

# Are there enough stimuli to develop sustainable farming in Lithuania?

Sustainable  
farming

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## Abstract

**Purpose** – The new programming period of 2021–2027 of the European Union (EU) Common Agricultural Policy requires reconsidering the policy measures. In the new period, the European Commission is to allow each member state (MS) developing eco-schemes to support and/or incentivise farmers to observe agricultural practices beneficial for the climate and the environment beyond their mandatory requirements. The purpose of this paper is to compare the performance of organic and conventional family farms.

**Design/methodology/approach** – Organic farming under the organic farming measure of the Rural Development Programme is one of the most widely applied sustainable farming practices in the EU as well as in Lithuania. By assessing the *ex post* economic impact of the organic farming measure on farm performance indicators, the authors seek to reveal possibilities and obstacles for the implementation of sustainable farming practices. A counterfactual *ex post* impact assessment method – propensity score matching (PSM) analysis – was used to evaluate *ex post* economic impact of the organic farming measure on the performance of farming indicators.

**Findings** – The application of the PSM allowed assessing both the effectiveness of the implemented measure and possibilities for applying this measure in the future. The research has revealed that organic farming is less profitable and the gap between farm income in organic and conventional farms has increased during the period of 2007–2013.

**Originality/value** – The most comprehensive economic information about the farm activities from the Farm Accountancy Data Network (FADN) was used for the *ex post* economic impact evaluation of the organic farming measure in Lithuania. The matched groups of Lithuanian family farms (organic and conventional) were compared. The results of the research provide a new knowledge about the effectiveness of the organic farming measure in Lithuania and suggest the ways of their improvement in the future. The results can also be generalised to other countries with similar agricultural structure.

**Keywords** Lithuania, Propensity score matching, Organic farming, Sustainable farming

**Paper type** Research paper

## 1. Introduction

Farmers play the key role in tackling climate change, protecting the environment and preserving landscapes and biodiversity (Modernising and simplifying the CAP, 2018; Zhao *et al.*, 2017). The agricultural sector in general and the food supply chains in particular will need to both adapt to the changing climate and contribute to the mitigation efforts (OECD-FAO Agricultural Outlook 2016-2025, 2016; Song, Fisher, Wang and Cui, 2018; Song, Peng, Wang and Dong, 2018; Song and Wang, 2018). FAO (2017) emphasises that sustainable agriculture cannot be maintained by embarking on high-input, resource-intensive farming systems. Indeed, such a way of farming renders a number of undesirable outcomes which include wide-scale deforestation, depletion of water resources, decrease in soil quality (and productivity) and excessive volumes of greenhouse gas emissions. All these impacts suggest that the conventional farming practices aiming for high productivity without environmental considerations are not capable of maintaining sustainable food and agricultural production. In order to overcome these limitations, the shift towards sustainable farming ensuring both productivity gains and environmental awareness is needed. These goals are manifested in



such concepts as agroecology, agro-forestry, climate-smart agriculture and conservation agriculture (Liu *et al.*, 2016; Wang and Wu, 2017; FAO, 2017; Chaudhary and Bisai, 2018). The latter concepts should be fostered by means of public support and extension services in order to streamline the agricultural development. Besides, technological progress remains important to induce reduction in input use so that fossil fuels and other resources could be exploited in a more sustainable manner (FAO, 2017).

Thanks to the Fourth Industrial Revolution (Industry 4.0), technological innovations and productivity of agricultural investments are boosting. Further attempts to reduce food losses and waste of agricultural output would lessen the need for production increases (FAO, 2017). The literature also indicates that only complex measures may help to avoid environmental degradation (Campbell *et al.*, 2017; Muller *et al.*, 2017). However, the desirable acceleration in productivity growth is hampered by the degradation of natural resources, the loss of biodiversity and the spread of transboundary pests and diseases of plants and animals, some of which are becoming resistant to antimicrobials (FAO, 2017).

