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An Overview of Development of Sustainable Agriculture in Lithuania

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Abstract. The purpose of this review paper is to analyse and evaluate the development of sustainable agriculture in Lithuania from 1990 to the present and to evaluate possibilities, willingness and motivation of farmers to participate in sustainable agriculture. It was established that sustainable agriculture developed from environmentally friendly agriculture and later from organic agriculture. Initially, organic agriculture prevailed and included compliance with environmental requirements; however, later it incorporated social and economic approaches as well. This paper analyses the organic farming practices that stimulated the development of sustainable agriculture. Agri-environmental agriculture has been found to be more popular with farmers as it provides compensatory payments and requires basic environmental knowledge. This work compares farmers' motivation to participate not only in agri-environmental measures, but also in sustainable agriculture. Noteworthy, agri-environmental measures also have elements of sustainable development. The work compares the results of previous research on farmers' motivation and willingness to participate in environmentally friendly farming measures. The research reveals that participation in voluntary programmes has to be economically encouraged. The main findings are as follows: sustainable agriculture developed from organic agriculture gradually by integrating principles of sustainable development; the results of comparative analysis discovered that farmers with deeper understanding of environmental protection are more motivated to implement farming that relies on sustainable agriculture approaches. The research is based on analysis and evaluation through such methods as descriptive and comparative data analysis in previous and recent periods and questionnaire based data collection in order to evaluate new types of farming.

Keywords: sustainable agriculture, organic farming, farmers, agrarian environment, sustainable development, environmental protection.

Introduction

The purpose of the present research is to analyse the current state and evaluate the perspectives of sustainable agriculture in Lithuania. The research also aims to investigate farmers' motivated participation and willingness to change from conventional (traditional) to sustainable agriculture practice. Usually farmers are willing to participate in conventional agriculture practice and lead one type of farming. Typical agriculture practice has been based mainly on economic reasons and less on social and environmental reasons. Despite the fact that farming practice is usually based on one type of farming, there are more opportunities to be involved in several types of farming by integrating social, economic and environmental approaches. Different types of farming create more opportunities to involve more local people in the regions and generate additional income.

The research is based on analysis and evaluation through such methods as descriptive and comparative data analysis in previous and recent periods and questionnaire based data collection in order to evaluate new types of farming.

The concept of sustainable agriculture was formed in the late 1930s and early 1940s, with establishment and development of biodynamic farms and introduction of Stewardship Award programmes (Darnhofer et al., 2010; Harwood, 1990). While biodynamic farms were merely the starting point for sustainable farming, Stewardship Award programmes covered a broader socio-economic context and in subsequent years included some environmental aspects as well. Between 1930s and 1940s, the number of biodynamic farms and Stewardship Award programmes increased in various Western European countries and the United States, as well as in Canada. However, World War II put an end to the growth of such farms and led to intensification of agriculture in the post-war period due to shortage of agricultural produce. When the market was saturated with agricultural produce, the focus shifted again to balancing the agriculture and developing organic agriculture.

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When it was widely understood that intensive agriculture had a huge negative social, economic and environmental impact, organic farms were introduced. Such initiatives were also driven by political change. Organic farms relied heavily on compliance with environmental requirements; however, they restricted the increase in agricultural produce, which led to promotion of sustainable farms. First sustainable farms were developed in economically strong countries when in the 1960s and 1970s the US, Canada, Australia, New Zealand, as well as parts of Western Europe, re-established the national programmes of responsible (Stewardship Award) and sustainable agriculture (Mierauskas, 2016b). Farmers were encouraged to participate in these programmes voluntarily; however, such farming was financially supported. Such global events as Brundland's report "Our common future" (1987), the United Nations Conference on Environment and Development (UNCED), Rio de Janeiro, 1992, encouraged integration of principles of sustainable development into various economic and social sectors including agriculture. This led to the transition from intensive farming and organic farming to sustainable agriculture (Allen et al., 1991; Gliessman, 1995; Harwood, 1990). In contrast to organic farming, which had been developed earlier and focused on environmental requirements, sustainable agriculture integrated environmental, economic and social aspects. This ensured sustainable and stable agriculture that satisfied the needs of various groups of society.

