3).

Charton-Vachet, F., Lombart, C., Louis, D. (2020). Impact of attitude towards a region on purchase intention of regional products: the mediating effects of perceived value and preference. *Intl J of Retail & Distrib Mgt* 48(7):707–725.

de Groot, J.I.M., Steg, L. (2008). Value Orientations to Explain Beliefs Related to Environmental Significant Behavior. *Environment and Behavior* 40(3):330–354.

Hur, W.M., Yoo, J.J., Chung, T.L. (2012). The consumption values and consumer innovativeness on convergence products. *Industrial Management & Data Systems* 112 (5): 688–706.

Meagher, R.K., Beaver, A., Weary, D.M., Keyserlingk, M.A.G. von, 2019. Invited review: A systematic review of the effects of prolonged cow-calf contact on behavior, welfare, and productivity. *Journal of dairy science* 102(70):5765–5783.

MIV (2021). Geschäftsbericht 2020/2021, Milchindustrie-Verband e.V., Berlin.

Nocella, G., Hubbard, L., Scarpa, R. (2010). Farm Animal Welfare, Consumer Willingness to Pay, and Trust: Results of a Cross-National Survey. *Applied Economic Perspectives and Policy* 32(2):275–297.

Placzek, M., Christoph-Schulz, I., Barth, K. (2020). Mehr als eine Nische? Untersuchungen zum Potenzial der kuhgebundenen Kälberaufzucht in der Vermarktung von Milch und männlichen Kälbern: Schlussbericht. Thünen-Institut für Ökologischen Landbau.

Placzek, M., Christoph-Schulz, I., Barth, K., 2021. Public attitude towards cow-calf separation and other common practices of calf rearing in dairy farming—a review. *Org. Agr.* 11(1):41–50.

Schütz, K., Mergenthaler, M. (2019). Neue Informations- und Kommunikationstechnologien für regionale Lebensmittel am Point of Sale. Umsetzungsperspektiven für flexible, individuelle Verbraucherinformationssysteme (fiVIS): GIL-Jahrestagung. Wien. 18.02.-19.02.

Sheth, J.N., Newman, B.I., Gross, B.L. (1991). Why we buy what we buy: A theory of consumption values. *Journal of Business Research* 22(2): 159–170.

Sirovica, L.V., Ritter, C., Hendricks, J., Weary, D.M., Gulati, S., Keyserlingk, M.A.G. (2022). Public attitude toward and perceptions of dairy cattle welfare in cow-calf management systems differing in type of social and maternal contact. *Journal of dairy science* 105(4): 3248–3268.

Sivapalan, A., Heidt, T. von der, Scherrer, P., Sorwar, G. (2021). A consumer values-based approach to enhancing green consumption. *Sustainable Production and Consumption* 28:699–715.

Sweeney, J.C., Soutar, G.N. (2001). Consumer perceived value: The development of a multiple item scale. *Journal of Retailing* 77(2):203–220.

van Riemsdijk, L., Ingenbleek, P.T., Houthuijs, M., van Trijp, H.C. (2017). Strategies for positioning animal welfare as personally relevant. *BFJ* 119(9):2062–2075.

Waiblinger, S., Wagner, K., Hillmann, E., Barth, K. (2020). Play and social behaviour of calves with or without access to their dam and other cows. *Journal of Dairy Research* 87(1):144–147.

# Transformation towards animal welfare improved livestock farming - Consumer attitudes and financing approaches

Sarah Kühl and Gesa Busch

**Abstract** – Society increasingly questions the animal welfare levels in conventional husbandry systems. However, a comprehensive transformation of animal farming, which is needed to increase animal welfare and gain social acceptance, is linked to high costs. Therefore, this study aims to investigate 1) how significant the changes in livestock husbandry need to be from the consumers' point of view, 2) which financing approaches consumers prefer, and 3) whether these preferences correlate with the perception of the need for change in current livestock farming. An online survey with 919 German meat consumers was conducted to answer these questions. The results reveal that the majority of consumers agree that fundamental changes in livestock farming are needed (62%) and most plead for financing through the purchase of animal welfare products (58%) followed by general taxes (46%) and additional taxes on animal products (36%). The approach that farmers pay for changes on their own reaches a lower approval (11%). However, this agreement positively correlates with the perception that no or only small changes are necessary whereas consumers who see the need for major changes agree more with the usage of taxes to finance animal welfare improvements.

## INTRODUCTION

A recent report on how the public evaluates animal welfare in European agriculture found that an overwhelming majority (92%) perceive the current legislation as inadequate to protect and guarantee animals' needs (European Commission, 2022). This is just one study of many showing that consumers and citizens rate the current legislation for conventional livestock farming and therewith the prevailing conditions for farm animals as unacceptable. From a citizen's point of view more space, straw bedding, and outdoor access, preferably pasture access is needed for good animal welfare (e.g. Busch and Spiller, 2018). Currently, the majority of conventional agricultural husbandry systems are far from this idea. Thus, it can be assumed that the animal industry is at risk of losing the "social license to operate" unless a comprehensive transformation of the sector takes place. However, such a comprehensive restructuring of husbandry systems towards more welfare-friendly systems is linked to high costs. In Germany, experts of the Scientific Advisory Council for Agricultural Policy at the Federal Ministry of Food and Agriculture estimated that around 3 billion euros per annum are needed until 2040 to increase animal welfare in farming to an adequate degree. Within these discussions, several approaches for financing are discussed (WBA, 2015). It seems unlikely that market mechanisms are able to generate the needed amounts as well as that farmers will (be able to) bear these costs out of their own pockets. Additionally, due to high uncertainty about what a planned federal

animal welfare label in Germany could look like, many farmers currently hesitate to invest in new husbandry systems. Apart from these transformation efforts, there are also some options to improve animal welfare right away with much smaller investments such as some more space or the provision of roughage or other manipulable material in conventional stables. However, it is known that most of these measures will not increase consumer acceptance of conventional husbandry systems significantly (Schütz et al., 2021). A real leap in acceptance and proper animal welfare improvements can only be achieved with systems including e.g. far more space, access to outdoor climate stimuli, or straw bedding.

Against this background, this study aims to investigate how large the animal welfare improvements in German animal farming should be from a consumer's point of view and how consumers assess different financing approaches for transforming the sector. It will be determined whether the attitudes regarding the changes needed in livestock farming correlate with the preferences for different financing approaches.

## METHODOLOGY

In order to answer the research questions, an online survey with 919 meat consumers living in Germany was conducted in March 2022. Quotas were set for gender, age, education, and income to generate an approximately representative sample for Germany concerning these aspects. In the first part of the survey, sociodemographic questions and food consumption behavior were asked. In the second part, statements regarding the participants' attitudes towards livestock farming in Germany and the perceptions of needed changes including proposals for their financing. In a subsequent third part, the participants' evaluation of small and large improvements in conventional pig stables was assessed. Next to descriptive analyses, two-sided Pearson correlations were applied. Data analyses were executed using IBM SPSS Version 27.

## RESULTS

Only 5% of respondents agree that no changes in current livestock farming are needed to achieve good animal welfare (Fig. 1). Furthermore, only 36% state that small changes are sufficient whereas 62% see the need for a comprehensive transformation of livestock farming. Additionally, 8% state that animal farming should be fully abandoned in Germany (Fig. 1).

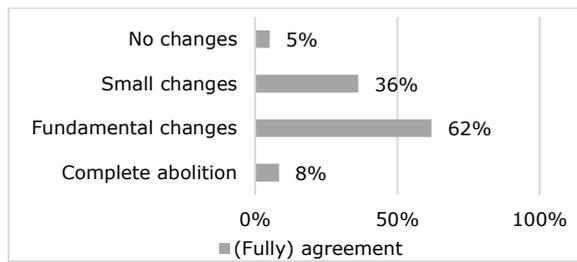


Figure 1. Participants' agreement (in %) on different levels of changes needed to achieve high animal welfare in livestock farming, n=919.

Concerning approaches for financing more animal welfare, most consumers prefer that consumers for whom animal welfare is important should buy corresponding products and therefore pay for it (58%), followed by the use of general taxes (46%) and taxes for all animal products (36%). The majority rejects that farmers should pay for transformation on their own – only 11% opt for this approach (Fig. 2).

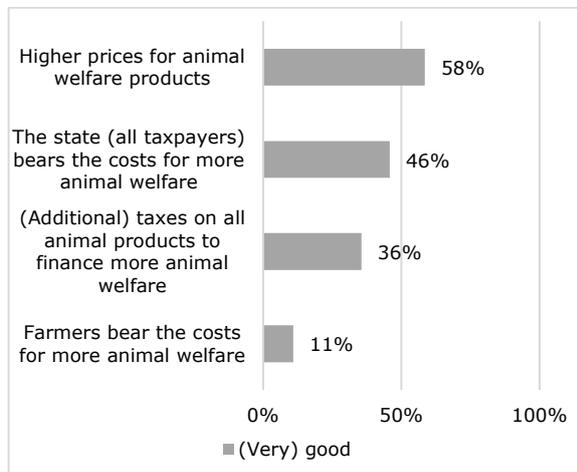


Figure 2. Consumers' assessment of different financing approaches for the transformation of livestock farming (in % of respondents), n=919.

