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Foreword

As has become customary, the first issue of this volume of *Studies in Agricultural Economics* has been compiled in partnership with the European Rural Development Network (www.erdn.eu). It shares the theme 'Innovation and Cooperation in Smart, Sustainable and Inclusive Rural Regions' with the 15th ERDN Conference which was organised by the Bundesanstalt für Agrarwirtschaft, Wien, and held in Eisenstadt (Austria) on 3-4 October 2017. Several of the papers included in this thematic issue were presented at the conference.

As the basic and infrastructural conditions in many rural regions of the European Union (EU) have steadily improved in recent decades, specific and integrative topics on the further development, chances and opportunities of rural regions are increasingly being addressed in research, policy making and the public discourse. Against this background, this issue of *Studies in Agricultural Economics* includes papers on diverse topics such as the provision of public goods, inclusive and sustainable development of rural municipalities, and changes in consumer preferences. Papers related to innovation in farming address adaptation to climate change and the roles of precision agriculture and organic farming.

In the frame of the EU H2020 research project PEGASUS, Nigmann, Dax and Hovorka explain the manifold interrelations among the diverse ecosystem services and functions of land use and land management, based on the empirical findings of twelve case study areas from across the EU. The Common Agricultural Policy has a core role for provision of ecosystem services beside other EU and national policies.

Owing to the nature of its history, Poland includes historical borderlines that separated diametrically-opposite agricultural systems. The impact of this historical factor was shown by Rudnicki, Jezierska-Thöle, Wiśniewski, Janzen and Kozłowski to be evident even today, especially in the territories further away from that borderline, particularly for features associated with agrarian structure, rural socio-demography, and productivity and profitability of agricultural holdings.

Monitoring and evaluation is crucial to enhance the sustainable development of municipalities in an inclusive and sustainable way, in terms of their long-term intention of greater attractiveness, competitiveness and sense of identity. CommunalAudit is a tool developed in Austria for achieving this development. Quendler sets out the relevant definitions and concepts of this tool and discusses its implementation, benefits and drawbacks, and further evolution.

The Leader approach is now well established across the EU. Chmieliński, Faccilongo, Fiore and La Sala show that their case-study Local Action Groups in Poland and Italy were generally working effectively. However, excessive institutionalisation (transfer of the proposal evaluation role away from the LAG in Poland, and excessive formalisation of the application rules in Italy) could be the major constraint to effective programme implementation.

In the context of the increasing interest in functional foods in Hungary, four consumer segments were identified by Soós and Biacs, and characterised according to socio-demographic, behavioural and attitude variables. Familiarity with the term 'functional food' is still limited, and consumers' demand for information to justify food purchase decisions varies according to their level of knowledge, involvement, personal attitudes and socio-demographic indicators.

The remaining three papers cover aspects of agricultural innovation and sustainability. Using different methodological approaches, Vígh, Fertő and Fogarasi sought to determine the climate factors which may influence the technical efficiency of Hungarian arable farms. Their results show that the processes resulting from climate change are determining factors in the evaluation of the adapted sectoral patterns and market conditions.

Precision agriculture technologies have been recognised as one of the rare win-win solutions for environmental and socio-economic goals. Data analysis and survey work conducted by Takácsné György and colleagues confirm that precision farming leads to increasing yields and has profitability benefits compared to conventional farming. The high investment cost is the main barrier to diffusion, while subsidies and more appropriate information could foster it.

Finally, Baer-Nawrocka and Blocisz compare the efficiency of Polish organic and conventional farms. In terms of efficiency criteria only, the organic farms show significant disadvantages in land and labour efficiency which should be considered when formulating agricultural policy objectives and conceptualising measures. Rather than competing with each other, the concepts should be seen as complementary.

ERDN seeks to advance international scientific cooperation in rural development and agriculture, as well as to share and promote scientific experiences and achievements in order to support policy makers and stakeholders. We, the joint Editors, hope that this thematic issue of the journal contributes to the further development of these objectives.

S. Egartner, J. Niedermayr and K. Wagner
Wien, March 2018

Thilo NIGMANN*, Thomas DAX* and Gerhard HOVORKA*

Applying a social-ecological approach to enhancing provision of public goods through agriculture and forestry activities across the European Union

Public goods provided by different land management practices in European regions have increasingly attained attention in agricultural policy debates. By focusing on the social-ecological systems (SES) framework, the systemic interrelations (e.g. drivers, resources, actors, governance regimes and policy impact) in land management across several case studies in various topographical and climatic conditions across ten European Union Member States are provided. The analysis of agricultural and forestry systems reveals a wide range of factors that drive the provision of 'ecologically and socially beneficial outcomes' (ESBOs). The respective influencing aspects cannot be reduced to market forces and policy support, but have to address simultaneously the pivotal role of social, cultural and institutional drivers as well. In particular, the tight interplay between public policies and private initiatives, and market mechanisms and societal appreciation of public goods delivery have shown to be the indispensable clue for understanding the relationship shaping the level of provision of public goods. Comparative analyses support the strong reliance on context, history, types of regions and differentiation of management systems which might be used for recommendations in the current debate on the future Common Agricultural Policy.

Keywords: agricultural policy, rural development, mountain farming, public goods, valuation

JEL classifications: H41, O13, O35, Q18, Q57, R11, R52

* Bundesanstalt für Bergbauernfragen, Marxergasse 2, A-1030 Wien, Austria. Corresponding author: thomas.dax@berggebiete.at; http://orcid.org/0000-0002-0281-0926

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Introduction

Land use and land management are increasingly analysed as activities that include functions that go well beyond their primary objectives and economic focus. It has been widely acknowledged for several decades that agricultural and forestry systems 'produce', in addition to food, timber and fibre, a great variety of public goods and ecosystem services. These joint products are of particular relevance for many rural regions, and positively contribute to rural vitality.

While the production function is seen as a result of individual firm business decisions, the latter functions increasingly attract public attention, manifested in discussions surrounding the provision of social and ecological goods and services from land management such as biodiversity, climate change mitigation, water management, soil erosion, rural vitality and rural depopulation, as well as animal welfare objectives among many others (Randal, 2002; Cooper *et al*., 2009; Renting *et al*., 2009; Dwyer and Hodge, 2016). Public goods and ecosystem services have increasingly gained attention in agricultural policy evolution and reform considerations as a result of the public demand expressed by this debate. In particular, the recent reform of the Common Agricultural Policy (CAP) (Erjavec and Erjavec, 2009) and the current preparation of shaping the CAP for the period after 2020 (Matthews, 2016; Buckwell *et al*., 2017) take legitimacy from linking land management types and management intensity with resulting levels of public goods and ecosystem service provision. Instruments of the agri-environmental programmes are the most direct expression of these relationships (OECD, 2013). Despite the commonly-acknowledged high public value and the elaboration of a set of policy interventions to secure public goods, there is increasing concern of a potential undersupply of crucial public goods with regard to current and future societal demand (Cooper *et al*., 2009; Stoate *et al*., 2009; Maréchal *et al*., 2017; Nilsson *et al*., 2017), and inherent limited impact of policy intervention (Westhoek *et al*., 2013).

Considering the wide variety of different landscape types as well as the variance in the effects of different management systems in the European Union (EU), the importance of better understanding how agriculture and forestry contribute to the provision of public goods becomes evident (van Zanten *et al*., 2014; Lefebvre *et al*., 2015). Yet, previous research mostly addresses this issue from an agricultural landscape perspective. The EU's Horizon 2020 Framework Programme commissioned, through a targeted call (ISIB-1-2014), two respective European research projects (PEGASUS and PROVIDE) to investigate the provision of public goods and ecosystem services from agriculture and forestry activities in the EU, and to formulate recommendations how to secure beneficial outcomes from and target policies at supporting sufficient levels of appropriate land management systems. This paper draws on the work of the PEGASUS ('Public Ecosystem Goods and Services from land management – Unlocking the Synergies') project, which focuses on the assessment of drivers that stimulate and/or hinder the service provision.

The project's approach does not only take into account land use and resource systems, but also integrates the actors' perspective, the organisation and effectiveness of governance regimes and institutional settings and place-specific dynamics (Dwyer *et al*., 2015). In analysing the wide scope of influences on how land management adopts effective strategies to provide such services, a social-ecological system based approach has been selected. This paper provides a synthesis of the comparative analysis of a range of case studies across EU Member States and regions, and summarises the emerging findings of the project work (Maréchal and Baldock, 2017; Sterly *et al*., 2017).

To display the relevance of this approach, the paper starts by presenting the theoretical concept and the methodological background of the project. It continues by discussing the main results of the selected in-depth case studies. The research goal is to develop a knowledge base regarding the role of these factors in provisioning beneficial outcomes to society in order to develop guidance and recommendations for both policy design and practice. The summary of findings in the following section thus highlights the main common findings, which intend to be a source for practitioners' action and policy considerations.

Theory and methodological background

The underlying theoretical concepts behind public goods and ecosystem services respectively are rooted in different disciplines but at the same time share much in common. The former looks through the lens of (neoclassical) economics while the latter provides an environmental science-based point of view (MEA, 2005; Dwyer *et al*., 2015). In order to capture both social and environmental aspects in an integrated way, the project elaborated a working concept that emphasises the intended 'positive' outcomes by the term 'environmentally and socially beneficial outcomes' (ESBOs) (Maréchal *et al*., 2016). Acknowledging the vast spatial differences in the environmental and socio-cultural context (van Zanten *et al*., 2014), as well as the differences in pan-European land use history and institutional settings, the project bases its empirical evidence on a set of 34 case studies in varied topographical and climatic conditions across ten EU Member States (Figure 1) (Maréchal *et al*., 2016). These are not only characterised by their spatial variation, but reflect also the important variability in land management systems across Europe. Out of these, a subset of twelve case studies was selected for in-depth analysis (Table 1). The selection was particularly based on the significance of empirical findings as well as access to stakeholders. Each case study represents some specific initiative or other forms of collective action at local, regional or territorial level.

The empirical findings of each case study are based on local, regional and national data sets, a range of semi-structured stakeholder interviews, focus groups and workshop sessions. In order to illustrate the systemic interrelations between natural resources, cultural aspects, governance regimes, drivers and actors which all impact on the provision of ESBOs to different degrees, a social-ecological system framework was applied for each case study (Figure 2). The SES framework is seen as instructive in sharpening the analysis on key influences, interrelations and acting persons as well as diverse policy and external inputs. It is particularly important to view this concept not as a static one, but rather as a structure that focuses analysis on the area observed. The interlinkages beyond the studied area are very important and (increasingly) affect the provision of ESBOs and the effectiveness of regional action.

While it is already a challenge to evaluate the impact of a certain driver on the provision of a single ESBO, it is even more challenging to evaluate how they interact synergistically in a social-ecological system on multiple ESBOs. In order to reduce the complexity and in an attempt to increase the significance of the findings, the case studies focus on key ESBOs which are primarily impacted by the case study initiatives. Yet, it is acknowledged that the analysed cases have an impact on a cascade of ESBOs. In Figure 2, the different clusters of the social-ecological system framework represent the variables involved in provisioning public goods while the arrows showcase the interactions between these clusters.

Figure 1: Locations of all 34 case study areas in the PEGASUS H2020 research project. The circles indicate the twelve in-depth case studies listed in Table 1.
Source: Maréchal and Baldock (2017)

Table 1: The twelve in-depth case studies and related environmentally and socially beneficial outcome (ESBO) provision.

No.	Study topic	Key ESBOs[1]
1	Organic farming label in the mountain Murau region	8, 10
2	Birds and amphibians support on wet meadows	8, 10, 12
3	Traditional orchard meadows in Hessen/Baden-Württemberg	8, 9, 10, 13
4	Grass-fed beef	4, 8, 10, 11, 12
5	Volvic water company, management agreements and agri-forestry	1, 2
6	Processed tomato supply chain in the Tomato District of northern Italy	1, 2, 6, 7
7	Bergamot, niche and organic products in Calabria	8, 10, 12
8	Outdoor-grazing payments in dairy farming	6, 8, 10, 11
9	Skylark foundation, a farmers' association for sustainable arable farming	1, 6
10	Small-scale peri-urban mosaic in Montemor-o-Novo	12
11	Agri-forestry in sub-alpine Slovenia (Upper Savinja Valley)	8, 10
12	WILD river basin management initiative	1, 5, 12

[1](1) water quality; (2) water availability; (3) air quality; (4) climate change mitigation; (5) flood protection; (6) soil functionality; (7) soil protection; (8) species and habitats; (9) pollination; (10) landscape character and cultural heritage; (11) farm animal welfare; (12) rural vitality; (13) educational activities
See Figure 1 for the geographical locations of the case studies
Source: IfLS/CCRI (2017)

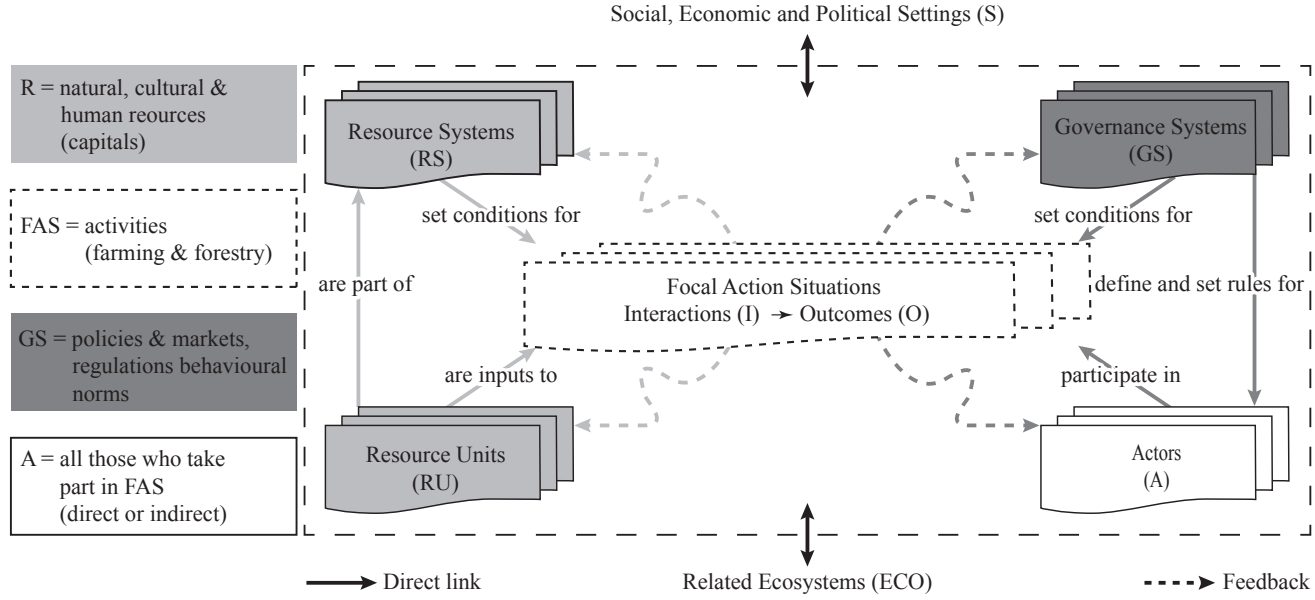

Figure 2: Illustration of a social-ecological system.
Source: adapted from McGinnis and Ostrom (2014)

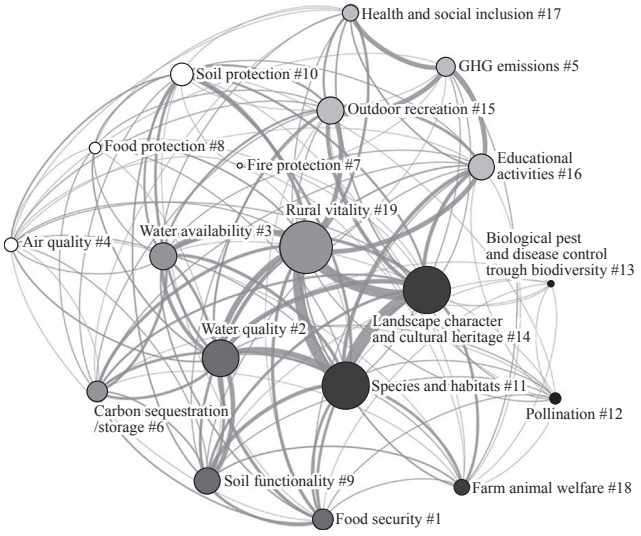

Figure 3: Distribution of environmentally and socially beneficial outcomes (ESBOs) among the case studies in the PEGASUS H2020 research project.
Source: Sterly *et al.* (2017)

In terms of ESBOs addressed within the case study areas, Figure 3 provides an indication of the main scope of relevance of the ESBOs. The case studies predominately focus on species and habitats (#11), rural vitality (#19), and landscape character and cultural heritage (#14). It seems important that there is great interrelation between these three ESBOs (co-production) which mutually strengthen each other. The distribution of the frequency of ESBOs is also due to the choice of case studies which indirectly were selected to support analysis in those areas which are most severely affected by 'negative' trends and threats of land abandonment and neglect of public goods provision. This leads also to the overall picture that the following important aspects are covered only to a limited extent: greenhouse gas emissions (#5), pollination (#12), fire protection (#7), and biological pest and disease control (#13). The presentation is not meant to make any allusion of the representativeness of the ESBOs across Europe; for such an analysis a comparative selection process of a wide larger number of areas would be required.

Emerging findings

In the analysis of the PEGASUS project, the project teams investigated a variety of approaches to providing public goods by a wide range of stakeholders, including in particular farmers, local administration, environmental bodies, local and national and international enterprises, and regional and national authorities. These actors aim in the analysed case studies to enhance the provision of public goods and ecosystem services in rural areas. In view of the wide range of these actors it was particularly important to capture their myriad intentions, views and experiences, and include alternative and effective governance systems (Rounsevell *et al*., 2012). The following findings are derived from the common analysis of all the case studies and the project analysis, aiming at recommendations for future policy adaptation and suggestions for practical work in relation to ESBO provision (Maréchal and Baldock, 2017).

All cases showed that the provision of ESBOs is driven by a wide range of different mechanisms that show overlapping and controversial features. It is evident that changes in ESBO provision are tied to a variety of social, cultural and institutional drivers (Mantino *et al*., 2016), which in some cases are also complemented by market forces and/or structural changes. Societal trends and aspirations of local actors are also decisive incentives in ESBOs appreciation, but quite often this becomes visible only through product and market differentiation strategies, market development, creation of higher value added as well as various forms of collective action (Knickel *et al*., 2017).

Table 2: Land use / management practices and associated provisioning mechanisms in the twelve in-depth case studies.

No.	Prevailing / concerned land use and management practices	Main mechanisms of initiatives	Additional aspects
1	Pastures (combined with dairy or meat production): Extensive, organic production, hay farming, dairy farming, cattle breeding, also forestry.	Private actor initiative built on consumer concern: Price premium for high quality milk from specific and localised production system as well as CAP payments.	
2	Pastures (combined with dairy or meat production): Irrigated (extensive) grassland for hay production, hunting.	Consumer/citizen concerns: Ecological enrichment of managed grassland through modified irrigation system and nature-friendly agriculture on a private reserve 'for birds and for the people' (purchase of land).	NGO-driven.
3	Permanent crops: Traditional orchard meadows, very extensive, organic production.	Consumer/citizen concerns: Crop surcharge initiative; creation of a new branding/labels, and of alternative supply chains / new product lines that can be connected back to traditional orchards and the related ecological benefits.	Private – citizens collaboration.
4	Pastures (combined with dairy or meat production): Grass-fed organic beef production.	Private actor initiative built on consumer concern: Whole value chain approach (production-processing-marketing) of grass-fed organic beef led by farmers' NGO Liivimaa Livaheis.	
5	Mixed land use systems: Mixed forest (53 per cent), mainly unmanaged; dominant agricultural land use: pasture, beef production, some (limited crop area).	Private actor led - territorial: The main strategy is to motivate appropriate land management and technical innovations by farmers/foresters via the provision of subsidies to land users to manage the risk of water contamination effectively.	Private sector water supplier with extensive interests in catchment.
6	Focus on tomato production (IPM and micro-irrigation introduction), in general: agriculture, mostly arable crops (wheat, maize) and forage. But also significant livestock farming.	Private actor initiative built on consumer concern: Interregional large-scale supply chain; innovative agricultural practices (integrated production, controlled irrigation and environmental certification) to reduce costs and increase crop competitiveness.	
7	Permanent crops: Citrus production, conventional and organic; irrigated, fertilising not so relevant, larger- and smaller-scale producers, intensification generally linked to landscape; water saving methods; rising share of organic production.	Private actor initiative built on consumer concern: Consortia trying to maintain the economic viability of distinctive bergamot production through market integration and cooperation in the food chain as well as CAP-derived aid.	
8	Pastures (combined with dairy or meat production): Grazing of dairy cows, manure management; rather intensive, but trend towards more animal welfare: trade-off between manure legislation and outdoor grazing: increasing the scale of production tends to be more efficient with in-house production systems.	Private actor initiative built on consumer concern: Branded cheese 'Beemsterkaas' is produced from defined outdoor-grazing systems.	
9	Arable crops and horticulture: Arable farms, with irrigation, some livestock keeping; intensive, innovations towards sustainable principles.	Private actor led - other: Sector-based funding mechanism (farmers and production related companies) to improve management in intensive systems e.g. to support buffer strips along field margins in return for land to be leased elsewhere.	
10	Mixed land use systems: Mixed small-scale land use: olives, sheep, vegetables, fruits; gravity irrigation; some beekeeping, hunting.	Private actor initiative built on consumer concern: Collective action by farmers and the linkage with other actors; Raising awareness about the value of rural life and increasing appreciation of aspects of it. Reviving/re-establishing local supply chains and more direct connections between smaller-scale producers and consumers.	Consumer concern.
11	Forestry: Mostly mountain forests, scattered rather large farms: ruminants, dairy and meat (sheep, cattle), managed forests.	Private actor initiative built on consumer concern: Private initiatives connecting producers and consumers (re. mountain wood).	
12	Mixed land use systems: Agriculture mostly commercial arable agriculture with some grazing land, small amounts of private woodland; major shifts from cattle production, increasing sheep counts; introducing herbal lay, increased arable land.	Consumer/citizen concerns: The strategy is to involve farmers and local communities in developing the understanding and commitment to the actions needed and sustained effort.	NGO and public body partnership.

See Table 1 for the topic of each case study
Source: adopted from Sterly *et al*. (2017)

Table 2 highlights the identified mechanisms of the selected in-depth case studies, which are closely associated with fostering provision. These mechanisms range from public sector governance-driven factors through consumer and citizen concerns-driven aspects to private actors-led initiatives at local or regional level. The case studies provide evidence that ESBOs are more effectively delivered when the initiative arises as a collective effort and trust relationships exist among regional or supply chain actors. This suggests that ESBOs are more effectively delivered when the mechanisms driving the provision are more strongly rooted in the respective territories, landscapes and supply chains, allowing institutions and governance regimes to work jointly towards desired outcomes. Critical success factors for building initiatives were identified as social capital, trust, transparent and inclusive communication, and cooperation. The following triggers were most frequently mentioned as being responsible for setting up collective initiatives: economic opportunities as well as the need to react to economic pressure was a prominent incentive of the analysed initiatives. The response to this was often to supply a premium market in connection with quality- and origin-centred marketing schemes. Examples for this approach are the case study on premium haymilk labelling in Austria (CS1; Nigmann *et al*., 2017) as well as organic grass-fed beef in Estonia (CS4). Regulations designed to stimulate or maintain certain land use practices and agricultural activities in certain areas were another powerful trigger. These may range from agri-environmental measures through Natura 2000 payments to payments associated with Areas of Natural Constraints. Environmental challenges may also stimulate collective action as in the case of UK catchment management (CS12). However, an important underlying factor for the creation and success of collective initiative is societal appreciation ultimately responsible for the protection and enhancement of ESBOs.

In many cases, the success of a certain initiative was based on an interplay between private and public actors. These relationships can take up different forms, ranging from purely public entity-driven, to mainly private commercial-driven over to voluntary- and civil society-driven and, most often, a combination of all of them. The way these interactions work depends strongly on local governance regimes and the respective collective initiative. The case studies suggest that taking into account these governance and institutional aspects also at a local level provides a better understanding of how collective initiatives and effective provision of ESBOs can be incentivised and maintained. Also in this sense, trust between actors including public officials and commercial actors acts as a vehicle for enabling the emergence of collective action.

Besides the supply of ESBOs, it is also relevant to understand the demand side. Therefore, all case studies engaged in a qualitative assessment of the appreciation of ESBOs by different actors. The development of causal linkages between the actions within initiatives and the level of provision and related demand is in most cases characterised by complex linkages and, quite often, substantial changes over time. As such, it is hardly feasible to delineate explicit causality. Complex interlinkages suggest the need to focus on direct or indirect indicators for levels of appreciation as, for example, the level of consumer demand and willingness to pay premia for certain product or service attributes, the level of farmer or NGO engagement as well as wider political discourse around certain types of management practices related to ESBO provision. Some cases showed how the 'value' of an ESBO can become either directly or indirectly part of agri-food products or services and how related costs for ESBO provision can partially be recovered via the value chain.

Beyond these direct and immediate market relationships, a more long-term perspective on the shaping of values and the underlying 'cultural' recognition of valorisation of products and activities that include the provision of public goods is crucial. This refers to the basic prerequisite of the existence of public appreciation (within a specific area and/or in the greater regional/national and societal context). Activities that increase public appreciation of ESBOs (specified for the context and particular topic) and which are conceived in a way so that they are able to transform this into demand seem particularly promising. This demand can either be directly expressed in pecuniary terms but may also take up different forms such as the creation of initiatives that sustain rural identity, which indirectly can be supportive to agro-tourism activities and regional competitiveness. In general, increasing the public's appreciation of environmental and social goods and services from agriculture and forestry systems could therefore contribute to transform this into an articulated demand and, consequently, would contribute to an increased provision.

In the current policy debates (see in particular the present discussion on the CAP post-2020 reform; Dax and Copus, 2016; EC, 2017), the proof of legitimacy of public funding is a 'hot' topic which centres increasingly on verifying and achieving the intended impact. The linkages from project analyses towards policy conclusions is rendered difficult as causal relationships between land management (both agricultural and forest management) and related ESBOs can hardly be delivered due to their complexity. At most, specific parts and immediate effects are analysed and described with sufficient accuracy. To some extent, the 'weakness' of this approach is due to the short timescale of studies and evaluation of programmes. The PEGASUS case studies and the project's mapping work underscore the difficulties in finding definite answers for closing these gaps.

In analysing the current provision and the potential to increase ESBOs, the involvement of local actors is indispensable if realisation of the concept and effectiveness is sought. The highly participatory approach applied in the PEGASUS study proved to be a useful method to capture some of the multiple interactions taking place between drivers, actors, practices and the outcomes delivered. It seems the most interesting way to detect and follow local application and relationships between different types of ESBOs and different types of land management. However, there are important limitations to this approach as it risks some environmental or social needs being overlooked (especially when these are more difficult to address such as climate issues). For the conclusive recommendations at the various scales this would mean that policy and practice should be

informed by a bottom-up/collective approach in combination with well-informed guidance from higher levels and regulatory schemes.

Conclusions

The observations across the diverse rural regions covered by the PEGASUS project revealed the presence of and the need to shape further and enhance ESBO provision through a place-based approach. This involves particular care in linking to local conditions, without neglecting the decisive national and European influences on local developments.

The high recognition of the topic in the CAP, but also in the demand for many of the public goods, is already 'translated' into market relationships. Many cases showed how markets for primary products and in particular how product differentiation and demand for quality regional products impact land use decisions and management practices. Hence, the private sector can be an important stimulus and agent of change. However, there is evidence that regional 'markets' are insufficient and market mechanisms alone are inadequate to secure appropriate provision of ESBOs.

The policy context and relevant regulations must not be neglected in any case, with the CAP having a core role through its interpretation and implementation at Member State level for the provision of ESBOs. While policies and instruments focusing directly on ESBOs, such as the agri-environmental scheme and nature protection measures, are significant, the indirect impact of other CAP measures and other EU and national policies are also critically important.

The interplay between public policies, private initiatives and market mechanisms have been shown to be the clue for understanding the relationship between land management and shaping the level of provision of public goods. Comparative analysis supports the strong reliance on context, history and evolution, recognition and demand, and differentiation by types of regions, institutional settings and land management systems. These findings hold a series of important lessons and conclusions for the discussion on the reform of the future CAP.

They indicate the serious need for incorporating a systems perspective in policy assessment and conceptualisation that addresses the multitude of triggers and drivers for land management. Spatial variance and differentiation of land management types is crucial for a proper understanding of relationships of land management practices to beneficial outcomes and for shaping policies that pay attention to the large scope of differentiation across EU regions and land management activities.

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References

Buckwell, A., Matthews, A., Baldock, D. and Mathijs, E. (2017): CAP - Thinking Out of the Box: Further modernisation of the CAP – why, what and how? Brussel: RISE Foundation.

Cooper, T., Hart, K. and Baldock, D. (2009): Provision of Public Goods through Agriculture in the European Union, Report Prepared for DG Agriculture and Rural Development. London: Institute for European Environmental Policy.

Dax, T. and Copus, A. (2016): The Future of Rural Development, in Research for AGRI Committee – CAP Reform Post-2020 – Challenges in Agriculture, Workshop Documentation. Brussel: European Parliament, 221-303.

Dwyer, J. and Hodge, I. (2016): Governance structures for social-ecological systems: Assessing institutional options against a social residual claimant. Environmental Science and Policy **66**, 1-10. https://doi.org/10.1016/j.envsci.2016.07.017

Dwyer, J., Short, C., Berriet-Solliec, M., Gael-Lataste, F., Pham, H-V., Affleck, M., Courtney, P. and Déprès, C. (2015): Public Goods and Ecosystem Services from Agriculture and Forestry – a conceptual approach. Deliverable 1.1. of the EU H2020 project PEGASUS.

EC (2017): The Future of Food and Farming. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee of the regions. COM(2017) 713 final. Brussel: European Commission.

Erjavec, K. and Erjavec, E. (2015): 'Greening the CAP' – Just a fashionable justification? A discourse analysis of the 2014–2020 CAP reform documents. Food Policy **51**, 53-62. https://doi.org/10.1016/j.foodpol.2014.12.006

IfLS/CCRI (2017): Case study reports – Step 3-4. Developing innovative and participatory approaches for PG/ESS delivery. Deliverable 4.3. of the EU H2020 project PEGASUS.

Knickel, K., Dwyer, J., Baldock, D., Hülemeyer, K., Dax, T., Westerink, J., Peepson, A., Rac, I., Short, C., Polman, N. and Brouwer, F. (2017): Approaches to an enhanced provision of environmental and social benefits from agriculture and forestry. Synthesis of Deliverable 4.3. of the EU H2020 project PEGASUS.

Lefebvre, M., Espinosa, M., Gomez y Paloma, S., Paracchini, M.L., Piorr, A. and Zasada, I. (2015): Agricultural landscapes as multi-scale public good and the role of the Common Agricultural Policy. Journal of Environmental Planning and Management **58** (12), 2088-2112. https://doi.org/10.1080/09640568.2014.891975

Mantino, F., Vanni, F. and Forcina, B. (2016): Socio-political, economic and institutional drivers. A cross-country comparative analysis. Synthesis report. Deliverable 3.3. of the EU H2020 project PEGASUS.

Maréchal, A. and Baldock, D. (2017): Key emerging findings from the PEGASUS project. Report published as part of the EU H2020 project PEGASUS.

Maréchal, A., Baldock, D., Hart, K., Dwyer, J., Short, C., Pérez-Soba, M., Paracchini, M.L., Barredo, J.I., Brouwer, F. and Polman, N. (2016): The PEGASUS conceptual framework. Synthesis report. Deliverable 1.2. of the EU H2020 project PEGASUS.

Matthews, A. (2016): The Future of Direct Payments, in Research for AGRI Committee – CAP Reform Post-2020 – Challenges in Agriculture, Workshop Documentation. Brussel: European Parliament, 3-86.

McGinnis, M.D. and Ostrom, E. (2014): Social-Ecological System Framework: Initial Changes and Continuing Challenges. Ecology and Society **19** (2), article 30. https://doi.org/10.5751/ES-06387-190230

MEA (2005): Ecosystems and Human Well-being: Synthesis. A Report of the Millennium Ecosystem Assessment. Washington DC: Island Press.

Nigmann, T., Hovorka, G. and Dax, T. (2017): Organic farming in the mountain region Murau. National report Austria. Deliverable 4.3. of the EU H2020 project PEGASUS.

Nilsson, L., Andersson, G.K.S., Birkhofer, K. and Smith, H.G. (2017): Ignoring ecosystem-service cascades undermines policy for multifunctional agricultural landscapes. Frontiers in Ecology and Evolution **5**, article 109. https://doi.org/10.3389/fevo.2017.00109

OECD (2013): Providing Agri-environmental Public Goods through Collective Action. Paris: OECD Publishing.

Randal, A. (2002): Valuing the outputs of multifunctional agriculture. European Review of Agricultural Economics **29** (3), 289-307. https://doi.org/10.1093/eurrag/29.3.289

Renting, H., Rossing, W.A., Groot, J.C., Van der Ploeg, J.D., Laurent, C., Perraud, D., Stobbelaar, D.J. and Van Ittersum, M.K. (2009): Exploring multifunctional agriculture. A review of conceptual approaches and prospects for an integrative transitional framework. Journal of Environmental Management **90** (2), S112-S123. https://doi.org/10.1016/j.jenvman.2008.11.014

Rounsevell, M.D.A., Robinson, D.T. and Murray-Rust, D. (2012): From actors to agents in socio-ecological systems models. Philosophical Transactions of the Royal Society B **367** (1586), 259-269. https://doi.org/10.1098/rstb.2011.0187

Stoate, C., Baldi, A., Beja, P., Boatman, N.D., Herzon, I., van Doorn, A., de Snoo, G.R., Rakosy, L. and Ramwell, C. (2009): Ecological impacts of early 21st century agricultural change in Europe – a review. Journal of Environmental Management **91**, 22-46. https://doi.org/10.1016/j.jenvman.2009.07.005

Sterly, S., Baldock, D., Dwyer, J., Hart, K. and Short, C. (2017): Synthesis report on cross-cutting analysis from WPs 1-4. Deliverable 5.1. of the EU H2020 project PEGASUS.

Van Zanten, B., Verburg, P., Espinosa, M., Gomez-Y-Paloma, S., Galimberti, G., Kantelhardt, J., Kapfer, M., Lefebvre, M., Manrique, R., Piorr, A., Raggi, M., Schaller, S., Targetti, S., Zasada, I. and Viaggi, D. (2014): European agricultural landscapes, common agricultural policy and ecosystem services: a review. Agronomy for Sustainable Development **34** (2), 309-325. https://doi.org/10.1007/s13593-013-0183-4

Westhoek, H.J., Overmars, K.P. and van Zeijts, H. (2013): The provision of public goods by agriculture: Critical questions for effective and efficient policy making. Environmental Science & Policy **32**, 5-13. https://doi.org/10.1016/j.envsci.2012.06.015

Roman RUDNICKI*, Aleksandra JEZIERSKA-THÖLE*, Łukasz WIŚNIEWSKI*, Jörg JANZEN and Leszek KOZŁOWSKI***

Former political borders and their impact on the evolution of the present-day spatial structure of agriculture in Poland

The paper deals with the results of an analysis of the spatial structure of agriculture in Poland which was aimed at assessing the impact of the historical factor. The territory of present-day Poland includes the political borders of the 19th and 20th centuries which divided the area into two parts: western (Kingdom of Prussia and the land belonging to Poland and Germany in the interwar period) and eastern (the land of the Russian Empire and the Austro-Hungarian Empire which later belonged to Poland in the interwar period). The historical factor and its impact were examined also in the comparative analysis of two adjoining stretches of land accepted as territorial units (East Poland and West Poland). We showed that historical borders constitute an important element affecting the evolution of the spatial structure of Polish agriculture. The impact of the historical factor was shown to be the strongest for the differences in the features associated with agrarian structure, rural socio-demography, and productivity and profitability of agricultural holdings.

Keywords: agrarian structure, agricultural development, historical factor
JEL classifications: Q10, N53, N54

* Uniwersytet Mikolaja Kopernika w Toruniu, Lwowska 1, 87 100 Toruń, Poland. Corresponding author: alekjez@umk.pl; https://orcid.org/0000-0002-7607-9531
** Freie Universität, Berlin, Germany.
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Introduction

The current spatial development of Poland features clearly-visible outcomes of the marked westward relocation of the national borders after World War II. At the Potsdam Conference in 1945, the leaders of the USA, the UK and the Soviet Union agreed that the Polish state would take possession of some territory that belonged to Germany before 1939. Poland thereafter included historical borderlines from the 19th and 20th centuries which, during the time when capitalism was replacing the feudal system, had separated diametrically-opposite agricultural systems or, to make things more complicated, immeasurably dissimilar socio-economic systems (Janzen, 1998; Viehrig, 2007). The process had commenced in the 19th century and evolved at the time when the Polish territory was partitioned by three states: Austria, Prussia and Russia, each of which had a different level and pace of economic development. The regional imbalances were still evident in the interwar period (Kostrowicka *et al*., 1984, Goldstein and Klüsener, 2010), which enhanced the significance of the Human Development Index (HDI, general level of development and state of agricultural culture) for the formation of the spatial structure of agriculture (Wyczański, 2003). Consequently, the post-1945 Polish borders contained rural areas with a highly differentiated agrarian structure and agricultural traditions, and a different history of settlement and economic development.