First initiatives of sustainable agriculture in Lithuania started after 1990 with promotion of organic farming. In Lithuania development of environmentally friendly farming is divided into three periods: 1) early (primary) period (1990–1999), when organic agriculture started to develop; 2) pre-accession period (2000–2003); 3) implementation of the EU Rural Development Programmes after Lithuania joined the European Union (from 2004). In each period, environmentally friendly farming had certain influence on development of sustainable agriculture (Kripaitis, 2009). However, implementation of the EU Rural Development Plan in 2004–2006 and Programmes in 2007–2013 and 2014–2020 has had a greater positive impact on conservation of biodiversity and development of sustainable agriculture.

The author conducted research and published papers on sustainable agriculture and conservation of biodiversity in 2010–2011, 2012–2013, 2014–2015 (Mierauskas, 2016a, 2016b, 2014, 2012, 2011), whereas the results of the research carried out in 2017–2018 are presented in this paper. The research was carried out in the same municipalities and mainly involved the same farmers. The main objectives of the research were to analyse the state of sustainable agriculture and the motivation and willingness of farmers to participate in environmentally friendly agriculture programmes and measures.

1. The state of sustainable agriculture and its transformation from conventional and organic agriculture

The European Union introduced voluntary agri-environmental measures in several countries starting from 1980, whereas in 1992 Council adopted a Regulation EEC 2078/92 of 30 June 1992 on agricultural production methods compatible with the requirements of the protection of the environment in social economic context. The maintenance of the countryside applied to broader areas was gradually introduced in all EU member states and became a key policy instrument for the conservation of agrarian environment (Uthers & Martzdorf, 2013). After the Council adopted a regulation on rural development by EC 1698/2005 in 2005, organic farming measures became compulsory in all Member States (European Commission, 2005). While many countries, including Lithuania, started from organic farming, they gradually began to promote agriculture in the broader socio-economic context and facilitated development of sustainable agriculture. Organic farming was based primarily on environmental requirements and limited the growth of agricultural produce.

Lithuania started the implementation of the EU agri-environmental measures later than other EU member states, however prior to them Lithuania had adopted programmes indirectly related to environmentally friendly measures. This could be one of the reasons why farmers and other land users were not actively involved in such programs and measures or other voluntary nature conservation programmes.

In Lithuania, sustainable agriculture developed alongside organic agriculture. Initially, this branch of agriculture has been developed by a foundation "Tatulos fondas" since 1993 and a non-governmental organization, the Lithuanian Organic Agriculture Association "Gaja" since 1990, which were first non-governmental organizations to promote organic and sustainable agriculture (Kripaitis, 2009; Svirskis, 1990; Žekonienė, 1997). Although the aim of the foundation "Tatulos fondas", which was later reorganized into "Tatulos programme", was to preserve environmental components in the pollution – sensitive karst region, it also focused on transformation of agriculture. Implementation of the programme started in the North – eastern part of Lithuania (covering the area of 194 thousand ha), but later the programme was applied in other regions of Lithuania as well. First, conventional farms were transformed into sustainable and later into organic. As compensatory payment for farmers on sustainable farms was lower than on organic ones by 30% to 50% depending on the crop species, fewer sustainable farms were set up. The program provided that by 2006 5% of traditional (conventional) farms would be transformed into organic farms. By 2005, about 100 farms and 30 enterprises participated in the programme as organic farms, but did not achieve the planned results (Gutkauskas, 1996; Kripaitis, 2009). In the later stages of the programme, up to 15% of farms were expected to be transformed into organic farms; however, this was not achieved despite the compensatory aid provided. Although fewer farmers who participated in the programme were involved in sustainable farming than in organic farming, it was an important step in the development of sustainable farming. The established National Rural Support Programme

(1997) provided for more support for organic farms than sustainable ones. This was also determined by the state agricultural policy, whereas sustainable development of agriculture had not yet become a priority area.

Despite the absence of more environmentally friendly agricultural programmes approved at governmental level, some environmental NGOs were active in promoting the implementation of environmentally friendly activities. In 1997, Lithuanian Fund for Nature together with a Dutch non-governmental organisation European Union for Coastal Conservation (EUCC) (Lithuanian Fund for Nature, 1997) created a nature conservation programme for Rusnė island (Nemunas delta regional park, coastal lagoon area, West Lithuania). The aim of the programme was not only to preserve biodiversity but also to develop sustainable agriculture. Local farmers received compensatory payments for the development of sustainable agriculture, promoting alternative socio-economic activities, i.e. improving the livelihoods of local farmers while reducing intensive farming and transiting to sustainable farming.