The European Union (EU) Common Agricultural Policy (CAP) is the main tool enabling to tackle the environment-related challenges in the EU. CAP, launched in 1962, has been constantly evolving and adapted to solve the most relevant problems in a given period. The new programming period of 2021–2027 is approaching with the new objectives determined by the global and local conditions. For this reason, European Commission (EC) facilitated public consultations during 2017, which voiced consensus in keeping a strong CAP at the EU level to address the challenges foreseen ahead (fair standard of living for farmers, environment and climate change), and a need for a simpler and more effective policy. The latest proposals for CAP adaptation legislative beyond 2020 were presented by the EC on 1 June 2018. As it was declared by EC, the new legislative proposals make the CAP apt to respond to future challenges. The future CAP is planning to increase focus on the environment and climate, supporting the transition towards a more sustainable agricultural sector and the development of vibrant rural areas (European Commission, 2018b, d): 40 per cent of the CAP's overall budget is expected to contribute to climate action (Modernising and simplifying the Common Agricultural Policy, 2018).

The EU agricultural policy will likely shift the emphasis from compliance and rules towards results and performance. The EU is bound to provide more incentives for farmers to go beyond the minimum mandatory requirements in relation to agri-environment and/or climate commitments undertaken and tougher penalties for insufficient progress. In addition to ambitious mandatory requirements, farmers will have the possibility to contribute further and receive additional support through various voluntary schemes (Modernising and simplifying the CAP, 2018).

The upcoming programming period will offer more favourable conditions for knowledge transfer, eco-friendly investments, innovation and cooperation in agriculture. An important message from the EC is that each member state (MS) will develop eco-schemes to support and/or incentivise farmers to observe agricultural practices beneficial for the climate and the environment, beyond their mandatory requirements (Modernising and simplifying the CAP, 2018). Following the strategy of country-specific development strategy, we focus our research on the case of Lithuania. Even though this paper is focussed on one of the sustainable farming practices most widely applied in the EU as well as in Lithuania – organic farming[1] cultivated under the organic farming measure – cursory analysis of the situation of organic farming in Lithuania is also outlined.

It is obvious that importance of sustainable farming is increasing in the entire world in the sense of scale and scope. The future EU CAP (2021–2027) is also to strengthen the focus on sustainable farming development (which is even incomparable with earlier periods of CAP). Recent literature suggests (Sanders *et al.*, 2016) that following organic farming

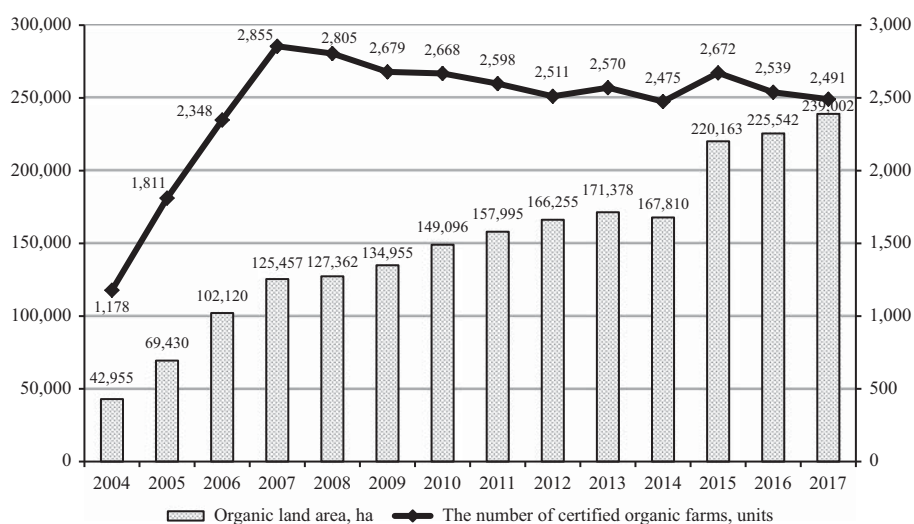
practices may create greater value added compared to conventional farming under certain conditions. Organic farming practices may increase viability of smaller farms and thus contribute to development of rural areas where large-scale farming is not applied. Given these theoretical and empirical considerations, we aim to address the case of Lithuania and clarify if there are enough stimuli to develop sustainable farming there. Specifically, we apply the farm-level Farm Accountancy Data Network (FADN) database along with propensity score matching (PSM) in order to facilitate the difference-in-differences analysis of Lithuanian family farms. As a result, the performance of organic farms can be reasonably compared to that of conventional farms.