Owing to the nature of the Polish political and economic history and as a result of the current Polish borders being drawn as recently as 1945, within the scope of the agricultural geography of Poland, the historically-shaped diversification of spatial structures in agriculture became an important research topic. Research has been carried out particularly by Kostrowicki (1968, 1973, 1978), as well as Bański (1999, 2007), Falkowski and Kostrowicki (2001), Kulikowski (2004), Rudnicki (2016) and Stanek *et al*. (2017). The methodology established by these researchers involved the analysis of agriculture in the form of a package of internal features (whereby several sub-groups are distinguished), the spatial patterns of which are analysed with regard to the external features of agriculture – natural and anthropogenic – such as agricultural production area quality; historical and economic determinants; urbanisation and industrialisation; food industry; access to communication; commercial outlets; and agriculture-related state policy (Falkowski and Kostrowicki, 2001).

Studies on the differences between agricultural systems, land use and land development in the context of present-day political borders have shown that large-scale socio-economic and political factors considerably affect the methods of spatial management in Europe (Kuemmerle *et al*., 2006; Lukas and Pöschl, 2006). Notwithstanding that, the literature (e.g. Juchler, 2000; Pawlak, 2004; Czapiewski and Kulikowski, 2005; Dannenberg and Kulke, 2005; Rumney, 2005) is deficient in terms of studies devoted to the *permanence* of the outcomes of the politically-driven divisions in European agriculture. The three major theoretical approaches in agricultural geography (based on the environment, economy and behavioural patterns; cf. Ilbery, 2014) make no mention of the role of borders in the development of agriculture, even though spatial studies of agriculture draw attention to the substantial impact of state-imposed agricultural policy and of the procedures of regionalisation and classification. The attempts to explain the diversified patterns in spatial structures in agriculture are currently being dominated by the integrated approach which combines various points of view and a multitude of methods, and enables a more effective explanation of the causes of spatial phenomena and processes (Lukas and Pöschl, 2005).

This paper is an attempt at the comprehensive analysis of the spatial structure of Polish agriculture with special regard to the impact of the historical factor. It enriches the body of

knowledge on the changes in spatial structures in agriculture, for example, by providing an answer to the question about the permanence of the consequences arising from the co-existence of different economic systems. The research is based on the results of the National Agricultural Census of 2010 (NAC 2010) and their spatial distribution, taking into account the most important political borderlines of the 19th and 20th centuries which can be traced in the present-day area of Poland.

We divided the territory of the bygone Kingdom of Poland into West Poland (with particularisation of the land belonging to Poland and Germany in the interwar period) and East Poland (land of the Austro-Hungarian Empire and the Russian Empire). According to the agricultural production area quality index for Poland, which averaged 66 points as calculated from data published by the Polish Institute of Soil, Science and Plant Cultivation, Puławy in 2000, the two separated areas do not differ much in terms of natural conditions. The western part scored 69 points, whereas the eastern part recorded 65 points. Thus, it can be assumed that the registered disproportions in agricultural features result from the impact of anthropogenic conditions, particularly the historical ones. The (LAU 1) *powiat* was used as the basic unit of the spatial analysis – the study covered 314 administrative units, according to the organisational division of the Agency for Restructuring and Modernisation of Agriculture. The *powiat* of Bieruń and Lędziny in Śląskie *Voivodship* and the *powiat* of Golub Dobrzyń in Kujawsko-Pomorskie *Voivodship* were impossible to qualify unambiguously to one or the other type due to their doubt-arising borderline; therefore, they were categorised upon another criterion: number of agricultural holdings (Rudnicki, 2009).

Methodology

Definition of territorial units

The analysis of the historical determinants was carried out within the timeframe marked by the important events of 1815 (Congress of Vienna, which maintained the political division of Europe); 1919 (Treaty of Versailles, which gave rise to the state of Poland); and 1945 (Potsdam Conference, which marked the current political borders of Poland). It facilitated the division of the *powiats* of the present-day Poland into two groups:

- Area of the Kingdom of Prussia (referred to here as 'West Poland' (WP), including the area which belonged to Germany and Poland in the period 1919-1939, i.e. the following (NUTS 2-level) *voivodships*: Dolnośląskie, Lubuskie, Opolskie, Pomorskie and Warmińsko-Mazurskie, and some of the *powiats* of Kujawsko-Pomorskie, Śląskie and Wielkopolskie *voivodships*. Our analysis also accounted for the bipartite division of this area, including the territories of two historical units: (a) the Kingdom of Prussia in the period of the Polish Partitions and Germany in the interwar period (KP/G); and (b) the Kingdom of Prussia in the period of the Polish Partitions and Poland in the interwar period (KP/P).
- Area of the Austrian and area of the Russian Partitions (referred to here as 'East Poland' (EP), including the area which belonged to Poland in the interwar period, i.e. the following *voivodships*: Lubelskie, Łódzkie, Mazowieckie, Podkarpackie, Podlaskie and Świętokrzyskie, and some of the *powiats* of Kujawsko-Pomorskie, Śląskie, and Wielkopolskie *voivodships*. Our analysis also accounted for the bipartite division of this area, including the territories of two historical units: (a) the Russian Empire in the period of the Polish Partitions and Poland in the interwar period (RE/P); and (b) the Austro-Hungarian Empire in the period of the Polish Partitions and Poland in the interwar period (AHE/P).

Owing to its more than one hundred-year-long existence and its major impact on the diversification of the HDI in Poland, the border between the historical Prussian Partition and the joint area of the Russian and Austro-Hungarian Partitions is of non-negligible significance. For this reason, we distinguished two belts of border-area *powiats* (BAP-W and BAP-E), and the difference in the level of their agricultural features was juxtaposed to the difference between their superior historical units (WP, EP). This provided grounds for drawing conclusions on the permanence of this borderline and its impact on the diversification of the spatial structure of the Polish agriculture (Figure 1).

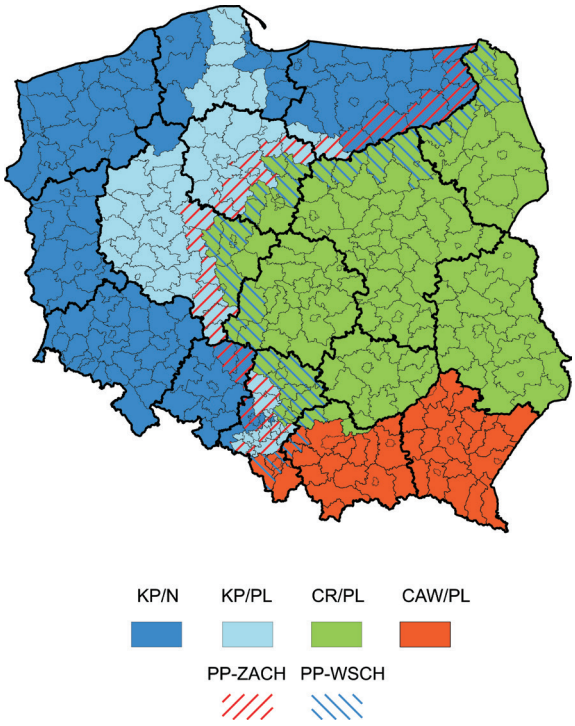

Figure 1: Political division of the territory of present-day Poland in the 19th and 20th centuries.

Key: PL-ZACH → West Poland – Prussian Partition, including: KP/N → KP/G – Kingdom of Prussia and Germany in the interwar period; KP/PL → KP/P – Kingdom of Prussia and Poland in the interwar period; PL-WSCH → East Poland – Austrian and Russian Partitions, including: CR/PL → RE/P – Russian Empire and Poland in the interwar period; CAW/PL → AHE/P – Austro-Hungarian Empire and Poland in the interwar period; PP-ZACH → BAP-W – belt of border area *powiats* in West Poland (along border with East Poland); PP-WSCH → BAP-E – belt of border area *powiats* in East Poland (along border with the West Poland)
Source: own composition

Box 1: The internal features used to describe the spatial structure of Polish agriculture.

I. Land quality and land use. These are important determinants of agricultural development, which in economic terms affect the scale of production:

1. Percentage of priority zone areas covered by agri-environment support in the total area of agricultural land (see Rudnicki, 2007 for details of areas of high environmental value);
2. Percentage of areas ranked highly for their ecological and natural values in the total area of agricultural holdings (excluding plantation areas; applies to: forest land, meadows, grazing land and fallow land).

II. Agrarian structure. Polish agriculture is characterised by a fragmented area structure:

3. Average area of farm with at least 1 ha agricultural land;
4. Percentage of farms with over 50 ha agricultural land in the total area of agricultural holdings;
5. Average area (ha) of a plot in agricultural holdings.

III. Socio-demographic features of agriculture. Agrarian overpopulation, unfavourable demographic structure and low farmer education are features of Polish agriculture:

6. Index of labour input in agriculture (features: number of workers per 100 ha agricultural land – in form of destimulant; agricultural area per AWU; ratio of full-time farm workforce – 2,120 hours/year or more – to the total farm workforce);
7. Age structure of farm managers (features: percentage of farms under management of one person for over 20 years – in form of destimulant; percentage of young farm managers (i.e. < 34 years of age); weighted average of farm managers' age – in form of destimulant);
8. Index of farm managers' education (features: percentage of farm managers with comprehensive education – high school, college and university graduates – in the total number of farm workers; number of people with agriculture-related qualifications in the total number of farm managers; average length of (relevant) vocational education).

IV. Technical infrastructure in agricultural holdings. These can determine the method of agricultural management, and can influence the increase of work efficiency and the increase of the productivity of the land:

9. Level of agricultural mechanisation (features: number of symbolic units of agricultural mechanisation per agricultural holding, whereby the following conversion formulae were applied: combine harvesters x 3 units; tractors x 2 units; other machines x 1 unit; number of tractor-mounted machines per tractor; number of combine, potato and beet harvesters – altogether per 100 ha of agricultural land);
10. Level of agricultural chemicalisation (features: consumption of dry component mineral and lime fertilisers (NPK and CaO) in kg per ha agricultural land; percentage of the total number of agricultural holdings using mineral fertilisers);
11. Index of water management in agriculture (features: irrigation systems in agricultural holdings – their share in the total number of agricultural holdings and in the total area of agricultural holdings, i.e. only the area of plantations which can be irrigated);

V. Agricultural production structure. This describes the level of agricultural production – crop and livestock production as well as the degree of agricultural commodity:

12. (Related to plant production): percentage of intensive farming (orchards, vegetables and industrial crops) in the total area of agricultural land;
13. (Related to animal production): percentage of animal production in the global agricultural production (see Goraj *et al*., 2012 for the determination of the global agricultural production.

VI. Agricultural productivity and profitability. These determine the financial income obtained from the sale of agricultural products and from non-agricultural activities:

14. Agricultural productivity index (basic features showing the global agricultural outputs per ha agricultural land, per agricultural holding with agricultural activity and per farm worker [AWU]);
15. Agricultural profitability index (features: percentage of agricultural holdings where the share of incomes from agricultural activity is greater than 50 per cent of the total income of that holding; percentage of households with non-agricultural incomes in the total number of agricultural holdings; and percentage of agricultural holdings using up to 50 per cent of residual value of agricultural outputs for self-supply in the total number of agricultural holdings).

Source: own compilation

Determination of internal features of agriculture

An agricultural database was compiled, based on the NAC 2010, which constituted a set of different kinds of elements (percentages, points etc.). To render them comparable and to undertake a holistic approach, specific internal features of agriculture were given in the form of standardised scores. The original value was replaced by the result of multiplication of the difference between a feature value, its mean average and the standard deviation value. Consequently, all the variables were comparable, the average of their statistical distributions equalled zero and their variances and standard deviations were expressed in full unity digits (Racine and Raymond, 1977). Such an analysis – according to Perkal's method – facilitated the presentation of the average standardised score of particular internal features and general agricultural development in

terms of both specified agricultural segments and the composite approach (average value of the segments). Fifteen internal features, gathered into six groups, were used to describe the spatial structure of Polish agriculture (Box 1).

The procedure of feature standardisation was also used in the analysis of the historical conditions and their impact on the spatial structure of agriculture. In order to carry out this analysis, the set of agricultural data and the indices used were aggregated for the specified historical units. The differences between the values of these standardised scores were the basis of the index of impact assessment of the historical factor in agriculture, which – in the form of absolute values – stood behind the creation of a five-point bonitation scale of that impact, i.e.: 1 point (< 0.25 – very weak impact); 2 points (from 0.25 to 0.50 – weak impact); 3 points (from 0.50 to 0.75 – significant impact); 4 points (from 0.75 to 1.00 – strong impact); and 5 points (> 1.00 – very strong impact on spatial diversification of agriculture). This method was applied to all the fifteen internal features presented in this paper and to all groups of the internal features of agriculture.

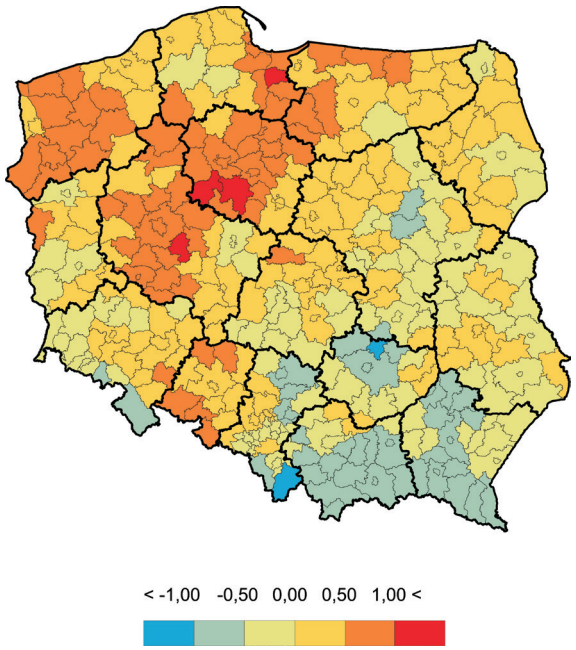

Figure 2: Level of general agricultural development in Poland by *voivodship* and *powiat* (means of standardised scores; as of 2010).

Key: distribution range by *voivodships* [RV]: from -0.71 in Podkarpackie *Voivodship* to 0.66 in Kujawsko-Pomorskie *Voivodship*; distribution range by *powiats* [RP]: from -1.34 in the *powiat* of Żywiec in Śląskie *Voivodship* to 1.39 in the *powiat* of Środa Wielkopolska in Wielkopolska *Voivodship*]

Source: own composition

Results

Internal features of agriculture

The level of general agricultural development was calculated as the average of the sum of the standardised values of the six groups of the internal features of agriculture listed in Box 1. It is characterised by large spatial variations at both the *voivodship* and *powiat* levels (Table 1 and Figure 2).

Spatial diversification of the historical units

The spatial diversification based on the political borderlines of the 19th and 20th centuries (the period of Partitions and between the World Wars) evinced large differences across Poland in the impact of historical factors. That diversification was assessed by the calculation of several agricultural features (as of 2010), taking their average levels for *powiats* and aggregating them for the historical units established earlier (Tables 2 and 3).

Table 1: Values of the internal features of agriculture and the level of general agricultural development in Poland by *voivodship* (means of standardised scores; as of 2010).

Voivodship	Internal features						General development
	I*	II	III	IV	V	VI	
Dolnośląskie	0.09	0.70	-0.13	-0.13	-0.30	-0.04	0.03
Kujawsko-Pomorskie	0.44	0.71	0.88	0.67	0.37	0.86	0.66
Lubelskie	0.11	-0.43	0.03	0.04	-0.25	-0.15	-0.11
Lubuskie	0.01	1.03	-0.03	-0.52	-0.05	0.09	0.09
Łódzkie	0.42	-0.46	0.19	0.68	-0.06	0.14	0.15
Małopolskie	-0.64	-0.72	-0.76	-0.65	-0.55	-0.61	-0.66
Mazowieckie	-0.33	-0.30	0.32	0.23	-0.04	0.30	0.03
Opolskie	0.86	0.70	0.16	0.53	0.26	0.42	0.49
Podkarpackie	-0.52	-0.56	-1.03	-0.76	-0.58	-0.84	-0.71
Podlaskie	-0.69	0.04	0.65	-0.05	-0.07	0.48	0.06
Pomorskie	0.33	1.20	0.58	0.11	-0.02	0.40	0.43
Śląskie	0.03	-0.46	-0.97	-0.43	-0.16	-0.48	-0.41
Świętokrzyskie	0.04	-0.66	-0.47	-0.09	-0.27	-0.33	-0.29
Warmińsko-Mazurskie	-0.13	1.49	0.64	-0.34	0.03	0.62	0.38
Wielkopolskie	0.35	0.44	0.69	0.51	0.36	0.82	0.53
Zachodniopomorskie	-0.05	2.14	0.55	-0.30	0.17	0.78	0.55

See Box 1 for descriptions of the six groups of internal features I-VI

* destimulant

Source: own calculations

Table 2: Values of the internal features of agriculture and the level of general agricultural development in selected historical and spatial units in Poland (as of 2010).

Internal feature		West Poland				East Poland			
			Including				Including		
Group	Feature	Total	Historical unit		BAP-W	Total	Historical unit		BAP-E
			KP/G	KP/P			RE/P	AHE/P	
I		0.21	0.15	0.30	0.14	-0.17	-0.07	-0.66	-0.29
	I.1	0.00	-0.02	0.03	0.19	0.00	0.01	-0.04	-0.15
	I.2	0.42	0.33	0.58	0.10	-0.35	-0.16	-1.28	-0.43
II		0.98	1.19	0.64	0.53	-0.48	-0.38	-0.64	-0.35
	II.3	0.92	1.06	0.71	0.51	-0.31	-0.11	-0.72	-0.13
	II.4	0.93	1.25	0.35	0.40	-0.82	-0.86	-0.58	-0.83
	II.5	1.09	1.25	0.86	0.68	-0.30	-0.16	-0.61	-0.10
III		0.36	0.26	0.49	0.30	-0.14	0.15	-0.92	0.04
	III.6	0.69	0.72	0.65	0.52	-0.31	-0.01	-1.36	0.09
	III.7	-0.21	-0.42	0.07	0.03	0.07	0.35	-0.59	0.06
	III.8	0.60	0.48	0.76	0.36	-0.19	0.10	-0.82	-0.04
IV		0.09	-0.17	0.47	0.37	-0.06	0.19	-0.82	0.13
	IV.9	-0.13	-0.44	0.32	0.26	0.10	0.41	-0.90	0.29
	IV.10	0.31	0.04	0.69	0.42	-0.25	0.03	-1.05	0.04
	IV.11	0.09	-0.12	0.41	0.45	-0.03	0.12	-0.51	0.05
V		0.20	-0.02	0.42	0.14	-0.17	-0.11	-0.52	-0.02
	V.12	0.36	0.40	0.29	-0.01	-0.32	-0.26	-0.63	-0.69
	V.13	0.03	-0.44	0.55	0.28	-0.03	0.03	-0.41	0.64
VI		0.52	0.31	0.84	0.55	-0.17	0.08	-0.77	0.19
	VI.14	0.64	0.39	1.04	0.60	-0.21	-0.04	-0.69	0.20
	VI.15	0.40	0.23	0.63	0.50	-0.13	0.20	-0.85	0.18
General development		0.39	0.29	0.53	0.34	-0.20	-0.02	-0.72	-0.05

See Box 1 for descriptions of the internal features 1-15 and their groups I-VI
See Figure 1 for definitions of the spatial units
Source: own calculations

Table 3: Selected elements of historical and comparative analysis based on index of impact assessment of historical factor in agriculture (difference between absolute values of standardised scores of agricultural features in point bonitation system*) including indicator of permanence of historical borders in agriculture.**

Internal feature		Nationwide perspective		By historical differences in						Indicator of permanence of historical borders in agriculture	
				West Poland		East Poland		Border areas			
Group	Feature	IAHFA† (WP) – (EP)		KP/G – KP/P		RE/P – AHE/P		(BAP-W) – (BAP-E)		(WP – EP) – (BAP-W – BAP-E)	
		Difference	Points	Difference	Points	Difference	Points	Difference	Points	Difference	Label/ points
I		0.38	2	-0.15	1	0.59	3	0.43	2	-0.05	R/1
	I.1	-0.01	1	-0.06	1	0.06	1	0.33	2	-0.34	R/2
	I.2	0.77	4	-0.24	1	1.12	5	0.53	3	0.24	F/1
II		1.46	5	0.55	3	0.26	2	0.88	4	0.57	F/3
	II.3	1.23	5	0.35	2	0.62	3	0.64	3	0.59	F/3
	II.4	1.75	5	0.90	4	-0.28	2	1.24	5	0.51	F/3
	II.5	1.39	5	0.40	2	0.45	2	0.77	4	0.62	F/3
III		0.50	3	-0.23	1	1.07	5	0.27	2	0.24	F/1
	III.6	1.00	5	0.07	1	1.34	5	0.43	2	0.57	F/3
	III.7	-0.28	2	-0.49	2	0.95	4	-0.03	1	-0.25	R/2
	III.8	0.79	4	-0.28	2	0.93	4	0.40	2	0.39	F/2
IV		0.15	1	-0.64	3	1.01	5	0.25	1	-0.10	R/1
	IV.9	-0.23	1	-0.76	4	1.31	5	-0.03	1	-0.20	R/1
	IV.10	0.56	3	-0.65	3	1.08	5	0.38	2	0.18	F/1
	IV.11	0.12	1	-0.52	3	0.63	3	0.40	2	-0.28	F/2
V		0.37	2	-0.43	2	0.41	2	0.16	1	0.21	F/1
	V.12	0.68	3	0.12	1	0.37	2	0.68	3	0.00	R/1
	V.13	0.06	1	-0.98	4	0.45	2	-0.37	2	0.42	F/2
VI		0.68	3	-0.52	3	0.85	4	0.36	2	0.32	F/2
	VI.14	0.84	4	-0.64	3	0.65	3	0.40	2	0.45	F/2
	VI.15	0.52	3	-0.40	2	1.05	5	0.32	2	0.20	F/1
General development		0.59	3	-0.24	1	0.70	3	0.39	2	0.20	F/1

* below 0.25: 1 point; 0.25-0.50: 2 points; 0.50-0.75: 3 points; 0.75-1.00: 4 points; above 1.00: 5 points
** R: rise in index value; F: fall in index value; below 0.25: 1; 0.25-0.50: 2; above 0.50: 3
† Impact assessment of the historical factor in agriculture
See Box 1 for descriptions of the internal features 1-15 and their groups I-VI
See Figure 1 for definitions of the spatial units
Source: own calculations

Nationwide perspective

From the nationwide perspective, the impact of the historical factor is determined by the differences in agricultural features between the territory of the Prussian Partition and the joint territories of the Austrian and the Russian Partitions. The difference in the standardised scores of these features was taken as the basis for assessing the impact of the historical factor on agriculture and for providing an answer to the following research question: is the former, more than a century-old border a determinant of the present-day spatial diversification in agriculture (cf. Kozłowski and Rudnicki, 2003)?

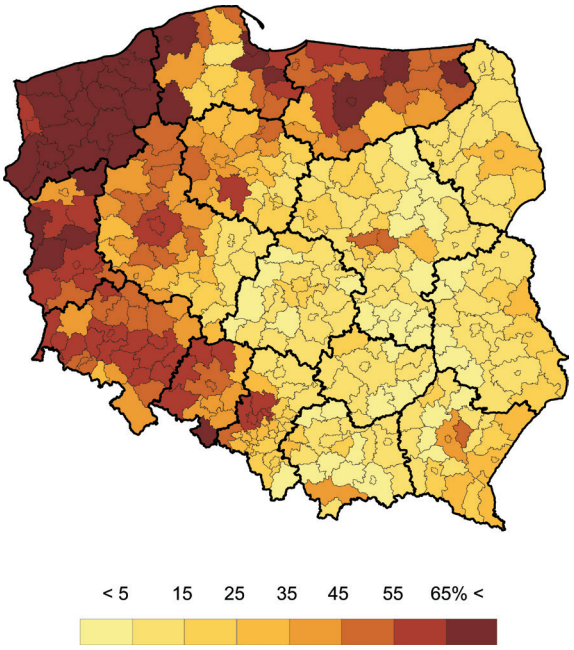

Figure 3: Percentage of farms with over 50 ha agricultural land in total area of agricultural holdings in Poland by *voivodship* and *powiat*, as of 2010.

Key: average for Poland: 30.3 per cent; distribution range by *voivodships* [RV]: from 6.5 per cent in Świętokrzyskie *Voivodship* to 70.7 per cent in Zachodniopomorskie *Voivodship*; distribution range by *powiats* [RP]: from 0.9 per cent in the *powiat* of Sucha Beskidzka in Małopolskie *Voivodship* to 84.2 per cent in the *powiat* of Słubice in Lubuskie *Voivodship*
Source: own composition

The studies demonstrated significant differences in the level of general agricultural development in West Poland (0.39) and East Poland (-0.20), with the index of impact assessment of the historical factor in agriculture amounting to 0.59 (3 points). The index had higher values in the territory of the Prussian Partition for all six internal features of agriculture, as defined above (from 1 point for features of technical infrastructure in agricultural holding, to 5 points for features of agrarian structure). Among the fifteen internal features of agriculture, only two (no. 7: age structure of farm managers; and no. 9: level of agricultural mechanisation) were lower in the Prussian Partition than in the Austrian and Russian Partitions (together). For four other features the impact of the historical factor was very strong (5 points) and was the strongest for the feature of agrarian structure – percentage of farms with over 50 ha agricultural land in total area of agricultural holdings – from 0.93 in WP (51.5 per cent) to -0.82 (11.6 per cent) in EP (a difference of 1.75: 5 points) (Figure 3).

Territory belonging to the Kingdom of Prussia

The analysis of the spatial differences in the agriculture of the area belonging to the Kingdom of Prussia included its division in the interwar period into: territories belonging to Germany (KP/G) and to Poland (KP/P). From the NAC 2010 it was evident that the area lying within the Polish borders in the interwar period (KP/P) had a higher level of agricultural development – 0.53 (KP/G – 0.29; difference of 0.24, i.e. 1 point). As regards the internal features of agriculture, only those representing the agrarian structure had a higher value in the area belonging to Germany in the interwar period (difference of 0.55, i.e. from 1.19 KP/G to 0.64 KP/P).

The differences in the internal features of agriculture were usually at the level of 1-3 points. A wider disproportion between the territories – at the level of 4 points (strong impact of the historical factor) – was registered only for features 4 and 13, whereby a stronger impact was measured for the share of the animal production in the global agricultural production: from -0.44 (41.1 per cent) in KP/G to 0.55 (56.7 per cent) in KP/P (Figure 4).

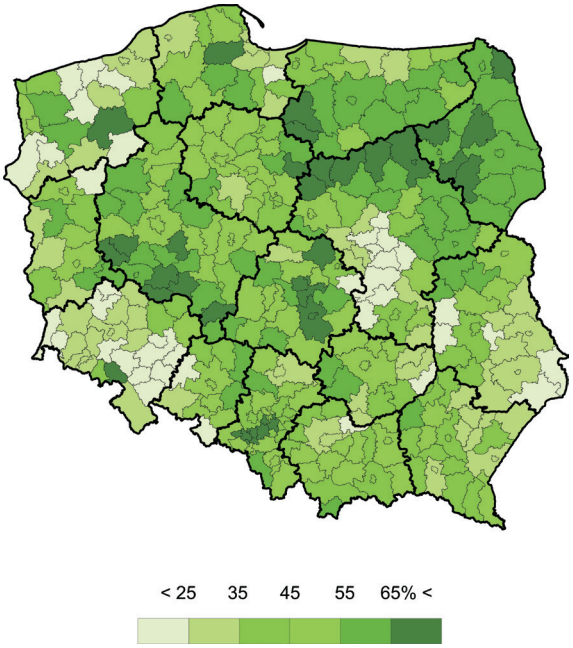

Figure 4: Share of animal production in global agricultural production in Poland by *voivodship* and *powiat*.

Key: average for Poland: 48.1 per cent; distribution range by *voivodships* [RV]: from 27.4 per cent in Dolnośląskie *Voivodship* to 63.4 per cent in Podlaskie *Voivodship*; distribution range by *powiats* [RP]: from 4.5 per cent in the *powiat* of Grojec in Mazowieckie *Voivodship* to 86.2 per cent in the *powiat* of Żuromin in Mazowieckie *Voivodship*
Source: own composition

Differences between territories of Russian Empire and Austro-Hungarian Empire

The impact assessment of the historical factor in the agriculture of East Poland included also the differences between the *powiats* lying within the borders of the Russian Partition (average of -0.02) and the Austrian Partition (average of

-0.72). The index showed the impact to be significant (0.70: 3 points). Only three of the internal features of agriculture in the Austrian Partition exceeded those in the Russian Partition (no. 7: 1 point; no. 9: 1 point; no. 13: 2 points). The widest gap between the territories (1.31: 5 points) was characteristic of feature no. 9 (level of agricultural mechanisation) from 0.41 (RE/P) to -0.90 (AHE/P). (Figure 5).

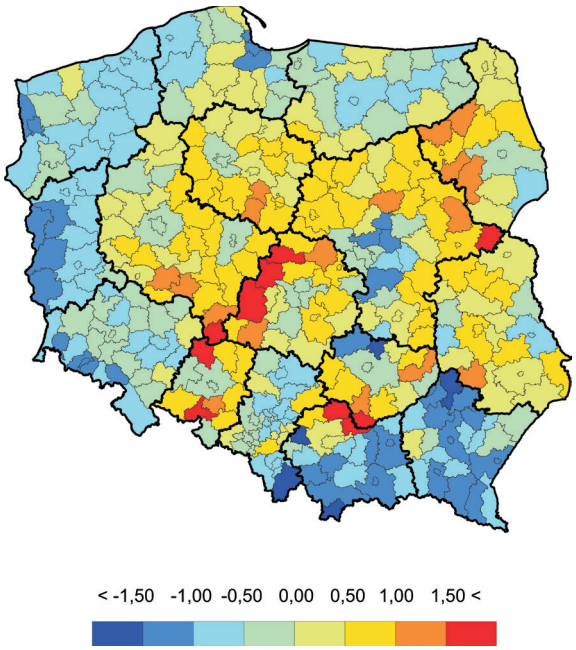

Figure 5: Level of agricultural mechanisation in Poland by *voivodship* and *powiat* (as of 2010; standardised score).

Key: distribution range by *voivodships* (RV): from -0.92 in Lubuskie *Voivodship* to 0.75 in Łódzkie *Voivodship*; distribution range by *powiats* (RV): from -2.15 in the *powiat* of Zakopane in Małopolskie *Voivodship* to 3.03 in the *powiat* of Kazimierza Wielka in Świętokrzyskie *Voivodship*
Source: own composition

Differences between belts of powiats

Within the study on the permanence of the impact of the former political borderline on agriculture, two adjoining belts of *powiats* were distinguished: those situated in West Poland (27 *powiats*; average level of general agricultural development at 0.34) and East Poland (29 *powiats*; average level of general agricultural development at -0.05).

The impact of the historical factor, at 0.39 (2 points: weak impact), was lower than that achieved in the nationwide analysis (WP; EP: 0.59). It implies that the historically-shaped differences in the spatial structure of Polish agriculture are gradually disappearing. To quantify this phenomenon, we introduced into the analysis another index – one which showed the permanence of historical borders in agriculture. Narrowing down of these differences (F-indicator in Table 3) was most pronounced in the groups of features describing the agrarian structure (0.57: 3 points) and agricultural productivity and profitability (0.32: 2 points). It was also noteworthy in the case of the average area of a plot in agricultural holdings (feature no. 5; result of 0.62: 3 points).

On the other hand, the phenomenon also had a completely opposite manifestation. Apart from the naturally-determined feature describing the percentage of priority zone areas covered with agri-environment support in the total area of agricultural land (feature no. 1; result of -0.34), the converse situation to the one described above was the most conspicuous in the group of features defining the technical infrastructure in agricultural holdings (features no. 9 – level of agricultural mechanisation; and no. 11 – index of water management in agriculture). This is disappointing, particularly owing to the fact that our analysis shows the agriculture and its conditions in 2010, by which time it had already been supported by European Union (EU) agricultural financial support programmes for almost seven years.

Discussion

The analysis of the spatial structure of Polish agriculture demonstrated that, in spite of Polish membership of the EU and coverage of agricultural holdings with several instruments within the Common Agricultural Policy in the context of considerable socio-economic growth, the conclusion of Kostrowicki (1978) is still valid, namely that Polish agriculture in its spatial structure has been highly diversified, whereby – at the national level – the differences are not so much associated with the variety of natural conditions as with historical events. Polish agriculture is characterised by a strong spatial diversification, usually marked by polarisation – with western Poland at one end of the scale (domination of features with a high indexation) and eastern Poland at the other end (domination of features with a low indexation) – and vast complexity of spatial arrangements in these areas. For example, the highest level of general agricultural development was found in the group of *powiats* situated within the borders of the Kingdom of Prussia and Poland in the interwar period; and the lowest level was registered in those of the Austro-Hungarian Empire.

The comparative analysis of the historical factor and its impact assessment in the agriculture of border area *powiats,* in juxtaposition to the indexation applying to Poland as a whole, showed that the historically-determined disproportions in the spatial structure of Polish agriculture were, in general, less and less overwhelming (the tendency was reflected by the four groups of internal features of agriculture and seven internal features). However, the phenomenon took an entirely opposite turn in the case of the features describing land quality and land use as well as those related to the technical infrastructure in agricultural holdings – here the historically-conditioned differences widened.

The present-day spatial patterns in agriculture (as of 2010) first and foremost result from the substantial impact of the historical factor (WP-EP: 0.59: 3 points). Even though Poland has been in existence for nearly seventy years, the principal determinant of the spatial diversification of its agriculture is represented by the historical conditions and defined by remarkably large disproportions in agricultural features between western and eastern Poland. The historical conditions have the potential for an all-encompassing impact on agriculture. From the nationwide perspective and with regard to the set of specified segments, their impact on the features of technical infrastructure in agricultural holdings was very weak (1 point); in the case of the features describing land quality and land use as well as agricultural production struc-

ture it was weak (2 points); it was stronger (3 points) for the socio-demographic features of agriculture and the features associated with agricultural productivity and profitability. Finally, for the features of agrarian structure the impact was very strong (5 points). How necessary is the narrowing of these disproportions is an issue considered by Rosner (2012) and Stanny (2013), and is an essential problem in the context of the socio-economic growth, including agriculture.

We can conclude from our results that the differences in the internal features of agriculture in territories which used to be subject to dissimilar economic systems are disappearing over time, most rapidly along the border between these systems; whereas the further away it is from that historical border, the permanence of the differences is gaining in prevalence. The regional and rural development policy lines should aim to eliminate the disproportions associated with the level of agricultural productivity and with the living standards of rural population.

From our results, it is now possible to answer the question about the permanence and the role of the historical factor – i.e. bygone socio-economic systems and political borders – in the present-day spatial structure of Polish agriculture. We demonstrated that the historical factor constitutes a significant determinant of diversity in the spatial structures of agriculture, especially the agrarian structure. Although the differences occurring along the former political border are vanishing, they remain potent in the territories further away from that borderline. This is a good basis for discussion on the role of the contemporary national borders in the agriculture of the EU. What is left for further deliberations is whether the present-day national borders in Central and Eastern Europe, including those between the EU Member States, have any significant impact on agricultural development, and if so, the extent of that impact.

References

Bański, J. (1999): Obszary problemowe w rolnictwie Polski [Problem areas in Polish agriculture]. Warszawa: IGiPZ-PAN.

Bański, J. (2007): Geografia rolnictwa Polski [Geography of Polish agriculture]. Warszawa: Polskie Wydawnictwo Ekonomiczne.

Czapiewski, K. and Kulikowski, R. (eds) (2005): Dorobek naukowy geografii rolnictwa w Polsce [Scientific achievements of agricultural geography in Poland]. Warszawa: IPiGZ-PAN.

Dannenberg, P. and Kulke, E. (2005): The Importance of Agrarian Clusters for Rural Areas. – Results of Case Studies in Eastern Germany and The West Poland. Die Erde **136** (3), 291-312.

Falkowski, J. and Kostrowicki, J. (2001): Geografia rolnictwa świata [Geography of agriculture in the world]. Warszawa: Wydawnictwo Naukowe PWN.

Goldstein, J.R. and Klüsener, S. (2010): Culture Revisited: Geographic Analysis of Fertility Decline in Prussia. MPIDR Working Paper WP-2010-012. Rostock: Max Planck Institute for Demographic Research.

Goraj, I., Bocian, M., Cholewa, J., Nachtman, G. and Tarasiuk, R. (2012): Współczynniki Standardowej Produkcji dla celów Wspólnotowej Typologii Gospodarstw Rolnych [Standard production coefficients for the purposes of the Community Typology of Agricultural Holdings]. Warzsawa: IERiGŻ-PIB.

Ilbery, B.W. (2014): Theory and Methodology in Agricultural Geography, in M. Pacione (ed.), Progress in Agricultural Geography. Abingdon: Routledge.

Janzen, J. (1998): Agrarstrukturwandel in Westpolen [Agricultural structural change in western Poland]. Geographische Rundschau **50** (1), 42-48.

Juchler, J. (2000): Zehn Jahre Transformationsprozess in Polen [Ten years of transformation process in Poland]. Osteuropa **50** (2), 189-200.

Kostrowicka, J., Landau, Z. and Tomaszewski, J. (1984): Historia gospodarcza Polski XIX-XX wieku [The economic history of Poland in the 19th and 20th centuries]. Warszawa: Książka i Wiedza.

Kostrowicki, J. (1968): Agricultural Typology, Agricultural Regionalization, Agricultural Development. Geographia Polonica **14**, 265-274.

Kostrowicki, J. (1973): Zarys geografii rolnictwa [Outline of agricultural geography]. Warszawa: Państwowe Wydawn. Naukowe.

Kostrowicki, J. (ed.) (1978): Przemiany struktury przestrzennej rolnictwa Polski 1950-1970 [Transformations of the spatial structure of Polish agriculture 1950-1970]. Warszawa: IGiPZ-PAN.