As mentioned above, sustainable agriculture in Lithuania, as in many other countries, was formed on the basis of organic farming, though it not only focused on meeting environmental requirements, but also included more activities. Apart from environmental aspects, sustainable farming covered a number of socio-economic ones. These included ensuring stable provision of high quality agricultural produce while maintaining the natural stability and balance of agricultural ecosystems, sustainable use of natural resources, as well as tackling health, unemployment and other socio-economic problems in rural areas. A scientific study "Possibilities for Sustainable Agriculture in Lithuania" drawn up by Lithuanian Fund for Nature and Coalition Clean Baltic (LFN & CCB, 1999) indicates the following goals of sustainable agriculture:

- To produce sufficient quantities of high-quality, nutritious agricultural products;
- To maintain and increase long-term soil fertility;
- To save natural and energy resources, give priority to renewable resources;
- To provide appropriate housing conditions for domestic animals and fowl;
- To reduce environmental pollution in agrarian landscapes;
- To promote health protection of rural population;
- To protect biodiversity;
- To use the natural qualities of agricultural products most efficiently;
- To ensure favourable living, safety and health conditions for agricultural producers;
- Not to strive to make profit solely by intensifying the agricultural production.

These goals of agriculture help to identify significant differences between this new type of agriculture and not only organic farming, but also intensive farming. Nonetheless, although sustainable agriculture had broader goals and requirements than organic agriculture, the former was not popular at the time. The report also analysed the state, barriers and perspectives of sustainable agriculture. According to the report on the state of agriculture in 1990–1998, several barriers to the development of sustainable farming in Lithuania were identified at that time (LFN & CCB, 1999):

- **Economic barriers.** These barriers are one of the most pervasive and difficult to manage because they are closely linked to the country's economic development process. Until 1990, Lithuanian agriculture was strongly supported, there was no taxation on natural and energy resources and pollution, and the purchase of agricultural products was centralized. Management of agriculture was also centralized. After 1990, following privatization of farms, agricultural production declined, thus conditions for the development of sustainable economy at the beginning of this period were unfavourable. As a result, both organic and more sustainable farms were established gradually, though their numbers increased every year. Moreover, this type of farming was low in demand in the market, because the economic downturn directly affected people's purchasing power and the cost of environmentally friendly products was higher. Only after the economic situation improved the market of environmentally friendly agricultural products became wider, creating conditions for the growth of environmentally friendly farming.
- **Political and legal barriers**. As it was emphasized earlier, "Tatulos" programme supported organic farming rather than sustainable farms in a certain region of Lithuania. The organic farming programme was approved by the Government only in 2002, while the National Rural Support Programme (1997) previously approved by the Government also supported organic farming. Thus, the Government's agricultural policy, which promoted intensive and partly organic farming, but not sustainable farming, had a role to play here in addition to poor education of farmers and the lack of political will.
- **Institutional barriers.** In the beginning of the period, organic farming activities were coordinated by the Ministry of Agriculture and "Ekoagros", which certified organic agricultural produce and farms. Regional institutions that provide direct advice to farmers were established later. However, development of sustainable agriculture was not encouraged because civil servants were not active in taking the responsibility for supporting new, conventionally unusual soil technologies. In addition, there were no institutions that would help to market environmentally friendly produce in a centralized way, which was a major barrier for farmers to market their produce. Moreover, there were only a few non-governmental organizations that

promoted sustainable farming, which resulted in failure to use a low-cost public form of efficient activity and farmers' education.

– **Lack of education as a barrier.** In the first years of the period, there was a major lack of consultations. This included the use of environmentally friendly technologies, opportunities to develop the product market, exclusion of public organizations from educational activities, and poor organization of training for farmers.

The mentioned barriers slowed down the development of organic, and especially sustainable, farming in Lithuania. It can be stated that in the period from 1990 until the accession to the European Union, the state policy was focused on intensive farming and to some extent on the development of organic farming, while NGO programmes and measures were mainly aimed at preservation of biodiversity and less at the development of environmentally friendly sustainable farming. It should be noted, however, that measures for conservation of biodiversity encouraged the development of sustainable farming, because compensatory payments also provided an economic incentive for farmers. However, NGO measures were applied locally, while the state programmes were applied in wider regions across the country, though rather inactively.