Table 1 shows that the perceived need for change correlates with the assessment of financing approaches. If consumers see no need for changes in livestock farming, they evaluate the approach that farmers pay for animal welfare improvements more positively. The perception that large changes are necessary correlates positively with the approach to use taxes for financing.

**Table 1.** Correlations between the need for change in livestock farming and the assessment of financing approaches.

Change	Financing approach			
	AWF	Taxpayer	AP tax	Farmers
None	-0,052 <sup>n.s.</sup>	-0,189**	-0,071*	0,330**
Small	0,016 <sup>n.s.</sup>	-0,098**	0,02 <sup>n.s.</sup>	0,203**
Large	0,093**	0,303**	0,191**	-0,128**
Abolition	-0,013 <sup>n.s.</sup>	0,305**	-0,112**	0,144**

Pearson's chi-squared test, <sup>n.s.</sup> not significant, \*P<0.05, \*\*P<0.01.

## DISCUSSION AND CONCLUSION

The results support the recent findings that current livestock farming in Germany seems unacceptable for the majority of consumers and that a comprehensive sector transformation is needed (Busch and Spiller, 2018). The slightly higher preference for market solutions through labels compared to taxes might be due to perceived responsibilities that especially consumers of animal products should pay for animal welfare improvements (Zühlsdorf et al., 2016). Additionally, labels offer the possibility of informed buying according to the consumers' needs (Lusk and Norwood, 2011). However, more analyses are needed to gain an understanding of why using general taxes is assessed more positively compared to levy taxes for animal products only.

The results further reveal that consumers' attitudes towards financing approaches correlate with the perceived need for how far-reaching a transformation of livestock farming should be. Consumers seem to be aware of the fact that a comprehensive transformation cannot be financed by farmers alone. How large support for different financing solutions in the population might be, should be analysed through further studies using information treatments.

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## REFERENCES

- Busch, G. and Spiller, A. (2018). Consumer acceptance of livestock farming around the globe. *Animal Frontiers* 8(1):1–3.
- European Commission (2022). Factual summary report of the online public consultation in support of the fitness check and revision of the EU animal welfare legislation. [https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12950-Animal-welfare-revision-of-EU-legislation/public-consultation\\_de](https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12950-Animal-welfare-revision-of-EU-legislation/public-consultation_de)
- Lusk, J.L. and Norwood, F.B. (2011). Animal Welfare Economics. *Applied Economic Perspectives and Policy* 33(4):463 – 483.
- Schütz, A., Busch, G., Sonntag, W. (2020): Environmental enrichment in pig husbandry – Citizens' ratings of pictures showing housing elements using an online-survey. *Livestock Sciences* 240:104218.
- Wissenschaftlicher Beirat Agrarpolitik beim BMEL [WBA] (2015): Wege zu einer gesellschaftlich akzeptierten Nutztierhaltung. Gutachten. Berlin
- Zühlsdorf, A., Kühl, S., Gaulty, S., Spiller, A. (2016): Wie wichtig ist Verbrauchern das Thema Tierschutz? Kommentiertes Chartbook zur repräsentativen Umfrage, Göttingen.

# What do farmers and consumers want from the German food retail sector in terms of its role in the Value Chain

Ivica Faletar, Marcus Mergenthaler and Inken Christoph-Schulz<sup>1</sup>

**Abstract – The German food retail sector is considered the key factor on which the satisfaction of consumers and farmers depends. However, it sees its role and actions differently than farmers and consumers would. This is the reason why these two groups want certain changes in food retailing. This study examines what farmers and consumers expect from food retailers. The results show that changes in three areas are needed: Marketing strategies, standards and pricing. The desired changes confirm that retailers need to make more efforts to meet demands and expectations of farmers and consumers.**

## INTRODUCTION

Food retailing not only plays a key role in food marketing but is also stuck between the wishes of farmers and consumers and the feasible conditions of the suppliers (Krampe et al., 2018). In general, today's consumers want safe and healthy food of high and consistent quality, as well as certain guarantees on the characteristics of the food supplied (Trienekens et al., 2012). Farmers, on the other hand, not only want to have a say in the production but also the sale of their products as strategic partners in the food value chain rather than as replaceable providers of input (Diamond et al., 2014). However, research has shown that food retailers have a clear picture of their role in the food chain, which, on the other hand, clearly does not match the expectations of farmers and consumers. Expert interviews with food retail representatives in Germany have shown that retailers strive to ensure the uncritical sale and consumption of meat focusing on long-term partnerships. When it comes to the diversity of the product range and product selection, food retailers are primarily guided by consumers buying behaviour. They do not see themselves as moral agents of consumer choice. Moreover, food retailers believe that government and independent labels are useful but that they also carry some risk of missing their target by overloading consumers with additional information (Krampe et al., 2018). This paper builds on the findings of the study by Faletar et al. (2021) that showed that farmers and consumers are critical of food retail pricing, profit distribution, standards under which products of animal origin are sold, and product information. Now, in a second step to the overall study from Faletar et al. (2021) the aim of this paper is to investigate what farmers and consumers want from German food retailing.

## MATERIAL AND METHOD

In March 2021, 18 online group discussions were conducted with 2 or 3 farmers and 2 or 3 consumers each in six German cities/towns. Pig farmers and consumers led discussions in Borken and Güstrow, dairy farmers and consumers in Flensburg and Kempten, and poultry farmers and consumers in Vechta and Magdeburg. The discussions were conducted as an Utopia in which the discussants expressed their wishes and expectations with regard to pig, dairy, and poultry farming. A guideline was created that included inter alia questions about ideal agricultural production, planning security, pricing, the value chain, food retailing, and policy. However, not all topics were part of every discussion. The focus of this study was on five conversations with a total of 26 discussants that focused, among other issues, on what farmers and consumers want and expect from food retailers. The discussions were audio- and video-recorded. An inductive and deductive content analysis was undertaken to analyse the discussions. A category system was created using MAXQDA software which then served as the basis for interpreting the results.

## RESULTS

The discussants had clear suggestions for food retailers on how to improve certain standards. They would also like to see fairer product pricing for farmers. Many of the wishes are shared by both, farmers and consumers.

When it comes to marketing strategies, the discussants' wishes head in several directions. Consumers and farmers want fewer but better labels when it comes to animal products. Labels should provide the ability to trace the product, i.e., it should be possible to identify the farm where the animal came from. These labels should include not only information on how the animal was slaughtered but also where it was raised and the conditions under which the animals were kept. One consumer said: *"That means I would also like to know that it came from us, at least from our federal state, and was not transported halfway across the European Union [...]* That you can simply use QR code which then leads you not to the slaughterhouse, but to the farm where the animal grew up." Farmers believe that retailers should launch campaigns to promote the value of German products by highlighting "Made in Germany" as a guarantee of quality, which would ultimately contribute to greater respect for national products.

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The discussants would like to see areas in supermarkets that offer only products from their region, as well as more variety on the shelves when it comes to animal products. One poultry farmer said: *"That there is, let me say, a regional section or a section where farmers from the region can showcase their products."* Some consumers mentioned that they would like to have webcams from the barn in the sections of supermarkets that offers animal products.

The discussants emphasized that standards in animal husbandry as well as in food production in general, are quite high in Germany and that they would like to see such standards throughout the European Union since the EU is a common market. One consumer said: *"If I want to have a common Europe then I have to have common standards."* The minimum expectations of the discussants are that the products imported to Germany are at the same level as German products. One consumer said: *"So for me personally, it would just be important [...] that the standards are just maintained. We produce here in Germany according to a very high food standard with a lot of control and milk is actually best monitored anyway. And that can or should be expected from imports as well."* In addition, farmers believe that food retailers should recognize those of them making an extra effort for more animal welfare and environmental protection, and that these should be rewarded financially. One dairy farmer said: *"And if the farmer is at least adequate, and if he does even more for animal welfare or the environment, he can always get something on top [...]."* Some farmers also stressed that it should be standard practice for retailers to give farmers a guarantee for a minimum purchase.