Kozłowski, L. and Rudnicki, R. (2003): Historical-economic basis of present regions in Poland. Proceedings of the International Conference 'Between Schengen Space and Enlargement to the East: The Territorial Recombining of the European Union', International Geographical Union, Commission on Political Geography. Metz and Schengen, 134-141.

Kuemmerle, T., Radeloff, V.C. Perzanowski, K. and Hostert, P. (2006): Cross-border comparison of land cover and landscape pattern in Eastern Europe using a hybrid classification technique. Remote Sensing of Environment **103** (4), 449-464. https://doi.org/10.1016/j.rse.2006.04.015

Kulikowski, R. (2004): Przestrzenne zróżnicowanie i przemiany rolnictwa w Polsce po 1990 r. [Spatial differentiation and changes in agriculture in Poland after 1990], in J.J. Parysek (ed.), Rozwój regionalny i lokalny w Polsce w latach 1989-2002. Poznań: Bogucki Wydawnictwo Naukowe, 193-209.

Lukas, Z. and Pöschl, J. (2005): Die Landwirtschaft der neuen Mitgliedsstaaten im Jahr danach [The agriculture of the New Member States the year after]. Osteuropa-Wirtschaft **50** (2), 125-150.

Lukas, Z. and Pöschl, J. (2006): Die Landwirtschaft der neuen Mitgliedsstaaten im Integrationsprozess [The agriculture of the New Member States in the integration process]. Osteuropa-Wirtschaft **51** (3-4), 193-211.

Pawlak, Z. (2004): Strukturwandel der Landwirtschaft in Westpolen [Structural change of agriculture in western Poland], in H. Stoll (ed.), Strukturwandel in Ostdeutschland und Westpolen. Hannover: Akademie für Raumforschung und Landesplanung, 91-102.

Racine, J.B. and Reymond, H. (1977): Analiza ilościowa w geografii [Quantitative analysis in geography]. Warszawa: PWN.

Rosner, A. (ed.) (2012): Rozwój wsi i rolnictwa w Polsce. Aspekty przestrzenne i regionalne [Rural development and agriculture in Poland. Spatial and regional aspects]. Warszawa: IRWIR-PAN.

Rudnicki, R. (2007): Przyrodnicze uwarunkowania zróżnicowania przestrzennego procesu absorpcji funduszy Unii Europejskiej w rolnictwie polskim [Natural conditions of spatial diversity of the absorption process of European Union funds in Polish agriculture]. In: S. Grykień, and W. Hasiński (ed.): Przyrodnicze uwarunkowania rozwoju obszarów wiejskich. Studia Obszarów Wiejskich 12, 113-128.

Rudnicki, R. (2009): Renty strukturalne jako czynnik przemian agrarnych i demograficznych w rolnictwie polskim w latach 2004-2006 [Structural pensions as a factor of agrarian and demographic change in Polish farming over the years 2004-2006]. Poznań: Bogucki Wydawnictwo Naukowe.

Rudnicki, R. (2016): Rolnictwo Polski. Studium statystyczno-przestrzenne (lata 2002-2010) [Polish agriculture. Statistical

and spatial study (2002-2010)]. Toruń: Wydawnictwo Naukowe Uniwersytetu Mikołaja Kopernika.

Rumney, T.A. (2005): The Study of Agricultural Geography: A Scholarly Guide and Bibliography. Lanham MD: Scarecrow Press.

Stanek, P., Żółkiewski, P., Teter, W., Chabuz, W., Litwińczuk, Z. and Bochniak, A. (2017): The role of main fodder area as a factor limiting the development of farms under conditions of sustainable agriculture. A case study from the Podkarpacie region (southern Poland, Western Carpathians). Agroecology and Sustainable Food Systems **42** (5), 477-492. https://doi.org/10.1080/21683565.2017.1359809

Stanny, M. (2013): Przestrzenne zróżnicowanie rozwoju obszarów wiejskich w Polsce [Spatial diversification of rural development in Poland]. Warszawa: IRWiR-PAN.

Viehrig, H. (2007): Polens Landwirtschaft und ländliche Siedlungen in der Transformation [Poland's agriculture and rural settlements in the transformation]. Potsdam: Universitätsverlag Potsdam.

Wyczański, A. (2003): Wschód a Zachód Europy w początkach doby nowożytnej [East and West of Europe at the beginning of modern day]. Warszawa: Semper.

Erika QUENDLER*

CommunalAudit, a guide for municipalities in Austria to foster inclusive and sustainable development

Municipalities in Austria have been exploring ways to adopt inclusive and sustainable development approaches based on the built environment. It is a fact that the tasks of municipalities are becoming more and more comprehensive, while the resources available are not increasing to the same extent. However, the sustainable provision of municipal public services must remain a key component in strengthening rural areas. One way is to conduct a CommunalAudit. In addition to the identification of optimisation and development options, the CommunalAudit tool serves as a basis for inter-communal cooperation. Moreover, it enables municipalities to look at their finances and entire infrastructure in an objective and systematic way and to compare them with those of others. Between 2008 and 2013, the CommunalAudit was one of the measures within the Rural Development Programme in Austria. This contribution (a) explores the implementation of CommunalAudit in Austria, (b) highlights the benefits and drawbacks for municipalities and citizenry, and (c) looks at the former's further development.

Keywords: assessment, continuous improvement, evolution, inclusive, municipalities
JEL classification: R58

* Bundesanstalt für Agrarwirtschaft, A-1030 Wien, Marxergasse 2, Austria. erika.quendler@awi.bmnt.gv.at
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Introduction

Municipalities are continually trying to improve themselves to face the challenges of the times (Niedomysl, 2006; Curristine *et al*., 2007; USAID, 2012; Enichlmair, 2015; Patsiorkovskiy, 2017; RSC, 2017; ProAudit, undated; NCC, undated). The ongoing challenges for inclusive and sustainable development definitely include the provision of more public services with less public spending, along with maintaining the attractiveness of the local territory for inhabitants and business investments. In particular, they involve the demographic and social (e.g. ageing populations and increasing health care), the economic (e.g. job opportunities) and the ecological (e.g. energy consumption, availability of alternative energy) need to improve the quality of life (e.g. living conditions). These challenges and needs for municipal services add to budgetary pressures and call for efficiency in public spending. Citizens are demanding that municipalities be made more accountable for what they achieve, i.e. making their activities and performance transparent. There is a need for evidence that municipalities increase their efficiency and improve their administrative capabilities (Curristine *et al*., 2007). The scale and complexity of municipal tasks have been increasing while budget restraints have been tightening.

In order to support municipalities in their task-oriented, structural and financial development in the face of the challenges and needs referred to above, a tool called CommunalAudit was developed in Austria (ProAudit, undated; RSC, 2017), based on an initiative of the Federal Ministry for Agriculture, Forestry, Environment and Water Management (BMLFUW). CommunalAudits were first launched in 50 municipalities of eight Austrian provinces in the autumn of 2003. Currently, some municipalities have completed their CommunalAudit to varying extents. This tool helps a municipality to analyse itself, to identify synergies and cooperation potentials, to manage change and to improve quality of life at the local level. It is not a static process: it must continue (re-evaluation) to reflect the potential for change in the municipality today and in the future. A CommunalAudit mainly deals with the following themes: (a) the financial viability of local public services, (b) targeting, and hedging of funding, (c) cost and performance accounting, and (d) establishing an inter-communal knowledge platform (ProAudit, undated).

This paper examines CommunalAudit as a monitoring and evaluation tool to track the success of municipalities in terms of attractiveness and competitiveness in rural areas. The main focus is on CommunalAudit as a measure within the Rural Development Programme based on the data of the 2007-2013 ex-post evaluation (BMLFUW, 2016a). The analysis being undertaken intends to draw lessons from implemented CommunalAudits to advance the development of municipalities in the Austrian context. At the same time, focusing on the Austrian evidence will reveal areas where there are both benefits and gaps for municipalities and citizens. This notwithstanding, this paper also serves as the basis for guiding further activities and research to improve municipalities' performance and audits globally, and streamline the process.

General background

The general background clarifies the context of this paper by outlining the relevant definitions and concepts. They are backed up by examples of applications that analyse municipalities in other countries as well as similar initiatives which indirectly address municipalities.

Definitions

Achieving sustainable development has been hampered by trade-offs in favour of economic growth over social well-being and ecological viability in the assessment of the local economy. Equally, the concept of inclusive development emphasises the social, ecological and political dimensions of development (Gupta and Vegelin, 2016). Linking these two concepts at the level of municipalities gives useful insights

into the current state and the future development required. Development, and in particular the inclusive and sustainable development of municipalities, is the critical driver to achieve enduring 'destinations' or 'places of choice' for people and businesses. A municipality is a single unit administering a settlement or a group of settlements (Gabler Wirtschaftslexikon, undated), and inhabitants, households, production and infrastructure are located on its territory. Municipalities are the agents of spatial development and the regional economy as a whole (Patsiorkovskiy, 2017). Municipalities play a particularly important role in stimulating the living and working conditions for citizenry and businesses, along with sustaining lively rural areas.

To ensure the sustainable and inclusive development of rural areas, it is necessary to focus on a limited number of core objectives at community level which foster and sustain the competitiveness and attractiveness of municipalities (EC, 2006). In the context of CommunalAudit, competitiveness should be in line with Porter's (2004) definition of competitiveness focused on the idea of productivity. Using the same lens, local competitiveness is how a municipality perceives its resources and how it uses these to improve the standard of living in the local area. Competitiveness provides information about the municipality's attractiveness. The overall attractiveness of municipalities in rural areas relies on their competitiveness and ensures the inclusive and sustainable availability of goods and services for the entire population as well as the whole complex of market relations (Niedomysl, 2006; Patsiorkovskiy, 2017; ProAudit, undated). However, the attractiveness of municipalities is difficult to define due to its abstract and subjective nature.

The CommunalAudit is a tool to assess local performance and development of municipalities in rural areas. Despite huge differences in the social, cultural, ecological, economic and political circumstances between municipalities, there is a general consensus on the overall objectives (cf. intervention logic). The CommunalAudit in the context of the Rural Development Programme deals with different objectives as follows (a) increasing capacity for the implementation of local strategies in the form of skills acquisition and animation with a view to preparing and implementing a local development strategy, i.e. CommunalAudit, Local Agenda 21 actions, cooperation etc.; (b) reinforcing territorial coherence and synergies in view of enhancing human potential required for the diversification of the local economy and provision of local services, i.e. information exchange, cooperation, outsourcing etc.; and (c) improving the quality of life. These objectives should not be confused with the main features of proper management (such as efficiency, transparency, accountability and participation). Although the three categories of objectives are different in nature, they are strongly connected. The attractiveness and competitiveness of municipalities as well as the living conditions of the population cannot be improved in the long run if municipalities do not know their performance and their capacity for improvement.

Setting

A fascinating debate on development is going on which is driven by the different stakeholders. The literature on, and politics of, sustainable development suggest that achieving a certain level of strong sustainability is rare. This concept does not allow for trade-offs between economic, social and ecological goals. Politicians tend to prefer trade-offs in favour of the economy and disregard social and ecological issues (Lorek and Spangenberg, 2014). Furthermore, the processes of globalisation allocate resources through a poorly regulated market, resulting in a 'one dollar, one vote' approach, rather than a 'one person, one vote' system at the local and national level, or a 'one country, one vote' system at the global level (Karabarbounis, 2011; Piketty, 2014; Stiglitz, 2015).

While sustainable development has ecological, social and economic aspects, the difficulties in optimising all three aspects for present and future generations has led to the rise of concepts that embody dualities of this trinity, i.e. green economy/growth which combines the environment with the economy (UNEP, 2011; WB, 2012), green society which combines the environment with social goals, inclusive growth which combines growth with social aspects, and inclusive development which focuses on social and ecological aspects (Gupta and Baud, 2015). Green development (or growth) and inclusive development (or growth) are the two most dominant dualities, and both have neo-liberal roots but take on an additional dimension — either environmental issues or the need to share economic growth with the poorest.

To make all this come true, different initiatives have been set up at different levels. The most prominent one is the Local Agenda 21. Based on the United Nations Conference on Environment and Development held in Rio de Janeiro in 1992, the economy (economic prosperity, ecology), ecological equilibrium and social aspects (social justice) need to be considered for sustainable solutions to take shape at the local level. Following this conference, the 'European Campaign for Sustainable Cities and Towns' was launched in 1994 in Aalborg. On the basis of the Rio de Janeiro Agenda 21, the issue of realisation at the local level was treated in greater detail and specifically for Europe. In Austria, Local Agenda 21 was implemented as a measure within the Rural Development Programme in 2007. Local Agenda 21 is not supposed to replace initiatives such as village renewal (*Dorferneuerung*), the Climate Alliance, healthy community (*Gesunde Gemeinde*), Leader, Learning Regions, CommunalAudit etc., but to build on these and to supplement them (ÖGUT, undated). The common development objective of all these initiatives is to improve living conditions and promote development investment in rural areas through modern inclusive planning practices and strategies. The main difference lies in the underlying concept and the focus on development at the local level.

Related initiatives

The inclusive and sustainable development or growth of a country, however, is not more than the sum of the growth of its territories and, of those, the growth of their populations. In this regard, there is the need to promote the development of competitive and dynamic territories that attract and retain investment and generate greater business and job opportunities, fostering the best quality of life for their populations. With this vision in mind, there are instruments which could

Box 1: Examples of instruments which could contribute to improving the governance quality and the attractiveness of municipalities for businesses and residents.

- ***Municipal Competitiveness Index*** (MCI) measures the business-enabling environment at the municipal level. One striking characteristic of USAID's MCI is that it does not rely on secondary data (e.g. published data from statistical or other data providers), but on the perceptions and opinions of surveyed enterprises. The goal of this approach, which is based upon the direct experiences and circumstances faced by local businesses, is to identify and tackle constraints on private sector development at the local level. The idea behind the MCI is to increase competition between municipalities and to improve the dialogue with the business community. In order to approach the entrepreneurs, a sample of businesses is taken at municipal level. A survey is conducted through face-to-face interviews. The MCI distinguishes eight thematic sub-areas with a total of more than 30 individual indicators, namely (a) transparency, (b) municipal services, (c) proactivity, (d) informal payments, (e) public safety, (f) time to compliance, (g) rates and taxes, (h) entry costs and (i) municipal regulations (USAID, 2011; 2012; 2013; 2014). Scores are tallied for each MCI sub-index to determine how much one municipality differs from another in each aspect of the business environment being measured. The municipalities are ranked in a scale from 1 to 10 for each sub-index, where 10 represents the best relative performance and 1 stands for the worst. In order to create a general MCI score, all the scores of each sub-index are combined and weighted. Five performance categories were created to classify the results: excellent, high, average, low and very low (USAID, 2009).
- ***Municipal Competitiveness Review*** (MCR) is a concept for the measurement of municipal competitiveness that is easily applicable and replicable in Kosovo. It is based on the MCI. MCR consists of two components, municipal fact sheets and a municipality ranking. The fact sheets for each of the 38 Kosovar municipalities include primary and secondary data on issues influencing competitiveness at the local level, allowing for the comparison of specific indicators between the municipalities and Kosovo overall. The municipality ranking comprises a ranking according to four subgroups ('performance of the local business sector', 'supply of human resources', 'business support services' and 'infrastructure') and an overall ranking which takes into account all indicators (Enichlmair, 2015).
- ***Cities and Municipalities Competitiveness Index*** based on an overall competitiveness score. The overall competitiveness score is the sum of scores on three main pillars including pool data from several sub-indicators. The three main pillars cover (a) economic dynamism, (b) government efficiency and (c) infrastructure. Scores are biased by the values of the actual data, as well as the completeness of the submitted data. The higher the score, the higher the competitiveness (NCC, undated).

Source: own compilation

contribute to improving the governance quality and the attractiveness of municipalities for businesses and residents. Different countries or institutions have come up with the examples presented in Box 1.

Apart from these examples which directly address municipalities, there exist other concepts measuring competitiveness. Although these concepts refer to the national or regional level, from the content point of view they are very similar. Some also address the performance of the government (Murray, 1992; Curristine, 2005; Dooren, 2006; Curristine *et al*., 2007). The best-known concept for measuring competitiveness is 'Doing Business' by the World Bank (WB, 2014) which measures competitiveness on the national level in comparison with other economies. Another model which is of interest is the European Union (EU) Regional Competitiveness Index (RCI, Annoni and Dijkstra, 2013). It focuses on the NUTS 1 and NUTS 2 levels and utilises mainly secondary data collected by Eurostat, the World Economic Forum (since 2013), OECD-PISA and OECD-Regpat, the World Bank as well as and the Cluster Observatory.

Methodology

This paper aims at a better understanding of the functioning of municipalities by looking at the measure CommunalAudit within the Rural Development Programme. The Austrian experience implementing CommunalAudit serves as the background. Consistent with the need to focus on a limited number of core objectives, the amount, number or value of the CommunalAudit is judged in accordance with the Handbook on Common Monitoring and Evaluation Framework (CMEF) of the Rural Development Programme 2007-2013 (EC, 2006). The input (amount of public expenditure), output (number of audits, number of participants), result (number of participants that successfully ended an audit) and impact (on quality of life in rural areas) were analysed in detail.

Figure 1 summarises the hierarchy of objectives in the context of the rural development regulation for the CommunalAudit (EC, 2006). The intervention logic covers a series of indicators at different levels for the achievement of the objectives of the CommunalAudit in the local region. These are used to measure in simple terms: (a) what objectives did the CommunalAudit pursue, (b) were these objectives achieved and to what extent, and (c) how were they achieved? Data were gathered through an analysis of documents and through semi-structured interviews with experts. Furthermore, detailed information about the expectations and motivation for the implementation of a CommunalAudit from the persons responsible within the municipalities was available from an online survey by ProAudit (ProAudit, 2009). The further development is verified by the latest literature on CommunalAudit (BMLFUW, 2016b; RSC, 2017) and similar concepts and tools (USAID, 2009; Enichlmair, 2015; NCC, undated).

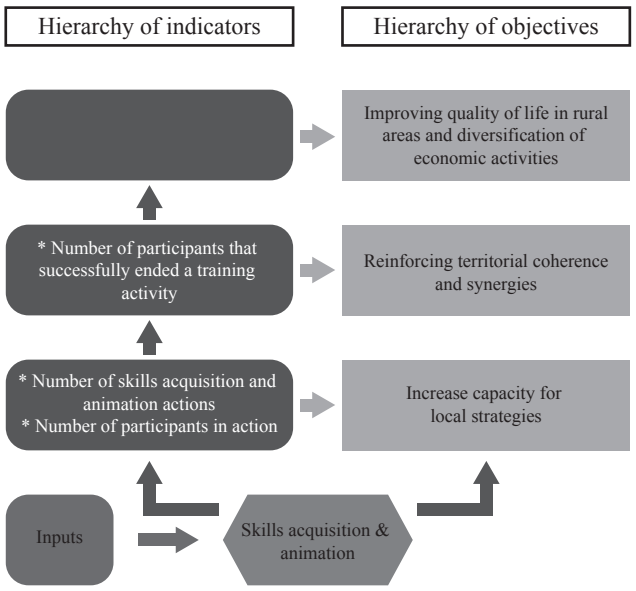

Figure 1: Evaluation scheme – link rationale of the measures and indicators.
Source: BMLFUW (2016a)

CommunalAudit's procedure

To know what a CommunalAudit is and to understand the results better, in this section the content-related description of the audit's procedure is explored. An audit is an evaluation or examination of a product, process or quality system by a person or a group of people (Russell, 2012). In this context, CommunalAudit is about professional consulting. The overall process of carrying out the CommunalAudit is shown in Figure 2. It covers the main elements funding, workshops, reporting and re-evaluation as well as the time requirement.

The CommunalAudit is voluntary. Once a municipality has decided to run one, there is a grant application. After the approval of funding, the audit starts with a kick-off workshop followed by three other workshops. After the final workshop the grant payment is made. A measure report for the improvement and development of the municipal services follows around six months after the final workshop. Then, 18 months after the measure report, there is a re-evaluation by the audit team.

The human and related resources required to manage, monitor and review the audit process should be made available. Each municipality that takes part in a CommunalAudit gets a password-protected access to the CommunalAudit interface. An integrated help system and an automated progress display support the survey process.

Firstly, the auditor presents the areas and submodules and explains the online tool. Next, data for the last three years in the areas *organisation* (submodules: administration, building yard and community facilities), *infrastructure* (submodules: water supply, sewage disposal, waste disposal, municipal roads, street lighting and energy), *finances* (submodules: comparison of the municipal services with the finances) and *environment* (submodules: quality of life and climate protection) are entered by the person responsible within the municipality. In the areas mentioned, more than 100 indicators are analysed to attain a picture of the competitiveness and attractiveness of the municipality. Comparing data and locations can identify savings potentials, assure the transparency and establish work strategies (for example outsourcing, cooperation) etc.

In the workshops the members of audit team work closely together. The audit team includes the auditor, the mayor and two employees of the municipality. Different experts are brought in when needed. CommunalAudit can either be carried out in one municipality, or several municipalities can undertake a CommunalAudit jointly. In the case of a single municipality audit, benchmarks are taken from the municipalities already analysed.

Results

This section illustrates, on the one hand, the assessment of the contribution to the overall objectives, given by EC (2006). On the other hand, it gives insights into the level of participation and geographical coverage in Austria, and into the motivation of the municipalities to implement a CommunalAudit.

Contribution to the core objectives

In the course of the audit, the indicators being analysed and the measures identified were assessed according to their contribution to the core indicators given by the EU (Figure 1). Of the indicators analysed, 72 per cent (130 out of 167) contributed to *increasing the capacity for local strategies*, as did 76 per cent (162 out of 214) of the measures set. Examples were funding from the LEADER programme, cooperation with private providers and other municipalities (library, museums etc.). Twenty-two per cent (36 out of 167) of the indicators analysed and 26 per cent (55 out of 214) of the measures set contributed to *reinforcing territorial coherence and synergies*. Examples were cooperation of the municipality with external providers (waste, water, education, consulting etc.), more tourist attractions, and shared municipal vehicle fleets, district heating, purchasing groups, exchange of information etc. Finally, 37 per cent (61 out of 167) of the indicators analysed and 42 per cent (89 out of 214) of the measures set contributed to the *improvement of the quality of life*. Examples were cooperation with regional providers (more kindergartens and services for old people, longer opening hours of communal services), more tourist attractions, private transport services, educational and information activities, benchmarking their costs with others (water, waste, rent), improving the situation for local services (bicycle rent, doctors, leisure facilities etc.) (ProAudit, undated).

Participation, scope and geographic coverage

In the period 2008-2013, a total of 570 municipalities successfully completed the CommunalAudit. The public funding was about EUR 2.05 million. The provinces of Niederösterreich and Oberösterreich showed the highest percentage of implementation, followed by Steiermark, Tirol

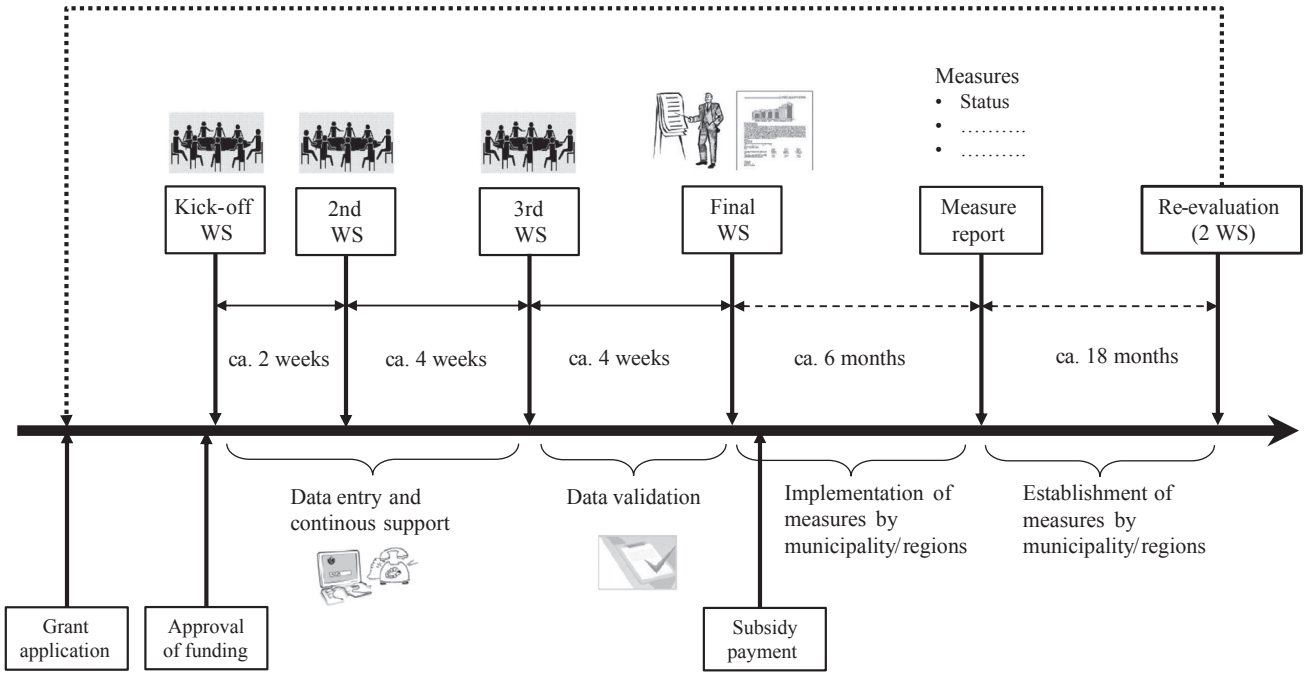

Figure 2: The overall process of carrying out the CommunalAudit.
Source: ProAudit (undated)

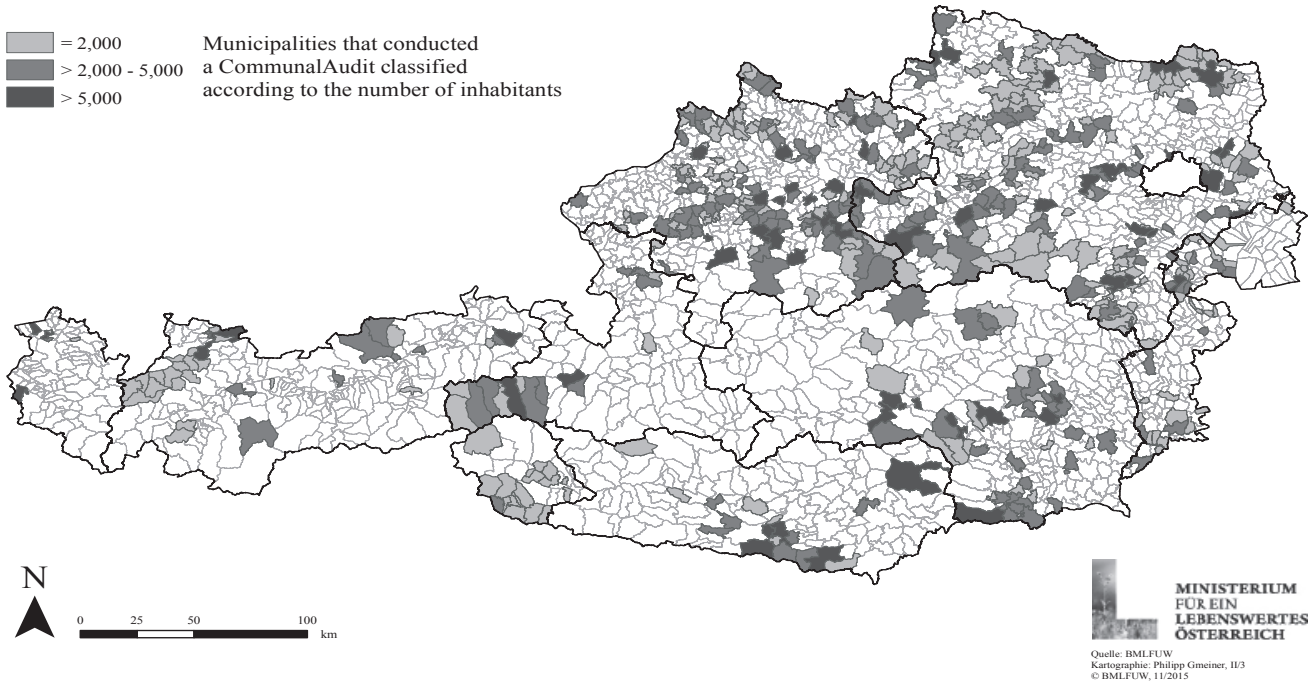

Figure 3. Participation, scope and geographic coverage of CommunalAudit.
Source: BMLFUW (2016a)

and Kärnten (BMLFUW 2016a, Figure 3). Furthermore, Figure 3 shows the populations of the municipalities which have carried out CommunalAudits. CommunalAudits were mainly carried out by those with few inhabitants: 66 per cent of the audits were in municipalities with fewer than 2,500 inhabitants, 23 per cent in municipalities with between 2,501 and 5,000 inhabitants, and the balance in municipalities with more than 5,000 inhabitants. Comparing the population size with the structure of expenditures allows the following conclusion: small municipalities (in terms of population) see the CommunalAudit as an instrument to improve their cost structure (BMLFUW, 2016a).

Self-assessment

The responsible persons within the municipality evaluated the actual value of the CommunalAudit for themselves. This self-assessment matrix predominantly highlights the perceived benefits by questioning the people involved on

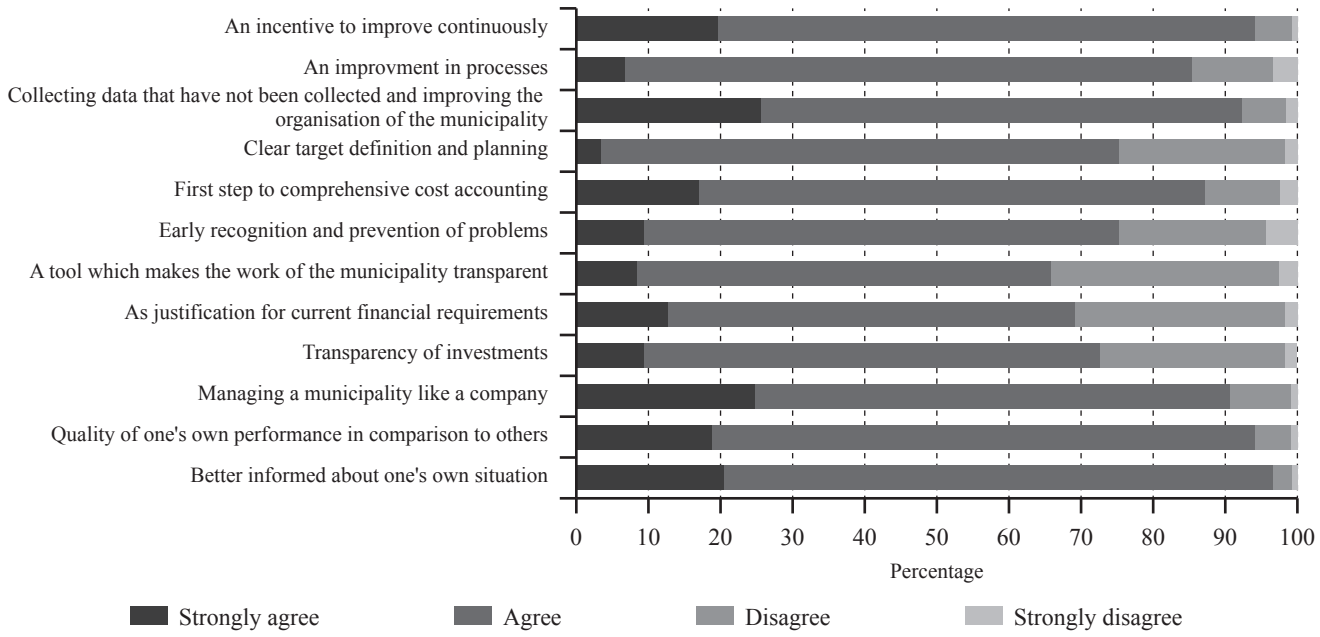

Figure 4: Self-assessment of CommunalAudit by the responsible persons within the municipality.
Source: ProAudit (2009)

their motivation to carry out the audit. The matrix identifies twelve main motivational statements for carrying out the audit and these were evaluated on a scale of 1 to 4, where 1 stands for strong agreement and 4 for strong disagreement. Participants were asked to what extent they agreed with the twelve statements. The results of the assessment are shown in Figure 4. All statements met with over 60 per cent agreement and the results further showed that almost 100 per cent of the participants saw the CommunalAudit as a tool to inform them of their own situation and as an incentive to improve the same. The statement which met with the least agreement (only 66 per cent of the participants) was that the CommunalAudit was a tool to make the work of the municipality transparent. All in all, Figure 4 clearly shows that the CommunalAudit was perceived as addressing the financial viability of local public services, the targeting and hedging of funding, management accounting, and establishing an inter-communal knowledge platform.

The way forward

In order to act in the present to shape the future, this section highlights the opportunities and drawbacks, along with the future perspective as CommunalAudit New. Based on the findings, some suggestions on the need for further research are made.

Turning opportunity into action

Most municipalities, whether they are rich or poor, large or small, in rural or urban areas, are facing problems of a similar nature. They have to regroup and rethink their response to developments in the marketplace and to consider how to implement their strategy on the ground. To remain competitive and sustain their attractiveness, municipalities need to improve their performance continually, while information, communication and the knowledge base are continually expanding. Obvious and ongoing responses range from the development of strategies and cooperation to more compact services and ways to improve infrastructure. In this context, municipalities are a resource in need of reshaping, guiding and managing, not only to meet these challenges but also to maximise their contribution to community development in an inclusive and sustainable way. Development can only be set by actions, i.e. measures. Viewed through the lens of inclusive and sustainable development, measures are being developed and implemented in ways that directly link the built environment of the municipality to an inclusive and sustainable well-being. The measures identified in the course of CommunalAudits include actions to improve the social, ecological and economic quality of the municipality in an inclusive way. In particular, these measures are required to (a) increase administrative efficiency and optimise the use of resources; (b) develop modern strategies; and (c) ensure the sustainability of policy and administration action. As a result, this CommunalAudit also improves the living situation and thus the quality of life (e.g. lower fee rates, better opening hours of the municipality, adapted and optimised services etc.) in the municipalities when implementing the measures identified. However, the results should also better be taken on board in practice at the local level. This said, most of the measures identified were not implemented. The main reasons were (a) the lack of financial resources and (b) no consequences for non-implementation (BMLFUW, 2016a).

CommunalAudit New

CommunalAudit undertakes to keep the debate about local competitiveness and attractiveness alive, and urges Austrian municipalities to include the debate in their own

democratic assemblies. The financial viability of the continuous development of the quality of life and location is a challenging task for politicians and administrative staff at the municipal level. In addition to a wide range of technical and legal competences, it also requires a resource-conserving, effective, fact- and method-based definition and implementation process founded on the broadest possible consensus with relevant stakeholders (RSC, 2017). With this background, BMLFUW in cooperation with the municipalities is offering the auditing process again in the form of CommunalAudit New. It is being promoted within the campaign '*Heimat.Land.Lebenswert*' as a tool for the development of rural areas and cities (BMLFUW, 2016b). With this more advanced audit, municipalities see exactly where they stand and which concrete measures are important for their future. The CommunalAudit New for the period 2014-2020 was set to start in autumn 2017. It has a new face. It is a combination of efficient methods for participative communal and municipal development and a software platform. The methods clearly focus on the analysis of the initial situation, the definition of development targets and the formulation of measures for future development. The software platform includes a data collection tool and provides a comprehensive database on indicators and values along with benchmarks and best practice examples. It is composed of two modules – the basis module and the individual one. The analysis is carried out in the basis module. In the subsequent individual module, strategic goals and measures are developed within the framework of two workshops (RSC, 2017). A detailed description of the process planned, the content, the technical requirements and working templates for the audit are presented in detail in a report on the website of the Ministry (BMLFUW, 2017).

Further activities and research

The development at the local level influenced by the global level and the empirical evidence give rise to the following concerns. In order to identify relevant areas of research and factors influencing the development at municipal level, it is important to learn from related concepts and other countries. Therefore, a knowledge exchange is strongly recommended. Consequently, the Austrian CommunalAudit can glean important insights from the measurement methods, construction of the indices and ranking undertaken from the examples described above. On the other hand, CommunalAudit provides information about identifying saving potentials and establishing work strategies at the local level. In practice, the paucity of data often makes it difficult to benchmark countries or municipalities of different countries. There is no common standardised concept and method. Given this, it would seem logical that further work be done to harmonise and expand these approaches on a global scale. This would potentially enable the provision of more information about the status quo *per se* and the development potential of municipalities including benchmarking under an inclusive and sustainable perspective. With this in mind, transnational comparisons could be useful to identify best practices in delivering public services in a cost-effective manner. Furthermore, this is one approach. Combining it with other instruments will potentially provide a viable tool for political decision making, stakeholder awareness as well as providing information to residents when considering a fair distribution of global resources and wealth. Furthermore, it would enable policy makers and residents to gain a fresh perspective on the function of municipalities at the local level as well as in the region.

Conclusion

Municipalities across Austria are in various stages of development and growth. With CommunalAudit they are working on the inclusive and sustainable development for their communities. Austrian municipalities are in a state of transition as ways are being sought to adapt to an internationalised marketplace. In the context of CommunalAudit, municipalities do not have a 'market' *per se*. For this reason, the comparison with others (benchmarking) is the only market equivalent, which gives feedback on how they can evolve and improve. The CommunalAudit is 'the' tool in Austria for the development of municipalities. There are also other instruments around the world. Through 'municipality-making' efforts, the long-term intent is to add value in an inclusive and sustainable way, resulting in a greater attractiveness, competitiveness and sense of identity within the municipality. This, in turn, allows municipalities to become 'destinations' or 'places of choice' for people and businesses.