Undoubtedly, when Lithuania started preparing for the accession to the European Union, a number of financial mechanisms were dedicated not only to the implementation of agrarian agriculture measures, but also to the development of sustainable agriculture. The first major financial mechanism was the SAPARD programme (Special Accession Programme for Agriculture and Rural Development), which ran from 2000 to 2006. One of the objectives of the programme was directly linked to sustainable agriculture: "Achieving sustainable rural development through the promotion of farming and other economic activities in harmony with the environment" (Ministry of Agriculture, 2007a). This objective supported not only efficient agricultural entities but also those engaged in a wide range of socio-economic activities, other than environmental, which were not approved by the programme. Compensatory payments for compliance with individual requirements for advanced agriculture were paid to land users, who were mainly farmers. Farmers are the most important individuals involved in advanced farming practices in agricultural areas (Ministry of Agriculture, 2007a).

As a follow-up to the SAPARD programme, a number of strategic documents covering sustainable agriculture were adopted. Some measures of the Rural Development Plan (2004–2006) and Programmes (2007–2013, 2014–2020), during the different programming periods, were focused on agri-environmental agriculture and at the same time on sustainable agriculture, although the main objectives of these strategic documents were intensification and efficiency of agriculture. Some objectives targeted support for agricultural entities, in combination with some socio-economic aspects. Compensatory payments for compliance with specific environmental requirements were paid to land users, who are mainly farmers. Farmers are the most important individuals involved in nature conservation activities in agricultural areas. The role of other land users is not as great as that of farmers (Uthes & Matzdorf, 2013).

The Rural Development Plan (2004–2006) set out an objective related to sustainable agriculture: "Farming in Less Favoured Areas and Areas with Environmental Restrictions". This objective aimed to support areas where productivity was lost due to certain obstacles, such as environmental, and to balance agricultural production and to secure income. The plan also identified certain measures and the most closely related to sustainable agriculture is the Agri-environmental measure. It provided for two schemes directly related to sustainable agriculture: Landscape Stewardship and Organic Farming schemes. The Landscape Stewardship scheme, in addition to environmental activities, also involved farmers in economic activities in order to balance various activities and increase employment of rural people. The Organic Farming Scheme also strived to balance implementation of environmental requirements with the economic benefits obtained from disposing organic produce. Both schemes also sought to involve more rural people in agricultural activities, whereas the second scheme also engaged them in disposing organic agricultural produce (Ministry of Agriculture, 2008).

In the second programming period (2007–2013), the programme consisted of four Axis, two of which were linked to sustainable agriculture: "Improving the environment and the countryside" and "The quality of life in rural areas and diversification of the rural economy". Although Axis II "Improving the environment and the countryside" focused on supporting, strengthening and modernizing agricultural and forest holdings, the activities also targeted appropriate farming methods and forest management practices within areas rich in biodiversity and encouraged farmers and forest owners within Natura 2000 network to apply biodiversity friendly practices (Ministry of Agriculture, 2007b).

The third programming period (2014–2020) includes measures and activities also linked to sustainable agriculture. One of them is to improve the environment and the landscape through sustainable use of land resources and to support development of sustainable farming. These measures are also related, namely, Environment-friendly farming practices (including "Agri-environment payments", "Organic farming scheme"), Mitigation of climate change, Preservation of biodiversity and development of high-nature value and traditional agrarian areas (Ministry of Agriculture, 2015).

Although the reviewed EU strategic documents focus mainly on rural development and intensification and efficiency of agriculture, they also concentrate on environmental agriculture, which is a priority area for the European Union. Sustainable agriculture is not distinguished as a separate instrument; however, it is integrated into agri-environmental and other measures. Nonetheless, the importance of sustainable agriculture is highlighted as one of the priority areas.

After Lithuania joined the European Union, agri-environment became one of the priorities in the general context of agriculture. As a result, the importance of sustainable agriculture gradually increased. After Lithuania transferred the European Union rural development provisions into its national legislation and rural development programs, the development of sustainable agriculture began to accelerate and intensify not only within state institutions, but also non – governmental organizations, as well as research of environmental and agriculture scientists and practitioners. Sustainable agriculture was analysed in a number of ways with the focus on the importance of its objectives in agricultural policy, its impact on agricultural development and agri-environment, and its importance for the society and farmers.