Farmers reported that they would like to negotiate prices directly with food retailers and that the prices are not just set by food retailers. They also want a price guarantee or information for what price to produce so they can plan for the future. One hog farmer said: *"So we need to know what prices we need to produce at to be competitive and what requirements we need to meet in the coming years, the 15-year plan."*

#### DISCUSSION AND CONCLUSION

From the wishes and demands of the discussants to food retailers, it is clear that food retailers still have a lot to do to meet the expectations of farmers and consumers. Most of the suggestions from these food value chain stakeholders were made in terms of food retail marketing strategies. In particular, marketing strategies need significant improvement. While farmers want special corners in supermarkets with products from the region, believing that this will make their products better known and appreciated nationwide, consumers want fewer labels but also more information in a simpler way about the product they are buying. Although the role of food certification is to increase consumer confidence in the food itself (Truong et al., 2021), it appears that policymakers are only adding to the confusion of German consumers with current labels by using too many of them for animal products. Representatives of the German retail sector expressed a similar opinion (Krampe et al., 2018). Both farmers and consumers

agree that animal products produced in Germany are of better quality than imported products. Therefore, they believe that when importing foreign products, retailers should make sure that the quality of imported products is on par with German products. Farmers generally want to actively and directly participate in pricing with retailers. While it is clear what changes consumers and farmers want from retailers, it is not clear how much retailers can do to meet the wishes and expectations of these two stakeholders, since they themselves have to take care of profitable business. In order to be able to meet the expressed expectations of farmers and consumers, it is necessary that not only food retailers but also food processors actively engage in this process. After all, it is the latter who are largely responsible for quality standards.

#### ACKNOWLEDGEMENT

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#### REFERENCES

- Diamond, A., Tropp, D., Barham, J., Muldoon, M.F., Kiraly, S. and Cantrell, P. (2014). Food Value Chains: Creating Shared Value to Enhance Marketing Success. U.S. Department of Agriculture, Agricultural Marketing Service. <http://dx.doi.org/10.9752/MS141.05-2014>.
- Faletar, I., Erler, M., Berkes, J., Ollier, C., Mergenthaler, M. and Christoph-Schulz, I. (2021). Den BIG4 machtlos ausgeliefert? Kritik am deutschen Lebensmitteleinzelhandel. *Strategien für den Agrar- und Ernährungssektor und den ländlichen Raum in Zeiten multipler Krisen*, 45.
- Krampe, C., Gier, N., Römhild, J. and Kenning, P. (2018). Standards, Hindernisse und Wünsche in der Nutztierhaltung – Die Perspektive des Handels. In: Christoph-Schulz, I. et al. (Hg.): SocialLab – Nutztierhaltung im Spiegel der Gesellschaft. *J Consumer Prot Food Saf* 13: 145-236.
- Trienekens, J.H., Wognum, P.M., Beulens, A.J. and van der Vorst, J.G. (2012). Transparency in complex dynamic food supply chains. *Advanced Engineering Informatics* 26(1): 55-65.
- Truong, V.A., Conroy, D.M. and Lang, B. (2021). The trust paradox in food labelling: An exploration of consumers' perceptions of certified vegetables. *Food Quality and Preference* 93: 104280.

**PARALLEL SESSION 15**  
**ENVIRONMENTAL/  
CLIMATE  
PROTECTION, RISK**



# Concepts of food wholesalers to avoid food waste in the course of the Covid-19 crisis - a survey by means of qualitative interviews with experts

Stephanie Köhler, Vera Kasperek-Koschatko and Siegfried Pöchtrager<sup>1</sup>

**Abstract** - The Covid-19 pandemic has turned proven processes in the food sector upside down and demonstrated the expandability of existing concepts to prevent food waste. Even before the pandemic, around one-third of the food produced worldwide was wasted every year. This paper analyses how the Austrian wholesale sector implemented concepts to avoid food waste in the face of unpredictable and sudden events. For this purpose, eleven representatives of Austrian wholesalers were interviewed. In total, about 40 concepts against food waste were identified. These concepts were evaluated according to their ecological and economic success. The paper illustrates the creativity of individual wholesalers in exceptional situations, their ability to adapt and the necessity of networking between food wholesalers with regard to their concepts.

## INTRODUCTION AND PROBLEM DEFINITION

According to estimates, around one-third of the food produced worldwide is wasted every year. Converted, that is around 1.3 billion tonnes (United Nations, 2020). Around 90 million tonnes are wasted in Europe (European Commission, 2013). In Austria, 121,800 tonnes of food from production, 120,000 tonnes from trade and between 175,000 and 258,000 tonnes from gastronomy end up in waste every year. However, around 270,000 tonnes of food are wasted in households (Lebersorger & Schneider, 2014; Austrian Court of Audit, 2021). In the wholesale food trade, 10,300 tonnes of food are thrown away every year. This corresponds to a financial loss of 21.5 million euros (Hietler & Pladerer, 2019). Ethical as well as economic and ecological impacts can be identified (FAO; IFAD; WFP, 2015).

Due to the Covid-19 crisis and the government-imposed lockdowns, restaurants in Austria had to close their doors for a total of almost ten months. Due to the closure, new concepts had to be developed to prevent the food in the warehouses from spoiling and thus becoming unusable.

The Covid-19 pandemic has demonstrated the expandability of existing concepts to prevent food waste and has caused the previously functioning infrastructure of certain food wholesale processes to collapse. This has presented food wholesalers with unforeseeable problems such as a sudden absence of customers, spoiled products and financial losses. In particular, new concepts had to be developed that take into account a potential closure of the gastronomy trade in the course of a lockdown.

The core objective was to explore whether food wholesalers had developed concepts to prevent food waste in the wake of the Covid-19 pandemic, and how they prepared for a future unexpected event. In order to categorise the concepts, it was important to determine in which areas these concepts were developed, to what extent a distinction was made between fast and slow perishable food, if they were successful for the individual food wholesaler and which concepts could be useful in the future. Furthermore, interviewees were asked about the strength, weaknesses, chances and risks of their concepts.

## METHODS AND PROCEDURES

Eleven semi-structured interviews were conducted with experts from the Austrian food wholesalers about their concepts before and during the Covid-19 pandemic. They were processed and evaluated with the help of a qualitative content analysis according to Mayring (Mayring, 2015). The interviewees were selected from the management, sales or quality management of food wholesalers as food waste can be prevented both in the area of procurement, distribution and within the storage period of these foods. The strengths, weaknesses, opportunities and threats of the implemented concepts were analysed.

## RESULTS

In total, about 40 concepts against food waste could be identified. Most concepts applied before the pandemic were also conducted during the Covid-19 pandemic. New concepts include the production of smaller containers, the establishment of a drive-in, the opening to private customers, the checking and extension of the best-before date of certain articles by laboratories, the reduction of the assortment, adjustments in the disposition and the establishment of online shops.

One of the concepts mentioned was implemented by one of the eleven food wholesalers interviewed: the return of suppliers, the controlling of spoilage, a recording system of which customer buys which item, a drive-in, an internal transfer of goods, a precise observation of customer behaviour, further processing of products, the involvement of other companies and many more. One of the following concepts was implemented by two interviewed food wholesalers: the change of container sizes, the checking and extension of the best-before date, the

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freezing of products, the support of gastronomy in the take-away concept or the stocking up on Austrian suppliers to reduce dependence on foreign countries. Three of the food wholesalers interviewed indicated either cooperation with other companies or training of employees or the reduction of the product range as a concept. Four of the eleven interviewed food wholesalers took back goods from the customer, expanded their online shop or introduced active telephone sales. Nine of the eleven interviewed food wholesalers gave their food to charities. All of the interviewed food wholesalers had or introduced promotions and sales for employees, adjusted their disposition, recorded the best-before date, relied on different distribution channels and opened for private customers. The graph below illustrates the most common food wholesale concepts implemented during the Covid-19 pandemic in Austria.

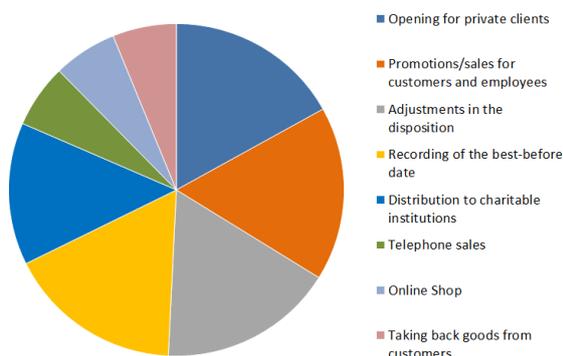


Figure 1. Most common concepts during the Covid 19 pandemic

Furthermore, the interviewees were asked about the strengths, weaknesses, opportunities and risks of the adopted concepts. The concepts were then evaluated according to their ecological and economic success and it was asked whether they could be further developed, adapted and applied in the future. Many wholesalers assessed their concepts as ecologically unsuccessful because, despite these concepts, they had to dispose of more food than before the pandemic. Others considered their concepts a success, having kept their food waste relatively low in relation to the large quantities of goods at risk of expiration.

#### DISCUSSION AND CONCLUSION

In general, food wholesalers were not prepared for an unpredictable and sudden event like a lockdown. Nevertheless, some of the concepts already applied before the Covid-19 pandemic could be successfully implemented during the lockdowns in Austria. Particularly surprising was the quick action of all food wholesalers avoiding food waste by implementing existing concepts. Thus, the results of the interviews not only reflect existing concepts but include newly developed concepts. A review of the assortment for less popular items and the limitation of these product groups was considered sensible. This reduction of the assortment in breadth and depth would make sense for all food wholesalers and should be considered. Furthermore, a first-in, first-out storage strategy minimises the risk of food waste (Hietler & Pladerer, 2019). This can reduce spoilage both inside and

outside the company. Furthermore, the often-discussed approval of grade II food could prevent food waste. However, systems for portion calculation for gastronomy customers do not allow grade II food. When critically reflecting on the weaknesses and risks of the concepts, the difference in the hierarchy of the interviewee within the company stood out.