References

Annoni, P. and Dijkstra, L. (2013): EU Regional Competitiveness Index RCI 2013. Ispra, Italy: European Commission Joint Research Centre.

BMLFUW (2016a): LE 07-13 Ex-post-Evaluierung: Evaluierungsbericht 2016. Teil B Bewertung der Einzelmaßnahmen [LE 07-13 Ex post evaluation: Evaluation report 2016. Part B Evaluation of the individual measures]. Wien: Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft.

BMLFUW (2016b): CommunalAudit NEU [www document]. Available online at https://www.bmlfuw.gv.at/lebenswerte-regionen/communalaudit.html (accessed 10 April 2017).

BMLFUW (2017): Aufruf zur Einreichung von Förderungsanträgen für die Vorhabensart 7.1.2. [Call for applications for the type of project 7.1.2.] [www document]. Available online at https://www.bmlfuw.gv.at/land/laendl_entwicklung/foerderinfo/veroeffentlichung_stichtag_aufrufe1/Aufruf-zur-Einreichung-von-F-rderungsantr-gen-f-r-die-Vorhabensart-7.2.1.html (accessed 19 September 2017).

Curristine, T. (2005): Government Performance: Lessons and Challenges. OECD Journal on Budgeting **5** (1), 127-151. https://doi.org/10.1787/budget-v5-art6-en

Curristine, T., Lonti, Z. and Journard, I. (2007): Improving Public Sector Efficiency: Challenges and Opportunities. OECD Journal on Budgeting **7** (1), 1-41. https://doi.org/10.1787/budget-v7-art6-en

Dooren, W. van (2006): Performance Measurement in the Flemish Public Sector: A Supply and Demand Approach. Leuven: Catholic University of Leuven.

EC (2006): Handbook on Common Monitoring and Evaluation Framework: Guidance document. Brussel: European Commission.

Enichlmair, C. (2015): Municipal Competitiveness Review (MCR) - Measuring the competitiveness of municipalities in Kosovo. Priština: Kosovo SME Promotion Programme.

Gabler Wirtschaftslexikon (undated): Gemeinde [Municipality] [www document]. Available online at http://wirtschaftslexikon.gabler.de/Definition/gemeinde.html (accessed 23 October 2017).

Gupta, J. and Baud, I.S.A. (2015): Sustainable development, in P. Pattberg and F. Zelli (eds), Encyclopedia of Global Environmental Politics and Governance. Cheltenham: Edward Elgar, 61-72.

Gupta, J. and Vegelin, C. (2016): Sustainable development goals and inclusive development. International Environmental Agreements: Politics, Law and Economics **16** (3), 433-448. https://doi.org/10.1007/s10784-016-9323-z

Karabarbounis, L. (2011): One dollar, one vote. The Economic Journal **121**, 621-651. https://doi.org/10.1111/j.1468-0297.2010.02406.x

Lorek, S. and Spangenberg, J.H. (2014): Sustainable consumption within a sustainable economy: Beyond green growth and green economies. Journal of Cleaner Production **62**, 33-44. https://doi.org/10.1016/j.jclepro.2013.08.045

NCC (undated): Cities and Municipalities Competitiveness Index [www document]. Available online at http://cmcindex.org.ph/ (accessed 25 October 2017).

Niedomysl, T. (2006): Migration and Place Attractiveness. Geografiska regionstudler 68. Uppsala: Uppsala Universitet.

Murray, R. (1992): Measuring Public Sector Output: The Swedish Report, in Z. Griliches (ed.), Output Measurement in the Service Sectors. Chicago IL: The University of Chicago Press.

Patsiorkovskiy, V.V. (2017): Attractiveness of municipalities for the population in 2010-2016. Public Administration Issues Special Issue, 60-71. https://doi.org/10.17323/1999-5431-2017-0-5-60-71

Piketty, T. (2014): Capital in the twenty-first century. Cambridge MA: Harvard University Press. https://doi.org/10.4159/9780674369542

Porter, E.M. (2004): Competitive Advantage: Creating and Sustaining Superior Performance. New York: NY: Free Press.

ProAudit (undated): CA CommunalAudit [www document]. Available online at http://portal.communalaudit.at/index.php?option=com_content&task=view&id=13&Itemid=31 (accessed 11 April 2017).

ProAudit (2009): Befragungs-ergebnisse Evaluierung CommunalAudit [Survey Results Evaluation CommunalAudit]. Linz: ProAudit.

ÖGUT (undated): Participation & Sustainable Development in Europe. Local Agenda 21 [www document]. Available online at http://www.partizipation.at/localagenda21.html (accessed 23 October 2017).

RSC (2017): Konzept CommunalAudit – Neu. Abschlussbericht kompakt [Concept CommunalAudit - New. Final report compact]. Linz: Ramsauer und Stürmer Consulting. Available online at https://www.bmnt.gv.at/dam/jcr:4fbd5020-7f50-4d9c-aa75-43c93f0676ab/CommunalauditNeu_Abschlussbericht_kompakt.pdf (accessed 19 September 2017).

Russell, J.P. (2013): The ASQ Auditing Handbook. Milwaukee WI: ASQ Quality Press.

Stiglitz, J.E. (2015): The great divide: Unequal societies and what we can do about them. New York NY: WW Norton and Company.

UNEP (2011): Towards a green economy: Pathways to sustainable development and poverty. Nairobi: UNEP.

USAID (2009): Municipal Competitiveness Index [www document]. Available online at http://indicemunicipalelsalvador.com/index.php?leng=ing (accessed 24 October 2017).

USAID (2011): The Kosovo Municipal Competitiveness Index Report 2011. Priština: USAID.

USAID (2012): The Kosovo Municipal Competitiveness Index Report 2012. Priština: USAID.

USAID (2013): The Kosovo Municipal Competitiveness Index Report 2013. Priština: USAID.

USAID (2014): The Kosovo Municipal Competitiveness Index Report 2014. Priština: USAID.

WB (2012): Inclusive green growth. The pathway to sustainable development. Washington DC: World Bank.

WB (2014): Doing Business 2015. Going Beyond Efficiency. Washington DC: World Bank.

Paweł CHMIELIŃSKI*, Nicola FACCILONGO[1], Mariantonietta FIORE**[2] and Piermichele LA SALA**[3]**

Design and implementation of the Local Development Strategy: a case study of Polish and Italian Local Action Groups in 2007-2013

We investigated the extent to which the Local Development Strategy (LDS) activities planned at the beginning of the European Union's Leader programme implementation period, and the associated budget allocation in response to the defined local needs, were confirmed at the end of the period. We used as examples the implementation of two LDSs, one by a Local Action Group (LAG) in Poland and one in Italy. We applied some simple indicators to assess how much the budget assumptions at the planning level were reflected in the successful implementation of projects, and conducted interviews with representatives of the two LAGs. We showed that the two LAGs were generally working effectively but that excessive institutionalisation could be the major constraint to the proper design of the LDS and thus the implementation of the Leader programme. For the Polish LAG, it was because of the transfer of the evaluating role outside of the LAG: assessment of applications was undertaken by the regional institution, the Agency for Restructuring and Modernisation of Agriculture. In the case of the Italian LAG, the reason was an excessive formalisation of the rules concerning project applications.

Keywords: assessment, implementation, rural development, policy, Leader programme

JEL classifications: R58, O21, Q18, O57

* Instytut Ekonomiki Rolnictwa i Gospodarki Żywnościowej - Państwowy Instytut Badawczy, Świętokrzyska 20, 00-002 Warszawa, Poland. Corresponding author: pawel.chmielinski@ierigz.waw.pl; https://orcid.org/0000-0001-8377-0702

** Università degli Studi di Foggia, Foggia, Italy.

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Introduction

The principles of local governance, i.e. an enhanced participation of local communities and organisations in the process of local policymaking and implementation, has spread to rural areas, even those of the periphery. Owing to the growing significance of non-farming functions of the countryside (e.g. settlement), the multifunctionality of agriculture as well as the development of large villages and small towns as centres of local socio-economic advancement is becoming more important (Gallo *et al.*, 2018). Also, community expectations with respect to the rural areas change: apart from the economic function, its landscape and environmental values are gaining in importance, as are social relationships and networking (Midmore, 1998; Dudek and Chmieliński, 2015).

The integrated concept of the decentralisation of regional governance and a bottom-up approach to implementing economic policy in rural areas was represented in the period 2007-2013 by the Leader Programme, Axis IV of the European Union's (EU) rural development programmes (RDP). Since 1991, the Leader approach has been a 'laboratory' for the development of new integrated and sustainable development approaches (Geißendörfer and Seibert, 2004) aimed at exploring new paths for making rural territories more competitive, thereby coping with challenges such the ageing population, low level of services and lack of employment opportunities. Thus, Leader departs from a sectoral approach, i.e. separate treatment of the problems of agriculture, environmental protection, the labour market or infrastructure, towards a territorial approach, with a focus on the identification of development opportunities and threats for a small territory. In this way, it facilitates a more comprehensive determination of development factors and their interrelationships in a given area.

Because individuals have much more difficulty accessing globalised systems, it is necessary to support communities to enter as a local network in global systems (Dini, 2012). Leader has proved to be an innovative and successful bottom-up policy tool, thanks to involvement of Local Action Groups (LAG) in local development activities (Spada *et al*., 2016). A LAG can be considered as an inter-municipal platform that promotes cooperation in Europe (Vrabková and Šaradín, 2017) and creates alliances between diverse local functional interests (Furmankiewicz and Macken-Walsh, 2016). The inclusion of social (third sector) and private (entrepreneurs) partners as well as public institutions (local governments) in the LAGs allows for the needs of various social and economic operators in rural areas to be considered in the planning process. Such an approach is based on the creation of a sense of local identity and responsibility of residents for their local area (Chmieliński, 2011).

The success of local development policies depends, to a large extent, on the level of local community participation in socio-economic life, which entails the necessity to build social capital. According to Putnam *et al*. (1993) and Fukuyama (1999), this is the capital whose value is based on mutual social relationships and personal trust, and which helps an individual to achieve more benefits, in both social and economic terms. Individual social capital, based on personal benefits flowing from the activity undertaken as part of interpersonal relationships, comes to play a critical role in building such relationships. Building social capital underpins the Leader approach; in the local dimension it is reflected in good communication, active participation of

[1] https://orcid.org/0000-0003-2034-3441
[2] https://orcid.org/0000-0002-9244-6776
[3] https://orcid.org/0000-0003-2081-8013

residents in local initiatives, but also in the involvement of representatives of the public, economic and social sectors in LAG activities.

This capacity to deal with development problems through new forms of partnerships is so rooted in the Leader approach that it has influenced national, regional and local policies, thus adapting rural policy-making to the diversity of rural areas' needs (EC, 2006). Therefore, over the last decade, EU rural development policies have been sustaining and promoting the development of rural areas and the implementation of strong networks between institutional and non-institutional actors, thus increasing the social inclusion of dissimilar rural population groups. This is one of the main objectives of the RDP (Arabatzis *et al*., 2010; Lošťák and Hudečková, 2010; Delin, 2012; Furmankiewicz and Macken-Walsh, 2016).

Because Leader adopts a place-based approach, and LAGs prepare for the programme's implementation based on an analysis of local needs and with special regard to the specificity of territory in which they operate, it can be assumed that the policy tasks and measures planned by the LAGs will be well suited to the needs of the local community. Centred on a case study in the Leader Programme in the Alentejo region of Portugal, Santos *et al*. (2016) examined the long-term survival rate of firms subsidised by public policy. Using binary choice models, they showed that the cumulative mortality rate of subsidised local firms in this region was over 20 per cent. However, the probability of survival increased with higher investment, firm age and regional business concentration. Through funding strategic investment, the Leader Programme promoted entrepreneurship in the Portuguese rural areas of Alentejo, but the sustainability of the results achieved depended on the effectiveness of decisions taken in the short term by the different players: the LAG and entrepreneurs.

However, a study on the LAGs in the Czech Republic (Boukalova *et al*., 2016) shows that the Leader approach is in many cases still a top-down policy based on an exogenous framework (as defined in the RDP) and thus it is not capable of using the endogenous resources (material and non-material assets) of local communities. This is why the efficient implementation of Local Development Strategies (LDSs) has been observed mostly for experienced LAGs (Volk and Bojnec, 2014; Pechrová and Boukalová, 2015). Another constraint on the effective implementation of the Leader approach has been the delays in the start of programme financing. This has had a negative impact on the functioning of the LAG office and the retention of experienced staff (Svobodová, 2015).

Our paper aims at assessing the measures implemented as part of the Leader Axis of the 2007-2013 RDP and the activities of two LAGs, one from Poland and one from Italy. This was the first EU programming period in which Polish LAGs could participate fully in the implementation of the Leader approach. For the Italian regions, it was the fourth programming period. It can be assumed that the Polish LAGs created during the LEADER+ Pilot Programme[4] were in a similar situation to the Italian LAGs in 1989-1993 (Leader I), while those operating in 2007-2013 were comparable to the Italian LAGs during the period 1994-1999. In 2007-2013, all Italian regions recognised 192 LAGs while in Poland there were 336. We tried to assess how innovative is the programming and implementation of LDSs under the Leader approach in the two case study areas. We checked the extent to which the LDS activities planned at the beginning of the implementation period, and the associated budget allocation in response to the defined local needs, were confirmed at the end of the period.

Methodology

We chose two NUTS 2 regions, Regione Puglia in south-eastern Italy (centred on the city of Bari) and Małopolskie *Voivodeship* in southern Poland (surrounding the city of Kraków), with similar structural problems. Both regions have low levels of labour and economic activity in comparison to national averages, low levels of public services provision (Charron, 2016), and are suffering from depopulation. In absolute terms, the two regions show large differences in the levels of their GDP and income per capita (Table 1). The reality is however better described by the GDP per capita in purchasing power standard (PPS), which allows meaningful volume comparisons of GDP between regions and countries. As GDP per capita in Italy is almost 2.5 times higher than in Poland, the levels of GDP per capita in PPS in the two regions are in fact very similar.

The presently-similar levels of GDP per capita in PPS in the two regions are the result of the dynamic development of the Małopolskie *Voivodeship* since Poland's accession to the EU in 2004, and shows the dynamics of changes in Poland because of participation in EU development policy instruments and programmes. Whereas for Regione Puglia the value of GDP per capita in PPS increased from EUR 16,000 in 2004 to EUR 18,100 in 2015, over the same period the increase for Małopolskie *Voivodeship* was from EUR 10,000 to EUR 17,800.

Table 1: Gross Domestic Product in the European Union and selected regions, 2015.

Territory	GDP		GDP per capita		
	EUR million	EUR million PPS	EUR	EUR PPS	PPS EU28= 100
EU-28	14,714,029		28,900	28,900	100
Italy	1,645,439	1,689,072	27,100	27,800	96
Puglia	72,135	17,700	17,700	18,100	63
Poland	429,794	761,156	11,200	19,800	69
Małopolskie	33,947	60,119	10,100	17,800	62

Data source: Eurostat

For our detailed analyses, we selected two LAGs, Meridaunia in Italy and Dolina Soły in Poland[5], whose territories are characterised by similar physical conditions (i.e.

[4] A special programme for Member States accessing the EU in 2004. In Poland it was implemented as measure 2.7. 'Leader + Pilot Programme' under the Sectoral Operational Programme 'Restructuring and Modernisation of the Food Sector and Rural Development, 2004-2006'. Until 2006, 167 LAGs were created, of which 122 (from a total of 336 LAGs) continued their activities in 2007-2013 (Chmieliński, 2011).

[5] In Puglia region in 2007-2013 there were 25 LAGs operating in total, and in Małopolskie *Voivodeship* – 39.

inland and mountain areas) and the fact that their activities cover around 100,000 inhabitants each. While the allocation of funds from the Leader axis took place on a competitive basis, the allocated funding is closely related to the number of inhabitants covered by the LDS. Therefore, the number of inhabitants is a more important LAG parameter than the physical area. Furthermore, the territories of both LAGs feature high levels of depopulation, low rates of economic activity and low levels of public services.

Open interviews were conducted at the end of 2017 and at the beginning of 2018 with representatives of the LAG offices, i.e. people directly involved in the planning, implementing and accounting of LDSs. Topics included problems encountered during the implementation of the 2007-2013 strategy, and information on the use of funds, implemented projects and administrative challenges. Interviewees also answered questions about changes in the functioning of the organisation in the context of local development problems. The information obtained was supplemented by Eurostat data as well as the implementing regulations of the RDPs. Furthermore, during the study, unpublished data were obtained regarding the number of applications filed, withdrawn and unsuccessful, as well as changes in the LAGs' budgets.

We compared the financial results of both LAGs: generated private expenditure, by comparing planned and implemented expenditures; type of funded activities, especially structural and services activities; design capacity index, i.e. the relationship between the planned and real funding in each of the measures; index of successful implementation of projects, which is the relationship between completed and funded projects. We also analysed the design mortality index: the ratio between the number of revocations/cancellations and the number of funded projects; the index of the satisfied applications, i.e. the ratio between the funded applications and the submitted applications.

Results

Implementation of local development strategies

The basis for determining the priorities regarding the choice of actions and the allocation of funds is the needs of the LAG area residents. In 2007-2013, EU Member States could choose to implement measures in line with their priorities from a 'menu' of actions eligible under Axis IV. These actions were determined at the central level in Poland, while in Italy, with its regional RDPs, activities were more decentralised. Therefore, in our cases, the Polish LAG implemented four measures under its LDS and the Italian LAG six (Table 2).

Although the LAG territories had similar numbers of inhabitants, their 2007-2013 LDS budgets were different. The LAG Meridaunia received nearly EUR 15 million for that period, while the LAG Dolina Soły was awarded only slightly more than EUR 3 million. In addition, the priority of the Italian LAG was for activities that encouraged tourism, for which it allocated nearly 40 per cent of the financial resources of the LDS, while the Polish LAG concentrated on infrastructure investments as part of Measure 322 (Table 2). During the period 2007-2013 (2015), the Italian LAG implemented 131 projects, and the Polish LAG 113.

In the 2007-2013 programming period, LAGs were obliged to implement pro-economic activities more focused on job creation. LAGs established mainly by the initiative of representatives of the social sector (NGOs) or the public sector have so far implemented mainly social activities focused on the integration of residents. In 2007-2013, they were entrusted with implementing Axis III (aimed at improving the competitiveness of rural areas) measures of the RDPs, in the scope of creating micro-enterprises and diversifying agricultural activities. Respondents from the Polish LAG

Table 2: Distribution of planned expenditure by measure in the Local Development Strategies of two LAGs, 2007-2013.

Measure	LAG Meridaunia (Italy)			LAG Dolina Soły (Poland)		
	Budget EUR	% total	% LDS	Budget* EUR	% total	% LDS
311: Diversification into non-agricultural activities	2,655,482	17.9	22.7	256,518	8.3	10.6
312: Support for the creation and development of micro-enterprises	320,000	2.2	2.7	384,777	12.4	15.8
313: Encouragement of tourism activities	5,850,000	39.3	50.1	-	-	-
321: Basic services for the economy and rural population	1,115,410	7.5	9.5	-	-	-
322: Village renewal and development	-	-	-	1,331,919	42.9	54.8
413: Small projects**	-	-	-	457,513	14.8	18.8
323: Protection and retraining of rural heritage	600,000	4.0	5.1	-	-	-
331: Training and information	1,145,291	7.7	9.8	-	-	-
Implementation of LDS – total	11,686,183	78.6	100.0	2,430,727	78.4	100.0
421: Development of interterritorial and transnational cooperation projects consistent with the objectives set by LDSs	496,110	3.3	-	62,864	2.0	-
431: Management. animation and acquisition of skills of LAGs	2,686,016	18.1	-	607,682	19.6	-
Total	14,868,308	100.0	-	3,101,272	100.0	-

* An exchange rate of EUR 1 = PLN 4.0543 is used in Tables 1 and 2, based on the ECB average rate for the period 2007-2015

** Projects that do not meet the conditions for granting aid under RDP Axis III measures, but which contribute to achieving the objectives of this Axis and thus implemented in Poland

Data sources: official and unpublished data of LAGs

recounted the fears that accompanied this process. Of particular concern was that the evaluation of applications of rural residents within these activities was entrusted to an external, regional-level institution, the Agency for Restructuring and Modernisation of Agriculture (ARMA). The LAG Dolina Soły budget allocated a smaller share of the funds for the implementation of activities related to farmers' diversification into non-agricultural activities (311) compared to LAG Meridaunia (Table 2). As ARMA acted as the paying agency also for many other activities directed to farmers, farmers were well aware of its existence, but the agency was little known in the wider local community. The LAG could not compete in the local community with twin actions under the RDP (Agrotec, 2010). This reflects the fears of the Polish LAG representatives, expressed during the interviews, about the interest of rural residents in this activity – competitive actions were also implemented by ARMA under Axis III of the RDPs – as well as the efficiency of implementation of this measure based on the decision-making engagement of an external institution.

Table 3: Distribution of expenditures on the implementation of the Local Development Strategies of two LAGs, 2007 and 2015.

Expenditure	Public funds		Private funds		Total
	EUR	%	EUR	%	EUR
LAG Meridaunia (Italy)					
Planned (2007)	11,686,183	62.8	6,914,334	37.2	18,600,517
Implemented (2015)	7,364,720	50.0	7,254,242	50.0	14,618,962
Change (2015 cf. 2007)	4,321,463	-12.8	-339,908	12.8	3,981,555
LAG Dolina Soły (Poland)					
Planned (2007)	2,430,727	65.5	1,281,345	34.5	3,712,072
Implemented (2015)	1,758,063	60.4	1,152,684	39.6	2,910,747
Change (2015 cf. 2007)	672,664	-5.1	128,661	5.1	801,325

Data sources: official and unpublished data of LAGs

Table 4: Planned and actual implementation of projects and funds according to the Local Development Strategy of the LAG Dolina Soły, Poland.

Indicator	Measure			
	311	312	322	413
Design capacity index (planned/real expenditure per measure)	5.0	2.5	1.5	1.3
Number of applications submitted	10	42	33	151
Number of completed projects	*2*	*10*	*24*	*77*
Number of financed projects	*2*	*10*	*24*	*77*
Index of successful implementation	1.00	1.00	1.00	1.00
Number of revocations/ cancellations	*8*	*18*	*8*	*36*
Number of financed projects	*2*	*10*	*24*	*77*
Design mortality index	4.00	1.80	0.33	0.47
Number of financed projects	*2*	*10*	*24*	*77*
Number of applications submitted	*10*	*42*	*33*	*151*
Index of satisfied applications	0.20	0.24	0.73	0.51

Data sources: official documents and unpublished data of the LAG Dolina Soły

The first source of information regarding the extent to which the planned activities were carried out in accordance with the intention of the LAGs is the relationship between the budget for the implementation of the LDS and the actual expenditure. Neither LAG managed to spend the planned amount of money (Table 3), but both managed to activate more private funding than they had planned in 2007-2008, at the beginning of the strategy implementation. This information signals that the LAGs have the potential to achieve local (private) capital integration. In the case of the LAG Meridaunia, the share of private funds in the implemented projects was more than 12 percentage points higher than expected, for the LAG Dolina Soły the figure was 5 percentage points. Nevertheless, both groups managed to spend a similar share of the planned budget: 78 per cent in the case of the Meridaunia LAG and 79 per cent in the case of the Dolina Soły LAG.

We analysed some simple indicators that illustrate the progress in the implementation of the LDSs. In the case of the LAG Dolina Soły, the planned activities were not divided into detailed actions and remained in line with the measures proposed by the European Commission. The LAG Meridaunia, on the other hand, divided the measures into detailed actions (sub-measures) which, because they were the subject of separate calls for applications organised by LAGs, can be analysed separately. This is the reason why the results are presented according to measures in Table 4, and by sub-measures (actions) in Table 5.

The efficiency capacity of the planning process at the stage of resource allocation is demonstrated by the design capacity index (DCI): the lower the value, the more properly planned were the projects. In the case of the LAG Dolina Soły, it turned out that measure 413 (small projects[6]) was the activity where payments were completed closest to those planned, and additionally the interest in the operation was the largest (Table 4). The respondents' opinions expressed during the interviews were confirmed in this analysis of the DCI. Measures aimed at diversification of agricultural activity and creation of enterprises turned out to difficult to implement: for measures 311 and 312 the relationship between the planned and used funding was unfavourable in the case of the Polish LAG.

A similar situation occurred with the Italian LAG, where the DCI indicator also illustrates low utilisation of expenditure in measures 312 and 313, related to creation and development of micro-enterprises and tourism activities. This result can be associated with the still low level of awareness among rural residents of knowledge about available funds, and the continuing problems associated with the effective application for assistance funds, as indicated by the number of applications submitted and the number of completed projects (Table 5).

The data for index of successful implementation, in which unity means full implementation of projects that were selected for funding and received funds, show that both LAGs were effective in selecting projects that had the best chance of success. However, the relationship between the number of revocations/cancellations and the number of financed projects shows how many projects were poorly pre-

[6] Small grants for implementing original ideas by the local community members, whether associated or non-associated within any formal structure (natural or legal person, NGOs, and any organisational unit without legal personality).

Table 5: Planned and actual implementation of projects and funds according to the Local Development Strategy of the LAG Meridaunia.

	Measure and sub-measure											
	311				312			313	323	321		
	1	2	3	5	1	3	4	5	1	1a	1b	1c
Design capacity index	4.7	2.4	2.4	-	25.4	4	4	15	6	1	4.2	2
Number of applications submitted	17	9	2	-	25	10	7	63	2	1	7	2
Number of completed projects	*15*	*6*	*2*	*0*	*20*	*10*	*6*	*36*	*1*	*1*	*7*	*1*
Number of financed projects	*15*	*6*	*2*	*1*	*20*	*10*	*6*	*36*	*1*	*1*	*7*	*1*
Index of successful implementation	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Number of revocations/cancellations	*1*	*3*	*0*	*4*	*5*	*0*	*1*	*10*	*1*	*0*	*0*	*1*
Number of financed projects	*15*	*6*	*2*	*1*	*20*	*10*	*6*	*36*	*1*	*1*	*7*	*2*
Design mortality index	0.07	0.50	0.00	4.00	0.25	0.00	0.17	0.28	1.00	0.00	0.00	0.50
Number of financed projects	*15*	*6*	*2*	*1*	*20*	*10*	*6*	*36*	*1*	*1*	*7*	*1*
Number of applications submitted	*17*	*9*	*2*	*5*	*25*	*10*	*7*	*63*	*2*	*1*	*7*	*2*
Index of satisfied applications	0.88	0.67	1.00	0.20	0.80	1.00	0.86	0.57	0.50	1.00	1.00	0.50

Data sources: official documents and unpublished data of the LAG Meriduania

pared (Tables 4 and 5). The higher the value of the design mortality index, the more unfavourable is the relationship between the number of projects that passed the assessment but were subsequently cancelled and those that were successfully completed. Therefore, this indicator refers to the mortality of initiatives because of poor policy design, especially of implementing regulations.

Similar conclusions can be drawn based on the analysis of the index of satisfied applications, which shows how much the demand for financial support from the local community was met. In the case of the LAG Dolina Soły, measures 311 and 312 again proved to be the most difficult to implement, and potential beneficiaries most often did not receive financing for their idea. As regards the LAG Meridaunia, the level of meeting the demand for payments was relatively low for measure 311 (LAG Meridaunia, 2015).

Our analysis showed that both LAGs struggled with the problem of effective implementation of the planned activities. In both cases, the most difficult measures to be implemented were those related to creating non-agricultural jobs which were planned under Axis III and implemented by the LAG. In the case of the Polish LAG, among the measures implemented under Axis IV, only measure 413 (small projects) was addressed directly to local communities. In the remaining cases, the invention and efforts relied on the LAG members or employees, as a result of which the residents were often reduced to the role of beneficiaries of the support provided by LAGs (participation in training sessions and calls for proposals to establish micro- and small enterprises). With the Italian LAG, efficient implementation of the strategy was inhibited by the formal and legal problem related to the preparation of the application and getting it through the formal evaluation. While the level of interest was satisfactory, many local ideas remain difficult to implement due to various formal restrictions.

The relatively good performance of the Polish LAG may also be associated with changes in the structure of members involved in their activity, and above all by the change in structure of the LAG's Council, the body that assessed the applications and business plans of potential beneficiaries (Table 6). Previous analyses (Agrotec, 2010) pointed to the problem of overrepresentation of the public sector in the LAG structure in Poland, which negatively affected

Table 6: Member structure of the LAG Dolina Soły in 2007 and 2015.

Year	Total	Social sector	Economic sector	Public sector
	Number			
LAG members				
2007	72	45	17	10
2015	78	32	35	11
Members of the LAG's Council				
2007	24	12	6	6
2015	15	5	7	3

Data source: unpublished data of the LAG Dolina Soły

the implementation of the Leader approach, in accordance with the original idea of a three-sector partnership. This was due to the lack of understanding of the Leader idea in local authority circles: which in the case of the LAG, where it had decision-making power, it treated the implementation of the LDS as an additional instrument for the implementation of local government policy. Some improvements in this respect occurred in the LAG Dolina Soły in the period 2007-2015, where a substantial increase (in both categories) in the number of people associated with the economic sector may be noted. This introduced an improved balance in the decision-making forces in the LAG's functioning process. In addition, representatives of local organisations, residents (the social sector) and representatives of entrepreneurs accounted for 80 per cent of the members of the LAG's Council (the decision-making body) in 2015. This is a symptom of the maturation of the private actors with regards to their social role in local development, and helped to overcome the oft-recognised problem of an 'inferiority complex' with respect to public actors who often dominated the early stages of Leader and LAG development (Granberg and Andersson, 2016).

Discussion

The current activity related to the implementation of Local Development Strategy assumptions is assessed well or even very well by all interviewees from both LAGs. Designing a LDS with active participation of the local community

should allow for a careful anticipation of the implementation of the strategy, including potential interest in activities and the size of support, by local companies, cultural institutions, schools etc. Our interviewees identified relatively positive effects of implementing the LDSs by both LAGs. Despite covering regions struggling with structural problems, the LAGs managed to plan a LDS and to spend 80 per cent of the allocated funding, while at the same time creating interest in their actions among local residents. For some of the measures, this interest exceeded the capacity of the LAGs to finance projects, as evidenced by the analysis of the index of satisfied applications. Moreover, in most cases, approved projects were successfully implemented.

The analysis of the LAG Dolina Soły in 2007-2013 shows that in the first full period of implementation of the Leader approach in Poland, the newly-formed associations of this type implemented the main objective of this programme, which is building social capital in the local community. The activities of the LAG Dolina Soły contributed to improving communication between the authorities of neighbouring communes, and supported projects with a high level of public utility (such as the construction/modernisation of cultural facilities, sports facilities, support for the creation and operation of cultural houses, publications on local traditions, or investments in playgrounds and libraries).

The results of the implementation of some of the measures of the RDP III axes by the LAGs were well predicted, while the ones of the measures for the development of entrepreneurship and diversification of agricultural activity were to a lesser extent correctly forecast.

Social organisations and economic entities play an increasing role in determining the course of action, specific measures and the distribution of funds for implementation of local development policy. A shift may be observed from the traditional concept of a hierarchical structure of local government to the notion of local governance, i.e. the involvement of many institutions in policy making and implementation, the fragmentation of the structure of the local administration, a greater role for horizontal networks of entities cooperating in a given area (social organisations and representatives of the private sector as partners for local governments), as well as regional and international cooperation (Bukve, 2008, Chmieliński, 2011). Local governance relies on individual and collective responsibility for the territory. The development of such governance models can be fostered, in particular, by the inflow of well-educated persons from urban areas, for which it will be of utmost importance to preserve the high settlement values of rural areas, and thus their cultural heritage and landscape values (Pike *et al*., 2009).

However, in both LAGs, interviewees pointed to a formal problem as a reason for difficulties in implementing the strategy. With the Polish LAG, it was the transfer of the evaluation role from the LAG to the regional institution ARMA, whose officials, having nothing to do with local specificity and local needs, had problems with correct and timely evaluation of applications. Their assessments were based solely on the statement of compliance with formal requirements, and the beneficiary was assessed without any context, the specifics of social and economic life in the LAG, and hence the 'local' economy. On the one hand, the LAG did not have the power to change this situation, on the other, the proper implementation of the tasks planned in the local development strategy was at stake.

For the Italian LAG, the problem was the over-formalisation of the rules for requesting assistance. The LAGs' lack of influence on the assessment of applications was a crucial problem in the implementation of Axis IV measures. The LAGs were responsible only for the announcement of a call, assessment of compliance with the LDS and technical implementation of the recruitment. Although potential beneficiaries submitted their application for the measure Micro-enterprises creation and development and diversification towards non-agricultural activities, formal requirements were often considered too difficult to meet by the beneficiaries, which led to the resignation of the project implementation, especially in the Italian LAG. As a result, in both LAG territories the main barrier to the implementation of the LDS were the difficulties associated with the duration of individual stages and the work of officials.

Thus, we conclude that, in line with the published literature (e.g. Chmieliński, 2011; Chevalier *et al*., 2012, Contò *et al*., 2012), although partnerships, networks and collaborations among stakeholders and consultations with the local population are the crucial drivers of the Leader approach, financing rules and lack of power in implementation of local strategy measures have been sources of weakness. LAGs are not vested with enough decision-making power to implement LDSs at all stages. In Poland the assignment of key competences (to evaluate the applications) to the regional units (*voivodeship* government and ARMA) had a negative impact on the LAG-centred integration process of local communities. Moreover, in the opinion of LAG representatives, the inclusion of Axis III (investment-oriented) activities for implementation as part of the Axis IV Leader approach proved to be an obstacle to the effective implementation of development strategies, as programmed in LAGs. LAG members indicated the necessity to strengthen the role of their respective units in supporting bottom-up initiatives (small projects) and in integrating local communities (aimed at establishing interregional and supra-national cooperation, and at promoting tradition and regional products). Such activity leads to promoting the region, as well as to shaping local identity, which has a direct influence on the social capital formation process at the local level (Chmieliński, 2011).

The analysis of programme assumptions and the status of implementation of Axis IV measures may lead to a general conclusion that its bottom-up approach allowed for effective implementation of local development objectives based on a more accurate diagnosis of local needs and capabilities. An example of this is the very clear response of LAGs in the case of the implementation of measure 413 (small projects) in Poland and the LAG's response to emerging barriers. In 2007-2013, LAGs were already trying to develop the most effective ways of implementing the Leader approach with the simplification of the rules as far as possible to allow for developing new solutions during the implementation of RDPs that could be used in the 2014-2020 programming period. Therefore, LAGs can represent, in the long term, an effective planning tool for local development (Spada *et al*., 2016).

The study has its limitations resulting from the technical approach to the assessment of LDS activities and budget.

The next step in the research should be a deeper examination of the type and size of submitted projects, their impact on local development, residents' recognition of LAG activities, or changes carried out in the LAGs' strategies for 2014-2020 and their relationship with experience acquired in 2007-2013. However, this can only be achieved after the end of the 2014-2020 programming period.

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References

Agrotec (2010): Mid-Term Evaluation of the Rural Development Programme for 2007-2013. Warszawa: Agrotec, IERiGŻ-PIB and IUNG-PIB.

Arabatzis, G., Aggelopoulos, S. and Tsiantikoudis, S. (2010): Rural development and LEADER + in Greece: Evaluation of Local Action Groups. Journal of Food, Agriculture and Environment **8** (1), 302-307.

Boukalova, K., Kolarova, A. and Lošťák, M. (2016): Tracing shift in Czech rural development paradigm (reflections of Local Action Groups in the media). Agricultural Economics (Czech) **62** (4), 149-159. https://doi.org/10.17221/102/2015-AGRICECON

Bukve, O. (2008): The governance field - a conceptual tool for regional studies. Paper presented at the RSA International Conference, Praha, Czech Republic, 27-29 May 2008.

Charron, N. (2016): Explaining the allocation of regional Structural Funds: The conditional effect of governance and self-rule. European Union Politics **17** (4), 638-659. https://doi.org/10.1177/1465116516658135

Chevalier, P., Maurel, M.-C. and Polá, P. (2012): L'experimentation de l'approche leader en Hongrie et en Republique Tcheque: Deux logiques politiques differentes [Experiments with the Leader approach in Hungary and the Czech Republic: Two different political rationales]. Revue d'Etudes Comparatives Est-Ouest **43** (3), 91-143. https://doi.org/10.4074/S033805991200304X

Chmieliński, P. (2011): On community involvement in rural development – a case of Leader programme in Poland. Economics and Sociology **4** (2), 120-128. https://doi.org/10.14254/2071-789X.2011/4-2/11

Contò, F., Fiore, M. and La Sala, P. (2012): The Metadistrict as the Territorial Strategy: From Set Theory and a Matrix Organization Model Hypothesis. International Journal on Food System Dynamics **3** (1), 82-94.

Delin, M. (2012): The role of farmers in Local Action Groups: The case of the national network of the Local Action Groups in the Czech Republic. Agricultural Economics (Czech) **58** (9), 433-442.

Dini, F. (2012): Oltre la globalizzazione?: ipotesi per le specializzazioni regionali [Beyond globalization?: hypothesis for regional specialisations]. Memorie Geografiche **9**, 557-572.

Dudek, M. and Chmielinski, P. (2015): Seeking for opportunities: livelihood strategies in the challenge of peripherality. Journal of Rural and Community Development **10** (1), 191-207.

EC (2006): The Leader Approach. A basic guide. Brussel: European Commission.

Fukuyama, F. (1999): Social Capital and Civil Society. Paper prepared for delivery at the Conference on Second Generation Reforms, Washington DC, USA, 8-9 November 1999.