Development of sustainable agriculture did not start to increase since the very first year of accession. The European Union Sustainable Development Strategy was adopted only in 2001 and Lithuania's first strategic document (National Sustainable Strategy) on this area was adopted in 2003 (Juknys, 2008). Sustainable agriculture in Lithuania was promoted not only by the EU and Lithuania's strategic documents, but also by scientists' works on organic agriculture. Čiegis and Ramanauskienė (2011), and Čiegis (2009) carried out an analysis and evaluation of sustainable agricultural development. Kripaitis (2011, 2009) thoroughly examined sustainable agriculture in Lithuania and the karst region of Northern Lithuania in the context of sustainable development. The author evaluated application of environmentally friendly programmes, motivation and willingness of farmers to participate in the applied programmes, and aspects of development of agriculture in the context of sustainable development. Melnikienė, Eičaitė, and Volkov (2018) performed evaluation of formulation of sustainable agriculture policy. Galnaitytė and Kriščiukaitienė (2017) analysed the possibilities of modelling sustainable agriculture. Social and economic aspects of sustainable agriculture were analysed by Mierauskas (2016a, 2016b, 2012, 2011), who in his original research evaluated the importance of nature conservation programmes for sustainable agriculture and also found that farmers are involved in programmes mainly for economic reasons. A scientific study on sustainable agriculture and regional development was drawn up by a team of authors (Galnaitytė et al., 2017). The study examined in detail the development of sustainable agriculture in the context of regional development. These works confirm the importance and influence of not only agrarian agriculture, but also sustainable agriculture on agricultural policy and development in Lithuania.

2. Analysis and evaluation of farmers' motivation and willingness to participate in sustainable agriculture

In some cases in Lithuania, sustainable agriculture is identified with organic. The differences and similarities between these types of agriculture were discussed in previous publications (Čiegis, 2009; Kripaitis, 2011, 2009; Mierauskas, 2016). Despite the differences, this paper presents the results of previous research on willingness of farmers to participate in biodiversity conservation. As the research conducted in 2011–2010 shows, a greater proportion of farmers (43%) tend to participate in nature conservation for economic reasons; 19% participate because of a better public image, 14% – because of self-realization, 10% – because of protection of biodiversity, 7% – because of moral commitment, and 7% – because of heritage for the future (Mierauskas, 2012, 2011). These works also address the socio-economic aspects of farming.

Farmers' surveys conducted in 2012–2013 revealed that only a little over half of the farmers link environmentally friendly farming to agri-environmental measures – i.e. 55%, whereas 25% of farmers link it to conservation of wild fauna and flora, 5% link it to management measures, and 15% have no opinion. Respondents who expressed most favourable opinion on preservation of the environment also indicated that they would take up more environmentally friendly measures in areas of conservation (70%) if additional payments were higher by 50–100% (Mierauskas, 2014). The research showed that the economic interest still prevails.

Beside motivation and willingness to participate in biodiversity conservation programmes, it is also important to determine the ratio of those wishing to participate in sustainable agriculture. Kripaitis' research (2009) conducted in Biržai and Pasvalys district municipalities helped to distinguish the most important reasons why traditional farmers did not actively participate in sustainable farming. It was found that 35% of the respondents did not see the benefits of sustainable farming, 30% indicated low motivation, 20% indicated higher costs, whereas 15% claimed that poor support for sustainable farming in comparison to organic farming was socially unjust.

In order to determine farmers' awareness and willingness to participate in sustainable agriculture, surveys conducted in 2014–2015 also sought to analyse the perception of the concept. The concept of sustainable farming is clear to 75% of the respondents (Mierauskas, 2016b); however, willingness of the farmers to participate in different forms of farming varies and depends on the possibilities to get income (Table 1). Meanwhile, their willingness to participate in sustainable agriculture depends on additional income and is low if there are no additional benefits (Table 2).

The research revealed that willingness to participate in sustainable agriculture varied slightly from year to year (Table 3). This might have been due to gaining additional knowledge, previous participation in agri-environmental measures and more experience and clarity, thus motivation for participation is differentiated.