The concepts implemented so far were still applicable for food wholesalers in the future. However, as many different concepts have been developed, there is a need for exchange between food wholesalers in order to be able to apply the concepts of other food wholesalers in case of another unforeseen event. The work presents the special creativity of individual wholesalers in exceptional situations and shows the necessity of networking between these food wholesalers in relation to their concepts.

#### REFERENCES

- Europäische Kommission. (2013). *Welternährungstag: Die Kommission ist entschlossen, die Lebensmittelverschwendung in Europa zu EU-Maßnahmen*. [https://ec.europa.eu/commission/presscorner/detail/de/IP\\_13\\_953](https://ec.europa.eu/commission/presscorner/detail/de/IP_13_953)
- FAO, IFAD, WFP. (2015). *The State of Food Insecurity in the World. Meeting the 2015 International Hunger Targets: Taking Stock of Uneven Progress*.
- Lebersorger, S., & Schneider, F. (2014). *Aufkommen an Lebensmittelverderb im österreichischen Lebensmittelhandel*.
- Mayring, P. (2015). *Qualitative Inhaltsanalyse - Grundlagen und Techniken* (12., übera). Beltz Verlag.
- Pladerer, C., & Hietler, P. (2019). Abfallvermeidung in der österreichischen Lebensmittelproduktion. Avoidable food waste accumulates along the entire value chain. *Österreichische Wasser- und Abfallwirtschaft*, 71(5-6): 238-245. <https://doi.org/10.1007/s00506-019-0578-9>
- Rechnungshof Österreich. (2021). *Verringerung der Lebensmittelverschwendung - Umsetzung des Unterziels 12.3 der Agenda 2030*. [https://www.rechnungshof.gv.at/rh/home/home/Bund2021\\_19\\_Lebensmittelverschwendung.pdf](https://www.rechnungshof.gv.at/rh/home/home/Bund2021_19_Lebensmittelverschwendung.pdf)
- Vereinte Nationen. (2020). *Agenda 2030 - Resolution der Generalversammlung verabschiedet am 25. September 2015: 1-38*.
- WWF. (2019). *Abfallvermeidung im österreichischen Großhandel*. Retrieved March 14, 2021, from <https://www.wwf.at/de/grosshandel/>

# Effectiveness of Multi-Peril Crop Insurances in Saxony (Germany)

Lorenz Schmidt, Günther Filler and Martin Odening<sup>1</sup>

**Abstract** - This study examines the effectiveness of a multi-peril crop insurance in Saxony (Germany). Based on a data set of about 150 farms over 15 years it is examined how an insurance would have worked in the drought year 2018. By using farm specific yields and revenues a panel data analysis is conducted. It turns out that with low coverage level only few farms are benefitting from crop yield insurance. In regard of the current supporting schemes of the European Union the study shows that with higher coverage level crop yield insurances would be more attractive for farmers.

## INTRODUCTION

Yield variability in agriculture is always in the focus of political debates when it comes to initiating new support instruments for agriculture. Especially in years with severe weather events such as droughts, floods or storms, there are calls for government support for farmers, as they suffer particularly from the meteorological effects. Crop yield insurances, which replace the physical yield, are seen as an adequate way to compensate for yield volatility. The way these insurances work can vary widely (Meuwissen et al., 2018). Some products cover any deviation from a certain value, no matter the cause, while other insurances only take effect in the case of certain causes of damage, such as hail. While hail insurance is very widespread in Germany, insurance policies that cover drought or, in some cases, multiple (weather) perils are much less common. This is often justified with the high costs of such insurances and the existing basic risk in some types of insurance. This has prompted the European Union, among others, to allow monetary subsidies for multi-peril crop insurance, so that under certain conditions the premiums can be subsidized up to 70% for insurance products with a coverage level of 80% (OJ L 350/16). The aim of this study is to investigate, based on a case study for Saxony in Germany, which insurance-relevant farm-specific yield fluctuations exist and how a crop insurance would have affected the revenue situation of the farms in 2018. For this purpose, farming accountancy data (FADN) of the Free State of Saxony are used, so that an extensive data set of about 150 farms over a period of at least 15 years is available. In total, yield and revenue data from about 2,250 annual financial statements are available. This analysis focuses on wheat as the most important crop in Saxony. For 2018, the area of wheat in Saxony was 195,150 ha and accounted for 27.7% of the total arable land (SMUL, 2019).

## BACKGROUND

The question of whether and to what extent multi-peril crop insurance should be subsidized and financially supported by the state is a recurring topic

of discussion. Especially in years with severe weather events, the question arises again and again whether emergency aid is the right thing to do or whether it would not be better to establish long-term support for the introduction of multi-peril crop insurance. In particular, the year 2018, in which there were weather-related yield losses in Germany and in Saxony, around 36 million euros emergency aid was provided to farmers in Saxony to compensate yield losses (SMUL, 2019). To answer the questions, a simple look at yield statistics and average farm incomes is not sufficient. This is because in such cases, farm-specific fluctuations play the essential role when it comes to assessing whether and to what extent a farm's existence is at risk. To the best of our knowledge, this is the first structural study of individual farm yield and revenues fluctuations of identical farms in Germany, so that these analyses can be expected to provide insights for the future discussion on the introduction of state support for multi-peril crop insurance. The methodology used here assumes an insurance where there is no basis risk, no deviation from individual farm yields, and it is assumed that the insurance settlement comes with no additional cost. Another assumption is that there are no lower costs due to reduced yields.

## METHODS AND DATA

The period used for the analysis here is 2004 to 2018, for which data are available from 148 farms. The farms have grown wheat in all 15 years. The farms have an average arable area of 988 ha and are distributed throughout Saxony. So-called agricultural comparison areas are used as the geographical reference unit. Saxony is divided into 12 regions with similar agricultural and geographical structures to carry out farm analyses. The objective of this study is to simulate the impact of multi-peril crop insurance in 2018 and at which proportion of farms such insurance would have been effective under which coverage levels. For this purpose, the farm average is first calculated for the years 2004-2017 and this is used as a reference value for the damage insurance. Based on different coverage levels, the shares of farms that would have included compensation from an insurance policy are determined. An indemnity is always paid if the coverage level is undercut. The income is compensated up to the coverage level. The monetary compensation is based on the farm-specific average price of the last five years. To examine the monetary impact of insurance, farms are divided into four classes based on their yield volatility, and then it is determined how insurance would have increased wheat revenue for 2018. This allows an assessment of whether and how insurance would have supported wheat in 2018.

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**Table 1.** Descriptive statistics for wheat (2004-2018)

Area	#-farms	Mean Yield	Variability Coefficient <sup>a</sup>
1	8	55.90 dt/ha	26.18%
2	26	69.77 dt/ha	17.18%
3	10	60.41 dt/ha	22.39%
4	14	68.60 dt/ha	16.34%
6	11	67.76 dt/ha	19.48%
6a	16	68.98 dt/ha	19.88%
7	16	79.34 dt/ha	13.07%
8	29	78.87 dt/ha	17.76%
9	11	74.01 dt/ha	17.45%
10	7	55.73 dt/ha	26.70%

<sup>a</sup>Standard Deviation/Mean.

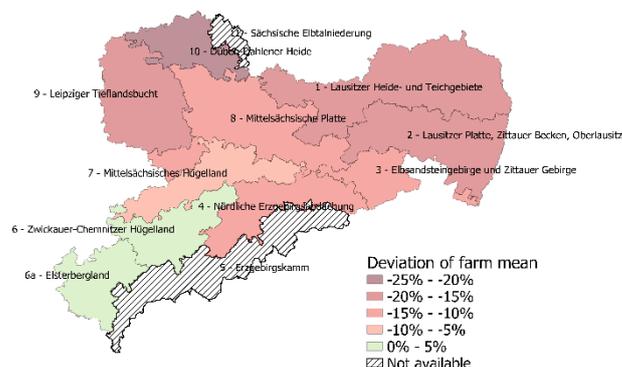
## RESULTS

In Table 1, the yields have different levels between the regions. It is noticeable that the regions with the lowest yields also have the highest variability. 2018 is a below average year with an average yield of 62.72 dt/ha in Saxony. The average over the years 2004-2018 is 70.5 dt/ha. However, the focus here is not on the average yield of Saxony but on the farm-specific yield. Figure 1 shows how the yields in 2018 deviate from the farm yield on average. Here, too, the regions are affected to varying degrees. In regions 6 and 6a, no negative deviation can be detected. The regions in the northern part of Saxony show noticeable deviations from the operating mean. On average, about 25% undercutting is present in area 10. The areas 1, 2 and 9 have an underrun of 15% - 20%. This uneven distribution is also reflected in the possible compensations by an insurance. Table 2 shows the compensation payments for coverage levels. At low coverage levels, hardly any payments would have been made for 2018. Even at a coverage level of 85%, more than half of the farms would not have received an insurance pay out.