Furmankiewicz, M. and Macken-Walsh, Á. (2016): Government within governance? Polish rural development partnerships through the lens of functional representation. Journal of Rural Studies **46**, 12-22. https://doi.org/10.1016/j.jrurstud.2016.05.004

Gallo, C., Faccilongo, N. and La Sala, P. (2018): Clustering analysis of environmental emissions: A study on Kyoto Protocol's impact on member countries. Journal of Cleaner Production **172**, 3685-3703. https://doi.org/10.1016/j.jclepro.2017.07.194

Geißendörfer, M. and Seibert, O. (2004): EU-weite Ex post-Evaluation der Gemeinschaftsinitiative LEADER II - Bewertung der Programme deutscher Bundeslander [EU-wide ex-post evaluation of the Community initiative LEADER II - Evaluation of the programmes of the German federal states]. Berichte Uber Landwirtschaft **82** (2), 188-224.

Granberg, L. and Andersson, K. (2016): Evaluating the European Approach to Rural Development: Grass-roots Experiences of the LEADER Programme. Abingdon: Routledge.

LAG Meridaunia (2015): Piano di Sviluppo Locale, I luoghi dell'uomo e della natura, Sintesi degli interventi previsti dal Piano di Sviluppo Locale del GAL Meridaunia [Local Development Plan, the places of man and nature, Summary of the interventions foreseen by the Local Development Plan of the LAG Meridaunia]. Bovino, Italy.

Lošťák, M. and Hudečková, H. (2010): Preliminary impacts of the LEADER+ approach in the Czech Republic. Agricultural Economics (Czech) **56** (6), 249-265.

Midmore, P. (1998): Rural policy reform and local development programmes: Appropriate evaluation procedures. Journal of Agricultural Economics **49** (3), 409-426. https://doi.org/10.1111/j.1477-9552.1998.tb01281.x

Pechrová, M. and Boukalová, K. (2015): Differences among Czech Local Action Groups in using selected principles of Leader. Scientia Agriculturae Bohemica **46** (1), 41-48. https://doi.org/10.1515/sab-2015-0015

Pike, A., Rodriguez-Pose, A. and Tomaney, J. (2009): Local and Regional Development. Abingdon: Routledge.

Putnam, R.D., Leonardi, R. and Nanetti, R. (1993): Making democracy work: Civic traditions in modern Italy. Princeton NJ: Princeton University Press.

Santos, A., Neto, P. and Serrano, M.M. (2016): A long-term mortality analysis of subsidized firms in rural areas: An empirical study in the Portuguese Alentejo region. Eurasian Economic Review **6** (1), 125-151. https://doi.org/10.1007/s40822-015-0035-4

Spada, A., Fiore, M., Caruso, D. and Contò, F. (2016): Explaining Local Action Groups heterogeneity in a South Italy Region within Measure 311 Axis III notice of LDP. Agriculture and Agricultural Science Procedia **8**, 680-690. https://doi.org/10.1016/j.aaspro.2016.02.079

Svobodová, H. (2015): Do the Czech Local Action Groups respect the Leader method? Acta Universitatis Agriculturae Et Silviculturae Mendelianae Brunensis **63** (5), 1769-1777. https://doi.org/10.11118/actaun201563051769

Volk, A. and Bojnec, S. (2014): Local Action Groups and the LEADER co-financing of rural development projects in Slovenia. Agricultural Economics (Czech) **60** (8), 364-375.

Vrabková, I. and Šaradín, P. (2017): The technical efficiency of Local Action Groups: A Czech Republic case study. Acta Universitatis Agriculturae Et Silviculturae Mendelianae Brunensis **65** (3), 1065-1074. https://doi.org/10.11118/actaun201765031065

SOÓS Gabriella* and BIACS Péter Ákos**

The role of product-related information and factors impacting consumer attitudes during health-conscious food purchase in Hungary

The aim of this study is to identify factors impacting consumer attitudes towards the purchase of functional foods, also known as foods with a positive physiological impact on health, in Hungary. Our work also focuses on the volume of information currently available to consumers when making such a choice, and on identifying consumer clusters. Particular attention is paid to the extent to which the available information can impact the respective purchase decision, which channels are used in obtaining such information, and which information is considered reliable or unreliable by shoppers. Based on the results of focus group research, we conducted a questionnaire-based survey (n=502). To reduce the high number and hard-to-interpret attitude variables, a factor analysis was performed, followed by the formation of consumer segments via cluster analysis according to the consumer attitude indicators. These segments were termed *Health-conscious consumers*, *Consumers with limited information*, *The sceptics* and *The price conscious*, and were characterised according to socio-demographic, behavioural and attitude variables. Then, we sought to identify the sources of information that would best address a given segment, and explored the efficiency of information transfer in the functional food market.

Keywords: functional food, healthy consumption, information process, segmentation

JEL classifications: D12, D81, D83, M31

* Eszterházy Károly Egyetem, H-3300 Eger, Eszterhazy tér 1, Hungary. Corresponding author: soos.gabriella@uni-eszterhazy.hu

** Szent Istvan Egyetem, Gödöllő, Hungary.

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Introduction

The legitimacy of functional foods is reflected in the changing dietary expectations of consumers. Diets are usually modified by health protection considerations or illness. "A food can be regarded as 'functional' if it is satisfactorily demonstrated to affect beneficially one or more target functions in the body, beyond adequate nutritional effects, in a way that is relevant to either an improved state of health and well-being and/or reduction of risk of disease. Functional foods must remain foods and they must demonstrate their effects in amounts that can normally be expected to be consumed in the diet: they are not pills or capsules, but part of a normal food pattern" (Anon, 1999, p.S6).

According to Bagdy (2010), *health consciousness* implies one's responsibility for the preservation of their personal and bodily integrity, consisting of sound bodily and emotional health based on balanced physical, psychological and interpersonal relationships. Thus, health consciousness can function as a foundation for subsequent decisions and the elaboration of the respective decision-making criteria. Specific actions are manifested in health-related conduct. Szakály (2011) defined *health-related conduct* as the sum of all behavioural forms connected with one's health deduced from health needs and health-related motivations promoting a healthy lifestyle.

Consumers have different priorities when embarking on healthy diets, including facilitating health preservation or preventing or treating illness. Consequently, their information demands concerning selectable foods also vary. Directive 2000/13/EC[1] of the European Parliament and the European Council and the subsequent Regulation 1169/2011[2] pertaining to the labelling and information content of foods determine the scope of product-related data and markings. Marketing-related or informal components can be placed on products or at the point of sale, but the amount of information given often limited by the size of the particular food item. Consumers are eager to find relevant product-related information that enables them to decide whether the chosen item meets their dietary requirements. Consequently, reading the product labels can help in considering the ingredients or, by extension, facilitating product selection (Chen *et al*., 2011; Méjean *et al*., 2011). A greater stake (fulfilling dietary requirements or weight-loss plan) a consumer has in the selection of a product, the more he or she needs information for decision making.

Soós *et al*. (2012) showed that the priority given to having a healthy lifestyle, and closely connected to this the acquisition of information, increases with the level of educational qualification. Similarly, evaluation of the information demands a specific level of knowledge that impacts interest in, and motivation for, information search. Several researchers have focused on the correlation between qualification and the willingness for information acquisition: Borgmeier and Westenhoefer (2009) noted that prior nutritional knowledge predicts the use of food labels. Kelly *et al*. (2009) pointed out the need to accompany the introduction of any front-of-pack labelling system with public education campaigns that inform consumers about how to interpret this labelling in the context of other nutrition guidelines. Campos *et al*. (2010) showed that more educated individuals have reported greater use of nutrition labels. Grunert *et al*. (2010) found that consumers with different levels of

[1] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32000L0013&from=HU

[2] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32011R1169&from=EN

nutritional knowledge will infer the healthiness of a food product in different ways.

In addition to educational background, the level of knowledge can have a role in determining the extent of one's need for information. Too much or too complex information can cause confusion: Campos *et al*. (2010) reported that some consumers found different nutrition label formats confusing; Temple and Fraser (2014) pointed out that front-of-package labels may give misleading information, so consumers are likely to find themselves confused by the information; and Miller and Cassady (2015) found a positive association between knowledge and food label use. Time pressures resulting from an accelerated lifestyle can make consumers turn to evasive strategies.

In the light of the abovementioned factors, our research explores the use of product information by consumers in Hungary, and examines the expected information content and the related difficulties of information use. Our starting point was the growing trend in health-conscious behaviour in the country. While this trend can impact several types of consumers, its direction and intensity can differ according to basic consumer attitudes. Consequently, in addition to a descriptive statistical analysis of consumer reactions, we paid special attention to the correlation between certain consumer characteristics and behaviour patterns. Our research was based on the following hypotheses: H1: The demand for information and obtaining the respective knowledge from product labels depend on the personal stake or involvement of the given consumer; H2: The higher the related knowledge level is, the more intense the need for further information is; and H3: Lack of information leads to declining interest or the use of avoidance strategies.

Methodology

Focus group method and questionnaire

In the summer of 2016 we performed a comparative examination of two groups with special emphasis on general familiarity with the functional product concept, the respective consumer attitudes, the typical demands and expectations, and the causes of potential rejection. The schedule of the inquiry was based on a model composed of related research findings (Soós, 2016). The results were used to develop a questionnaire composed of 30 closed, open answer, general scale, ranking and Likert scale type questions. The starting point was the growing trend of health-conscious behaviour. While this trend can impact several types of consumers, its direction and intensity can differ according to basic consumer attitudes.

The questionnaire was conducted among the general public in Hungary by trained staff in the spring of 2017, and 502 usable responses were obtained. We collected the data either in person or via e-mail, and the sampling method was non-probable. The survey did not aim to be representative of the entire Hungarian adult population, but rather focused on the most relevant sections of society. Thus, 70.7 per cent of the respondents were woman (52.3 per cent of the Hungarian population was female in 2017), so they are overrepresented, but in Hungary women frequently do the shopping for the family (Soós *et al*., 2012). Furthermore, men are more likely to refuse to answer this type of questionnaire.

Of the 502 respondents, 39.9 per cent were single, 57.5 per cent married and 2.6 per cent were widow(er)s. The average age was relatively young: 42.5 per cent were aged 18-30, 17.4 per cent 31-40, 20.8 per cent 41-50, 10.6 per cent 51-60, and 8.8 per cent 60+. Around half (47.1 per cent) had children. Most had white collar, mainly sedentary jobs, more than 90 per cent stated that they could survive on their incomes but were either unable to save any money or could put some money aside. Around half lived in Budapest or a (NUTS 3) county town and around 50 per cent exercised weekly or more (Table 1). The data were recorded and analysed using the SPSS software package (IBM Corporation, Armonk, NY, United States).

Sample testing for determining the suitability of factor analysis

During the questionnaire survey, we strove to examine the highest possible number of attitude factors. Inevitably, the large number of variables made segmentation difficult, and consequently we performed a factor analysis in order to facilitate data reduction. The variables used in factor analysis are metric, mostly represented on an interval scale. Firstly, the normality test of dependent and non-dependent

Table 1: Employment, income, residence and exercise frequency profiles of the respondents.

What kind of job do you have?	*%*	*How do you evaluate your income?*	*%*
Hard physical	3.8	Cannot survive on my income	5.8
Light physical	14.0	Unable to save any money	46.7
Mental with some mobility	25.9	Can put some money aside	45.3
White collar, mostly sedentary	56.3	Well off	2.2
Where do you live?	***%***	***How frequently do you exercise?***	***%***
Budapest	7.8	Never	8.0
(NUTS 3) county town	41.5	Occasionally	32.1
Other town	27.3	1-2 times per month	10.8
Village	22.2	Every week	18.6
Other type of settlement	1.2	Several times per week	21.4
		Daily	9.2

Source: own data, n=502

variables was performed. In line with recent research findings, absolute value 1 was the maximum declared normal value for slanted or peaked graphs. The respective distribution was also examined by the Shapiro-Wilk test. As Jurecková and Picek (2007) and Liang *et al*. (2009) assert, its efficiency level is optimal even with a high component number or sample population. Accordingly, all dependent variables assumed a value near 1 and, based upon the principle of normality, this is acceptable too (Huzsvai and Vincze, 2012). The homogeneity of the sample was assessed using the Levene test. The shared variance is applicable to the whole sample, the dependent (attitude) variables scheduled to be subjected to factor analysis display identical distribution in the context of the various levels of non-dependent variables, thereby proving the existence of homoscedasticity (based on Sajtos and Mitev, 2007).

We prepared a correlation matrix in order to explore the applicability or eligibility of the respective data. The correlation was statistically significant for all variables, and very low correlation coefficients (0.096) were found in only two cases, while the value of the strongest correlation was 0.55. Thus, the expectation related to variables, namely the existence of a correlation which is not too close or strong, was met and the respective variables could be appropriately allocated or divided into factors.

As expected, the extradiagonals (indicating a variance not depending on the variables) of the anti-image-matrix covariance chart were low. The partial correlation coefficients of the anti-image correlation table were also low, leading to the conclusion of the existence of strong factors. The measure of sampling adequacy (MSA) values displayed in the diagonal line of the matrix were high (≥0.5, the smallest was 0.864) indicating a potentially close integration into the factor structure. The significance level of the Bartlett test was 0, suggesting that the starting variables were suitable for factor analysis. The Kaiser-Meyer-Olkin (KMO) criterion was 0.885, implying that the average of the MSA values was 'very good', confirming the eligibility of the given variables for factor analysis (after Sajtos and Mitev, 2007).

Cluster analysis

Reflecting the attitudes of functional food consumption, two consumer groups, '*Price-conscious*' and '*Health-conscious*', were initially set up in line with Soós *et al*. (2012) but, after examination of the impact of information on attitude, additional clusters were formed in order to improve our results. For the cluster analysis, the survey questions were allocated to three basic groups:

- *Descriptive questions*, used for the preparation of basic descriptive statistics facilitating the basic characterisation of the multitude and the assessment of suitability for integration into the sample;
- *Cluster-forming questions*, to facilitate segmentation and help in the creation of groups while mostly containing scale-displayed attitude variables;
- *Segmentational questions*, which serve the more detailed description of the clusters, and vary according to their type.

Results

Profiles of the respondents

Three quarters of the respondents believed that diet can significantly influence their health, but only 11.8 per cent said that they always tried to purchase healthy products. Furthermore, 57.1 per cent mostly, and 29.1 per cent rarely, consider the available product information. Four fifths of those paying attention to product selection are motivated by maintenance of health or the prevention of illness, 8.4 per cent want to improve their general health and 4.0 per cent do so because of a treatment of an illness or disorder. Replies in the 'Other' category included such remarks as "I choose such products which are cheaper", and references to sports, diet, avoiding harmful materials and the demands of child rearing.

In terms of their self-assessed levels of nutrient consumption, respondents recorded the lowest average value for alcohol consumption, followed by fat, sugar and salt (Figure 1). Higher than average consumption was reported for wholegrain products, seeds, coffee and tea, and the highest consumptions were of dairy products and foods containing fibre.

The 652 health-related responses gathered from the 502 interviewees reflect the fact that several respondents answered positively to more than one topic. Almost one third of those surveyed reported no health-related issues (Figure 2). The most frequent determining factor of diet is the choice of type, which can be either weight loss or candida oriented, and this is followed by food allergy or some kind of intolerance, along with the effect of sports on eating and nutrition. The diet of some respondents was influenced by such health issues as high cholesterol level, diabetes and heart conditions.

We were also interested in knowing which factors played a role in food purchase-related decision making by the respondents, and they were asked to rank the factors shown in Figure 3. Respondents considered product composition, with a score of 3.0, to be the most important factor, followed by flavour or taste, price and nutritional value. Brand, location of production and trademark were accorded much lower priorities, and the least important factors included the potentially reduced price, organic nature and packaging of foods.

Factor analysis

We began the factor analysis with the KMO criterion and, according to our original, exploratory intent, identified factors with a value of at least 1. Although with this method two factors can be discerned, this phenomenon explained only 47.6 per cent of the respective variance. Thus, it was necessary to include factors with a value below 1. Subsequently, we applied the elbow rule and could recommend the exploration of four factors. We identified the optimally integrable model by the maximum likelihood method. While the two- or three-factor approach did not result in appropriate integration (ML<0.01), with four factors the model was optimally integrated (ML=0.011). However, with the four-factor model, the explained variation quotient was only 55.7

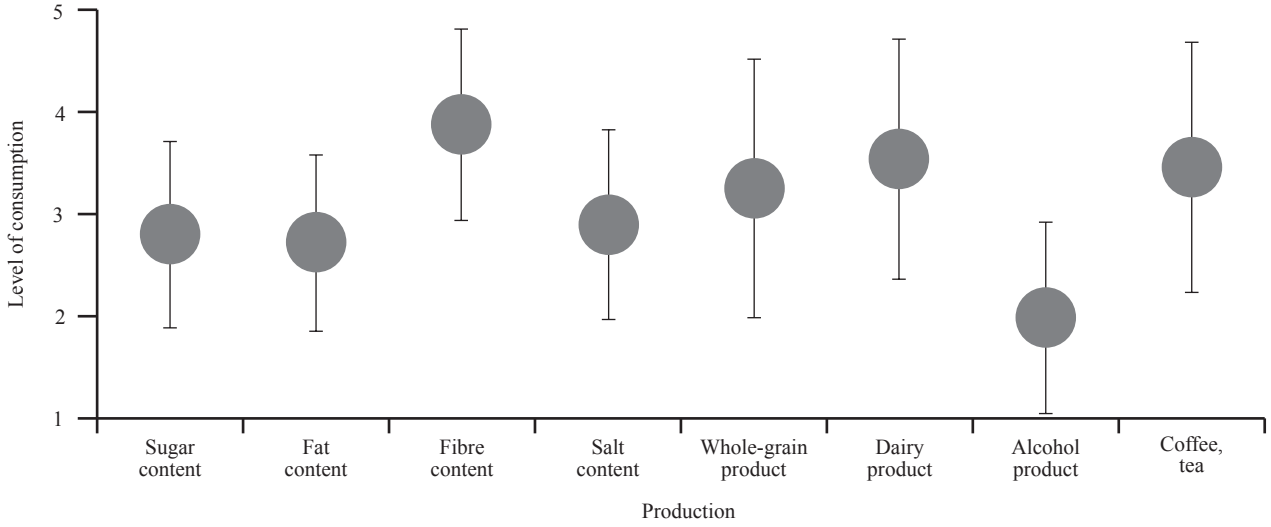

Figure 1: Self-assessed levels of consumption selected nutrients among the respondents.

1: respondent does not consume such nutrients; 5: high level of consumption
Source: own data, n=502

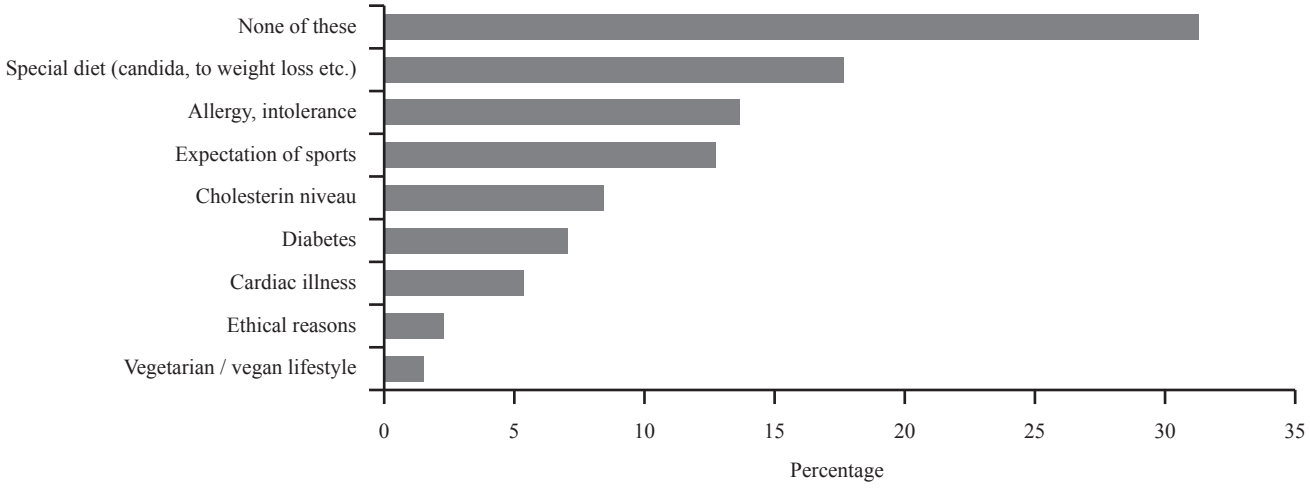

Figure 2: Incidence of illnesses reported by the respondents, per cent of all responses.

Source: own data, n=652

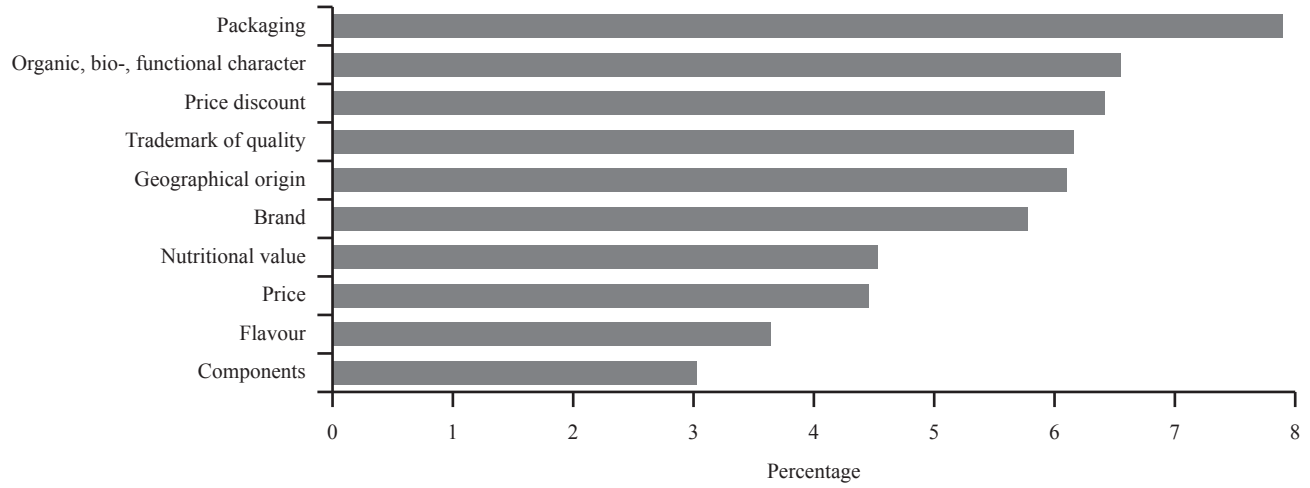

Figure 3: Ranking by respondents of food purchase or selection-related decision-making factors.

1: extremely important; 9: unimportant
Source: own data, n=500

per cent. Since for social science research the explained or interpreted variance quotient is expected to be around 60 per cent, we explored the option of including a fifth factor. Consequently, we could explain 61.6 per cent of the variance while the ML indicator of integration is significantly improved (ML=0.387).

Normally, only factors with a weight at least 0.5 are considered for analysis but we noted a factor weight below 0.5, i.e. 0.41 for a variable referring to attitudes to packaging-related information. In order to determine whether this variable should be excluded from the model we performed the abovementioned test without it. Since neither the appropriateness nor interpretation of the respective results were modified, the variable remained part of the model. Thus, the analysis resulted in the following factors: (a) 'health-conscious attitude'; (b) 'price and safety orientedness'; (c) 'conviction'; (d) 'physiological impact'; (e) 'the information transfer function of packaging'.

Cluster analysis

Based upon the results of the factor analysis and the attitude indicators of the respondents, the cluster analysis resulted in four consumer segments: *'Health-conscious consumers'* represented 30 per cent of the respondents, '*Consumers with limited information'* made up 20 per cent, '*The sceptics'* accounted for 28 per cent, and 22 per cent of the sample were '*The price conscious'*. Below, we firstly characterise the four clusters, and then compare the knowledge and attitudes towards diets and functional foods, food consumption habits and the criteria determining them, and the price sensitivity of the different clusters.

Characterisation of the clusters

Three quarters of the *'Health-conscious consumers'* are women, and most of them live either in county towns or Budapest. The proportion of the older age group, aged 40 or over, in this segment is relatively high. Many are either occasionally or regularly involved in sports activities, and they tend to have savings (Table 2).

Young adults are the dominant population of the *'Consumers with limited information'* cluster, thus the number of households without children is the highest. Two thirds of the sample have completed secondary education, and most live in towns, with one quarter residing in villages. They tend to exercise weekly. Like the members of the first cluster they have savings, but the number of men is the highest in this segment. Members of the frequently do not shop alone or someone else does the food shopping for the household. Their limited knowledge can be due to their relatively young age, their hectic life style or not being impacted by conditions affecting the other groups.

One half of the '*The sceptics'* cluster is more than 41 years old, and they are mostly married with children. Secondary education is dominant and the incomes are sufficient only for subsistence. They primarily shop on their own and are mostly blue-collar workers whose sports activities can be either sporadic or regular.

Finally, '*The price conscious'* cluster includes either young or middle-aged people; most of them are married, but 57 per cent of the households have no children. They have completed secondary education, and may be either white- and blue-collar workers, but the income of 56 per cent is only sufficient to meet basic needs. They may live either in the city or countryside, and exercise occasionally or not at all.

Table 2: Age, education, work and exercise profiles of the four clusters.

Characteristic	Group	Cluster (% within cluster)			
		1	2	3	4
Age (years)	18-30	38.5	45.4	40.1	47.7
	31-40	19.6	26.8	8.0	17.8
	41-50	20.3	14.4	29.2	17.8
	51-60	14.0	7.2	10.9	9.3
	Over 60	7.7	6.2	11.7	7.5
Education (level)	Primary	0.0	0.0	0.7	0.0
	Secondary	1.4	0.0	3.6	1.9
	Secondary with certificate	46.2	61.9	59.1	62.6
	Diploma or degree	52.4	38.1	36.5	35.5
Work (type)	Heavy physical	2.1	5.2	5.1	2.8
	Light physical	11.9	12.4	16.8	15.0
	Mental with some mobility	32.2	22.7	24.1	24.3
	'White collar'	53.8	59.8	54.0	57.9
Exercise (frequency)	Never	3.5	2.1	12.4	11.2
	Occasionally	20.3	39.2	28.5	47.7
	1-2 times per month	9.8	9.3	16.8	7.5
	Weekly	19.6	24.7	14.6	17.8
	More than weekly	35.0	20.6	16.8	8.4
	Daily	11.9	4.1	10.9	7.5

Clusters: 1: *'Health-conscious consumers'*; 2: *'Consumers with limited information'*; 3: *'The sceptics'*; and 4: *'The price conscious'*
Source: own data (n=484)

Influence of diet on health

'Health-conscious consumers' are convinced that diet can have a significant impact on their health (Table 3). *'Consumers with limited information'* and '*The sceptics'* have an occasional awareness of health-conscious food selection, and '*The price conscious'* are the least convinced about the physiological impact of food.

Table 3: Respondents' assessments of the extent to which their diet affects their health status by cluster.

Extent of effect	Cluster (% within cluster)			
	1	2	3	4
Entirely	1.4	1.0	0.0	0.9
Substantially	90.2	76.3	72.3	54.2
Average	8.4	20.6	24.1	39.3
Somewhat	0.0	2.1	2.9	5.6
Not at all	0.0	0.0	0.7	0.0

For cluster labels see Table 2
Kendall's tau-b: 0.271, sig. = 0.000; Kendall's tau-c: 0.196, sig. = 0.000
Source: own data (n=484)

Table 4: Respondents' attitudes to diet and to food labels by cluster.

Statement	Mean of cluster			
	1	2	3	4
Diet has a serious effect on my health	4.6	4.4	4.2	3.9
I am satisfied with my consumed food products	3.9	3.5	3.5	3.4
I have enough knowledge to choose the most beneficial product for me	3.9	3.4	3.3	3.3
I am willing to try a new product providing that it is healthier	4.5	4.2	3.9	3.5
I can easily give up my accustomed food to be on a diet	2.6	2.2	2.0	1.9
I can easily give up my accustomed food to be healthier	4.0	3.3	3.3	2.9
I can easily give up my accustomed food to avoid illnesses	4.2	4.0	3.7	3.5
There is too much information on the product labels	2.5	2.9	2.8	2.9
The product label is appropriate to choose the best product	3.0	3.0	2.8	2.6
The contents of the product labels are clear and understandable	2.9	2.6	2.6	2.5
*The information on the product labels are credible and authentic	2.5	2.4	2.3	2.4
It is easy to distinguish the healthy food from the traditional type	3.0	2.8	2.7	2.7

For cluster labels see Table 2
Data are significant (ANOVA $\alpha<0.5$, except * $\alpha<0.6$)
1 = completely agree; 5 = completely disagree
Source: own data (n= 502)

Attitudes to diet and to food labels

'Health-conscious consumers' are the most willing to try new types of foods and to forego traditional ones for the sake of their diet (Table 4). Consequently, they try to select foods with a positive physiological impact primarily for maintenance of their health, even if the flavour of the food is reduced or its price increases. Furthermore, they understand, interpret and trust product labels and can easily recognise safe foods and those with healthy physiological impact among the traditional ones. Their nutritional needs are often controlled or impacted by the expectations of the sports they pursue, food allergy, or special, weight-loss diets, but in most cases food-related decisions are not connected with health issues or diseases. Members of this group consider themselves the most informed regarding the health food market (Table 5).

Table 5: Respondents' perception of adequacy of information availability regarding the health food market by cluster.

Do you have enough information?	Cluster (% within cluster)			
	1	2	3	4
Yes	15.4	7.2	8.8	13.1
I have much but try to improve my knowledge	57.3	50.5	32.1	32.7
I have some but I need more	26.6	41.2	51.8	43.0
I do not understand much of the information	0.7	1.0	7.3	11.2

For cluster labels see Table 2
Kendall's tau-b: 2.02, sig. = 0.000; Kendall's tau-c : 0.185, sig. = 0.000
Source: own data (n=484)

Although many *'Consumers with limited information'* are familiar with the term 'functional food', they do not consider themselves to be well informed about its meaning. Although they wish to acquire more detailed knowledge, 91.7 per cent of them have much or some information about this topic. They are unable to interpret or understand the product labels; they do not consider the information reliable and it is difficult for them to distinguish foods with a positive physiological impact from traditional items. They are not as eager to find healthy foods unless they are motivated by the maintenance of health or the prevention of diseases, i.e. allergies, and special diets play a role in their decision making.

Similarly, *'The sceptics'* do not consider themselves to be well informed, but they are slightly less convinced about the impact of nutrition on health. Thus, health disorders or illnesses play a limited role in their decision making and they tend not to take special dietary needs into consideration. Information on food packaging, including the product's influence on health, does not play a significant role in their purchasing decisions. Furthermore, they are reluctant to buy new products. While they do not often read the information on food labels, they consider the information to be reliable.

'The price conscious' are the least sure in their food-related knowledge and can hardly interpret the available information; they consider their knowledge insufficient to determine which food can be beneficial to health. Dietary considerations do not influence their decision making and they pay little attention to product data. Owing to their existing health disorders, they tend to select the same products and do not opt for new ones.

Food consumption habits

'Health-conscious consumers' try to limit sugar, fat, salt, alcohol or coffee intake, and prefer foods with substantial fibre content and whole-grain cereals (Table 6). *'Consumers with limited information'* strive for a favourable diet and have the highest milk consumption among the four clusters, while their alcohol, coffee and tea intakes are among the lowest. The diet of *'The sceptics'* contains more fat, salt, alcohol, coffee, tea and fibre, while '*The price conscious'* consume the most sugar, fats, salt, alcohol, the least amount of fibre and whole-grain products, and drink much milk, coffee and tea. The following data show the self-assessed nutritient consumption of the respondents.

Table 6: Respondents' consumption of foodstuffs by cluster.

Nutrient	Mean of cluster			
	1	2	3	4
Sugar	2.5	2.9	2.9	3.3
Fat	2.5	2.7	2.8	3.1
Fibre	4.3	3.7	3.8	3.7
Salt	2.8	2.9	3.1	3.2
Maize, whole-grain products	3.9	3.2	3.1	2.8
Dairy	3.4	3.8	3.6	3.8
Alcoholic drinks	2.0	1.9	2.1	2.2
Coffee, tea	3.4	3.4	3.7	3.5

For cluster labels see Table 2
1 = not at all; 5 = very much
Source: own data (n=484)

Criteria of food purchasing habits

The main defining criteria of the food purchasing habits of *'Health-conscious consumers'* include product structure, nutritional value, flavour and the organic aspects of the item (Table 7). The food purchase-related decisions of *'Consumers with limited information'* are based on content, flavour, nutritional value and price; product labels play a lesser role than for their health-conscious counterparts. The primary factors determining food purchase among '*The sceptics'* are taste, composition and price: these are more important for them than the physiological impact. The food purchase decisions of *'The price conscious'* are based on taste, price, composition and brand. Thus, their food purchase decision is mostly determined by taste and price compared to the physiological impact, even if it is scientifically justified.

Table 7: Defining criteria of respondents' food purchasing habits.

Criterion	Mean of cluster			
	1	2	3	4
Ingredients	2.2	2.7	3.3	3.9
Taste	4.8	3.7	3.0	2.9
Brand	6.7	5.4	5.7	5.2
Price	5.5	4.6	3.9	3.7
Nutritional value	3.7	4.2	4.6	5.7
Trademark	5.7	5.6	6.4	6.9
Geographical origin	5.5	6.1	6.4	6.7
Packaging	8.5	8.1	7.8	7.1
Discount	7.2	6.6	6.0	5.5
Organic, bio-, functional character	5.0	6.6	7.0	7.9

For cluster labels see Table 2
1 = important; 10 = not important
Source: own data (n=502)

Frequency of buying healthy products

There is notable difference among the clusters in terms of food consumption (Table 8). *'Health-conscious consumers'* buy healthy products often or always, while much larger percentages of the '*The sceptics'* and *'The price conscious'* clusters occasionally or never do so.

Table 8: Frequency of buying healthy products by cluster.

I buy healthy products …	Cluster (% within cluster)			
	1	2	3	4
never	0	0	1.5	1.7
occasionally	4.9	21.6	35.0	29.3
often	71.3	73.2	56.2	57.2
always	23.8	5.2	7.3	11.8

For cluster labels see Table 2
Kendall's tau-b: 0.421, sig. = 0.000; Kendall's tau-c: 0.366, sig. = 0.000
Source: own data (n=484)

Awareness of the term 'functional food'

Among *'Health-conscious consumers'*, 45.5 per cent are familiar with the term 'functional food' (Table 9). '*The sceptics'* tend to be less familiar with this concept as, although they heard about it, they do not have a clear idea of the meaning.

Table 9: Awareness of the term 'functional food' by cluster.

Awareness	Cluster (% within cluster)			
	1	2	3	4
Yes, I know what the term means	45.5	27.8	22.6	16.8
I have heard the term, but I do not know precisely what it means	43.4	47.4	45.3	43.9
No, I have never heard the term	11.2	24.7	31.4	39.3

For cluster labels see Table 2
Kendall's tau-b: 0.249, sig. = 0.000; Kendall's tau-c: 0.243, sig. = 0.000
Source: own data (n=484)

Regularity of reading product labels

To choose the most appropriate product, the costumers need to have more information. One of the most important sources of information is the product label. The more regularly consumers read the label, the greater is their awareness level. There is a significant difference among clusters according to the usage of product label (Table 10).

Table 10: Regularity of reading product labels by cluster.

Regularity	Cluster (% within cluster)			
	1	2	3	4
Always	19.6	5.2	4.4	8.9
Mostly	73.4	56.7	46.7	52.9
Sometimes	5.6	23.7	34.3	25.2
Rarely	1.4	14.4	13.9	12.2
Never	0	0	0.7	0.8

For cluster labels see Table 2
Kendall's tau-b: 0.393, sig. = 0.000; Kendall's tau-c: 0.360, sig. = 0.000
Source: own data (n=484)

Sources of information on functional foods and their credibility

'Health-conscious consumers' are the most likely to listen to the opinions of doctors and pharmacists, but also use the Internet sources to gather information (Table 11). Advertisements play little role in their food selection. They consider information issued by professional organisations (i.e. food safety regulating authorities) credible, along with that

from the Internet and from professional organisations (Table 12). Most frequently they read the information on the packaging or on the label. They are mainly interested in the composition, product description, nutritional value and expiry date of the foods. They believe consumer awareness can be improved by more informative labels and the integration of such topics in school curricula. Moreover, they consider functional foods safe for one's health. Their food purchase is determined by credible, detailed and scientifically-sound information. Since their main information source is the Internet they can be reached without difficulty.

'Consumers with limited information' peruse food labels for components, description, expiry date and nutritional value. Whereas their most frequent source of information is the shop itself, they also tend to consider the views of professional organisations, their families and friends. They do not trust Internet sources or advertisements. In addition to more understandable and intelligible product descriptions, they would welcome information from authorities and commercial chains.

Table 11: Respondents' preferred sources of information on functional foods by cluster.

Source of information	Cluster (% within cluster)			
	1	2	3	4
Shop	39.4	49.5	51.8	54.2
Internet	39.4	28.9	24.8	19.6
Doctor or pharmacist	3.5	0.0	0.7	0.0
Television	1.4	4.1	1.5	4.7
Advertisements	0.7	5.2	5.8	6.5
Professional organisations or associations	4.2	2.1	0.7	0.0
Friends and family	7.7	10.3	13.1	14.0
Other	3.5	0.0	0.7	0.9
None	0.0	0.0	0.7	0.0

For cluster labels see Table 2
Phi 0.324 Sig. 0.001, Cramer 0.187 Sig. 0.001
Source: own data (n=483)

Table 12: Most credible sources of information on functional foods by cluster.