The paper is structured as follows: Section 2 briefly summarises the major trends in organic farming in Lithuania. Description of the data used and methods applied are presented in Section 3. The results of the *ex post* economic impact assessment of the organic farming measure in Lithuania are presented in Section 4. Finally, Section 5 concludes the paper.

## 2. Organic farming in Lithuania

Since the Lithuania's accession to the EU in 2004, the share of organic agricultural land area has been steadily increasing and reaching 8.1 per cent of the total utilised agricultural area in 2017 (Eurostat, 2018). The dynamics in the number of agricultural farms and the organic agricultural land area are presented in Figure 1. The share of certified organic farms during the same period has increased from 0.5 to 1.9 per cent. These trends indicate the increasing prevalence and scale (if looking at an average organic farm) of the organic farming in Lithuania. However, the development of the organic farming in Lithuania has been impacted by public support, i.e. the EU CAP. This requires further analysis of the trends and factors behind the changes.

Based on data provided by Eurostat (2018), one can state that contribution of organic farming to the implementation of environmental objectives in Lithuania is insufficient: meadows and pastures occupied less than one-third, and arable land occupied almost two-thirds of total organic land area in 2016. Cereals and legumes predominated in arable land of organic farms: the share of cereals and legumes in arable land was considerably higher than in other Baltic Sea region countries, where much more plants are cultivated for green fodder. The further development of organic farming can be affected adversely by the lack of development of organic



**Figure 1.**  
The number of certified organic farms and organic land area in Lithuania 2004–2017

livestock: the share of livestock in Lithuanian organic farms is comparatively low as compared to the other Baltic Sea region countries. It may cause insufficient organic fertilizer supply.

It has also been noted that the organic farming might be related to generation of higher value-added. Analysis based on the FADN shows that net margins per unit of production are higher but labour input and net market receipts per labour unit are lower. Higher subsidies partly compensate these differences (European Commission, 2018a).

The study of three East German states – Brandenburg, Saxony and Saxony-Anhalt – reports that direct payments have led to labour shedding, whilst the only measures which contributed to an increase in employment were the agri-environmental ones. The reason behind these findings was support to conversion to organic farming (Petrick and Zier, 2011; European Commission, 2018c). Thus, organic farming can be a more labour-intensive farming practice opposed to conventional farming. This might be related to both different farming technologies and the areas the organic farms are located in (e.g. hilly terrains, sandy soils, etc.), which provide economic and technological barriers for machinery use. However, an increase in employment when switching to organic farming is related to diverse outcomes. On the one hand, the creation of work places is desirable in the sense of viability of rural areas. On the other hand, labour productivity may stagnate in case the labour force remains employed in low-productivity economic activities.

### 3. Data and methodology

*Ex post* impact assessment is an important tool for policymakers. Appropriate knowledge about the effectiveness of the policy measure may suggest decision of future implementation and the ways of the measure improvement. However, it is important to choose the appropriate benchmarks in order to avoid false reasoning.

Fully balanced panel farm-level data from the FADN (Lithuanian Institute of Agrarian Economics, 2018) were used for this research. The data cover Rural Development Programme implementation period of 2007–2013. Lithuanian FADN provides detailed data for some 1,300 farms each year. However, balanced panel data are available from 279 farms, with 31 of them participating in the organic farming measure.