**Table 2.** Compensation per farm in %-havalue

Coverage level	Mean	25%-quantile	Median	75%-quantile
70%	1.03%	0.00%	0.00%	0.00%
75%	1.76%	0.00%	0.00%	0.00%
80%	2.81%	0.00%	0.00%	0.00%
85%	4.43%	0.00%	0.00%	4.85%
90%	6.69%	0.00%	0.65%	9.85%
95%	9.82%	0.00%	5.65%	14.85%
100%	9.82%	0.00%	5.65%	14.85%

Table 3 further supports the findings from the previous analysis. It again shows that only certain farms benefit from coverage levels up to 80%. On average, the farms with the lowest historical revenue volatility would not have received any increase in revenue in 2018 up to a coverage level of 80%. In contrast, farms in the second and third quartiles do not differ significantly. The farms with the highest volatility have a considerable increase in revenue at all coverage levels.



**Figure 1.** Deviation from average wheat yield in dt/ha in Saxony (Germany) for 2018

**Table 3.** Increase in % of wheat revenues in year 2018 with insurance grouped by historic yield volatility

Coverage level	1-Quartile	2-Quartile	3-Quartile	4-Quartile
70%	0.00%	1.00%	0.96%	6.03%
75%	0.00%	1.82%	2.08%	8.83%
80%	0.00%	3.10%	3.61%	12.24%
85%	0.20%	5.07%	6.04%	16.56%
90%	1.19%	8.06%	9.22%	21.35%
95%	3.86%	12.00%	13.24%	26.37%
100%	3.86%	12.00%	13.24%	26.37%

## DISCUSSION AND CONCLUSION

The results of this analysis show that, particularly at relatively low coverage levels, only a few farms would have benefited from insurance in 2018. Against this background, it is right that the EU regulations have been raised to promote not only insurance with a maximum coverage level of 70%, but that 80% is now also possible. Further adjustments up to 90% would further expand the circle of beneficiaries and possibly make crop insurances more effective and more attractive as a risk management tool. Another finding is that the farms that would have particularly benefited from insurance have also had high volatility in the past. This means, in a broader sense, that experience with yield fluctuations has existed and so the fluctuations in 2018 were not a new phenomenon. For this reason, the payment of emergency aid can also be viewed critically, as such aid is intended for unforeseeable events in particular.

## ACKNOWLEDGEMENT

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## REFERENCES

- Sächsisches Staatsministerium für Umwelt und Landwirtschaft (SMUL) (2019). Agrarbericht in Zahlen 2019. Dresden.
- Meuwissen, M. P., de Mey, Y., & van Asseldonk, M. (2018). Prospects for agricultural insurance in Europe. *Agricultural Finance Review*.

# Farm-level indicators for the evaluation of sustainable agriculture in Slovenia

Maja Kožar, Sara Bele, Matej Bedrač and Tomaž Cunder<sup>1</sup>

**Abstract** – This paper presents the key outcomes of the process of compiling a set of indicators of sustainable agriculture in Slovenia at farm level. In the framework of two participatory workshops, a set of 29 topics and 90 indicators at farm level was proposed, considering all three dimensions of sustainability (economic, environmental and social). Almost one fifth of proposed indicators can be based solely on FADN data, 18% on other existing farm-level databases and 22% on combined data sources. Around 41% of proposed indicators would need to be based on data of additional on-farm questions/measurements. Further prioritization of proposed set of topics and indicators is recommended. Synchronisation with the process of conversion of FADN to FSDN would enable abundant synergies, content- and cost-wise.

## INTRODUCTION

Nowadays, it is not possible to create a quality agricultural policy decision without a reliable system for capturing real environmental, economic, social and other data. In the field of agri-food sector, Slovenia still does not have a unified, integrated database at various levels, which would enable systematic, effective monitoring and evaluation of sustainable orientation of farms and formulation of evidence-based sectoral development policies. Especially, there is a lack of data and indicators at farm level, despite the growing data needs.

Following the example of good practice from FLINT project (Vrolijk and Poppe, 2021) and plans of the European Commission to convert and expand FADN microeconomic database with the environmental and social indicators into FSDN (Farm Sustainability Data Network), we propose the FADN as a starting point for the compilation of sustainability topics and farm-level indicators also for Slovenia. The aim of the paper is to present the key outcomes of this process.

## METHODOLOGICAL APPROACH

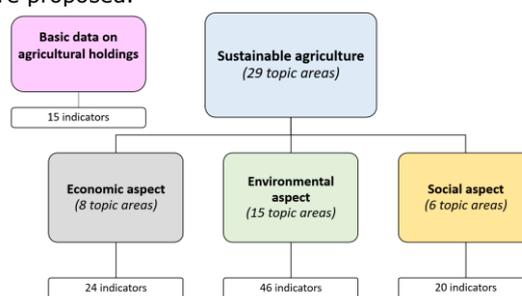
Two participatory workshops (Bertoncelj et al., 2021) were held to define the key topics of sustainable agriculture that could contribute to specific objectives of Slovenian agricultural policy (Resolution MAFF, 2020) and a set of indicators at the level of agricultural holdings. At the first workshop, based on the review of the FLINT outcomes (Kelly et al., 2015; Final publishable summary report, 2016; Vrolijk and Poppe, 2021), relevant literature, as well as based on the review of the available farm-level databases for Slovenian agriculture, key topics and an initial (broader) set of indicators, considering all three dimensions of sustainability (economic, environmental and social) were proposed.

At the second workshop, the initially proposed set of topics and indicators was thoroughly reviewed in terms of their relevance for Slovenian agricultural policy and feasibility of collecting data (Bertoncelj et al., 2021). Some topics were merged, some were added or excluded, and the initial (broader) set of indicators was refined. After some additional refinements, a final (shorter) set of indicators was proposed to monitor the sustainable orientation of agriculture at the level of agricultural holdings. For

each farm sustainability topic and indicator, detailed descriptive sheets were prepared. Inter alia, the topic descriptions include the reference and expected contribution of the topic to specific objectives of the Slovenian agricultural policy, whereas the indicator description sheets detail the methodology for their calculation and monitoring, as well as the required datasets at farm level.

## RESULTS AND DISCUSSION

Altogether, 29 topics are proposed (Figure 1.), which cover all three dimensions of sustainability (economic, environmental, and social). The proposed set of topics and indicators is not comprehensive or definitive and can be adapted according to the policy needs and feasibility of the data collection at farm level. Within the economic dimension of sustainable agriculture, 8 topics and 24 indicators are proposed. Within the environmental dimension, 15 topics and 46 indicators are defined, while for the social dimension of sustainable agriculture, 6 topics and 20 indicators are proposed.



**Figure 1.** Number of topics and indicators according to the dimensions of sustainable agriculture

Within the economic dimension of sustainable agriculture, the following topics are proposed: Farm income level, Farm income stability, Farm vitality and resilience, On-farm innovations, Protected agricultural products and foodstuffs, Marketing channels and producer groups, Parcel fragmentation of the farm, Farm modernization.

The environmental dimension of sustainable agriculture is described with the following topics: Permanent grassland, Sowing structure, Biodiversity, Use of plant protection products, Nutrient content and soil acidity, Indirect energy consumption, Direct energy consumption, Production of energy from renewable sources, Agricultural practices to reduce on-farm plant nutrient losses, Agricultural practices to reduce soil erosion, Increasing legume production, Intensity of greenhouse gas emissions in agriculture, Greenhouse gas emissions per hectare of arable land, Irrigation of agricultural land, Soil carbon sinks.

The social dimension of sustainable agriculture is proposed by the following topics: Farm advisory services, Farm education and training, Farm ownership and management, Social inclusion and participation, Employment and working conditions, Quality of life.

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In addition to the proposed set of topics and associated indicators of sustainable agriculture, it is also proposed to collect a descriptive set of data on agricultural holdings, which is important for understanding and interpreting the assessment of sustainable agriculture. Such a basic dataset includes data about farm's production resources, production type, production intensity, farm owner/manager and agricultural household.

A descriptive sheet was prepared for each proposed topic of sustainable agriculture, and an indicator sheet was prepared for each proposed indicator within an individual topic. The descriptive sheet describes the relevance of individual topics for Slovenian agricultural policy and their contribution to the objectives of this policy. Further, individual indicators of sustainable agriculture at farm level are proposed for each sustainability topic and additional information is defined (e.g. required and already available data for preparation of these indicators, methodology for their preparation, etc.). As mentioned, the indicator sheets present in more detail the individually proposed indicators and the methodology for their preparation and monitoring.

**Table 1.** Number of indicators according to the dimensions of sustainable agriculture and the availability of data sources required for their preparation.