Source of information	Cluster (% within cluster)			
	1	2	3	4
Advertisements	0.7	1.0	5.1	9.3
Traders	16.1	12.4	10.9	9.3
Internet	30.1	17.5	24.1	15.0
Journals and magazines	5.6	11.3	7.3	5.6
Friends and family	17.5	27.8	17.5	35.5
Professional organisations or associations	23.1	24.7	23.4	14.0
None of these	7.0	5.2	11.7	11.2

For cluster labels see Table 2
Phi 0.311 Sig. 0.000, Cramer 0.18 Sig.0.000
Source: own data (n=484)

'*The sceptics'* regard information provided by professional organisations, and family and friends reliable, but they are divided on the credibility of Internet-based sources and do not trust advertisements or information provided by merchandisers. They object to the small size of lettering on product labels, but most of them do not fully understand the respective data, and one quarter of the sample is not even interested. Those reading the product labels seek information on expiry date, composition, product description and price. They expect product labels to be readable and more informative.

Among '*The price conscious'*, the most frequent sources of information are the point of sale and the opinions of family members and friends. Members of this group do not consider advertisements and Internet-based resources reliable. One half of the sample do not read the labels due to a lack of interest; if they do, however, they check the expiry date, price and the product description.

Price sensitivity

'Health-conscious consumers' show the lowest level of price consciousness, as 16 per cent of the sample are willing to pay 20 per cent more for a chosen product (Table 13). *'Consumers with limited information'* are willing to pay between 1-15 per cent more for healthy foods regardless of taste or price. *'The sceptics'* are more price conscious, as they would only pay 1-10 per cent more for a healthy food product. Consciousness or sensitivity to price is the highest among '*The price conscious'* as 41 per cent would only pay 1-5 per cent more for a healthy product, while 31 per cent are willing to spend 6-10 per cent more for such items.

Table 13: Respondents' price sensitivity by cluster.

I would pay % more for a healthy product …	Cluster (% within cluster)			
	1	2	3	4
0	2.8	4.2	3.6	9.3
1-5	11.2	22.9	32.8	41.1
6-10	33.6	42.7	35.8	30.8
11-15	20.3	21.9	16.1	12.1
16-20	15.4	4.2	8.0	4.7
more than 20	16.8	4.2	3.6	1.9

For cluster labels see Table 2
Kendall's tau-b: 0.281, sig. = 0.000; Kendall's tau-c: 0.282, sig. = 0.000
Source: own data (n=483)

Discussion

Consumption-related research should not use the term 'functional food' due to the public's limited familiarity with the expression. Although the 17 per cent rate of familiarity with the concept reported by Soós *et al*. (2012) has since increased, still 70 per cent of those surveyed have no clear idea of the meaning of the term. In questionnaires addressed to shoppers, we suggest using the term 'product with healthy physiological impact' instead.

The consumer's use of food product labels depends primarily on the extent of their involvement, either in terms of regularly shopping for food or having health conditions that restrict the food selection. We have shown that among consumers that pay little attention to the available product information the shopping is mostly done by another member of the family, and the frequency of nutritional disorders is lower (R1). In line with the survey of Campos *et al*. (2010), according to which "label use was generally high: 82 per cent in New Zealand, 52 per cent in Canada, 47 per cent in the European Union and 75 per cent in the USA", in our

survey 61.1 per cent of the respondents read the label always or most of the time.

Health-conscious, highly-informed consumers demand product information most often and they obtain it from several sources (R2). Those with more limited education do not even take advantage of information available at the point of sale, or pay attention only to a few factors, primarily the expiry date. This result is consistent with the statement of Grunert (2010) that "a lower use of nutritional information in the lower classes is due to lower nutrition knowledge, lower interest in healthy eating, or other factors". Their decision making is based on habit and is primarily aimed at avoiding risks (R3).

Consumers' knowledge of the physiological impact of the ingredients of healthy or functional foods should be increased so as to help them understand the content of food labels. Even if they are not actively seeking information, they could be given food-related information at the point of sale by the sales personnel. They are willing to pay a higher price for a healthy product if they find the information reliable, reinforced by the given reference group. Such motivation can be increased by effective information transfer. The *'health-conscious consumers'* pay the most attention to a healthy lifestyle and are more likely to buy healthy food, as price is not a decisive factor for them. As long as they are open to innovations, they can be easily influenced by point of sale, QR code-based, or info-point data search. The motivation of the *'Price conscious'* could be increased with more readable and understandable product data.

Consumers' demand for information to justify food purchase decisions varies according to their level of knowledge, involvement, personal attitudes and socio-demographic indicators. The higher the level of existing knowledge and the extent of involvement, the greater the need for information. Furthermore, attitude can impact the search for and processing of the respective information. Socio-demographic data suggest that higher income and higher educational qualifications increase information demand; the lower amount of obtained or 'learned' information limits the expectations of young shoppers, and existing nutrition-related disorders in the older age group call for informed and sound decision making. This statement is consistent with the findings of Miller and Cassidy (2015), according to which "food label use may be even more important for older adults because of their higher risk of diet-related chronic diseases".

In order to make an informed and optimal decision, consumers need reliable data, but they do not trust some of the available information and the latter remains ineffective. Reliable data obtained from effective sources can vary according to the given segment. The health-conscious consumers need more and more information on the point of purchase (POP), so we suggest that more informative, readable and easily understandable product-related information, along with the placement of digital accessories such as QR codes with the size of the given product in mind or infopads at the point of sale, along with the provision of more information on the credible and authentic Internet sites can help in realising these objectives. Thanks to the growing popularity of the digital word, these modern methods and instruments can be used successfully in many countries of the world, including Hungary.

References

Anon. (1999): Scientific Concepts of Functional Foods in Europe: Consensus Document. British Journal of Nutrition **81**, S1-S27. https://doi.org/10.1017/S0007114599000471

Bagdy, E. (2010): Vitalitásgenerátorok [Vitality generators]. Lege Artis Medicinae **19** (1), 6-7.

Borgmeier, I. and Westenhoefer, J. (2009): Impact of different food label formats on healthiness evaluation and food choice of consumers: a randomized-controlled study. BMC Public Health **9**, 184. https://doi.org/10.1186/1471-2458-9-184

Chen, X., Jahns. L. and Gittelsohn, J., Wang, Y. (2011): Who is missing the message? Targeting strategies to increase food label use among US adults. Public Health Nutrition **15** (5), 760-772. https://doi.org/10.1017/S1368980011002242

Campos, S., Doxey, J. and Hammond, D. (2010): Nutrition labels on pre-packaged foods: a systematic review. Public Health Nutrition **14** (8), 1496-1506. https://doi.org/10.1017/S1368980010003290

Grunert, K.G., Wills, J.M. and Fernaendez-Celemín, L. (2010): Nutrition knowledge, and use and understanding of nutrition information on food labels among consumers in the UK. Appetite **55** (2), 177-189. https://doi.org/10.1016/j.appet.2010.05.045

Huzsvai L. and Vincze Sz. (2012): SPSS-könyv [SPSS book]. Hungary: Seneca Books. Available online at http://seneca-books.hu/doc/spsskonyv.pdf (accessed 9 July 2017).

Jurecková J. and Picek J. (2007): Shapiro-Wilk-type test of normality under nuisance regression and scale. Computational Statistics & Data Analysis **51** (10), 5184-5191. https://doi.org/10.1016/j.csda.2006.08.026

Kelly, B, Hughes, C., Chapman, K. and others (2009): Consumer testing of the acceptability and effectiveness of front-of-pack food labelling systems for the Australian grocery market. Health Promotion International **24** (2), 120-129. https://doi.org/10.1093/heapro/dap012

Liang, J., Tang, M.L. and Chan, P.S. (2009): A generalized Shapiro-Wilk W-statistic for testing high-dimensional normality. Computational Statistics and Data Analysis **53** (11), 3883-3891. https://doi.org/10.1016/j.csda.2009.04.016

Méjean, C., Macouillard, P., Pe´neau, S., Hercberg, S. and Castetbon, K. (2011): Perception of front-of-pack labels according to social characteristics, nutritional knowledge and food purchasing habits. Public Health Nutrition **16** (3), 392-402. https://doi.org/10.1017/S1368980012003515

Miller, L.M. and Cassady, D.L. (2015): The effects of nutrition knowledge on food label use. A review of the literature. Appetite **92**, 207-216. https://doi.org/10.1016/j.appet.2015.05.029

Sajtos, L. and Mitev, A. (2007): SPSS Kutatási és adatelemzési kézikönyv [SPSS Manual for research and data analysis]. Budapest: Alinea Kiadó.

Soós, G. (2016): A termékinformáció fogyasztói magatartást befolyásoló hatása az élelmiszervásárlás során [The impact of product information on food purchase-related consumer behaviour]. Táplálkozásmarketing **3** (1), 73-83. https://doi.org/10.20494/TM/3/1/6

Soós, G., Biacs, P. and Kiss, A. (2012): Fogyasztói attitűdök a funkcionális élelmiszerfogyasztás területén [Consumer attitudes related to functional foods]. Élelmiszer, táplálkozás és marketing **9** (1), 13-22.

Szakály, Z. (2011): Táplálkozásmarketing [Nutrition Marketing]. Budapest: Mezőgazda Kiadó.

Temple, N.J. and Fraser, J. (2014): Food labels: A critical assessment. Nutrition **30** (3), 257-260. https://doi.org/10.1016/j.nut.2013.06.012

VÍGH Enikő*[1], FERTŐ Imre[2] and FOGARASI József*‡**

Impacts of climate on technical efficiency in the Hungarian arable sector

The aim of this study is to estimate the influence of climate factors on the technical efficiency of Hungarian arable farms. The technical efficiency of farms is affected by several factors such as the technology used, the relative factor abundance, the institutional reforms with the input and output market environment, the farm size and scale economies, the organisation and management, and the farm's specialisation. We employed a two-step approach to identify the impact of climate change on the efficiency of these farms. In the first step, using the Data Envelopment Analysis model, we calculated the efficiency (dependent variable in the second stage of analysis) of these processes. In the second step, we investigated the effect of climate and soil factors (independent variables) on efficiency by applying the Simar and Wilson (2007) approach. In this way we can assess the impacts of matched environmental variables through a robust, representative dataset for Hungary. Our results show that temperature and precipitation increases had statistically significant, positive effects on the technical efficiency of farms in the seeding and vegetative periods in both the constant and variable returns to scale models, and temperature increase during the generative phase of crop production had a negative effect on production efficiency.

Keywords: climate change, arable farms, bootstrap

JEL classifications: Q12, C61, Q51, C31

* Agrárgazdasági Kutató Intézet, Zsil utca 3-5, 1093 Budapest, Hungary. Corresponding author: fogarasi.jozsef@aki.gov.hu; https://orcid.org/0000-0001-7989-8375

** MTA Közgazdaság- és Regionális Tudományi Kutatóközpont, Közgazdaság-tudományi Intézet, Budapest, Hungary.

‡ Also Partiumi Keresztény Egyetem, Oradea, Romania.

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Introduction

The changing climate may cause increasing variability of crop production efficiency and poor economic returns. Between 2006 and 2015, the global average annual surface temperature increased steadily by 0.83-0.89 °C. Globally, 2015 was the warmest year, with a 1 °C increase compared to the pre-industrial period. Meanwhile, European countries experienced even higher (1.5 °C) average temperature rises with respect to the same base period. The summer of 2012 was marked by strong rainfall anomalies, which led to flooding in northern Europe and droughts and wildfires in southern Europe (Dong *et al*., 2013). Trnka *et al.* (2011) estimated that, based on agro-climatic indices in western and central Europe, there is a risk of an increasing number of extremely unfavourable years, which might result in higher interannual yield variability, resulting in poor economic returns. Throughout most of the environmental zones, there were clear signs of agro-climatic condition deterioration and a marked need for adaptive measures. Rainfed agriculture might face more climate-related risks, although the analysed agro-climatic indicators will most likely remain at a level that permits acceptable crop yields.

An extensive body of literature exists on the effects of climate change in the global context on farm-level performance of arable farms. The variations in environmental factors, such as increasing temperature and extreme rainfall patterns, can have a significant effect on agricultural output (IPCC, 2014). Most notably, extreme events such as recently-observed heatwaves and droughts have greatly reduced the yield of some crops (EEA, 2016). More generally, the scientific literature on the impacts of climate change and further environmental externalities reports highly heterogeneous compliance and directions, depending on farm characteristics, regarding the technical efficiency of arable farms (e.g. Olesen *et al*., 2002; Chavas *et al*., 2009; Trnka *et al*., 2011; Trapp, 2015; Hatfield and Prueger, 2015; Vanschoenwinkel *et al*., 2016) The seasonal rainfall and temperature forecasts are expected to have a positive effect on the economic performance of agriculture. However, the effectiveness of climate forecasts on improving technical efficiency is sensitive to the type of climate index used (Solis and Letson, 2012). Temperature is a primary factor affecting the rate of plant development. The warmer temperatures expected with climate change and the potential for more extreme temperature events will have an impact on plant productivity.

In contrast to the above, relatively few studies on the impacts of climate change in agriculture have been conducted in central and eastern European countries. Yet, recent projections (Szépszó and Horányi, 2009; Olesen *et al*., 2010; Mezősi, 2016) identify climate change in the Carpathian Basin as one of the largest uncertainties. This territory, with Hungary at its centre, roughly equates to the so-called Pannonian Biogeographic Region (Sundseth, 2009), which has a temperate climate, with frequent showers and cold, snowy winters and warm summers. The region is characterised by a transitional zone between the humid-continental climate to the north and east, and the humid-subtropical climate to the south and west (Sippel and Otto, 2014). Owing to climate characteristics, the primary impact of climate change is expected to be precipitation change, drought and temperature extremes.

Vanschoenwinkel *et al*. (2016) combined climate, soil, geographic, socio-economic and farm-level data in a linear mixed-effect model and examined whether eastern and western Europe will have the same climate responses, and how these responses will change if regional adaptive capacity increases. They concluded that both regions currently

[1] https://orcid.org/0000-0001-8384-7685
[2] https://orcid.org/0000-0002-3742-5964

have a significantly different climate response, but that if eastern Europe were to implement the same adaptation options as western Europe, it could avoid a large decrease in land value and even benefit from climate change depending on the climate scenario. The research community has responded by monitoring and evaluating climate change effects in both spatial and time scales. Szépszó and Horányi (2009) and Trnka *et al.* (2011) concluded that there is a risk of an increasing number of extremely unfavourable years in both western and central Europe. Accordingly, positive effects on agriculture may become apparent in northern European areas (Olesen and Bindi, 2002). Interannual variability analysis of meteorological variables during the reproductive stage of vegetation result reduced yields but seasonal rainfall and temperature forecasts have a positive effect on economic performance of agriculture (Solis and Letson, 2012).

In addition to the lack of published research in central and eastern Europe, the scientific literature evaluating phenological performance of arable crops from the efficiency perspective is also limited. This paper tries to fill these gaps by (a) investigating the effects of climatic conditions on Hungarian arable farms, and (b) developing the typical phenology phase-based results from an agricultural production efficiency perspective using panel data for the period 2002-2013. We aimed to analyse the extent to which environmental changes may be captured in the efficiency of the cereal, oilseeds and protein crops sector in Hungary, a net agricultural exporting European country. In terms of data, the main feature of our research is the use of high-resolution daily gridded temperature and precipitation data for Hungary, which have not previously been exploited much in climate change and agriculture research.

Methodology

Analytical approach

In the literature, two main approaches compete for efficiency and productivity change calculations: parametric techniques based on stochastic frontier analysis (see Bakucs, 2011), and non-parametric techniques based on Data Envelopment Analysis (DEA) (Coelli *et al*., 1998). We employed a two-step approach for assessing the influence of climatic and soil characteristics on technical efficiency. In the first step, we calculated the technical efficiency of farms using the DEA output-oriented model (Farrell, 1957; Thiele and Brodersen, 1999). The main advantages of DEA are that (a) it does not require any assumption on the functional form, (b) it can treat multiple outputs and inputs, and (c) it is able to determine the best practice for every decision unit (Coelli *et al*., 2005). In this case, we used an output-oriented DEA model for analysis, with fixed input measures. The value of the obtained result is the technical efficiency score for the arable farms. When the efficiency is equal to 1, the farm is considered to be fully technically efficient. However, the standard DEA approach may produce potential bias of efficiency estimates, while the accuracy of DEA results may be affected by sampling variation of the estimated frontier and the non-measurement of random error.

The non-parametric approach focusses on the best operational processes by constructing a production frontier, and all units of analysis are related to this frontier. Thus, the DEA non-parametric technique uses linear programming to construct a deterministic piece-wise efficient frontier using the best-performing observations of the sample. The represented distance from a farm to the constructed frontier represents a measure of efficiency: farms located on the frontier are fully efficient; in contrast, farms under the frontier are inefficient, and the increasing distance from frontier provides less efficient farms (Contreras, 2017).

In the second step of the analysis, we focused on the impact of climate and soil factors on the technical efficiency scores. The DEA estimations provide scores taking values between 0 and 1, and the dependent variables have a censored structure, due to the variables taking values in a limited range (Davidson and MacKinnon, 2003).

Simar and Wilson (1998) first introduced the bootstrap procedure to estimate the uncertainty of traditional statistical inference in DEA. In 2007, they extended their approach to account for the impact of environmental variables on efficiency, in which the factors responsible for the inefficiency may be revealed. Simar and Wilson (2007) algorithms are the only known method for making valid inference in the second stage since conventional methods fail to give valid inference with inappropriate regression results (Keramidou and Mimis, 2011; Benito *et al*., 2014). Simar and Wilson (2007) noted that the DEA efficiency estimates are biased and serially correlated, which invalidates conventional inference in two-stage approaches. They proposed the bootstrap procedure (Simar and Wilson, 1998) that enables consistent inference within models explaining efficiency scores while simultaneously producing standard errors and confidence intervals for these scores. The procedure of Simar and Wilson (2007) completes the instrument for regression analysis of DEA efficiency scores in two-step approaches. Unlike naïve two-step approaches, the Simar and Wilson procedure accounts for DEA efficiency scores being bounded – depending on how efficiency is defined – from above or from below at the value of 1, and for DEA generating a complex and generally unknown correlation pattern among estimated efficiency scores.

Simar and Wilson (2007) went on to (a) define a statistical model where truncated regression yields consistent estimation of model features; (b) demonstrate that conventional, likelihood-based approaches to inference are invalid; and (c) develop a bootstrap approach that yields valid inference in the second stage regression when such regressions are appropriate. They proposed two bootstrap algorithms for solving the two-stage efficiency estimation problem. The algorithm-2 is described in Latruffe *et al*. (2008) and we applied algorithm-1 with 2,000 iterations in our study as follows: (1) a DEA output-orientated efficiency score is calculated for each farm, (2) the maximum likelihood method is used in the truncated regression model, (3) for each farm, bootstrap estimates are performed with 2,000 iterations, and (4) the bootstrap values are able to construct the estimated confidence intervals for each farm.

Data

A representative set of Farm Accountancy Data Network (FADN) data of arable farms were used for DEA calculations for the period 2002-2013 in the first step. The output variable is the gross production value (HUF, deflated) and the input variables are *agricultural land area* (ha), *labour* (annual working unit), *capital* (HUF, deflated), and *intermediate consumption* (HUF, deflated).

We used different soil and meteorological data to check the effects of climate change in the second step. The panel dataset adopted the soil variables *agricul* (dominant limitation to agricultural use of soils), *hwc_sub* (water capacity of subsoil), *hwc_top* (water capacity of topsoil) and *loc* (dummy variable, 1=low organic content below 2 per cent, 0 otherwise) based on the EUSOILS dataset of the ESDA European Union Joint Research Centre (EU-JRC).

In the literature, the EUSOILS dataset is often used as the control variable. Audsley *et al.* (2014) defined available water capacity, saturation to permanent wilting point, soil stoniness and soil texture variables, based on the EUSOILS dataset on soil type-grid combinations, up to 47 different soil types. Moriondo *et al.* (2009) defined the water balance and soil properties (thickness and texture) as variables at grid point scale based on the EUSOILS database, the soil type having the highest frequency within each 50×50 km grid point grid (in every soil mapping unit, SMU) being considered as representative for the whole unit. Fezzi and Bateman (2015) used EUSOILS data as environmental and other control variables. These variables were: soil texture as the share of fine particles (clay), depth to rock and slope. Janssen *et al.* (2008) also used EUSOILS-derived data for integrated environment modelling, where the central concept of the analysis is to define 'representative farms', which defines a 'farm type' in an FADN region in Europe for a specific year. A 'farm type' is specified according to the dimensions of farm size, farm intensity and farm specialisation (by total output: EUR <500 per hectare: low intensity; EUR 500-3000: medium intensity and EUR >3000: high intensity).

In this study, the meteorological variables focused on average daily temperature and daily precipitation variables; based on the AGRI4CAST MARS Crop Yield Forecasting System of the EU-JRC. These variables were divided into three technological sections, the first for the period 1-30 April, the second from 1 May to 30 June and the third from 1 July to 31 August, representing the seeding season for the initial development ($T_{seeding}$, $P_{seeding}$), the vegetative growth stage for stem extension ($T_{vegetative}$, $P_{vegetative}$) and the generative growth stage for the ripening and harvesting ($T_{generative}$, $P_{generative}$) of the crops (Trapp, 2015). These periods are defined for the Carpathian Basin, especially for Hungary, and represent the main crop phases for the relevant crop species (Table 1).

The 10x10 km gridded soil data files were grouped into SMU; each SMU corresponds to a part of the mapped territory and we used the dominant occurrence of SMU for every observed locality. Shares for three soil-related parameters (limitations, organic content and water adsorbtion capacity) and characteristics were constructed for each location.

The temperature and precipitation data were stored in 25x25 km regular latitude-longitude grids. The observed 118 grid points were considered sufficient to allocate the environmental data accurately. The grid-cell information was allocated to location level, which allowed the matching with FADN farm data. In this way we could assess the impacts of matched environmental variables through a robust representative dataset for Hungary.

Results

During the period 2002-2013, the median value of total technical efficiency (constant returns to scale, CRS) of Hungarian arable farms ranged between 0.35 and 0.45 (Figure 1). These low efficiency values indicate a high heterogeneity of farms in production performance, and for poorly-performing farms there is a high potential output increase with this input use.

During the analysed period, around 2 per cent, in the case of the CRS estimation, and about 4-6 per cent, in the case of the variable returns to scale (VRS) estimation, of the arable farms were on the efficient frontier. Pure technical efficiency

Table 1: Descriptive statistics of the variables used in the study.

Variable	Unit	Mean value	Standard deviation	Minimum value	Maximum value
Total output	HUF 1000	39,049.7	97,122.6	90.4	2,034,271.0
Agricultural land	ha	236.7	434.0	1.2	5,506.7
Workforce	AWU	4.0	9.2	0.1	215.7
Capital	HUF 1000	51,671.1	86,240.2	2.7	1,929,056.0
Intermediate consumption	HUF 1000	30,111.1	76,552.9	267.5	1,781,878.0
$T_{seeding}$	°C	12.0	1.1	8.6	16.0
$T_{generative}$	°C	18.5	1.2	14.9	22.3
$T_{vegetative}$	°C	21.9	1.0	18.6	24.6
$P_{seeding}$	mm	37.7	25.9	0.0	135.6
$P_{generative}$	mm	133.0	62.2	7.3	441.6
$P_{vegetative}$	mm	126.8	65.5	18.5	348.2
agricul	% farms	0.97	0.16	0.00	1.00
hwc_sub	% farms	0.55	0.50	0.00	1.00
hwc_top	% farms	0.95	0.21	0.00	1.00
loc	% farms	0.52	0.50	0.00	1.00

Source: own calculations

(VRS) of arable farms accounts for the effectiveness of managerial decisions of farmers, which has been increasing faster than the median value of total technical efficiency (CRS) since 2010.

The results from the double bootstrap estimation based on Simar and Wilson (2007) are presented in Table 2. As mentioned earlier, the dependent variable represents the efficiency of selected arable farms, while independent variables represent the climatic and soil variables. In this context, the temperature and the precipitation increases had a statistically significant positive effect on efficiency of farms in the seeding and vegetative periods in both the CRS and VRS models. In contrast, the temperature increase during the generative phase of crop production had a negative effect on production efficiency: the direction of the effects is consistent with our a priori expectations. Soil dummies were found to have significant coefficients. The biophysical results suggest that the high water holding capacity of the top- and subsoil had a positive effect on efficiency. The same negative relationship was identified for low organic content of soil as we expected: the low organic content of soil lowers the efficiency on both the constant and variable returns to scale models.

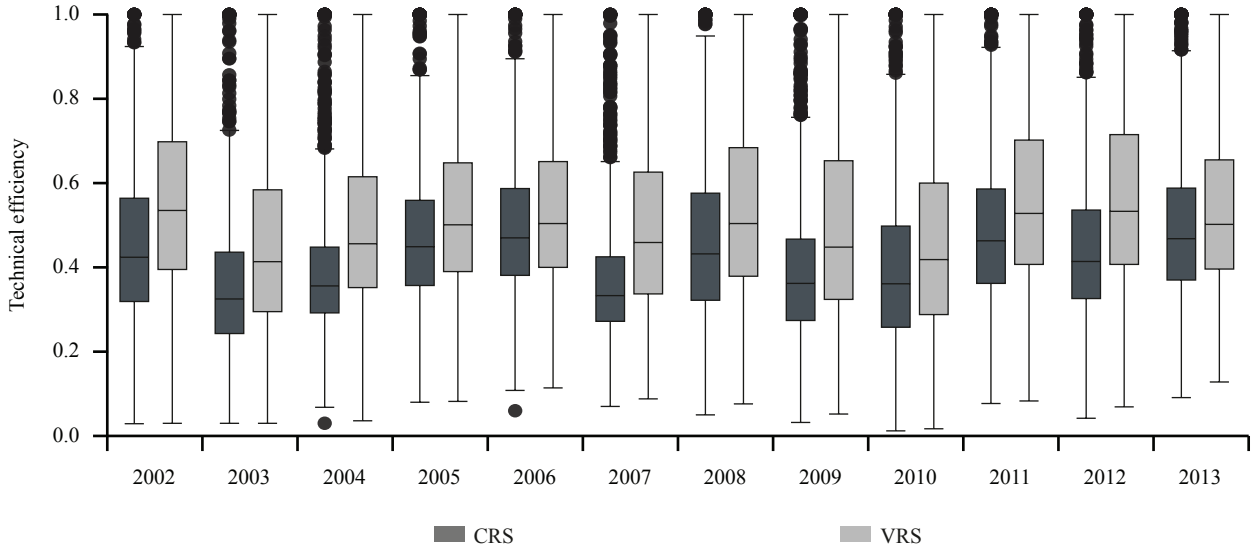

Figure 1: Box plots of Data Envelopment Analysis scores.
Source: own calculations

Table 2: Simar-Wilson regression results.

Explanatory variable	Constant returns to scale	Lower bound	Upper bound	Variable returns to scale	Lower bound	Upper bound
$T_{seeding}$	0.231***	0.1872	0.2741	0.223***	0.1683	0.2771
$T_{seeding2}$	-0.009***	-0.0105	-0.0070	-0.009***	-0.0107	-0.0064
$T_{vegetative}$	0.372***	0.2928	0.4478	0.340***	0.2477	0.4313
$T_{vegetative2}$	-0.010***	-0.0116	-0.0074	-0.009***	-0.0112	-0.0063
$T_{generative}$	-0.225***	-0.3688	-0.0886	-0.309***	-0.4877	-0.1375
$T_{generative2}$	0.005***	0.0014	0.0078	0.007***	0.0028	0.0107
$P_{seeding}$	0.003***	0.0027	0.0036	0.002***	0.0013	0.0024
$P_{seeding2}$	-0.000***	0.0000	0.0000	-0.000***	0.0000	0.0000
$P_{vegetative}$	0.000	-0.0002	0.0003	0.000	-0.0003	0.0003
$P_{vegetative2}$	-0.000**	0.0000	0.0000	-0.000**	0.0000	0.0000
$P_{generative}$	-0.000**	-0.0004	0.0000	-0.000	-0.0003	0.0002
$P_{generative2}$	0.000	0.0000	0.0000	-0.000	0.0000	0.0000
AGRICUL	0.019*	-0.0012	0.0385	0.036***	0.0124	0.0612
HWC_SUB	0.024***	0.0176	0.0311	0.018***	0.0105	0.0262
HWC_TOP	0.014*	-0.0007	0.0299	0.010	-0.0088	0.0278
LOC	-0.013***	-0.0193	-0.0066	-0.017***	-0.0249	-0.0093
cons	-2.001***	-3.3292	-0.6037	-0.701	-2.3527	1.0128
sigma	0.168***	0.1655	0.1704	0.197**	0.1936	0.2000
Wald chi^2	754.831	-	-	388.337	-	-
N	11,785	-	-	11,785	-	-

*p<0.1; **p<0.05; *** p<0.01
Source: own calculations

Discussion

Climate variability is one of the major factors influencing crop productivity, thus farmers' decisions along with their expectations of the coming year's potential outputs are highly affected. The impacts of climate change have been observed on European, including Hungarian, crop and livestock production in recent decades. Variation in the phenology of plants is one of the most sensitive ecological responses to climate change (Menzel *et al*., 2006). In continental climates, temperature increases in the spring can advance the spring phenological phases but warming in autumn and winter may slow the fulfilment of chilling requirements, as evidenced by recent phenology delays in response to warming at some locations. As warming continues, the phenology-delaying impacts of higher autumn/winter temperatures may increase in importance (Guo *et al*., 2014). Our findings illustrate the kind of phenological responses to climate change that can be expected to occur in Hungary. Among the environmental factors affecting agricultural efficiency, our estimations showed that the increasing temperature in the seeding and vegetative periods of plant production (April, May and June) had a positive effect on technical efficiency in Hungarian crop production. By contrast, a negative linkage between temperature and efficiency was demonstrated in the generative period (July and August) when the decreasing water capacity induced lower levels of efficiency. The decreasing precipitation level (e.g. droughts linked to climate change) in the seeding, vegetative and generative periods also had a negative effect on plant production.

Our analysis showed that among the meteorological factors, efficiency in the generative phase is reduced. Similarly, Hatfield and Prueger (2015) concluded that the major impact of warmer temperatures was during the reproductive stage of development and in all cases grain yield in maize was significantly reduced. Our results are also in line with those of Chavas *et al*. (2009), who examined the potential climate change impacts on the productivity of five major crops in eastern China: canola, maize, potato, rice and winter wheat. They found climate variables to be more significant drivers of simulated yield changes than changes in soil properties, except in the case of potato production in the northwest where the effects of wind erosion are more significant. Positive effects on economic performance of agriculture are shown by Solis and Letson (2012), which partly correspond to our results.

Assuming the efficiency scores obtained from the DEA as dependent variables, regression analysis was applied in the second stage of our study to examine the meteorological and environmental variables affecting the efficiency as explanatory variables. From a methodological perspective, the Simar and Wilson (2007) estimation (Table 2) shows that stronger relationships result. The double bootstrap estimation showed that the direction of the effects is consistent with our a priori expectations in the first step.

There is growing concern among policy makers and public interest groups about the effect of climate change on food security and agricultural sustainability. The United Nations Framework Convention on Climate Change aims to combat climate change by limiting average global temperature increases and by coping with the negative impacts. Climatic factors, including temperature and rainfall, have a strong impact on agricultural output, inducing adaptation strategies that can lead to structural changes in farming. In Europe, the Seventh Environment Action Programme of the European Parliament guides the climate and energy framework for handling climate policy goals by conserving natural capital, enhancing resource efficiency and reducing environmental pressures. The outlines of adaptation trends have been developed, and farmers are taking steps to mitigate the negative effects of climate change, such as by changing the timing of cultivations and choosing more appropriate crop species and cultivars. The evaluation of good agricultural practices and factors influencing farmers' decisions is crucial in the agricultural sector.

However, environmental challenges have a strong regional dimension. In the south-east European region, the number of temperature extremes is increasing more rapidly than mean temperature: heatwave intensity, length and frequency have increased. The temperature and precipitation changes also show an increase in return time, although the results are subject to uncertainties (Sippel and Otto, 2014). The Carpathians are subjected to climate change through the weather-related extremes (Spinoni *et al*., 2015). In Hungary, spatial and year-to-year variability of precipitation patterns are notable. The country-wide annual precipitation showed a decreasing tendency during the last century. Owing to the extreme events, there were two floods in the Tisza and in the Danube rivers in 2006 and there was serious inland damage from excess water and other floods (Dong *et al*., 2013). The Hungarian Meteorological Service warns that emerging climate factors, such as increasing number of heat days (for the 1971-2000 period, the average number of heat days was 21) and decreasing number of frosty days (down by 20 per cent from 1900 to 2000) affect both traditional and intensive crop production. Indirect effects of water availability and temperature level show that fertilisers and mineral materials adsorption ability of plants may change considerably.

Owing to different inputs, farmers may apply various adaptation methods according to regional differences through the different climate, technological and soil patterns (Olesen *et al*., 2010). The development of the most appropriate regional- or local-level responses is crucial. Our results showed that the farms, through the climate change effects in the generative phase, achieved lower levels of efficiency in July and August. Our findings can contribute to the necessary development of targeted adaptation strategies to the impacts of climate change for Hungary and its neighbouring countries.

References

Audsley, E., Trnka, M, Sabaté, S., Maspons, J., Sanchez, A., Sandars, D., Balek, J. and Pearn, K. (2014): Interactively modelling land profitability to estimate European agricultural and forest land use under future scenarios of climate, socio-economics and adaptation. Climatic Change **128** (3-4), 215-227. https://doi.org/10.1007/s10584-014-1164-6

Bakucs, L. (2011): Parametric farm performance and efficiency methodology: stochastic frontier analysis. Studies in Agricultural Economics **113**, 97-104. https://doi.org/10.7896/j.1006

Benito, B., Solana, J. and López, P. (2014): Determinants of Spanish regions' tourism performance: a two-stage, double-bootstrap data envelopment analysis. Tourism Economics **20**, 987-1012. https://doi.org/10.5367/te.2013.0327

Chavas, R.D., Izaurraldea, R.C., Thomsona, A.M. and Gao, X. (2009): Long-term climate change impacts on agricultural productivity in eastern China. Agricultural and Forest Meteorology **149** (6-7), 1118-1128. https://doi.org/10.1016/j.agrformet.2009.02.001

Coelli, T., Prasada Rao, D.S. and Battese G.W. (1998): An introduction to efficiency and productivity analysis. Boston: Kluwer Academic. https://doi.org/10.1007/978-1-4615-5493-6

Coelli, T.J., Rao, D.S.P., O'Donnell, C.J. and Battese, G.E. (2005): An Introduction to Efficiency and Productivity Analysis (2nd edition). New York NY: Springer Science+Business Media.

Contreras, S. (2017): Gender Differentials and Determinants of Female-Male Holders Revenue Efficiency during the implementation of the GTP plan in Ethiopia: A Panel Data Study. Paper presented at the 49th Annual Meeting of the Southern Agricultural Economics Association, Mobile, Alabama, USA, 4-7 February 2017.

Davidson, R. and MacKinnon, J. (2003): Econometric Theory and Methods. New York: Oxford University Press.

Dong, B., Sutton, R. and Woollings, T. (2012): The extreme European summer of 2012. Bulletin of the American Meteorological Society **93**, 28-32.

EEA (2017): Climate change, impacts and vulnerability in Europe 2016. An indicator-based report. København: European Environment Agency.

Farrell, M.J. (1957): The measurement of productive efficiency. Journal of the Royal Statistical Society, Series A, **120** (3), 253-290. https://doi.org/10.2307/2343100

Fezzi, C. and Bateman, I. (2015): The Impact of Climate Change on Agriculture: Nonlinear Effects and Aggregation Bias in Ricardian Models of Farmland Values. Journal of the Association of Environmental and Resource Economists **2** (1), 57-92. https://doi.org/10.1086/680257

Guo, L., Dai, J., Wang, M., Xua, J. and Luedeling, E. (2014): Responses of spring phenology in temperate zone trees to climate warming: A case study of apricot flowering in China. Agricultural and Forest Meteorology **201**, 1-7. https://doi.org/10.1016/j.agrformet.2014.10.016

Hatfield, J.L. and Prueger, J.H. (2015): Temperature extremes: Effect on plant growth and development. Weather and Climate Extremes **10** (A), 4-10. https://doi.org/10.1016/j.wace.2015.08.001

IPCC (2014): Climate Change 2014: Impacts, Adaptation, and Vulnerability. Cambridge: Cambridge University Press.

Janssen, S., Andersen, E. Athanasiadis, J.N. and Van Ittersum, M. (2008): An European database for integrated assessment and modeling of agricultural systems, in: M. Sànchez-Marrè, J. Béjar, J. Comas, A.E. Rizzoli and G. Guariso (eds), Proceedings of the iEMSs Fourth Biennial Meeting, Barcelona, Catalonia, 7-10 July 2008, 719-726.

Keramidou, I. and Mimis, A. (2011): An application of the double-bootstrap data envelopment analysis to investigate sources of efficiency in the Greek poultry sector. World's Poultry Science Journal **67**, 675-686. https://doi.org/10.1017/S0043933911000754

Latruffe, L., Davidova, S. and Balcombe, K. (2008): Application of a double bootstrap to investigation of determinants of technical efficiency of farms in Central Europe. Journal of Productivity Analysis **29**, 183-191. https://doi.org/10.1007/s11123-007-0074-2

Menzel, A., Sparks, T.H., Estrella, N., Koch, E., Aasa, A., Ahas, R., Alm-Kübler, K., Bissolli, P., Braslavská, O., Briede, A., Chmielewski, F.M., Crepinsek, Z., Curnel, Y., Dahl, Å., Defila, C., Donnelly, A., Filella, Y., Jatczak, K., Måge, F., Mestre, A., Nordli, Ø., Pe-uelas, J., Pirinen, P., Remišová, V., Scheifinger, H., Striz, M., Susnik, A., Van Vliet, A.J.H., Wielgolaski, F.-E., Zach, S. and Zust, A. (2006): European phenological response to climate change matches the warming pattern. Global Change of Biology **12** (10), 1969-1976. https://doi.org/10.1111/j.1365-2486.2006.01193.x

Mezősi, G. (2016): The Physical Geography of Hungary. Cham (ZG), Switzerland: Springer International Publishing.