Counterfactual analysis method allows to establish a virtual reference point to be compared to current situation. In this paper, counterfactual analysis is used for the *ex post* impact assessment of the organic farming measure in Lithuania. Application of the counterfactual analysis allowed to compare the trends in development of conventional and organic farms in Lithuania across multiple dimensions. The comparison was made by considering farms featuring similar structural indicators (matching variables).

The most widely applied approaches for counterfactual analysis are PSM, difference-in-differences (DID) and combined PSM and difference in differences (PSM-DID). The PSM has been selected for this research, as it does not necessarily require baseline survey. Unfortunately, pre-programme baseline data on participants and non-participants are insufficient in Lithuania. PSM is a useful approach when only observed characteristics are believed to affect the participation (Khandker *et al.*, 2010). As far as DID, and, consequently, PSM-DID methods require pre-programme baseline data, we are not able to use either of these methods to evaluate the net effect on selected outcome indicators of the organic farming measure in Lithuania.

It is worth to mention that the nature of the organic farming measure causes complicated definition of the starting point of the measure implementation: entering this measure is not immediate but gradual – it has a transitional period of two years. Therefore, only PSM method can be used to evaluate *ex post* economic impact assessment of the organic farming measure in Lithuania. We compare results of the similar participants and non-participants of the organic farming measure with the purpose to perceive tendencies of the development of conventional and organic farms' in Lithuania.

The logit model of the measure participation was constructed and propensity score was derived from it, where participation in the organic farming measure appears as an endogenous variable. After the participation equation is estimated, the predicted values of  $T$  from the participation equation can be derived. Binary treatment indicator  $T$  equals 1 whether farm participated in the measure ( $T=1$ ) or zero otherwise ( $T=0$ ). It is notable (Khandker *et al.*, 2010) that the participation equation is not a determinants model, therefore estimations such as  $t$ -statistics and the adjusted  $R^2$  are not informative and may be misleading. For this stage of PSM, causality is not of as much interest as the correlation of  $X$  with  $T$ . While the selection of  $X$  variables is likely data driven and context specific, we follow Heckman *et al.*'s (1997, 1998) suggestions: the same survey instrument or source of data should be used for participants and nonparticipants, if possible; a representative sample survey of participants and non-participants can greatly improve the precision of the propensity score; and the larger sample of non-participants is, the more good matching will be facilitated. Nevertheless, including too many  $X$  variables in the participation equation should also be avoided (Khandker *et al.*, 2010). Also, it is important to identify the factors driving measure participation (e.g. surveys). Therefore we use six main participation determining factors, proposed by Kriščiukaitienė *et al.* (2013): utilised agricultural area, labour input, livestock units, land quality, farmer's age and the book value of buildings and machinery.

The individual treatment effect  $\Delta$  is calculated as a difference between potential outcomes of treated  $Y_1$  and non-treated  $Y_0$  farms:

$$\Delta = Y_1 - Y_0. \quad (1)$$

Potential outcome indicators  $Y$  may reflect the effect of the programme at a micro-level such as income, profits, employment, labour productivity, total factor productivity, etc. (Michalek, 2012). We use income per hectare indicator for this research. The standard potential outcome model developed by Roy (1951) and Rubin (1974) formalises the problem inference about the impact of a treatment on the outcome of an individual unit. The standard potential outcome model, adjusted to evaluations of the Rural development programmes, assumes that every farm (participant and non-participant of the relevant measure) in the sample must fulfil participation criteria of the measure (Michalek, 2012). As it was mentioned before, we also have to know participation determining factors. Then we are able to construct counterfactual: from a large group of non-participants, we create a control group that is as similar to the treatment group in terms of observed characteristics not affected by the measure. Each participant is matched with an observationally similar nonparticipant, and then the average difference in outcomes across the two groups is compared to get the measure treatment effect (Khandker *et al.*, 2010).