Availability of data	Economic dimension	Environmental dimension	Social dimension	Total
FADN database	10	3	4	17
Other (existing) databases	2	13	1	16
Questionnaire at agric. holding	7	17	13	37
Combined data sources	5	13	2	20
Combined with FADN	4	11	1	16
Other combined data sources	1	2	1	4
<b>Total</b>	<b>24</b>	<b>46</b>	<b>20</b>	<b>90</b>

It is estimated that almost a fifth of the proposed indicators can be prepared exclusively on the basis of FADN data, a further 18% exclusively on the basis of other existing databases (e.g., administrative databases) and 22% of proposed indicators on the basis of combined data sources (Table 1.). Around 41% of all proposed indicators should be prepared solely based on data collected with additional questions/measurements on farms. Almost 18% of proposed indicators could be prepared based on a combination of FADN data with other databases or with additional questions/measurements on agricultural holdings. FADN data, exclusively or in combination with other data sources, can thus be used to prepare just around 37% of all proposed indicators for monitoring sustainable agriculture.

The highest share of the proposed indicators of sustainable agriculture, for which additional data would need to be collected anew on farms, are within the social dimension of sustainable agriculture (65%), and the lowest within the economic dimension (29%). In the context of the environment, additional data collection on agricultural holdings would be needed to prepare 37% of the proposed indicators. As expected, the largest share of indicators, for the preparation of which only FADN data can be used (without combination with other data sources), is proposed within the economic dimension of sustainable agriculture (42%) and the lowest within the environmental dimension (7%). Within the social dimension of sustainable agriculture, FADN data alone can be used for one fifth of proposed social indicators.

As mentioned, the proposed list of sustainability topics and indicators for Slovenia is not comprehensive or definitive. Therefore, it is highly recommended to further prioritize it according to the strategic policy needs, feasibility of data collection at farm level and refine it with the participation of key stakeholders in the country. This process is recommended to be synchronised with the process of conversion of FADN to FSDN (2022), which would enable abundant synergies, content- and cost-wise.

#### ACKNOWLEDGEMENT

The paper presents the results of the project "Establishment of a reference agricultural holdings system for the purpose of permanent monitoring of indicators of sustainable agriculture" supported by the Ministry of Agriculture, Food and Forestry of the Republic of Slovenia. The authors would like to thank project partners and associates for their valuable inputs and contributions to the proposed set of farm sustainability topics and indicators.

#### REFERENCES

- Bertoncelj, I., Kožar, M., Bele, S., Simončič, A., Cunder, T., Kastelic, K., Bedrač, M., Jelen, R. (2021). *Izhodišča za vzpostavitev sistema vzorčnih kmetij*. Intermediate report for the work package 6 of the project CRP V4-1813 *Establishment of a reference agricultural holdings system for the purpose of permanent monitoring of indicators of sustainable agriculture*. Ljubljana: Agricultural Institute of Slovenia.
- Final publishable summary report. (2016). *Final Report Summary - FLINT (Farm Level Indicators for New Topics in Policy Evaluation)*: <https://cordis.europa.eu/project/id/613800/reporting> (Accessed April 22, 2022)
- FSDN. (2022). *Conversion to a Farm Sustainability Data Network (FSDN)*. Brussels: European Commission. [https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12951-Conversion-to-a-Farm-Sustainability-Data-Network-FSDN\\_en](https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12951-Conversion-to-a-Farm-Sustainability-Data-Network-FSDN_en) (Accessed April 22, 2022)
- Kelly, E., Ryan, M., Finn, J., Hennessy, T. (2015). *Farm-level indicators for evaluating sustainability and emerging new policy topics*. A report on WP1 progress: Farm Level Indicators of Sustainability. Deliverable D 1.4 of 7FP project FLINT (Farm Level Indicators for New Topics in Policy Evaluation). Ireland: Teagasc. [http://www.flint-fp7.eu/downloads/reports/FLINT%20WP1\\_%20D1%204.pdf](http://www.flint-fp7.eu/downloads/reports/FLINT%20WP1_%20D1%204.pdf) (Accessed April 22, 2022)
- Resolution MAFF. (2020). *Resolution on the National Program on Strategic Directions for the Development of Slovenian Agriculture and Food "Our Food, Rural and Natural Resources from 2021" (ReNPURSK)*. Official Gazette of the Republic of Slovenia, No. 8/20, 7.2.2020.
- Vrolijk, H., Poppe, K. (2021). Cost of Extending the Farm Accountancy Data Network to the Farm Sustainability Data Network: Empirical Evidence. *Sustainability* 13(15): 8181. <https://doi.org/10.3390/su13158181> (Accessed April 22, 2022)

# Potentials to reduce pesticides with an ECO-Scheme – the case of Baden-Württemberg

Felix Witte, Christian Sponagel and Enno Bahrs<sup>1</sup>

**Abstract - Chemical synthetic plant protection products (CSPs) are increasingly viewed critically by the public. Germany therefore introduces an ECO-Scheme for the abandonment of CSPs within the framework of the CAP 2023. The one-year abandonment of chemical-synthetic plant protection is to be rewarded up to 130 €/ha in certain crops. We analyse the expected application of the ECO-Scheme in Baden-Württemberg on the basis of an economic geodata-based land use model under two different price scenarios. We find that implementation of the ECO-Scheme is highly sensitive to the scenarios. It is applied to a maximum of 23% of conventional arable land under price scenario 1. At the high price scenario 2, reflecting spring 2022, this value is significantly lower with up to 11%. Spring cereals are a beneficiary of the ECO-Scheme. The reduction of CSPs measured with the treatment frequency index is under-proportional, with 8-13% in the first scenario. Hence, the contribution to the reduction of CSPs is questionable. Further steps should also consider biodiversity effects under different landscape configurations, for which the model is predestined due to its high spatial resolution.**

## INTRODUCTION AND RESEARCH QUESTION

Chemical synthetic plant protection products (CSPs) are increasingly viewed critically by the public. Therefore, Germany is introducing an ECO-Scheme in the course of the Common Agricultural Policy (CAP) 2023 to abandon the use of CSPs for a one year period. Generally this refers to the term from January to the end of August; plant protection products with approval in organic farming are exempt. The ECO-Scheme is available for the following crops rewarded with 130 €/ha: root crops, summer cereals, corn, summer oilseeds, legumes and field vegetables. In permanent crops, for grass and green fodder, the payment is 50€/ha. Payments in the first group are to decrease to 120 €/ha in 2024 and 110 €/ha in subsequent years. The paper analyses to what extent this ECO-Scheme could be implemented on arable land in Baden-Württemberg (BW) and how it impacts the reduction of CSPs, depending on premium levels and price scenarios. BW aims to reduce the use of CSPs by 40-50% by 2030 (Land Baden-Württemberg 2020). BW is located in the southwest of Germany and has about 730.000 ha of conventional arable land.

## METHOD AND DATA

We apply a mixed-integer programming model. The model maximizes the total gross margin by selecting a crop rotation at field level, determining whether and in how many crops in the rotation the ECO-Scheme is implemented. The data on fields are stem from the Integrated Administration and Control System (InVeKoS). The crop rotations are derived using CropRota (Schönhart et al. 2011) based on the proportions of crops in the municipality (LAU2 level).

All fields used for conventional arable farming in 2021 are considered. The rotations include the following crops: winter wheat, winter barley, sugar beets, silage and grain maize, winter rapeseed, arable and clover grass, summer barley, oats and potatoes. They accounted for 81% of the considered area in 2021. The model uses various restrictions at the LAU2 level ( Table 1).

**Table 1** Overview of the constrains at the LAU2-level

Activities	Constraints
Sugar beet, silage maize, potatoes	No increase vs. 2021
Corn maize	≤100% increase vs.2021
Available labour force (in hours)	No increase vs. 2021
Produced Feed (Getreideeinheiten)	No decrease vs. 2021

The total labour force is based on the crops grown in 2021 and calculation data from LEL (2021). The gross margins and yield levels are also derived from calculation data (LEL 2021). Each field was assigned one of three yield levels based on the Flurbilanzkarte, which divides the land into four categories depending on soil quality and slope. The lower two are aggregated. It does not cover all LAU2 areas completely. Hence, 5.2% of the conventional arable land are not considered. Table 2 shows the assumed yield losses when CSPs are not used. They are based on the assumptions of Röder et al. (2021) and field trials from the NOCsPS project (<https://nocps.uni-hohenheim.de>). Gross margins include costs for mechanical weed control when no CSPs are used. Fertilizer costs are calculated after withdrawal and are reduced accordingly if no CSPs are used.

**Table 2** Assumed yield loss affiliated with not using CSPs.

Crop	Yield loss
Grass	5%
Maize	15%
Oat	20%
Potato	50%
Sugar beet	40%
Summer barley	20%

A scenario based on three-year calculation data (2018-2020) from the LEL and a scenario based on the high price level in spring 2022 are considered. The price increases, shown in Table 3, are based on LfL (2022) forecasts for the harvest of 2022, as well as price differences of current forward contracts compared to the three-year average of 2018-20.

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**Table 3** Core Assumptions in the higher price scenario.