Table 1. Willingness of the farmers to participate in different forms of farming

Forms of farming	Willingness to participate (%), 2017–2018, data of the author
Sustainable farming without additional payments	10
Application of agri-environmental measures with additional payments	30
Conventional (traditional) agriculture	55
No opinion	5

Table 2. Agreement of the farmers to participate in sustainable agriculture (Mierauskas, 2016)

Types of agreement of the farmers to participate in sustainable agriculture	Agreement to participate, %
Agreement to participate in sustainable agriculture with additional payments	65
Agreement to participate in sustainable agriculture without additional payments	18
No willingness to participate in any additional measures	12
No opinion at the moment	5

Table 3. Farmers' motivation to participate in sustainable agriculture measures (%) in different periods

Motivation to participate in sustainable agriculture	2014–2015 (Mierauskas, 2016), %	2017–2018 (author's data, %)
No motivation to participate in sustainable agriculture	20	15
Low motivation to participate in sustainable agriculture	15	20
High costs discourage participation	20	25
It is more attractive to participate in agri-environmental measures	45	40

It can be stated that farmers' willingness to participate more actively in additionally reimbursed measures on both biodiversity conservation and sustainable farming is natural. Implementation of additional measures alongside the existing agri-environmental measures requires more human resources, time, knowledge and, in many cases, more financial resources.

In conclusion, participation of farmers in voluntary measures or programmes other than agri-environmental is not frequent in Lithuania. Their involvement is often fragmented and related to programmes or projects that go beyond agri-environmental measures under the Rural Development Program. This provides additional financial support for farmers. Farmers who are involved in agri-environmental measures are also often most motivated and active.

Discussion and conclusions

In Lithuania, sustainable agriculture started developing only since 1990, whereas in a number of Western European countries, the United States, and Canada it dates back to the late 1930s and early 1940s, due to development of biodynamic farms and introduction of Stewardship Award programmes that covered agricultural and socio-economic aspects. In Lithuania, this was determined not only by economic and social conditions, but also by the fact that intensive farming was prevalent in both the interwar and post-war Soviet periods, while environmental protection was not a priority. After Lithuania regained independence, the political approach to environmental protection changed and integration of environmental aspects into various sectors of economic development, including agriculture, started. This is how environmentally friendly farming practices began to form.

As the environmental policy changed both in the world and in Lithuania and was integrated into agriculture, development of alternative agriculture, later called "organic agriculture", was promoted. Initially, development of organic farming was fragmented, e.g. the foundation "Tatulos fondas", which was later transformed into a programme, in Biržai and Pasvalys districts (since 1993) and activities of the Lithuanian Organic Agriculture Association "Gaja" (since 1990). This association promoted activities in the field of organic agriculture. Meanwhile, "Tatulos programme" started to transform conventional agriculture into sustainable and organic. As a result, not only organic but also sustainable farms were set up in Lithuania. However, the programme provided lower compensatory payments to farmers who had sustainable farms than to those with organic farms, which hindered the development of sustainable agriculture. The National Rural Support Programme, approved by the Government in 1997, also gave higher priority

to organic than sustainable agriculture. The higher priority of organic agriculture was also determined by the country's agricultural policy.

It is noteworthy that sustainable agriculture was also promoted by non – governmental organizations, which relied more on priorities of Western countries. The economic, political, legal, institutional and educational barriers to sustainable agriculture were also evaluated and brought to the attention of the public authorities. This contributed to the growth of sustainable agriculture but no specific financial incentive mechanisms were introduced. The accession of Lithuania to the European Union facilitated introduction of such financial instruments (mechanisms), which supported not only organic agriculture (mainly agri-environmental measures) but also sustainable agriculture. Sustainable development was one of the policy priorities in the European Union, therefore, in addition to environmental principles, rural development plans and programmes embraced principles of sustainable development (in particular after adoption of the European Union Sustainable Development Strategy, 2001). Such documents as the SAPARD programme, the Rural Development Plan (2000–2006) and the Rural Development Programmes (2007–2013, 2014–2020) all have facilitated the development of sustainable agriculture in Lithuania.

Sustainable agriculture in Lithuania has also been encouraged by publications and studies of numerous scientists and specialists. Their works contributed to the development of a common agricultural and rural development policy. Trainings of farmers encouraged the development of not only organic agriculture, but also sustainable agriculture. In addition, farmers became more aware of not only agri-environmental and biodiversity protection measures, but also sustainable agriculture. A series of studies revealed that during the period 2010–2018 farmers' understanding and attitude towards sustainable agriculture improved. However, it should be noted that farmers participate in additional programmes when they are supported by higher payments.