The PSM method used in this research employs non-parametric PSM estimator created and developed by Rosenbaum and Rubin (1983a, b, 1985), Heckman *et al.* (1997, 1998), Heckman *et al.* (1999), Smith and Todd (2005), etc. Matching estimators aim to overcome selection bias on observables by matching each treated individual with one or more non-treated individuals that have similar observed characteristics, the covariates  $X$  (Smith and Todd 2005; Arata and Sckokai, 2016). Rosenbaum and Rubin (1983a) proposed the idea of conditioning on a function of  $X$ , the probability  $P(X)$  of being treated, such that the conditional distribution of  $X$ , given  $P(X)$ , is independent of the treatment assignment. Accordingly, PSM is based on  $P(X)$ . To assign participants to non-participants single nearest-neighbour matching without replacement technique was used.

The non-participant with the value of  $P_j$  that is closest to  $P_i$  is selected as the match (Caliendo and Kopeinig, 2005; Smith and Todd, 2005; Bartova and Hurnakova, 2016):

$$C(P_j) = \min_j \|P_i - P_j\|. \quad (2)$$

The most common evaluation parameter is mean the impact of treatment treated (TT), which estimates the average impact of the policy measure among those participating in it (Smith and Todd, 2005):

$$TT = E(Y_1|X, T = 1) - E(Y_0|X, T = 1). \quad (3)$$

The treatment effect of the measure using these methods can either be represented as the average treatment effect (ATE) or the average treatment effect on the treated (ATT). Typically, researchers can ensure only internal (as opposed to external) validity of the sample, so only the ATT can be estimated. The difference of the mean outcomes of the treated and matched non-treated control group (ATT), in general, can be written as (Khandker *et al.*, 2010; Caliendo and Kopeinig, 2005; Arata and Sckokai, 2016):

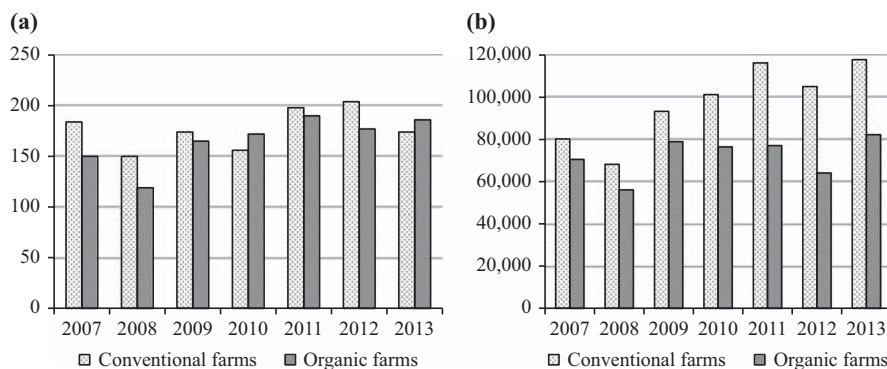
$$ATT = \{E(Y_1|T = 1, P(X)) - E(Y_0|T = 0, P(X))\}. \quad (4)$$

Package “MatchIt” for “R” language was used for PSM evaluation (Ho *et al.*, 2011). Specifically, the performance of participant and non-participant groups was compared over the time.

#### 4. Results and discussion

*Ex post* economic impact assessment of the organic farming measure on the performance of farming was carried out by comparing indicator values for farms participating in the organic farming measure and those for farms not participating in the latter measure. For this comparison, each organic farm was matched with the observationally similar (as defined by a set of matching characteristics) farm from the large group of conventional farms. Matching characteristics were selected based on the earlier literature. Kriščiukaitienė *et al.* (2013) found out that farm size measured in terms of utilised agricultural area, labour input in working hours, herd size in livestock units, land quality, farmer’s age, and the book value of buildings and machinery could determine farmers’ decisions to embark on organic farming. It is expected that variables related to farm size (utilised agricultural area, labour input, herd size, and the book value of buildings and machinery) would decrease the propensity to opt for organic farming as larger farms face more difficulties in implementing the required practices. As regards to land quality, farms with lower land quality are expected a higher propensity to switching to organic farming. Finally, the likelihood of choosing organic farming is expected to decrease with the farmer’s age. These variables were used to establish the logit model and derive the propensity scores for conventional farms. Conventional farms showing the highest values of the propensity scores were then used as a reference group. Thus, we compared average differences in outcomes across these two groups as the effect of agri-environmental measure organic farming implemented under the CAP in Lithuanian family farms.