Input/Output	Price change
Silage maize, sugar beet, grass	+20%
Grain, corn maize	+50%
Rapeseed	+100%
Nitrogen fertilizer	+300%
Phosphorus fertilizer	+265%
Potassium fertilizer	+160%
Diesel	+75%
Pesticides	+25%

### RESULTS

Figure 1 shows the share of conventional arable land on which the ECO-Scheme is applied, depending on the payment level. At 130 €/ha, the ECO-Scheme is implemented on about 23% of the area. However, the results also show that a reduction in the payment level, as intended, would result in a disproportionate reduction in application. At 110 €/ha, the expected share drops to 13%.

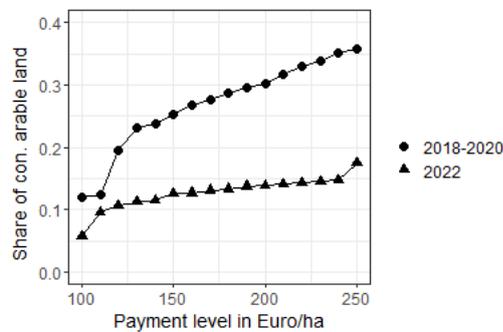


Figure 1 Percentage of arable land in BW used for the ECO-Scheme depending on the amount of the payment per ha

Implementation is lower in the second scenario and amounts to 11% at 130 €/ha or only 9.5% at 110 €/ha. Figure 2 shows the shift in crop shares depending on the payment level in the first scenario. In general, the ECO-Scheme mainly increases the cultivation of spring cereals. Root crops, which are also eligible for payments, can hardly benefit. Winter cereals lose the most significant area shares.

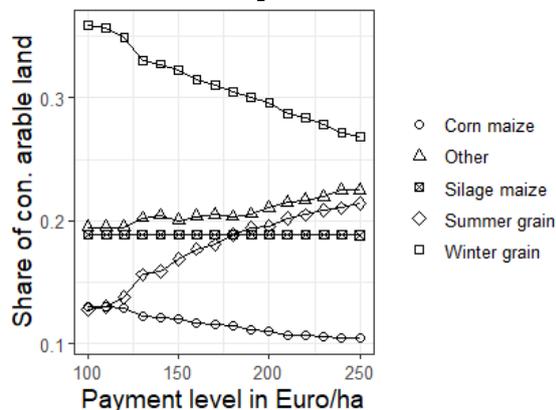


Figure 2 Percentage of arable land in BW used for different crops depending on the amount of the payment per ha

CSPs intensive crops are more likely not to be substituted. Thus, the reduction of CSPs is under-proportional to the area used for the ECO-Scheme. In scenario 1 at 130 €/ha, the treatment frequency

index (TFI) is reduced only by 13%. At 110 €/ha, the total TFI is 8% lower than in the baseline.

### DISCUSSION

The analyses show that the application of the ECO-Scheme is possible on a significant area. But its contribution to the reduction of CSPs is questionable. Furthermore, the implementation is price sensitive. However, some limitations of the model approach should be considered when interpreting the results. This applies to system boundaries and the decision level of the model. In reality the application of the ECO-Scheme is subject to restrictions on the farm level, which are reflected in a simplified manner by restrictions on the LAU2 level. The present c. p. consideration also does not account for a possible increase in organic farming or an opt-out from direct payments by farmers. Non-economic motivations as well as acceptance by farmers are not considered. Additional risks due to possible higher yield variations of the non-use of CSPs could limit acceptance of risk averse farmers and therefore lead to a considerable reduction in the actual application of the ECO-scheme. Subsequent questions are possible ecosystem services, especially a higher biodiversity, which could follow from a CSPs abandonment and reduced nitrogen fertilizing. However, biodiversity effects strongly depend on the landscape configuration (Tschardt et al. 2005). So spatial distribution of the ECO-Scheme would matter. This and other metrics for CSPs reduction, especially in terms of risks to humans and the environment, could be assessed using our model in the following steps.

### ACKNOWLEDGEMENT

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### REFERENCES

- Land Baden-Württemberg (22.07.2020): Gesetzesnovelle stärkt Biodiversität. [bit.ly/37qKTMj](https://bit.ly/37qKTMj)
- LEL (2021): Kalkulationsdaten Marktfrüchte - konventioneller und Ökologischer Landbau. Landesanstalt für Landwirtschaft, Ernährung und Ländlichen Raum. [bit.ly/3KjSxH6](https://bit.ly/3KjSxH6)
- LFL (2022): LfL Deckungsbeiträge und Kalkulationsdaten. Bayerische Landesanstalt für Landwirtschaft. [bit.ly/3x6pzGZ](https://bit.ly/3x6pzGZ)
- Röder, N.; Dehler, M.; Laggner, B.; Offermann, F.; Reiter, K.; de Witte, T.; Wüstemann, F. (2021): Ausgestaltung der Ökoregelungen in Deutschland – Stellungnahmen für das BMEL. Band 2. Thünen-Institut. Braunschweig.
- Schönhart, M.; Schmid, E.; Schneider, U. A. (2011): CropRota – A crop rotation model to support integrated land use assessments. In: *European Journal of Agronomy* 34 (4), S. 263–277.
- Tschardt, T.; Klein, A.; Krüess, A.; Dewenter, I.S.; Thies, C. (2005): Landscape perspectives on agricultural intensification and biodiversity – ecosystem service management. In: *Ecology Letters* 8 (8), S. 857–874.

# THEMATIC WORKSHOPS



## Thematic Workshop 1:

# Better together! Study groups as an efficient method for professional training

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Language of workshop: English / Slovene

The study group is an effective agricultural extension method that works along the principle of problem solving through group dynamics with the help of a moderator, which ensures that all members are actively involved. In such a group there is an exchange of views and experiences between the stakeholders themselves.

For a successful operation of a study group, it is necessary to involve motivated participants that share similar problems and interests and pursue similar goals related to their agricultural practice. Prerequisites for a successful operation of study groups such groups are (i) trust (information is not spread outside the group), (ii) respect for the ideas of all participants, (iii) open exchange of ideas and experiences between the study group participants and (iv) a certain level of responsibility of the study group members (ie. regular and active participation). The moderator has a pivotal role in the operation of the study group. This role is usually attributed to agricultural extension officers; apart from moderating the study group, they usually perform also the expert role, preparing the quantitative basis for the exchange of views and experiences between the study group members. Depending on the topic, other extension specialists may also take part in the meetings.

Successful study groups are characterised by a mutual flow of knowledge and experience among farmers themselves, the moderators, and other specialists that may take part in the knowledge exchange.

This workshop will present and compare the practical experience, and knowledge gained throughout the implementation of agricultural study groups in Austria and Slovenia. In order to provide comparable grounds for the workshop, the practical experience will be shared on the operation of the study groups with dairy farmers. In both countries, dairy sector brings major contribution to the overall agricultural output. The choice of the dairy sector also draws from the fact that organisation of dairy production is particularly complex, which in turn requires a complex and versatile approach towards study group moderation. In this sense, study groups in dairy production could

serve as raw models for organisation of study groups of any other sector.

Exchange of experience on study groups between Austria and Slovenia will be particularly interesting, as study groups in Slovenia were largely building on Austrian expertise and experience. Over the years though, they have modified the approach in order to adapt to the context. It will be useful and instructive to see how the approaches differ nowadays.

The workshop will be an excellent opportunity for the agricultural extension communities to exchange and evaluate their practice with their neighbouring counterparts. It is also an excellent opportunity to deepen and extend cooperation between the farm extension specialists from Austria and Slovenia.

The structure of the workshop will be as follows:

1. Introductory presentation of the theory of study groups in agriculture and an overview of their operation in Slovenia and Austria (15'); dr. Marco Horn and mag. Martin Nose\*
2. Presentation of experiences with the operation of study groups among dairy farmers in Austria (20'); Peter Kristof and dr. Marco Horn
3. Presentation of experiences with the operation of study groups among dairy farmers in Slovenia (20'); Damjan Jerič \*
4. Moderated group discussion (25'); moderator mag. Martin Nose
5. Conclusions and take-away messages (5'); dr. Marco Horn

\* slides in English, presentation in Slovene

We encourage extension officers and farm management specialists to actively to contribute with applied knowledge and experiences in the discussion part of the workshop. The outcomes of the discussion may well go beyond the initial focus of the workshop, which is the dairy sector.

## Thematic Workshop 2: Effective strategies for science-policy knowledge transfer to support climate action in the European agri-food system

Martin Schönhart<sup>1</sup>, Elisabeth Jost<sup>1</sup>, Erwin Schmid<sup>1</sup>, Emil Erjavec<sup>2</sup> and Franz Sinabell<sup>3</sup>

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<sup>3</sup>Austrian Institute of Economic Research WIFO

Language of workshop: English

Climate change is a major environmental and societal challenge of our time. The global agri-food system emits about one third of all green-house-gas emissions globally indicating a substantial role for climate change mitigation. Agricultural land use offers opportunities to sequester carbon and to provide renewable energy resources. Climate change impacts on agricultural land use and livestock husbandry on the other hand call for adaptation strategies to maintain production in the long run. The key role of land use in the earth system, e.g. to safeguard biodiversity, requires both mitigation and adaptation strategies to be carefully planned and operationalized in order to maintain long-term resilience.