The following conclusions can be drawn: 1) in Lithuania sustainable agriculture was formed gradually on the basis of organic agriculture; 2) at governmental level organic agriculture received more support than sustainable agriculture due to a number of conventional circumstances; 3) the financial mechanisms under the EU Rural Development Plan and Programmes contributed to the development of sustainable agriculture in Lithuania; 4) various publicity measures enhanced farmers' awareness of not only biodiversity conservation but also sustainable agriculture; 5) despite application of various incentives, the majority of Lithuanian farmers are reluctant to practice sustainable agriculture, but participate when additional compensatory payments are provided, as they not only cover the additional costs but also generate additional income.

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Author contributions

Pranas Mierauskas conceived the study and was responsible for development of data collection, analysis and design.

References

Allen, P., Van Dusen, D., Lundy, J., & Gliessman, S. (1991). Integrating social, environmental, and economic issues in sustainable agriculture. *American Journal of Alternative Agriculture*, *6*(1), 34–39. https://doi.org/10.1017/S0889189300003787

Čiegis, R. (2009). Darnaus žemės ūkio plėtra Lietuvoje [Development of sustainable agriculture in Lithuania]. *Vadybos mokslai ir studijos – kaimo verslų ir jų infrastruktūros plėtrai* [Management Theory and Studies for Rural Business and Infrastructure Development], *16*(1), 1–8.

Čiegis, R., & Ramanauskienė, J. (2011). Integruotas darnaus vystymo vertinimas: Lietuvos atvejis [Integrated assessment of sustainable development: Lithuania Case]. *Vadybos mokslai ir studijos – kaimo verslų ir jų infrastruktūros plėtrai* [Management Theory and Studies for Rural Business and Infrastructure Development], *26*(2), 1–12.

Darnhofer, I., Lindenthal, T., Bartel-Kratovichil, R., & Zollitsch, W. (2010). Conventionalization of organic farming practices: From structural criteria towards an assessment based on organic principles. A review. *Agronomy for Sustainable Development*, *30*, 67–81. https://doi.org/10.1051/agro/2009011

European Commission (EC). (2005). *Agri-environmental measures: Overview on general principles, types of measures and application.* Brussels, 24 p.

Galnaitytė, A., & Kriščiukaitienė, I. (2017). Lietuvos žemės ūkio sektoriaus tvaraus ūkininkavimo plėtros modeliavimas [Simulation of sustainable farming practices development in Lithuania]. *Viešoji politika ir administravimas* [Public Policy and Administration], *16*(2), 264–278.

Galnaitytė, A., Baležentis, T., Makutėnienė, D., Pilipavičius, V., Dapkus, R., Štreimikienė, D., Atkočiūnienė, V., Kiaušienė, I., & Švagždienė, D. (2017). *Darni žemės ūkio ir neurbalizuotų regionų plėtra* [Sustainable agriculture and non-urbanized regions development]. Akademija, Aleksandro Stulginskio universitetas [Aleksandras Stulginskis University], 346 p.

Gliessman, S. R. (1995). Sustainable agriculture: An agroecological perspective. *Advances in Plant Pathology, 11*(1), 45–57. https://doi.org/10.1016/S0736-4539(06)80005-X

Gutkauskas, A. (1996). Water quality protection policy and integrated agricultural and environmental protection strategies in Lithuania. In P. Howsam & R. C. Carter (Eds.), *Water policy: Allocation and management in practice*. Proceedings of International Conference on Water Policy, 23–24 September 1996, Cranfield University. Chapman & Hall, 128–134.

Harwood, R. R. (1990). A history of sustainable agriculture. In C. A. Edwards, R. Lal, P. Madden, R. H. Miller & G. House (Eds.), *Sustainable Agricultural Systems* (pp. 3–19). Soil and Water Conservation Society, Ankeny, Iowa.

Juknys, R. (2008). *Darnus vystymasis* [Sustainable Development]. Kaunas, Vytauto Didžiojo universitetas [Vytautas Magnum University], 221 p.