Farm size in terms of utilised agricultural area was one of the matching characteristics. Therefore, we do not observe any big notable in utilised agricultural area across conventional and organic farms during the period of 2007–2013 (Figure 2(a)). Looking at the trends of farm size in terms of utilised agricultural area, one can note that it has increased by a quarter for organic farms, whereas a decrease of 5.4 per cent was observed for conventional farms during the period of 2007–2013. It is important to mention that organic farm size (as measured in terms of utilised agricultural area) follower a clearly linear upward trend during the period considered. Indeed the expansion of the average organic farm area was implemented by acquiring own land: the share of rented land decreased by 3.9 percentage points from 45.8 per cent in 2007 to 41.9 per cent in 2013. Note that the proportion of own and rented land in conventional farms varied during the period analysed.



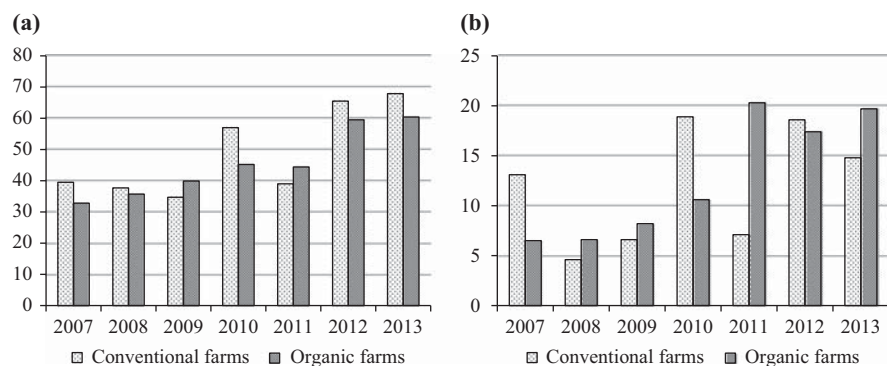
Notes: (a) Utilised agricultural area, ha; (b) economic farm size, EUR

Figure 2. Farm size of conventional and organic farms in Lithuania, 2007–2013

The average rented land share (2007–2013) in conventional farms was higher than that in organic farms and amounted to 52.2 per cent.

Economic farm size represents the level of standard output produced on the farm. This measure accounts not only for the differences in physical size of the farm, but also for differences in the structure of output. The trends of economic farms size development during the period of 2007–2013 were not promising for the organic farms: economic size of organic farms increased only by 17 per cent, while the economic size of conventional farms followed a more robust trend and increased by 47 per cent (Figure 2(b)). This implies that Lithuanian organic farms were not able to improve their output levels by switching to more profitable crops. This finding holds even though land quality was considered in the matching model.

The herd size (as measured in livestock units) was also included in to the matching characteristics. Therefore we can see similar levels of herd size across conventional and organic farms (Figure 3(a)). A clearly positive trend in herd size was observed for both farming practices during the period of 2007–2013. Specifically, organic farms showed increase by 84 whereas conventional farms by 72 per cent. As Lithuanian farms are highly dependent on the own feedstuff use, the area of meadows and pastures is highly related to the herd size. This can be confirmed by looking at the results presented in Figures 3(a) and (b). As there had been an increase in herd size for both farming practices, the area of meadows and pastures followed the same trend and increased by three times in organic farms and by 13 per cent in