Moriondo, M., Bindi, M, Kundzewicz, Z.W., Szwed, M. Chorynski, A. Matczak, P., Radziejewski, M. McEvoy, D. and Wreford, A. (2009): Impact and adaptation opportunities for European agriculture in response to climatic change and variability. Mitigation and Adaptation Strategies for Global Change **15** (7), 657-679. https://doi.org/10.1007/s11027-010-9219-0

Olesen, J. and Bindi, M. (2002): Consequences of climate change for European agricultural productivity, land use and policy. European Journal of Agronomy **16** (4), 239-262. https://doi.org/10.1016/S1161-0301(02)00004-7

Olesen, J.E., Trnka, M., Kersebaum, K.C., Skjelvag, A.O., Seguin, B., Peltonen-Sainio, P., Rossi, F., Kozyra, J. and Micale, F. (2010): Impacts and adaptation of European crop production systems to climate change. European Journal of Agronomy **34** (2), 96-112. https://doi.org/10.1016/j.eja.2010.11.003

Simar, L. and Wilson, P.W. (1998): Sensitivity analysis of efficiency scores: how to bootstrap in nonparametric frontier models Management Science **44**, 49-61. https://doi.org/10.1287/mnsc.44.1.49

Simar, L. and Wilson, P.W. (2007): Estimation and inference in two-stage, semi-parametric models of production processes. Journal of Econometrics **136** (1), 31-64. https://doi.org/10.1016/j.jeconom.2005.07.009

Sippel, S. and Otto, F. (2014): Beyond climatological extremes - assessing how the odds of hydrometeorological extreme events in South-East Europe change in a warming climate. Climatic Change **125** (3-4), 381-398. https://doi.org/10.1007/s10584-014-1153-9

Solis, D. and Letson, D. (2012): Assessing the value of climate information and forecasts for the agricultural sector in the Southeastern United States: multi-output stochastic frontier approach. Regional Environmental Change **13** (Supplement 1), 5-14. https://doi.org/10.1007/s10113-012-0354-x

Spinoni, J., Lakatos, M., Szentimrey, T., Bihari, Z., Szalai, S., Vogta, J. and Antofiea, T. (2015): Heat and cold waves trends in the Carpathian Region from 1961 to 2010. International Journal of Climatology **35** (14), 4197-4209. https://doi.org/10.1002/joc.4279

Sundseth, K. (2009): Natura 2000 in the Pannonian Region. Brussel: European Commission.

Szépszó, G. and Horányi, A. (2009): Transient simulation of the REMO regional climate model and its evaluation over Hungary. Quarterly Journal of the Hungarian Meteorological Service **112**, 203-231.

Thiele, H. and Brodersen, C.M. (1999): Differences in farm efficiency in market and transition economies: empirical evidence from West and East Germany. European Review of Agricultural Economics **26**, 331-347. https://doi.org/10.1093/erae/26.3.331

Trapp, N. (2015): The Economic Impacts of Climate Change and Options for Adaptation: A Study of the Farming Sector in the European Union. Hamburg: Max-Planck-Institut für Meteorologie.

Trnka, M., Olesen, J.E., Kersebaum, K.C., Skjelvåg, A.O., Eitzinger, J., Seguin, B., Peltonen-Sainio, P., Rötter, R., Iglesias, A., Orlandini, S., Dubrovský, M., Hlavinka, P., Balek, J., Eckersten, H., Cloppet, E., Calanca, P., Gobin, A., Vučetić, V., Nejedlik, P., Kumar, S., Lalic, B., Mestre, A., Rossi, F., Kozyra, J., Alexandrov, V., Semerádová, D. and Žalud, Z. (2011): Agroclimatic conditions in Europe under climate change. Global Change Biology **17** (7), 2298-2318. https://doi.org/10.1111/j.1365-2486.2011.02396.x

Vanschoenwinkel, J., Mendelsohn, R. and Van Passel, S. (2016): Do Western and Eastern Europe have the same agricultural climate response? Taking adaptive capacity into account. Global Environmental Change **41**, 74-87. https://doi.org/10.1016/j.gloenvcha.2016.09.003

TAKÁCSNÉ GYÖRGY Katalin[1], LÁMFALUSI Ibolya*[2], MOLNÁR András*, SULYOK Dénes***, GAÁL Márta*[3], KEMÉNYNÉ HORVÁTH Zsuzsanna*[4], DOMÁN Csaba*[5], ILLÉS Ivett*, KISS Andrea*, PÉTER Krisztina* and KEMÉNY Gábor*[6]**

Precision agriculture in Hungary: assessment of perceptions and accounting records of FADN arable farms

Technological progress can provide several solutions to the most significant challenges faced by agriculture. Precision agriculture (PA) technologies have been recognised as one of the rare win-win solutions for environmental and socio-economic goals. Although they have been available for decades, their diffusion progresses at a slow rate. Therefore, in recent years, precision farming has been receiving more attention from agricultural economists. Perceptions of Hungarian FADN arable farms about precision farming were collected through a survey in order to compare with cost-benefit analyses. The survey not only revealed the details of the application of different technologies but also their impacts perceived compared to a baseline situation. For the main crops, the results confirmed that precision farming leads to increasing yields and has profitability benefits compared to conventional farming. According to the respondents, the high investment cost is the main barrier to diffusion, while subsidies and more appropriate information could foster it. Therefore, a specific subsidy package implemented both in the 'greening' component and in the Rural Development Programme of the European Union's Common Agricultural Policy would be a stimulating factor for the wider spread of PA.

Keywords: site-specific farming, technology diffusion, cost-benefit analysis, FADN data, survey
JEL classifications: O33, Q11, Q16

* Agrárgazdasági Kutató Intézet, Zsil utca 3-5, 1093 Budapest, Hungary. Corresponding author: molnar.andras@aki.gov.hu; https://orcid.org/0000-0002-7010-7917
** Óbudai Egyetem, Budapest, Hungary.
*** KITE Zrt., Nádudvar, Hungary.
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Introduction

Any technology – such as precision farming – that is in line with the concept of sustainable intensification can contribute to achieving a sustainable food system. However, these possibilities can only be achieved if the associated benefits can be properly measured and at the same time farmers perceptions and behaviour are better understood.

Modern precision agriculture (PA) started after 2000, when GPS signals were made available to the public. In the last ten years, PA has moved from state-of-the-art science to standard practice and already 70-80 per cent of new farm equipment sold contains some form of PA component (CEMA, 2014). Precision farming can be considered as an agricultural innovation. It has been shown that young, well-capitalised farmers with large land areas and higher levels of education tend to be more willing to apply new technologies. PA technologies require significant investment of both capital and time, but provide both productivity and profitability benefits. The data generated by these technologies have been one of the reasons that farmers adopt PA (Griffin *et al.*, 2017). Conversely, among the main barriers are the high investment cost, cost of specific precision services, lack of IT knowledge, insufficient communication and co-operation between actors and, very importantly, a gap in knowledge transfer between science and practical applications. (Fountas *et al*., 2005; DEFRA, 2013; Antolini *et al.*, 2015; EIP-AGRI, 2015).

Currently, the biggest share of PA use takes place in the USA. The results of the most recent farm-level study in the USA show that the proportion of non-adopters has significantly declined, especially over the last six years, to 33 per cent by 2016 (Griffin *et al.,* 2017). It is important to note that in this case high labour costs encourage the spread of technology. Furthermore, significant state subsidy also promotes its broader application (Technavio, 2015). Even so, USDA's Agricultural Resource Management Survey (Schimmelpfennig, 2016) shows that adoption rates vary significantly across different types of PA technology and uptake also depends on the crop. For example, maize and soybeans have higher shares of cropped area (above 30 per cent) using yield mapping than other crops, guidance was used by 45-50 per cent of all crops, while the adoption of variable-rate technology (VRT) in maize, soybeans and rice were all above 20 per cent.

In Australia, 20 per cent of maize producers used precision cultivation in 2012 (OECD, 2016), but this proportion is much higher among farmers with large land areas. Llewellyn and Ouzman (2014) reported that 77 per cent of farmers growing more than 500 hectares of grain use automatic steering and 33 per cent carry out yield mapping. Thirty-five per cent of farmers have variable-rate fertiliser capability, but only 15 per cent of them use VRT.

PA has been making its way into farms across Europe, but the uptake is still very slow, and there is great variation among European Union (EU) Member States. According to a survey completed in 2012 (DEFRA, 2013), in England only

[1] https://orcid.org/0000-0002-9129-7481
[2] https://orcid.org/0000-0001-8141-742X
[3] https://orcid.org/0000-0002-5707-1876
[4] https://orcid.org/0000-0003-2918-4977
[5] https://orcid.org/0000-0002-6447-8877
[6] https://orcid.org/0000-0002-1849-5991

22 per cent of farmers used GPS-based vehicle navigation, 20 per cent used soil mapping, 16 per cent used variable-rate application and 11 per cent used yield mapping. In Germany, 10-30 per cent of farmers have adopted at least one element of PA (OECD, 2016; Paustian and Theuvsen, 2017). According to recent data of EurActiv (2016), 150 000 hectares in France are managed using precision agriculture, and half of the farms have a tractor equipped with a monitor.

Precision farms emerged in Hungary in the last 15 years, but for many people it is still an unknown concept. According to Tóth (2015), only half of the crop producers have heard about it, but this percentage depends on the farm size. Adopters of precision farming are primarily younger than 40 years old, have higher education and cultivate more than 300 hectares of land, which is consistent with international experiences (Lencsés *et al*., 2014). In 2015, 44 per cent of farmers used GPS, and among farmers under the age of 40 years this share reached 48 per cent (Pólya and Varanka, 2015). Site-specific soil sampling, the use of guidance systems and, increasingly, automatic steering can be considered to be standard management practices. More than half of the precision farmers use guidance systems, and around 30 per cent of them use autopilot, followed by machine control, VRT seeding and fertiliser applications (25 per cent). The applications of sensors for pest control, drones and precision irrigation are still at the inception phase: the rate of their application is only around 5 per cent (Kemény *et al.*, 2017).

It is widely accepted that the economic potential or profitability of PA depends on the farm size, heterogeneity of agricultural land cultivated by the farm, the applied technology mix (both PA and non-PA), the cultivated crops, and the experiences and ICT skills of the farmers. Castle *et al.* (2017) demonstrated using regression analysis that the profitability of PA technology adoption increases with the years after adopting the technology.

In order to lower the additional investment costs of PA, technologies are usually introduced sequentially. However, this approach to adoption may seem inefficient and time-consuming compared to adoption of complete, possibly complementary technologies (Schimmelpfennig and Ebel, 2016). Zarco-Tejada *et al.* (2014) estimated the economic benefits of guiding systems for a 500-hectare farm in the UK to be at least EUR 2.2 per ha. A more complex system would lead to additional returns of EUR 18-45 per ha for winter wheat production. In Germany, economic benefits due to savings of inputs were assessed at EUR 27 per ha for winter wheat. According to Schrijver (2016), the potential savings for EU farmers are EUR 260 per ha compared to a gross margin of EUR 400-700 per ha, which could be realistically achievable by 2050.

Although profitability is critical to the adoption decision by farmers, several studies only estimate changes in input use and yield, and the reported data are sometimes rather variable. For example, automatic machine guidance is expected to result in a 10-25 per cent decrease in fuel consumption, weed detection can reduce the herbicide use by 6-81 per cent, and precision irrigation typically enables 25 per cent water savings. For site-specific nitrogen management, the input use saving ranges from 6 to 46 per cent, and the yield increase from 1 to 10 per cent. Beyond the economic benefits, lower environmental impact (reduction of residual nitrogen in soils by 30 to 50 per cent) is also mentioned (Jacobsen *et al*., 2011; Zarco-Tejada *et al.*, 2014, Schrijver, 2016; Balafoutis *et al.*, 2017).

Based on these insights, the aim of the study was to demonstrate statistically the economic benefits of PA for arable farming in Hungary. At the same time, farmers' perception related to different aspects of PA was assessed. The paper investigates the following hypotheses: H1: The most important hindering factor for the penetration of precision farming in Hungary among arable farms is the high investment costs; H2: The introduction of precision fertilisation and pest management applications would cause a decrease in the input use; H3: Precision farming in case of the main arable crops (winter wheat, maize, oilseed rape, sunflower) increases yield, with cost and profitability benefits compared to current conventional agronomy practices.

Methodology

Farmers' perceptions and the main barriers are usually evaluated based on questionnaires. A questionnaire survey among the approximately 1,000 arable crop farms of the Hungarian Farm Accountancy Data Network (FADN) was conducted in 2016 with the aim to obtain detailed picture about the penetration of PA and soil conservation tillage in Hungary. Responses were received from 656 farms, i.e. approximately 70 per cent of the sample farms, so the sampling can be considered as representative. During the survey, we investigated how different information sources are used by farmers to gain knowledge about PA and soil conservation management; farmers' opinions on the barriers (H1) and stimuli to the diffusion of these technologies; their judgement on the contribution of PA to environmental/economic/social sustainability; and their experiences (if any) after the adoption of these technologies. The questionnaire was composed of a combination of (a) multiple-choice questions where respondents could select and/or rank among several predefined answers, and (b) questions to be answered using a 1-5 Likert scale from 'very low' to 'very high'. The 656 questionnaires received yielded 425-460 (depending on the questions) evaluable responses regarding PA. Although some researchers have used Poisson regression (e.g. Castle *et al*., 2016) or binary logistic regression (e.g. Paustian and Theuvsen, 2017) to determine the factors influencing adoption, we did not gather data on factors such as age, education level, computer literacy and number of employees. Firstly, univariate methods were used to describe the sample and represent frequencies. Quantitative scores assigned by farmers were used to generate the average numeric assessment of indicators.

The respondents also provided information about the area cultivated under PA by crop type and about the technological elements applied during the 2014/2015 crop season. Among the respondents, 45 farms (6.9 per cent) were precision producers in the examined season. Of these, 17 had information available for a longer period, at least three years prior to the introduction of precision farming technology, and three years afterwards (the year of adoption also included). Their questionnaire answers were analysed together with the bal-

ance sheet and profit and loss statement data. The cost and income calculations were based on the national extended FADN database maintained by the Research Institute of Agricultural Economics (AKI) in Budapest. Since the aim of the study was to detect the benefits of site-specific arable crop production, hereafter our analysis was conducted at the sector (crops) level, thereby filtering the distorting effect of subsidies and land lease.

Economic assessment of PA is usually based on pairwise or ANOVA comparison of mean values of input cost, production cost, gross production value or net profit for adopters and non-adopters. Schimmelpfennig (2016) used a robust empirical treatment-effects model to test the impacts of farm size, labour, machinery and field operation variables on both the identified rates of PA adoption and different measures of profit. During our research, we used several different benchmarking methods to test the hypotheses of decreasing input use (H2) and economic benefits (H3), as follows:

- Comparison of the 45 PA farms to control groups of 'conventional' FADN farms, based on the results of the 2014/2015 crop year. Control groups farms were selected by crop type, and their similar legal status (corporate or private farms) was considered.
- PA farms having at least three years of data were compared to control groups. Crop area and production cost (as a proxy for the intensity of production) were also considered in the selection of the control groups, and a maximum of 20 per cent difference was allowed compared to the PA farms. The number of farms involved varied depending according to crop type, and three-year data were used as a repetition to minimise any bias caused by weather effects. One-way ANOVA was applied to check the treatment effects (precision cf. conventional farming) on the yield, production value, production cost, unit cost and income for the main cultivated crops. Assumptions of normal distribution and homogeneity of the variances were checked using the Shapiro-Wilk and Levene's tests respectively.
- In the following assessment, three-year results of the before and after adoption of PA were compared for the 17 farms, but no statistical analysis was done due to the small sample size. In this case, the effect of price level change had to be considered. The input costs were deflated based on the price indices determined by the Hungarian Central Statistical Office.

MySQL and PostgreSQL were used for database management, while statistical analyses were carried out using the SPSS software package (IBM Corporation, Armonk, NY, United States).

Results

Adoption of precision agriculture technologies

Although 95.5 per cent of respondents had heard about PA, only 6.9 per cent of the respondents (i.e. 45 farms) claimed to be involved in PA to some extent. The first farm (among the respondents) adopted PA technology in 2004. The uptake of the technology was initially characterised by slow growth until 2012 (Figure 1). Subsequently, a more dynamic increase can be observed, particularly in 2014 and 2015. The respondents have collectively cultivated 13 crop types, among which the prevalence of PA use was the highest for winter wheat, both in terms of the total area and the number of farms (Table 1).

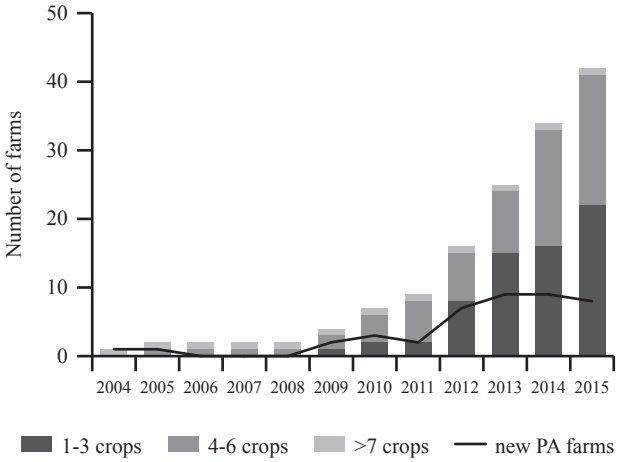

Figure 1: Adoption of precision agriculture among the questionnaire respondents since 2004 (n=656).

Source: survey data (three farms did not provide the start date)

Table 1: Production area and number of farms involved by main crop among the questionnaire respondents (n=656).

Crop	PA area (ha)	Number of PA farms
Winter wheat	4,161	38
Maize	4,019	35
Sunflower	2,795	32
Oilseed rape	2,016	20
Winter barley	825	15

Source: survey data

Of the examined farmers, 31.1 per cent did not use GPS correction at all, so were not capable of ±2 cm cultivation (sowing, fertilisation etc.) accuracy. Annual Real-Time Kinematic (RTK) signal subscription was bought by 26.7 per cent of the respondents, while 13.3 per cent had their own RTK base station. In addition, 15.6 per cent used corrections other than RTK. The remaining farmers (8.9 per cent) used RTK services based on the amount of data used or had a temporary subscription only in work periods (2.2 per cent). In addition, one farm indicated that it had both a RTK subscription and a base station.

Of all tractors, 29.6 per cent were equipped with auto-steering and 45.6 per cent were suitable to use an on-board computer. While 5.7 per cent of the tillage machines could be linked to an on-board computer, only 2.1 per cent were suitable for variable-depth cultivation. Among the wide row spacing drills, 56.6 per cent could be connected to an on-board computer. One quarter of them were suitable for variable-rate sowing, while 27.6 per cent were suitable for non-overlapping cultivation. More than half of the fertiliser

spreaders could be connected to a computer, 23.0 per cent of them could prevent overlaps, and 36.1 per cent were enabled for variable-rate application. Just over 26 per cent of the harvesters were capable for auto-steering and 15.1 per cent for yield mapping. The number of trailed sprayers was higher than the self-propelled sprayers, whereas the ratio was reversed as regards precision ability. Of the self-propelled sprayers, 84.2 per cent could be connected to an on-board computer, 57.9 per cent were suitable for overlap-free active ingredient spraying, and 47.4 per cent were variable dose rate sprayers.

Field boundary mapping was carried out 88.9 per cent of PA farms, 82.2 per cent of them carried out soil sampling and soil mapping, while 64.4 per cent made nutrient management plans. These technologies were primarily used as external services. Weed or pest monitoring by drones or field sampling was made by 42.2 per cent of the farms, but only one third of the respondents used yield mapping.

However, adoption rates depended greatly on PA technologies and crop type (Figure 2). Precision nutrient management was dominant in oilseed rape, winter barley and winter wheat, while precision sowing was typical for maize and sunflower. The adoption level could be characterised by the number of different technologies being adopted by the producer. In this respect, only half of the farmers can be considered to be advanced users, applying several technologies.

In terms of the differences perceived following the introduction of precision farming, 31.1 per cent of the farmers reported a slight decrease in variable costs (mostly inputs), 20.0 per cent noted a more significant decrease, while 20.0 per cent reported a slight increase (Figure 3). As to profitability, 53.3 per cent of the respondents gave an account of a slight increase, while 8.9 per cent reported that a greater increase occurred due to the technology. Regarding the impact on yield, 46.7 per cent of the farms reported a slight, 13.3 per cent a higher increase, whereas 26.7 per cent perceived no difference. Crop quality improvement was reported by 53.3 per cent of the farmers. Opinions varied about the effect on labour use: farms experienced almost equally a slight decrease or no effect, or a significant decrease.

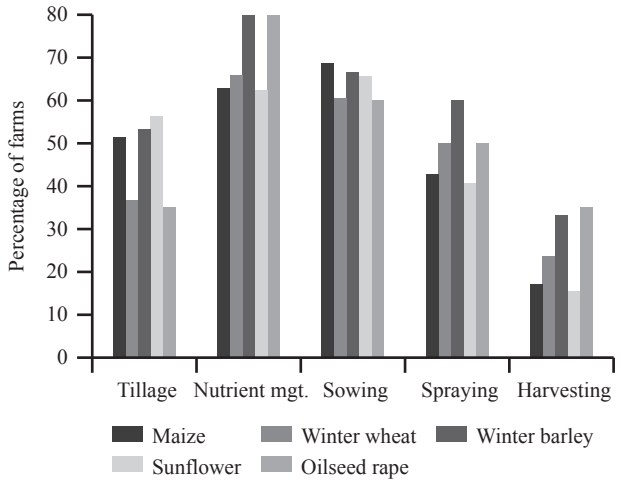

Figure 2: The share of precision technology components used in agro-technical factors in major crops (N=45).

Source: survey data

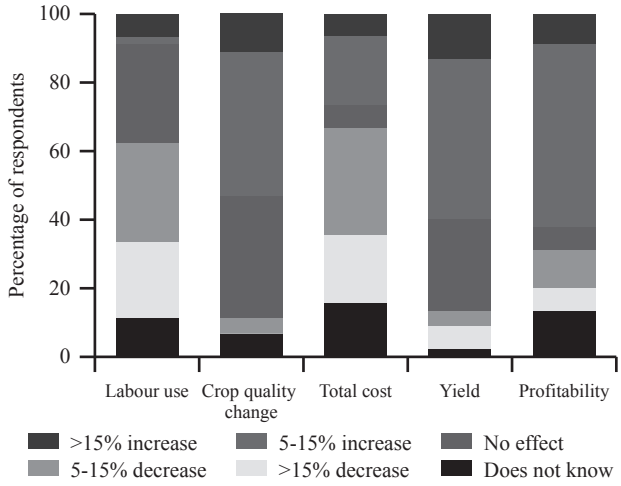

Figure 3: Perceptions among the respondents of the effects of precision farming (N=45).

Source: survey data

Cost and profitability

Economic analyses were carried out using control farms as described above. The first comparison (Table 2) was calculated for the 45 PA farms compared to conventional farms. Based on the FADN balance sheet and profit and loss statement data analyses at crop level, it was found that the yields of PA adopters exceeded the control group's results for each crop examined. The average total income of precision farms, apart from winter wheat and oilseed rape, was higher – by 13 per cent for maize, 25 per cent for winter barley, and 50 per cent for sunflower – than for the control farms. Compared to similar but conventional farms, both the quantity and the cost of fertilisers were higher for precision farms, except for sunflower. This shows that the technology does not necessarily entail a reduction in production costs. The pesticide cost also exceeded, by between 8 and 56 per cent, the cost

Table 2: Impact of the application of precision agriculture on the most important financial figures based on the 45 farms, per cent (crop year 2014/2015).

Indicator	Winter wheat	Maize	Sun-flower	Oilseed rape	Winter barley
Yield	107	109	110	111	105
Production value	**113**	**116**	**111**	**124**	**113**
Total revenue	97	113	150	100	125
Cost of inputs					
of which:					
seed	*86*	*112*	*108*	97	*114*
fertiliser	*129*	*141*	*91*	*131*	*123*
pesticide	*110*	*156*	*125*	*137*	*108*
machinery	102	86	89	100	87
of which:					
tractors	*96*	*75*	*85*	*97*	*78*
Production cost	**109**	**123**	**103**	**119**	**109**
Gross margin	112	101	112	121	105
Crop income	**123**	**83**	**128**	**140**	**130**
Unit cost of main product	93	100	90	99	94
Return on costs	110	64	123	102	124

Source: own calculations

Table 3: Group results for precision agriculture (PA) and conventional (Conv.) farms.

	Winter wheat		Maize		Sunflower	
	PA (N=36)	Conv. (N=33)	PA (N=24)	Conv. (N=24)	PA (N=23)	Conv. (N=23)
Average yield (t/ha)	5.52*	5.05	7.56*	6.74	2.9***	2.54
Production value (thousand HUF/ha)	252.2	236.6	335.3***	286.5	292.3**	246.4
Production cost (thousand HUF/ha)	183.2	179.4	206.1	127.2	169.0	123.6
Crop income (thousand HUF/ha)	69.0	57.2	127.2***	80.5	123.6***	77.4
Unit cost (thousand HUF/ha)	33.6*	36.7	28.3**	33.3	58.6***	70.8

Source: own calculations (*P <0.05, **P <0.01 and ***P <0.001)

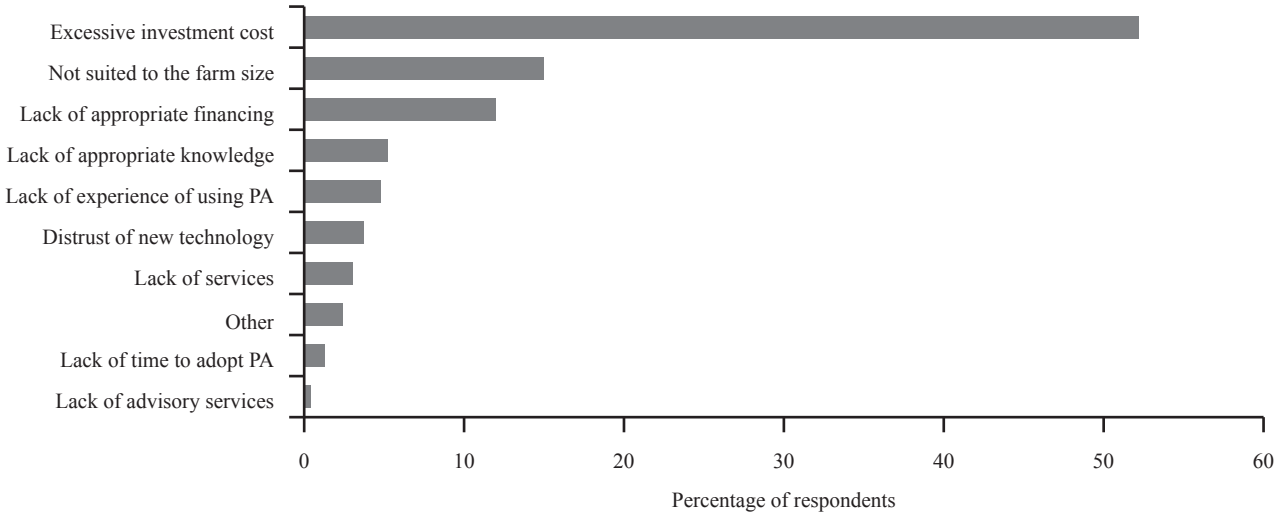

Figure 4: Barriers to the adoption of PA according to the farmers (N=460).
Source: survey data

incurred by conventional producers. Thus, our hypothesis H2 on decreasing input consumption could not be verified based on one-year data of the examined sample.

The total production cost exceeded the values of the control farms. In contrast, the gross margin rate surpassed the conventional farms for all included arable crops. The income results for crops, apart from maize, also showed positive differences. For winter wheat 23 per cent, for sunflower 28 per cent, and for barley 30 per cent surplus was achieved using PA technology, while the highest sectoral income excess was resulted for winter rape (40 per cent). However, PA sample farms achieved 17 per cent less income for maize.

During the research, we assumed that the introduction of precision farming would result in extra yield, cost savings and profitability advantage for arable crop producers (H3). This hypothesis cannot be assessed statistically based on a single year, therefore a smaller group having three years of data were selected both from the PA farms and the control group. We found that the use of precision technology had a clear benefit on the yield and unit costs for winter wheat, while the crop income did not increase significantly (Table 3). However, for sunflower and maize, the effects of PA were significant for all the economic indicators examined, except production cost. The latter is understandable, since production cost was considered in the selection of the control farms, in order to achieve the same production intensities.

As a final step, the effect of the transition to precision technology was assessed for the 17 farms having three years of before and after data. Owing to the small sample size, statistical analysis was not carried out in this case. However, we found that the new technology generally did not reduce the production costs, but resulted in yield increases. The yield increase was 17 per cent for winter wheat, 8 per cent for maize and 9 per cent for sunflower. Of the 35 crops grown by the examined farms, the crop income increased for 23 crops, but above 250 hectares the increase in crop income proved to be obvious. Overall, therefore, PA provides higher yield and higher production value, but the reduced input use (H3) and increased efficiency could not be verified. The effect of the PA on the crop income depends on the crop and the farm size.

Factors influencing the adoption of PA

Economic considerations appeared to be an important aspect in the decision to adopt, as can be documented by ranking factors that were taken into consideration. Fifty-two per cent of the respondents indicated the excess investment cost as the main barrier to widespread adoption of PA. Fifteen per cent of the respondents indicated that the technology cannot work effectively for their farm size, and according to 12 per cent of the respondents, there are no adequate financial possibilities for the additional expenditures (Figure 4).

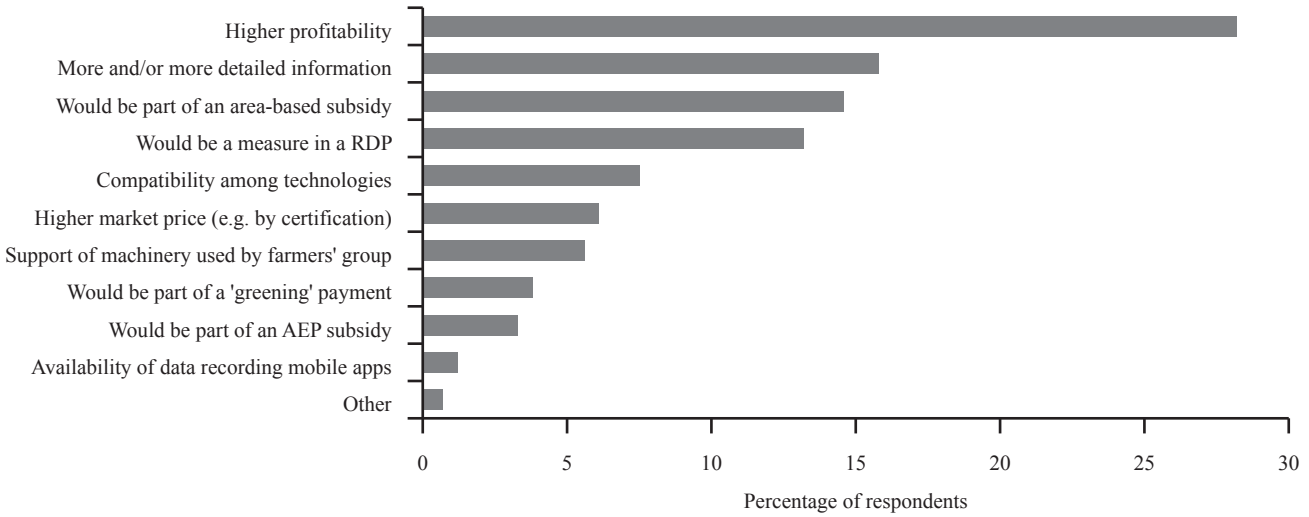

Figure 5: Drivers of PA adoption (N=425).
Source: survey data

Among those respondents which could not envisage the success of the introduction of precision technology for their farm size, 77.8 per cent cultivate fewer than 200 hectares of land. Just under 84 per cent of those emphasising the lack of financing opportunities are members of small family farms, private entrepreneurs or licensed traditional small-scale producers. Our hypothesis H1 was confirmed as in the producers' view the biggest barrier to the PA diffusion is the high access investment cost.

Among the respondents, 28.2 per cent indicated that higher profitability would be their main motivation for adopting PA. More detailed information was in second place on the list and, according to our survey, any benefit related to subsidy would also promote the use of PA (Figure 5).

Discussion

The aim of our survey was to examine the penetration and application levels of PA technologies in Hungary. The 425-460 evaluable responses (depending on the questions) can be considered satisfactory, compared to other survey samples, for example 227 respondents in Germany (Paustian and Theuvsen, 2016) or 228 returns of questionnaires in the Czech Republic (Kušová *et al*, 2017).

Almost all of our respondents had heard about precision agriculture, in contrast to the 50 per cent observed in an earlier survey (Tóth, 2015). However, only 6.9 per cent of them claimed to be involved in PA to any extent. This is a very low rate compared to the Western European countries, Australia, and especially to the USA (BIS Research, 2016; OECD, 2016).

Among our respondents, PA was most commonly used for winter wheat, followed by maize, sunflower, oilseed rape and winter barley. However, compared to the total harvested areas published by the Hungarian Central Statistical Office, the proportion of PA fields is more than double for oilseed rape than for the other crops.

According to CEMA (2014), 70-80 per cent of new farm equipment sold has some form of PA component inside. The survey shows that only 29.6 per cent of the tractors are equipped with auto-steering and 45.6 per cent are suitable to use on-board computer. It means that PA farmers do not have modern machines. Complete machinery change is not a realistic option but existing machinery can be updated with precision equipment.

Field boundary mapping is the most frequently used PA practice, followed by site-specific soil sampling and nutrient management. These findings are in line with international experiences. Somewhat surprisingly, only one-third of the respondents reported that they use yield mapping. This might indicate that yield level optimisation is not the main goal in general. In accordance with the findings of Schimmelpfennig (2016), adoption rates among our respondents vary significantly across PA technologies as well as across crops.

Our farmers' perceptions and the analysis of their accounting figures do not always match. Only 60 per cent of the farmers perceived an increase in yields. Based on the 'before and after' analysis, farmers could realise an average 16.5 per cent yield increase for 80 per cent of the crops. According to the FADN figures, the technology change resulted in a 7-17 per cent yield increase for winter wheat, 2-9 per cent for maize, and 6-10 per cent for sunflower. This is consistent with the international literature (Basso *et al.*, 2016; Balafoutis *et al.*, 2017).

Most scholars have approached the expected economic effect of PA from decreasing input costs (Tozer, 2009). In our survey, 51.1 per cent of the farmers reported a decrease in variable costs. In contrast to this and our expectations, we could not prove the H2 hypothesis statistically. The increase of input use can be explained by the low initial level of fertiliser use, quite common among arable farms in Hungary. However, the amount of fertiliser itself is not the issue that really matters. The real question is how the efficiency of use changes. Therefore, the yield level and associated nutrients need to be studied. The exact input application results in a more efficient nutrient utilisation and less negative environmental impact. And even if input

use and production costs increase under PA, yields can grow enough to increase profit (Schimmelpfennig, 2016).

Owing to the many complex factors, profitability cannot be demonstrated in all cases (Zarco-Tejada *et al.,* 2014). Based on our calculations, 23-133 per cent additional income can be achieved for winter wheat and 28-52 per cent for sunflower, while income growth for maize is uncertain. A significant increase in profitability could be confirmed only in those farms that apply PA for at least three years. Accordingly, 62.2 per cent of the respondents reported some increase in profitability, while 17.8 per cent realised a fall in crop income. The fact that many farmers have not realised/perceived any direct increase in their profitability is a real barrier to the wider adoption of PA. That higher profitability would be the main driver for PA was reported by 28.2 per cent of the respondents. The sigmoid (S-shaped) curve can be representative of many different skills and certainly could describe PA technology. Castle *et al.* (2017) demonstrated that the impact of adoption is initially small but during this period knowledge and skills are gained and important data are collected. Then, once sufficient data and skills are present, the gains from adoption of PA technology could grow quickly to a point where the benefits are largely realised and further gains are limited. The parameters reported suggest that from 5 to 19 years after adoption of PA there is a significant improvement in the net farm income. Most the farmers surveyed are still in the learning phase of PA, having only a few years of experience. Therefore, this is a very important message, which has to be well communicated to the farmers, and advisors have a great role in doing so.

Most of the farmers that believe that PA does not fit to their farm size have fewer than 200 hectares of land, and 83.6 per cent of the respondents that emphasised the lack of financing opportunities are traditional small-scale producers. PA technologies can be applied successfully also in medium-sized or in small farms, partly based on own equipment and partly through common machinery usage (i.e. machinery rings), as well as of course by services.

More than half of the respondents indicated the high investment cost as the main barrier to adoption. A lack of appropriate financing was listed in third place among the barriers; at the same time the need for subsidies appears in third place among the drivers. Our view is that precision crop production can be one of the means of enhancing the green component, as an environmentally-friendly farming practice, drafted within the direct subsidy system of the EU's Common Agricultural Policy proposed for the 2020-2027 planning period. Within the range of Pillar II measures available within Regulation (EU) No 1305/2013 of the European Parliament and of the Council of 17 December 2013, several of them are available to EU Member States to support PA development through their rural development programmes (RDPs, Zarco-Tejada *et al.*, 2014). Since PA benefits are rather specific to local conditions, it is for Member States to define the measures they want to be co-financed in their RDPs. With the aim to help decision makers in this respect, Kemény *et al.* (2017) demonstrated macroeconomic estimations.