Kripaitis, R. (2009). *Tausojančio ūkininkavimo strateginės nuostatos Šiaurės Lietuvos karstiniame regione darnaus vystymosi kontekste* [Strategic Management Regulations of Sparing Farming Spread in Northern Lithuanian Karst Region in the Context of Sustainable Development]. Nepublikuota daktaro disertacija (Unpublished doctoral dissertation). Vilnius, Mykolo Romerio universitetas [Mykolas Romeris University], 192 p.

Kripaitis, R. (2011). Tausojančio ūkininkavimo strateginio valdymo kryptys Karstiniame regione [Directions of strategic management in sparing farming in the karst region]. *Vadybos mokslai ir studijos – kaimo verslų ir jų infrastruktūros plėtrai* [Management Theory and Studies for Rural Business and Infrastructure Development], *1*(25), 146–153.

Lithuanian Fund for Nature & Coalition Clean Baltic. (1999). *Possibilities for sustainable agriculture in Lithuania*. Vilnius, Lithuanian Fund for Nature, 56 p.

Lithuanian Fund for Nature. (1997). *Management of Rusne island, Nemunas delta regional park* (Report of Lithuanian Fund for Nature). Vilnius, 44 p.

Melnikienė, R., Eičaitė, O., & Volkov, A. (2018). Tvaraus žemės ūkio vystymasis: politikos formavimas ir apribojimų vertinimas [Sustainable development of agriculture: Policy formulation and assessment of constraints]. *Viešoji politika ir administravimas* [Public Policy and Administration], *17*(2), 226–239.

Mierauskas, P. (2011). Biologinei įvairovei palankaus ūkininkavimo kai kurie socialiniai ekonominiai aspektai [Some social and economical aspects of biodiversity friendly farming]. *Darnaus vystymosi strategija ir praktika* [Sustainable Development Strategy and Practice], *1*(5), 104–113.

Mierauskas, P. (2012). Gamtosaugos programų įgyvendinimo žemės ūkyje socialiniai ekonominiai aspektai [Social and economic aspects of the implementation of nature conservation programmes]. *Socialinių mokslų studijos* [Societal Studies], *4*(4), 1503–1517.

Mierauskas, P. (2014). Biologinei įvairovei palankių ūkininkų dalyvavimo Lietuvos saugomų teritorijų valdyme vertinimas [Evaluation of biodiversity of friendly farmers' participation in the Lithuanian management of protected areas]. *Socialinių mokslų studijos* [Societal Studies], *6*(2), 421–439. https://doi.org/10.13165/SMS-14-6-2-12

Mierauskas, P. (2016a). An overview of nature conservation programmes in Lithuanian agriculture. In D. Kovacevic (Ed.), *VII International Scientific Agriculture Symposium "Agrosym 2016" Abstracts*, 06–09 October 2016, University of East Sarajevo, Jahorina, Bosnia, 758.

Mierauskas, P. (2016b). Darnaus ūkininkavimo samprata agrarinės aplinkosaugos kontekste [Conception of sustainable farming in the context of environmental agriculture]. *Socialinių mokslų studijos* [Societal Studies], *8*(1), 132–142.

Ministry of Agriculture of the Republic of Lithuania. (2007a). *Final implementation report Special Accession Programme for Agriculture and Rural Development (SAPARD) 2000–2006*. Vilnius, 95 p.

Ministry of Agriculture of the Republic of Lithuania. (2008). *Rural Development Plan 2004–2006 Lithuania*. Vilnius, 331 p.

Ministry of Agriculture of the Republic of Lithuania. (2015). *Lietuvos Kaimo plėtros 2014–2020 metų programa* [Lithuanian Rural Development Programme 2014–2020]. Vilnius, 648 p.

Ministry of Agriculture of the Republic of Lithuania. (2007b). *Rural Development Programme for Lithuania 2007–2013*. Vilnius, 185 p.

Svirskis, A. (1990). *Alternatyvioji žemdirbystė* [Alternative Agriculture]. Vilnius, Lietuvos Respublikos Žemės ūkio ministerija [Ministry of Agriculture of the Republic of Lithuania], 36 p.

Uthes, S., & Matzdorf, B. (2013). Studies on agri-environmental measures: A survey of literature. *Environmental Management, 51*, 251–266. https://doi.org/10.1007/s00267-012-9959-6

Žekonienė, V. (1997). *Ekologinė žemdirbystė* [Organic Agriculture]. Kaunas, Lietuvos žemės ūkio universitetas [Lithuanian Agriculture University], 95 p.