Notes: (a) Herd size, livestock units; (b) meadows and pastures, ha

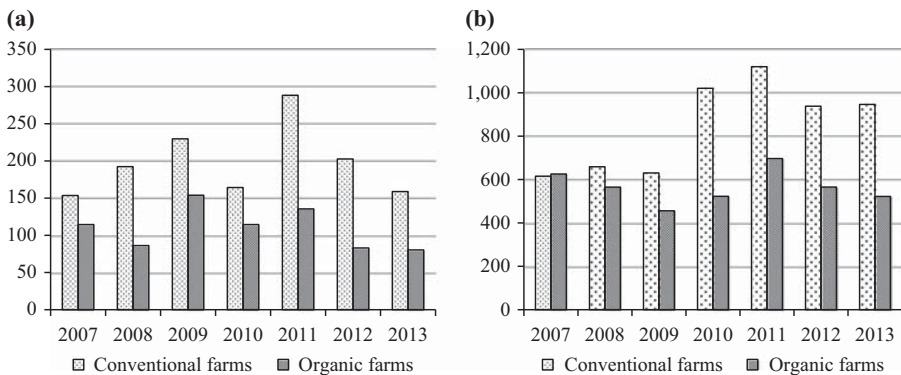
Figure 3. Livestock units' number and area of meadows and pastures in conventional and organic farms in Lithuania, 2007–2013

conventional farms during the period of 2007–2013. However, the volatility of the areas of meadows and pastures differed across the farming practices. An obviously increasing trend was observed in organic farms, while the direction of change was less certain for conventional farms. Especially, 2011 saw a steep decline in the areas of meadows and pastures for conventional farms. On the contrary, organic farms showed a remarkable growth of the area of meadows and pastures. Such trends were preconditioned by greater opportunities of conventional farms to adapt to market conditions with less attention to crop rotation and other activities contributing to sustainability. Therefore, the measures of price risk management might be more important for organic farms.

The difference in labour input across organic and in conventional farms was negligible. As regards the the average value, it equalled 6,100 h per year per farm or 36 h per hectare of UAA in spite of the farming practice applied for 2007–2013. Considering the changes in the labour input, organic farms showed a declining trend, while conventional farms exhibited a more volatile path over the period of 2007–2013. This can be related to differences in farm and production structure in the matched conventional farms. The decline of labour input in the conventional farms does not confirm the hypothesis that organic farms contribute to job creation to a higher extent if compared to the conventional ones. The expansion of the organic farms (Figure 2(a)) suggests that labour intensity has decreased in the organic farms over the period covered.

The level of input intensity is measured by variable costs per land area unit. In Lithuanian family farms, the variable costs per hectare of UAA were twice lower in organic farms than in conventional ones on average during 2007–2013 (Figure 4(a)). The lower intensity of input use rendered lower land productivity (as well as lower labour productivity). The output per hectare in organic farms was lower by one third if compared to conventional farms over the research period (Figure 4(b)). Thus, one can clearly note a performance gap existing between conventional and organic farming in Lithuania. Besides regulations imposed on the organic farming, the fact that many organic farms locate in less favoured areas can explain the lower productivity of organic farming.

Fertilizers and agrochemicals are one of the most important inputs in agriculture. Thus, we further analyse the differences in fertilizer and agrochemical use across the conventional and organic farms. The share of fertilizers and agrochemicals in the total variable costs is five-fold lower in organic farms than in conventional ones. It is important to notice that even the share of organic fertilizers in variable costs is higher in conventional farms than in organic ones. Besides, the share of organic fertilizers in variable costs for organic farms showed a negative trend.