Hungary was one of the first countries to establish a national Digital Agriculture Strategy, and as part of this it will be the task of AKI to monitor the development of ICT use among the country's farmers. The wealth of data that will become available from this work will allow the further adoption of precision agriculture in Hungary to be analysed in detail.

References

Antolini L.S., Scare R.F. and Dias A. (2015): Adoption of precision agriculture technologies by farmers: a systematic literature review and proposition of an integrated conceptual framework. IFAMA World Conference June 14-17, 2015, Saint Paul, Minnesota, USA. Paper 1259. http://docplayer.net/4068154-Adoption-of-precision-agriculture-technologies-by-farmers-a-systematic-literature-review-and-proposition-of-an-integrated-conceptual-framework.html (accessed 18 September 2017)

Balafoutis, A., Beck, B., Fountas, S., Vangeyte, J., Wal, T., Soto, I., Gómez-Barbero, M., Barnes, A. and Eory, V. (2017): Precision Agriculture Technologies Positively Contributing to GHG Emissions Mitigation, Farm Productivity and Economics. Sustainability 9 (8), 1339. https://doi.org/10.3390/su9081339

Basso, B., Dumont, B., Cammaranob, D., Pezzuoloc, A., Marinello, F. and Sartori, L. (2016): Environmental and economic benefits of variable rate nitrogen fertilization in a nitrate vulnerable zone. Science of the Total Environment 545-546, 227-235. https://doi.org/10.1016/j.scitotenv.2015.12.104

BIS Research (2016): Global Precision Agriculture Market – Analysis & Forecast, 2016-2022. http://bisresearch.com/industry-verticals/agriculture-technologies/global-precision-agriculture-industry-forecast.html (accessed 18 September 2017)

Castle, M.H., Lubben, B.D. and Luck, J.D. (2016): Factors influencing the adoption of precision agriculture technologies by Nebraska producers. Presentations, Working Papers, and Gray Literature: Agricultural Economics. 49. http://digitalcommons.unl.edu/ageconworkpap/49 (accessed 15 October 2017)

Castle, M.H., Lubben, B.D., Luck, J.D. and Mieno, T. (2017): Precision Agriculture Adoption and Profitability. Cornhusker Economics. http://agecon.unl.edu/cornhuskereconomics/2017/precision-adoption-profitalbility (accessed 12 October 2017)

CEMA (2014): Precision farming – producing more with less. http://www.cema-agri.org/page/precision-farming-0 (accessed 16 October 2017)

DEFRA (2013): Farm practices survey October 2012 – Current farming issues. Department for Environment, Food & Rural Affairs, UK https://www.gov.uk/government/statistics/farm-practices-survey-october-2012-current-farming-issues (accessed 16 October 2017)

EIP-AGRI (2015): Precision Farming Final Report https://ec.europa.eu/eip/agriculture/sites/agri-eip/files/eip-agri_focus_group_on_precision_farming_final_report_2015.pdf (accessed 18 September 2017)

EurActiv (2016): Precision agriculture: future of the CAP? Stakeholder conference, https://www.euractiv.com/section/agriculture-food/video/precision-agriculture-future-of-the-cap/ (accessed 18 September 2017)

Fountas A., Pedersen, S.M. and Blackmore S. (2005): ICT in Precision agriculture – diffusion of technology, in Gelb E. and Offer A. (eds), ICT in agriculture: perspective of technological innovation. http://departments.agri.huji.ac.il/economics/gelb-table.html (accessed 18 September 2017)

Griffin, T.W., Miller, N.J., Bergtold J., Shanoyan, A., Sharda, A. and Ciampitti, I.A. (2017): Farm's sequence of adoption of information-intensive precision agricultural technology. Applied Engineering in Agriculture 33 (4), 521-527. https://doi.org/10.13031/aea.12228

Jacobsen, L-B., Pedersen, S.M., Jensen, H.G. and Kirketerp Scavenius, I.M. (2011): Socioeconomic impact of widespread adoption of precision farming and controlled traffic systems. Future Farm Project. http://www.futurefarm.eu/system/files/FFD5.8_Socioeconomic_Impact_PF_CTF_final.pdf (accessed 16 October 2017)

Kemény G., Lámfalusi I. and Molnár A. (eds) (2017): A precíziós szántóföldi növénytermesztés összehasonlító vizsgálata [Comparative study of precision arable crop production]. Budapest: AKI.

Kušová, D., Těšitel, J. and Boikalová, Z. (2017): Willingness to adopt technologies of precision agriculture: a case study of the Czech Republic. WIT Transactions on Ecology and the Environment 220, 109-117. https://doi.org/10.2495/WRM170111

Lencsés E., Takács I. and Takács-György K. (2014): Farmers' perception of precision farming technology among Hungarian farmers. Sustainability 6 (12): 8452-8465. https://doi.org/10.3390/su6128452

Llewellyn R. and Ouzman J. (2014): Adoption of precision agriculture-related practices: status, opportunities and the role of farm advisers. Report for Grain Research and Development Corporation. CSIRO Agriculture Flagship.

OECD (2016): Farm management practices to foster green growth. OECD Green Growth Studies. Paris: OECD Publishing.

Paustian, M. and Theuvsen, L. (2017): Adoption of precision agriculture technologies by German crop farmers. Precision Agriculture 18, 701-716. https://doi.org/10.1007/s11119-016-9482-5

Pólya, Á. and Varanka, M. (2015): Információszerzés és döntéstámogatás az agráriumban. Piackutatási jelentés. AgroStratéga http://agrostratega.hu/letoltesek/AgroStratega_kutatasi_jelentes_2015_standard.pdf (accessed 13 October 2017)

Schimmelpfennig, D. (2016): Farm profits and adoption of precision agriculture. ERR-217, U.S. Department of Agriculture, Economic Research Service. https://www.ers.usda.gov/webdocs/publications/80326/err-217.pdf?v=42661 (accessed 13 February 2018)

Schimmelpfennig, D. and Ebel, R. (2016): Sequential adoption and cost savings from precision agriculture. Journal of Agricultural and Resource Economics 41 (1), 97-115.

Schrijver, R. (2016): Precision agriculture and the future of farming in Europe. Scientific Foresight Study, Brussels: EPRS, STOA. http://www.europarl.europa.eu/RegData/etudes/STUD/2016/581892/EPRS_STU(2016)581892_EN.pdf (accessed 16 October 2017)

Technavio (2015): Global precision agriculture market 2015-2019. http://www.technavio.com/report/global-agricultural-equipment-precision-agriculture-market (accessed 18 September 2017)

Tóth B. (2015): PREGA kutatás [PREGA study]. Agroinform.hu – Market Insight.

Tozer, P.R. (2009): Uncertainty and Investment in Precision Agriculture – Is It Worth the Money? Agricultural Systems 100, 80-87. https://doi.org/10.1016/j.agsy.2009.02.001

Zarco-Tejada O., Hubbard N. and Loudjani P. (2014): Precision agriculture: an opportunity for EU farmers – Potential support with the CAP 2014-2020. Brussels: EP DG for Internal Policies http://www.europarl.europa.eu/RegData/etudes/note/join/2014/529049/IPOL-AGRI_NT%282014%29529049_EN.pdf (accessed 13 October 2017)

Agnieszka BAER-NAWROCKA* and Justyna BŁOCISZ*

Efficiency of Polish organic and conventional farms

The main objective of this study is to compare the efficiencies of organic and conventional farms in Poland. As shown by the conducted analysis, acting in compliance with the essential production principles, organic farms practiced extensive farming which resulted in reduced efficiency of productive inputs. The efficiency of land and labour measured by the Adjusted Net Value Added was respectively nearly 30 and 65 per cent higher in conventional holdings. Moreover, subsidies contribute more to the income of organic farms, making them strongly dependent on external support (this is especially true for farms with grazing livestock). As a part of policy planning, it should be taken into consideration that organic farms may in the future encounter a development barrier stemming from lower efficiency, difficult access to subsidies and, finally, lower levels of income.

Keywords: profitability, factors of production, producers' support, FADN

JEL classifications: D24, O13, Q12

* Uniwersytet Przyrodniczy w Poznaniu, ulica Wojska Polskiego 28, 60-637 Poznań, Poland. Corresponding author: nawrocka@up.poznan.pl; https://orcid.org/0000-0002-5724-1505

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Introduction

Farmers face multiple challenges posed by the need to meet economic, ethical and environmental standards at the same time. Various degrees of compliance with these standards are enabled by specific agricultural production systems. While some production systems ensure a more efficient pursuit of economic goals, others contribute more to environmental and ethical objectives. Organic farming and conventional farming are two extremely different production systems in terms of their reliance on industrial productive inputs and environmental impacts. In highly developed countries, conventional farming is based on the use of agrochemicals and intensive production methods, and demonstrates several characteristics which include: low use of labour in agricultural production; high productivity of labour; concentration of land and production. In turn, organic farming is a highly restrictive system from the environmental protection perspective (Pimentel *et al*., 2005, Lampkin and Stolze, 2009, Dévényi, 2011). According to Council Regulation (EC) No. 834/2007[1], organic production is an overall system of farm management and food production that combines best environmental practices, a high level of biodiversity, the preservation of natural resources, the application of high animal welfare standards and a production method in line with the preference of certain consumers for products produced using natural substances and processes. This is reflected by the total prohibition on productive inputs of industrial origin (e.g. mineral fertilisers, pesticides and synthetic feed additives). The use of antibiotics, growth stimulants and veterinary medicines is also prohibited[2].

As emphasised by Runowski (2009), the two farming systems differ by the efficiency of pursuing economic and environmental objectives. The use of extensive production methods, high labour intensity and low capital intensity of organic farming make it less efficient than conventional farming; this translates into lower effectiveness of providing private production effects. This observation was made by many authors, including Tamaki *et al*. (2002), Pimentel *et al*. (2005), Badgley *et al*. (2007), Tomek de Ponti *et al*. (2012) and, as regards Polish agriculture, Runowski (2004, 2009), Łuczka-Bakuła (2011, 2013) and Gołaś (2017). Conversely, conventional farming has a stronger environmental impact and is therefore less effective in the pursuit of environmental objectives. However, it should be noted that both systems provide an opportunity to serve the environmental goals better (environmental goods). Similarly, neither conventional nor organic farming has yet made full use of its production capacities (private goods).

In a broader context, the functioning of conventional farming enables food self-sufficiency, effective use of productive inputs, and improving the agricultural population's standards of living by increasing the individual incomes of agricultural producers (through the increase of labour productivity and production efficiency). As long as agriculture does not provide enough foodstuffs corresponding to the population's consumption level, these objectives are also consistent with the expectations of consumers who demand cheap, standard food. As a consequence of agricultural development, consumer demand becomes gradually satisfied in quantitative terms. At the same time, the growth of consumer welfare is accompanied by a shift in the nature of demand: there is growing demand for high-quality products which include organic food. This is a part of the evolution taking place in today's consumption patterns. Factors affecting the decision to purchase organic products primarily include healthcare; the population's income level; and care for the natural environment and animal welfare (Dimitri and Dettmann, 2012; Ozguven, 2012; Shafie and Rennie, 2012). However, according to Łuczka-Bakuła (2011), the demand for organic foods emerges as an economic and social pro-

[1] Council Regulation (EC) No 834/2007 of 28 June 2007 on organic production and labelling of organic products and repealing Regulation (EEC) No 2092/91.

[2] The classification of main production systems provided in the relevant literature also includes integrated farming as an intermediate form between conventional and organic farming. According to the International Organization for Biological and Integrated Control: Integrated production/farming is a farming system that produces high quality food and other products by using natural resources and regulating mechanisms to replace polluting inputs and to secure sustainable farming. Emphasis is placed on: 1) a holistic systems approach involving the entire farm as the basic unit, 2) the central role of agro-ecosystems, 3) balanced nutrient cycles, and 4) the welfare of all species in animal husbandry (Boller *et al*., 2004).

cess only if high incomes are accompanied by environmental awareness of the consumers.

Based on the wide literature, it could be concluded that, in addition to natural potential, the development of organic agriculture strongly depends on economic factors, mainly including demand, prices of organic products and the level of producers' support. Factors influencing the economic performance include also the effective use of productive inputs. This purpose of this paper is an attempt to answer the question on the scale of differences in the efficiency of productive inputs and profitability of Polish organic and conventional farms. These issues are presented against the background of development trends of organic farming in Poland.

Organic farming in Poland

The beginnings of organic farming in Poland date back to the 1920s. However, a stronger growth has been experienced only since 1998, driven by the introduction of subsidies towards farm inspection costs and, in 1999, direct payments towards organic agricultural land. Meanwhile, until 2002, the absence of countrywide inspection systems that would allow to orchestrate the market, improve exports and protect the consumers was a barrier to the development of organic farming in Poland. Key changes in this area were triggered by Poland's accession to the European Union (EU). On the one hand, this enabled the producers to access higher payments towards organic agricultural land while, on the other, it provided more opportunities for the growth of demand for organic products they offer (Kowalska, 2010).

There was a considerable growth of organic farming in Poland in the period 2004-2016. The numbers of both organic farms and organic food processing enterprises increased. The total number of organic producers in that period increased more than six-fold. In 2016, there were 23,400 organic producers; they cultivated 536,600 ha of land which means a 3.7 per cent share in the total utilised agricultural area (UAA, Table 1). According to Eurostat data[3], in the EU-28 Member States, the average share of the organic sector in the total UAA was 6.2 per cent, with the highest levels being recorded in Austria (19.1 per cent), Sweden (15.4 per cent) and Estonia (13.3 per cent). In turn, as regards countries similar to Poland in terms of agricultural production structure (due to climate conditions), such as Germany and France, the share of organically-farmed land in the total UAA was 6.3 and 4.7 per cent respectively. Despite the overall growth in the organic farming sector, the area of organic land decreased from 2014. This may result from several reasons. Firstly, as shown by the statistics, the largest decline in organically-farmed area was recorded in farms producing permanent crops. Usually, these farms were poorly linked to the market and considered the EU subsidies to be a form of rent. For them, the expiry of five-year commitments (under the 2007-2013 EU Rural Development Programme (RDP), agreements were entered into for a five-year term) meant the end of organic farming. This may be illustrated by the example of walnut tree growers in Zachodniopomorskie Voivodeship where the largest decline in the number of organic farms was reported[4]. The second important reason behind the declining interest of producers in organic farming is the growing bureaucracy involved in documenting and controlling their activities. This is especially true for small holdings (in particular, animal farms) where organic production is an ancillary activity to agriculture, their main source of income. Also, the multitude of regulations and principles, the documentation that needs to be kept, and the control mechanisms require extensive know-how. The difficulties in hiring people willing to work in agriculture are another reason, having in mind that organic farming is more labour-intensive, as mentioned earlier in this paper. Undoubtedly, the reasons also include poor quality soils used by Polish farmers.

Table 1: Organic utilised agricultural area and farms in Poland, 2000-2016.

Year	Utilised agricultural area (thousand ha)		Number of organic farms	Share of organic farms in total farms
	Organic[1]	Total		(%)
2000	11.7	17,812	949	0.05
2001	44.9	17,611	1,778	0.06
2002	53.5	16,899	1,977	0.07
2003	61.2	16,169	2,286	0.08
2004	104.9	16,327	3,760	0.13
2005	166.3	15,906	7,182	0.26
2006	228.0	15,957	9,194	0.35
2007	288.3	16,177	12,121	0.46
2008	314.9	16 154	15,206	0.58
2009	416.3	16,119	17,423	0.68
2010	519.1	14,860	20,956	1.36
2011	605.5	15,134	23,847	1.42
2012	661.7	14,969	26,376	1.76
2013	670.0	14,609	27,093	1.86
2014	657.9	14,558	25,427	1.76
2015	580.7	14,545	23,015	1.63
2016	536.6	14,515	23,375	1.66

Note:[1]UAA in and after conversion
Source: IJHARS (2015)

Methodology

The study relies on data collected in the Polish Farm Accountancy Data Network (FADN; http://fadn.pl), grouped by agriculture types and economic size classes. The survey sample covered 357 organic farms and 12,330 conventional farms. Conventional farms form a statistically-representative sample for the field of observation of

[3] http://ec.europa.eu/eurostat/web/agriculture/data/database

[4] Under the 2004-2006 RDP, one of the highest rates of subsides for the cultivation of fruit species was allocated to walnut tree growers. Throughout the support period, they were not required to report yields, and therefore a large amount of funds was absorbed by owners of low-cost orchards. As a consequence, lower payments were allocated to this type of cultivation under the 2007-2013 RDP. In turn, because of poor interest in vegetable crops (as shown by their negligible share in the structure of aid disbursed), the dedicated payments were increased (IJHARS, 2015).

Polish FADN, extending to 730,861 commercial farms in Poland in 2014. As regards organic farms, the data are not statistically representative, and therefore cannot be interpreted as the situation of the entire group of Polish organic farms. However, the FADN database is the largest and most comprehensive source of data on organic farms so far, enabling the analysis of their economic situation. The comparative analysis used average levels of indicators for specific farm groups selected by type and economic size class. In accordance with FADN data dissemination principles, the results for types or classes composed of fewer than 15 farms are not published. This condition was met for three types of organic farms: horticultural crops, pigs and poultry, and for two size classes of farms: large and very large holdings. Therefore, they were omitted in the Tables prepared for both organic farms and conventional farms. The basis for calculating the efficiency indicators of productive inputs was assumed to be the net value added adjusted with operating activity subsidies as per the following formula:

Gross farm income (SE410) – Depreciation (SE360) = Farm net value added (SE415) – Total subsidies excluding on investment (SE605) = Adjusted net value added (ANVA)

According to Goraj and Mańko (2011), this procedure enables a more extensive assessment of the situation of farms covered by financial support (included in the calculation at the gross value added stage). Thus, the efficiency measures of productive inputs were as follows:

Land efficiency = ANVA / Utilised agricultural area (SE025)

Labour efficiency = ANVA / Total labour input (SE010)

Capital efficiency = ANVA * 100 / Total assets (SE436)

The farmer, as an entrepreneur, places importance on farming incomes as they compensate for own work. According to the FADN methodology, the family farm income includes operating activity subsidies.

Results

In accordance with the classification by agriculture type, both in the organic farms group and in the conventional farms group, farms engaged in mixed production represented around one third of the total population in 2014 (Figure 1). Ranked next (21 and 27 per cent for organic and conventional farms respectively) were field crops farms. Dairy cows and other grazing livestock organic farms types had comparable shares. As regards conventional farms, the importance of the latter type was lower (3.8 per cent compared to 20.4 per cent for organic farms).

When analysed by economic size class, small farms had the largest share (57.7 per cent) in the organic farm group, followed by medium-small and very small ones (Figure 2). Together, these two farm classes accounted for nearly 92 per cent of all organic farms covered by FADN. This structure differed from that of conventional farms, especially as regards the share of the farms classed as large and very large. Together, they accounted for 10.5 per cent of all conventional farms, compared to only 2 per cent of organic farms. At the same time, it should be emphasised that, in the structure of Polish conventional holdings, small and medium-small farms (with a share of 64 per cent of all farms) are by far more numerous than in Western European countries.

As regards efficiency indicators, for organic farms the average levels of all indicators were lower than for conventional farms. On average, land efficiency and total labour efficiency of organic farms were just 64.7 and 31.8 per cent respectively of the efficiency of conventional farms. This results from the greater amounts of human labour involved in organic production with many time-consuming manual tasks. Their crop technologies are less dependent on physical capital; this requires a greater number of employees, especially seasonal workers. The smallest differences between organic and conventional farms exist as regards capital efficiency measured as adjusted net value added per PLN 100 of total assets. At PLN 2.3 for organic farms, the value is 82.1 per cent of that of conventional farms (PLN 2.8). This may be related to lower levels of expenditure in organic farms; at

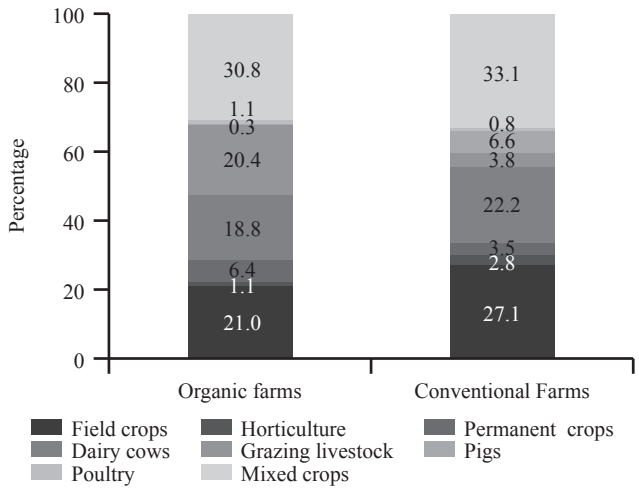

Figure 1: Structure of organic and conventional farms by type, 2014.

Data source: Polish FADN

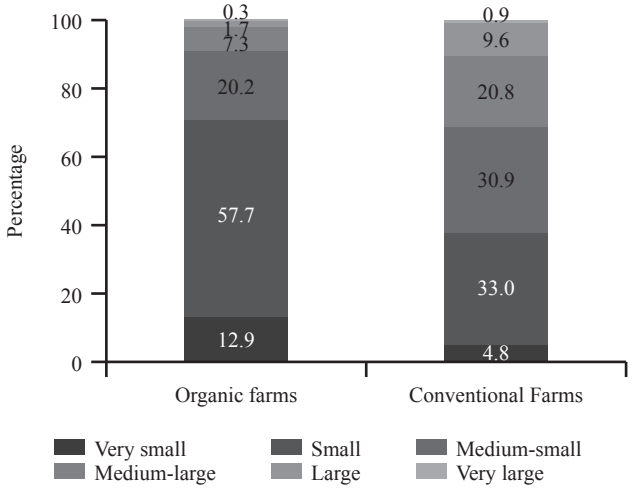

Figure 2: Structure of organic and conventional farms by economic size class, 2014.

Data source: Polish FADN

the same time, it could possibly be explained by the law of diminishing marginal efficiency of expenditure in conventional farms.

Based on the analysis of specific farm types (Table 2), it may be concluded that the largest differences in the efficiency of land and labour between organic farms and conventional farms were experienced for dairy cow farms. The efficiency of the above productive inputs was about 60 per cent lower for organic farms. Meanwhile, it should be noted that, as regards both organic farms and conventional farms, dairy cow holdings had the highest land efficiency and one of the highest levels of labour efficiency. In Poland, owing to favourable climate conditions, the cattle grazing period is nearly six months, which is conducive to cheap, high-quality production. Also, organic farms demonstrate a distinctively large share of permanent pasture which provides favourable conditions for organic milk production (Gołaś, 2017). Specific attention should be paid to two types of organic farms (grazing livestock and mixed production) which reported negative efficiency indicators after removing the operating activity subsidies from farm net value added. This is demonstrated by the fact that for these types of farms, production efficiency (and the related profitability) was mainly determined by subsidies.

Considering the clustering of farms by economic size class, it may be concluded that among organic farms the highest land efficiency was reported by very small holdings (Table 3). Moreover, in these holdings, the efficiency of productive inputs was higher than for conventional farms. This may result from the fact that the group of very small farms included high-density, highly productive poultry and horticulture farms. In turn, as regards conventional farms, the capital efficiency ratio of very small farms was negative. The productive input efficiency indicators increased in line with the economic size of conventional farms. According to Średzińska (2017), this confirms the common belief that the increase in production scale favourably affects production efficiency and, consequently, financial performance. This is demonstrated by the ratio of family farm income per family work unit (FWU). At the same time, as the economic size of conventional farms grows, the share of subsidies in incomes declines. Although the level of subsidies was increasing, this was determined by the size of the production potential expressed as UAA eligible for payments. A similar situation took place in the group of organic farms; however, in each farm class, the levels of family farm income and subsidies were above the corresponding figures for conventional farms. The biggest (more than double) differences in incomes and subsidies were recorded in very small holdings; and in medium-small and medium-large holdings respectively.

When it comes to the classification by agriculture type, in organic farms the highest average family farm income per FWU was reported by holdings specialising in field crops, followed by those specialising in permanent crops. This means organic farms outperformed the corresponding types of conventional holdings nearly four times (permanent crops) and twice (field crops). In turn, in the conventional farms group, the highest family farm income per FWU was earned by dairy cow holdings. Undoubtedly, the contributing factors were, on one hand, the highest efficiency of productive inputs and, on the other, one of the highest levels of operating activity subsidies. Nevertheless, conventional dairy cow farms had the lowest share (42 per cent) of subsidies in their incomes. It was similar for that type in the organic farms group; however, the corresponding share was higher (74 per cent).

As indicated by the above figures, the impact of funds disbursed under the Common Agricultural Policy (CAP) on the functioning and incomes of farms is much stronger in the organic farms group than in the conventional farms group. The subsidies often compensate for losses caused by lower efficiencies when shifting to organic farming. However, as emphasised by Łuczka-Bakuła (2013), because of high per-hectare subsides, many farmers employ only the minimum extent of organic production principles in order to access funds. Furthermore, many beneficiaries of payments establish fake organic farms which are not aligned with market expectations.

Table 2: Efficiency of organic and conventional farms by type of farm, 2014.

Specification	Field crops	Permanent crops	Dairy cows	Grazing livestock	Mixed
Conventional farms					
Land efficiency (PLN/ha)	516	1,125	1,442	363	331
Labour efficiency (PLN/AWU)	12,436	6,101	21,384	5,343	4,469
Capital efficiency (PLN/PLN 100 total assets)	2.3	1.8	4.2	1.2	1.3
Family farm income per FWU (SE430) (PLN/FWU)	29,970	12,684	34,401	15,136	14,142
Total subsidies, excluding on investment (SE605) (PLN)	37,887	19,455	25,392	25,460	21,769
Share of total subsidies in family farm income (%)	86	113	42	120	101
Organic farms					
Land efficiency (PLN/ha)	422	385	621	-265	-327
Labour efficiency (PLN/AWU)	10,928	6,628	8,563	-7,064	-4,233
Capital efficiency (PLN/PLN 100 total assets)	2.1	1.5	2.2	-1.1	-1.2
Family farm income per FWU (SE430) (PLN/FWU)	58,187	48,452	27,771	28,229	23,537
Total subsidies, excluding on investment (SE605) (PLN)	72,515	58,541	36,715	60,150	36,524
Share of total subsidies in family farm income (%)	90	109	74	136	99

Note: EUR 1 = PLN 4.3
Data source: Polish FADN

Discussion and conclusions

The purpose of this paper was to identify the scale of differences in the efficiency of productive inputs and profitability of Polish organic and conventional farms. Because of different assumptions underpinning both farming systems, it may be concluded that rather than competing with each other, they are mutually complementary. Conventional farming is focused on mass production with the use of a production technology based on the consumption of large amounts of industrial productive inputs, resulting in high vegetable and livestock productivity. The overarching objective of this production type is to maximise profits. Often, this is accompanied by adverse environmental impacts. Conversely, the basic objective of organic farming is to make high-quality products while caring for the environment. In the Council Regulation No. 834/2007, the European Commission emphasises that the organic production method thus plays a dual societal role, where it on the one hand provides for a specific market responding to a consumer demand for organic products, and on the other hand delivers public goods contributing to the protection of the environment and animal welfare, as well as to rural development. However, what also matters from the producer's point of view is the economic effect whose determinants include production efficiency. As suggested by the calculated efficiency indicators of productive inputs, conventional farms have a greater average efficiency than organic farms. The lower economic performance is the consequence of lower technical efficiency. According to Offermann and Nieberg (2000), organic farm yields are on average 20-30 per cent lower than conventional farm yields. This is also true for milk and meat production. For instance, based on FADN data, Gołaś (2017) indicates that cow milk yield in Polish conventional farms was on average more than 50 per cent higher. In a sense, the lower efficiency of organic farms is a natural consequence of extensive productive methods and rigorous rules for certified crops and livestock breeding, especially including the total prohibition of synthetic fertilisers and chemical plant protection products. This may be a barrier to the improvement of farming efficiency, and therefore may adversely affect the ability to pursue environmental goals in the long term in the entire agriculture sector. Runowski (2009) emphasises that the income-to-expenditure ratio is quite narrow in organic farming. Therefore, an important aspect of the functioning of organic farms is to supplement the incomes with external funds (subsidies) and with higher prices of organic products compared to conventional products. However, there are certain restrictions to both of these sources of supplementary income for organic producers. This is because, according to a survey conducted by Nestorowicz *et al*. (2009) with Polish residents of large cities (with a population above 50,000), both frequent and occasional purchasers as well as non-purchasers of organic food find these products to be too expensive. However, at the same time, frequent consumers admitted that organic food was good value for money. In turn, according to studies by Smoluk-Sikorska and Łuczka (2014), demand factors, primarily including low consumer incomes, are the key barriers to the development of the organic food market. The average level of expenditure on organic products in Poland in 2015 was more than twelve times lower than the overall EU average, reaching EUR 4.4 per capita. The Polish organic products market was worth EUR 167 million, and the share of organic food in the total foodstuffs market was around 0.5 per cent. However, in recent years, the Polish market for these products has experienced a dynamic growth at an estimated annual rate of around 15 per cent (Łozińska-Wróbel, 2017; Willer *et al*., 2017). Nevertheless, despite some symptoms of improvement on the demand side of the organic food market, organic farming may be expected to remain for a long time a system focused on a relatively narrow market niche and on a specific consumer group.

As regards external sources of financing for organic farms, the above data show the vital importance of operating activity subsidies for the functioning of farms. It may also be noted that the significantly higher level of subsidies

Table 3: Efficiency of organic and conventional farms by economic size class (EUR), 2014.

Feature name	Very small 2,000 < 8,000	Small 8,000 < 25,000	Medium-small 25,000 < 50,000	Medium-large 50,000 < 100,000
Conventional farms				
Land efficiency (PLN/ha)	742	1,338	1,909	2,315
Labour efficiency (PLN/AWU)	5,157	14,233	32,322	57,847
Capital efficiency (PLN/PLN 100 total assets)	-0.6	1.3	3.2	4.8
Family farm income per FWU (SE430) (PLN/FWU)	6,307	15,738	34,651	66,780
Total subsidies, excluding on investment (SE605) (PLN)	10,798	20,070	34,250	56,691
Share of total subsidies in family farm income (%)	137	82	55	45
Organic farms				
Land efficiency (PLN/ha)	1,128	506	965	1,044
Labour efficiency (PLN/AWU)	8,534	7,187	19,426	37,928
Capital efficiency (PLN/100PLN total assets)	0.3	0.6	1.8	4.2
Family farm income per FWU (SE430) (PLN/FWU)	14,920	19,468	41,274	92,702
Total subsidies, excluding on investment (SE605) (PLN)	17,342	35,911	68,830	135,192
Share of total subsidies in family farm income (%)	98	123	94	76

Note: EUR 1 = PLN 4.3
Data source: Polish FADN

accessed by organic farms was related to their lower capacity to generate incomes (compared to conventional holdings). As a result, it may be concluded that the economic situation of organic farms depends more strongly on subsidies which compensate, to a large extent, for the lower efficiency.

These issues matter in the context of the future of organic farms. The unknown development of the CAP after 2020 and the foreseen reduction of funds allocated to support the agricultural sector are factors that mean that organic producers face a difficult, precarious situation. Dilemmas surround many issues, such as various strategies contributing to improving the economic situation as the subsidies are restricted, including the ability to reduce production costs as a consequence of extending the production scale or seeking new sales channels to boost demand. As a part of policy planning, it should be taken into consideration that organic farms may encounter in the future a development barrier stemming from lower efficiency, difficult access to subsidies and, finally, lower levels of income. In addition to indisputable environmental benefits for the entire population, organic farming may also become an opportunity for farmers operating under unfavourable conditions which make conventional farming difficult and economically unviable. Therefore, in the long run, it will provide positive economic effects.

References

Badgley, C., Moghtader, J., Quintero, E., Zakem, E., Chappell, M.J., Avilés-Vázquez, K., Samulon, A. and Perfecto, I. (2007): Organic agriculture and the global food supply. Renewable Agriculture and Food Systems **22** (2), 86-108. https://doi.org/10.1017/S1742170507001640

Boller, E.F., Avilla, J., Joerg, E., Malavolta, C., Wijnands, F.G. and Esbjerg, P. (eds) (2004): Integrated Production Principles and Technical Guidelines. IOBC Bulletin **27** (2), 1-12.

Dévényi, P. (2011): The new proposal on agricultural product quality schemes – quality legislation on quality questions? European Food and Feed Law Review **6** (3), 159-166.

Dimitri, C. and Dettmann, R.L. (2012): Organic food consumers: what do we really know about them? British Food Journal **114** (8), 1157-1183. https://doi.org/10.1108/00070701211252101

Gołaś, Z. (2017): Organizacja, produktywność oraz dochodowość ekologicznych i konwencjonalnych gospodarstw rolnych ukierunkowanych na chów bydła mlecznego [Organisation, productivity and profitability of organic and conventional dairy farms]. Infrastruktura i ekologia terenów wiejskich Nr I/1/2017. Warszawa: Polska Akademia Nauk, 101-117.

Goraj, L. and Mańko, S. (2011): Model szacowania pełnych kosztów działalności gospodarstw rolnych [Model for estimating total costs of agricultural holdings' activity]. Zagadnienia Ekonomiki Rolnej **3**, 28-58.

IJHARS (2015): Raporty o stanie rolnictwa ekologicznego w Polsce w latach 2013-2014 [Condition of organic farming in Poland. The report 2013-2014]. Warszawa: Główny Inspektorat Jakości Handlowej Artykułów Rolno-Spożywczych.

Kowalska, A. (2010): Czynniki wpływające na rozwój rolnictwa ekologicznego w Polsce i innych krajach europejskich [The determinants of organic agriculture development in Poland and in other European Countries]. Lublin: Wydawnictwo Uniwersytetu Marii-Curie Skłodowskiej.

Lampkin, N. and Stolze, M. (2009): Policy for organic farming: Rationale and concepts, Food Policy **34**, 237-244. https://doi.org/10.1016/j.foodpol.2009.03.005

Łozińska-Wróbel, K. (2017): Żywność ekologiczna w Polsce [Organic food in Poland]. Wrocław: IMAS International.

Łuczka-Bakuła, W. (2011): Decyzje zakupu na rynku żywności a świadomość i zachowania proekologiczne konsumentów [Purchasing decisions in the market for food and consumer pro-ecological awareness and behaviour]. Handel Wewnętrzny **3**, 52-59

Łuczka-Bakuła, W. (2013): Development of organic farming vs the support from the RDP 2004-2006 (Rural Development Programme) and RDP 2007-2013. Journal of Agribusiness and Rural Development **4** (30), 161-175.

Nestorowicz, R., Pilarczyk, B., Jerzyk, E., Rogala, A. and Disterheft, D. (2016): Raport z badań przeprowadzonych w ramach projektu 'Postawy etnocentryczne konsumentów (w ujęciu lokalnym) a szanse i bariery rozwoju rynku żywności ekologicznej' [Report on research carried out under the project 'Ethnocentric attitudes of consumers (in local terms) and the chances and barriers to the development of the organic food market']. Poznań: Uniwersytet Ekonomiczny w Poznaniu.

Offermann, F. and Nieberg, H. (2000): Economic Performance of Organic Farms in Europe. Organic farming in Europe: Economics and Policy: 5. Stuttgart: Universität Hohenheim.

Ozguven, N. (2012): Organic food motivations factors for consumers. Procedia – Social and Behavioral Sciences **62**, 661-665. https://doi.org/10.1016/j.sbspro.2012.09.110

Pimentel, D., Hepperly, P., Hanson, J., Douds D. and Seidel, R. (2005): Environmental, energetic, and economic comparisons of organic and conventional farming systems. BioScience **55** (7), 573-582. https://doi.org/10.1641/0006-3568(2005)055[0573:EEAECO]2.0.CO;2

de Ponti, T., Rijk, B. and van Ittersum, M.K. (2012): The crop yield gap between organic and conventional agriculture. Agricultural Systems **108**, 1-9. https://doi.org/10.1016/j.agsy.2011.12.004

Runowski, H. (2004): Gospodarstwa ekologiczne w zrównoważonym rozwoju rolnictwa i obszarów wiejskich [Role of organic farms in sustainable development of agriculture and rural areas]. Wieś i Rolnictwo **3** (124), 24-36.

Runowski, H. (2009): Rolnictwo ekologiczne. Rozwój czy regres? [Organic farming. Progress or regress?] Roczniki Nauk Rolniczych **96** (4), 182-193.

Shafie, F.A. and Rennie, D. (2012). Consumer perceptions towards Organic Food. Procedia – Social and Behavioral Sciences **49**, 360-367. https://doi.org/10.1016/j.sbspro.2012.07.034

Smoluk-Sikorska, J. and Łuczka, W. (2014): Uwarunkowania handlu detalicznego żywnością ekologiczną [Determinants of retail trade in organic food]. Warszawa: Difin.

Średzińska, A. (2017): Czynniki kształtujące dochody gospodarstw rolnych Unii Europejskiej według klas wielkości ekonomicznej [Factors determining income of farms in the European Union according to economic size classes] Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu **477**, 305-314.

Tamaki, M., Itani, T. and Nakano, H. (2002): Effect of continuous organic farming on the growth and yield of rice. Japanese Journal of Crop Science **71**, 439-445. https://doi.org/10.1626/jcs.71.439

Willer, H., Schaack, D. and Lernoud, J. (2017): Organic farming and market development in Europe and European Union, in H. Willer and J. Lernoud (eds), The World of Organic Agriculture. Statistics and Emerging Trends 2017. Frick: FiBL and Bonn: IFOAM, 207-243.

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