Societal change, e.g. expressed by civil society movements such as Fridays For Future, requires politics to take action but decision making is difficult due to the wicked nature of the climate change – land use nexus.

Therefore, the European Joint Programming Initiative for Agriculture, Food Security and Climate Change (FACCE JPI) initiated the science-policy knowledge forum MACSUR SciPol. This pilot project shall support the strategic design of climate change adaptation and mitigation responses in the European agri-food sector. The forum synthesizes scientific knowledge for evidence-based policy support to achieve carbon neutrality by 2050, adapt to climate change and understand synergies and trade-offs in achieving these targets (for further details see <https://macsur.eu>).

This workshop will utilize knowledge and resources from MACSUR SciPol to elaborate on the opportunities and challenges of science-policy knowledge transfer in the agri-food system. Its objective is to reveal promising strategies, typical pit-falls and research needs taking into account experiences from both the Austrian and Slovenian agri-food system.

The structure of the workshop will be as follows:

1. Introductory presentation of MACSUR SciPol and first results of the science-policy knowledge forum (10').
2. Presentation of experiences in science-policy exchange related to climate change from representatives of Austria and Slovenia (20').
3. Focus group discussions (1-3 groups) of the following key questions (50'):
  - a) What are the information requirements, i.e. contents, for evidence-based climate change policy design in the agri-food sector?
  - b) What are major obstacles for evidence-based policy design and enforcement? How can science contribute to overcome these obstacles?
  - c) What are best-practice formats of knowledge transfer?
4. Conclusions on the key questions (10')

Results of the workshop will feed into a policy brief to inform the MACSUR SciPol network.

We encourage scientists, policy makers and planners, and any other practitioners from the agri-food system to contribute with applied knowledge and experiences.

The workshop is planned as physical meeting. However, we may involve researchers from the MACSUR network via a video conference.

# Thematic Workshop 3:

## Participatory research for resilient rural development in Central European regions: Walking in the shoes of strangers

Hannah Politor<sup>1</sup>, Kathi Klinglmayr<sup>1</sup>, Stefan Kirchweiger<sup>1</sup>, Ilona Rac<sup>2</sup> and Tanja Šumrada<sup>2</sup>

<sup>1</sup>Study group for International Analysis (STUDIA), Schlierbach

<sup>2</sup>Chair for agricultural economics, policy and Law, Biotechnical faculty, University of Ljubljana

Language of workshop: English

### Background

Central European regions have been shaped by humans for centuries and provide valuable functions for both the people who live there and their visitors. For example, these functions include providing food and energy as well as space for living and leisure activities. Next to this, certain areas may harbour unique flora and fauna and are used for nature conservation. To pursue a resilient development of such regions, all functions must be considered. In order to analyse and create socially robust strategies and instruments for the future of rural areas, participatory research, including the knowledge of stakeholders, is a key approach in scientific projects. However, each stakeholder values each function differently, depending on personal relations, employment or interest. This may result in a clash of different interests, conflicts within the process, biased outcomes and socially non-robust solutions. In dealing with such conflicting interests of different groups, participatory research is particularly challenging.

### Objectives

The aim of this workshop is to discuss different methods and process design of participatory and transdisciplinary research which can help to facilitate processes in which all stakeholder groups are on an equal footing. In particular, we want to focus on how to motivate stakeholders to look at the problem from another perspective. Furthermore, we want to share our experiences on facilitating discussions between stakeholders from conflicting groups and achieving compromise on contested land-use (and other) issues that is both acceptable to all and usable for policymaking. Overall, this should strengthen the participatory and transdisciplinary research process in order to identify concrete and socially robust orientations for a resilient development of such regions, and support stakeholders in generating their own solutions and strategies.

### Workshop Outline

The workshop will start with short presentations on concepts and methods used in different projects (STUDIA: LANA-Partizip, UL: SHERPA & CRP V4-2019). Afterwards, the challenges and methodological solutions for participatory research met in those projects will be discussed in small groups on the following topics:

- "Walking in each other's shoes" – how to motivate stakeholders to look at the problem from another perspective (e.g., the perspective of tourists)
- "Lost in Translation" – How to facilitate discussions between stakeholders from conflicting groups? How can we support the different stakeholder groups in finding a common language?
- "The devil is in the details" – while discussions may yield a fruitful result at the level of principle, it is a challenge to translate general statements into concrete solutions. How can different stakeholder groups be stimulated to co-create practical solutions and real-life policies that are both acceptable and workable?
- "From science to practice and back" – Where does participatory research fit in the rural and conservation biology studies? Can stakeholder discussion and focus groups be used as a preliminary or complementary method to other quantitative and qualitative approaches?

In a final plenary discussion, the results from the break-out groups are brought together. Identified best practices on methods and process design in participatory research will be summarised.

# Thematic Workshop 4:

## Think Tank Organic Research

### Socioeconomic Research Gaps to further improve organic farming with regard to societal and environmental changes

Doris Pick

Bundesprogramm Ökologischer Landbau (BÖL)  
Language of workshop: English and German

This Workshop will start with a short overview about main results of Socioeconomic Research funded by the Federal Scheme for Organic Farming (BÖL) regarding the last 10 Years. BÖL is located in the Federal Office for Agriculture and Food (BLE) in Bonn, Germany.

The workshops main objective is to discuss and generate together with the workshop participants still existing socioeconomic research gaps in the field of organic farming. Afterwards we will try to prioritize the discovered research gaps with regard to societal changes, loss of biodiversity, water management and climate change.

All over Europe, including Germany it is the aim to make farming fit for societal as well as environmental changes including climate change. Research, especially socioeconomic research findings in the field of organic farming can be a good basis to enable society to conquer rising environmental problems like loss and damage of biodiversity and water resources. In addition, the use of chances like e.g. local and regional food systems, humus rich soils, a large variety of food plants or diverse agroforest systems can be more often found in organic production and have the potential to benefit society as a whole as well as vulnerable environmental systems on which society depends.

The format of this workshop for a 1.5 hours slot includes one or two Impulse Presentations, which are the basis for the following discussion of still existing socioeconomic research gaps in organic farming. Depending on the number of workshop participants, the discussion will be held in one group or if there are more participants, the group will be divided. The Workshop-Facilitator speaks English as well as German. If there would be enough German-speaking participants, there could be one group in German and one in English.

The main questions for the discussion would be:

1. What knowledge is still needed to conquer recent societal and environmental challenges and to use chances?
2. Which knowledge gaps do you see in socioeconomic research in the field of organic farming?

3. Which research questions and conclusions could be drawn in order to fill these knowledge gaps?

Literature:

Jahnke, B., Kilian, D., Puteri, B., Zander, K. (2022): Marketing von Suboptimal Food im Öko-Handel, Abschlussbericht, Kassel-Witzenhausen, 178 Pages.

Stein-Bachinger, K., Preißel-Reckling, S., Kühne, S., Reckling, M. (2022): More diverse but less intensive farming enhances biodiversity. *Trends in Ecology & Evolution* 37, 5, 395-396.

Tietz, A., Neumann, R., Volkenand, S. (2021): Untersuchung der Eigentumsstrukturen von Landwirtschaftsfläche in Deutschland. Thünen Report 85, Thünen-Institut, Braunschweig, 90 Pages.

Behrendt, G.; Häring, A. M.; Peter, S.; Saß, C., Sterly, S. (2020): Alternative Finanzierungsmodelle entlang der Wertschöpfungskette für ökologische Lebensmittel, Synthesebericht, Frankfurt am Main.

Sanders, J., Hess J. (eds) (2019): Leistungen des ökologischen Landbaus für Umwelt und Gesellschaft. Braunschweig, 364 p, Thünen Rep 65.

Pick, D. (2019): How are farmers in Germany supported in converting to organic farming? Presentation, given at the French Direction Générale de l'Enseignement et de la Recherche Ministère de l'agriculture et de l'alimentation, Paris, 24.06.2019.

Skinner, C., Gattinger, A., Krauss, M., Krause, H.M., Mayer, J., van der Heijden, M., Mäder, P. (2019): The impact of long-term organic farming on soil-derived greenhouse gas emissions. *Scientific Reports*, 9:1702; DOI: 10.1038/s41598-018-38207-w.

Pick, D. (2013): Preisgestaltung und Fairness als Themen in Forschungsprojekten des BÖLN, in Achim Spiller (Hrsg.), A. Hellberg-Bahr (Hrsg.) und B. Brümmer (Hrsg.): Preise und Fairness in Wertschöpfungsketten – Methodische Ansätze und empirische Ergebnisse, Cuvillier Verlag, Göttingen, Page 21-37.

Pick, D. (2007): Ökologische Landwirtschaft: Ein Indikator für Nachhaltigkeit in der Raumordnung verankert. In *ÖKOLOGIE&LANDBAU*, 141,1/2007, Page 54-56.