**Figure 4.** Variable costs and output in conventional and organic farms in Lithuania, 2007–2013

**Notes:** (a) Variable costs, EUR/ha; (b) output, EUR/ha

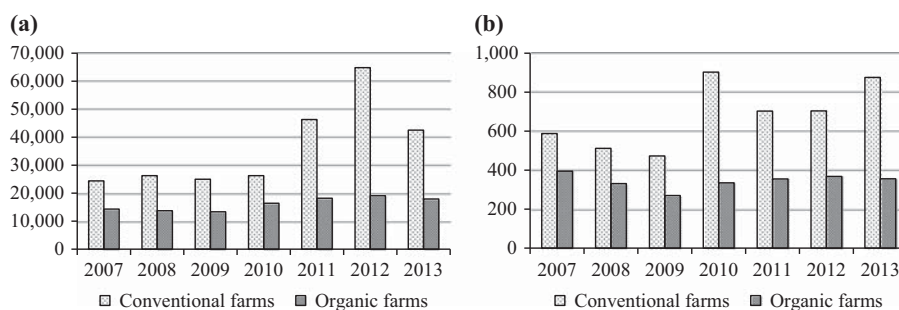


During the period of 2007–2013, both output (Figure 4(b)) and income (Figure 5) tended to increase in conventional farms. This indicates improving farming profitability. However, the differences between organic and conventional farming prevailed. Both income-related indicators are twice lower in organic farms than in conventional ones on average. Farm income in EUR per AWU (which reflects labour productivity) showed a clear tendency to increase both in conventional and in organic farms. However, the gap between initial farm income levels and the average growth rates differ significantly: farm income in EUR per AWU grew up by 15 per cent in conventional farms and by just 4.3 per cent in organic farms. Thus, the profitability of the organic farms still needs to be improved in Lithuania even after accounting for structural differences.

The gap between farm income in organic and conventional farms increased during the period of 2007–2013. ATT, i.e. effect of organic farming on farming results, was negative and went up during the period of 2007–2013. Farm income was lower in organic farms than in conventional farms by 200 EUR/ha in 2007 and by 493 EUR/ha in 2013. The ATT for 2007–2013 was –293 EUR/ha. The increasing yields and prices have determined this boost in performance gap between conventional and organic farming. Different trends of subsidy rates (per hectare) in conventional and organic farms during the period of 2007–2013 also contributed to the widening gap. Subsidy rates increased by 20 per cent (from 172 to 207 EUR/ha) in conventional farms, whereas organic farms saw a decrease in subsidies of 11 per cent (from 380 EUR/ha down to 340 EUR/ha) during 2007–2013. Therefore, the differences in support rates and (possibly related) lower intensity of input use rendered lower productivity and income levels in the organic farms if opposed to conventional ones.

The tendencies revealed above has shown inadequate development of organic farming, which is the most widely applied sustainable farming practice in Lithuania. Such a development of farm incomes causes doubts about farmers' willingness to develop organic farms when conventional farming is much more profitable. Compensatory payments amounts revision and promotion of the implementation of technological innovations of organic farms are desirable.

Comparing the findings of our research with the findings of other research, we can observe some similarities and differences among the results. Uematsu and Mishra (2012), using large farm-level data, employing a non-parametric approach and using the nearest neighbour matching method, carried out the research under which they explored the relationship between organic certification and farm household income with its various components in the USA. The results of the mentioned research, carried out by Uematsu and Mishra (2012), revealed that certified organic farmers do not earn significantly higher household income than conventional farmers: despite their higher revenue, they incur higher production expenses. Most of the additional cost for organic farming mentioned authors' explained by labour cost, insurance expenses and marketing charges. Uematsu and Mishra (2012) also found out that



Notes: (a) Income, EUR/AWU; (b) income, EUR/ha

Figure 5. Farm income in conventional and organic farms in Lithuania, 2007–2013

organic farmers are more risk prone than conventional farmers; however, they are very active in hedging greater risk and uncertainty inherent in organic farming. Uematsu and Mishra (2012) concluded that the lack of economic incentives can be an important barrier to conversion to organic farming. The results of our research revealed considerably higher farm income in conventional farms than in organic farms in Lithuania. In the light of EU CAP goals, this situation could be considered as inappropriate and should be revised; otherwise, the conversion to organic farming will not develop to a desirable extent.

Petrick and Zier (2011) applied a DID estimator to analyse the effects of a portfolio of CAP measures on the labour input across the three East German States. They found out that agri-environmental measures kept labour intensive technologies in production or induced them (Petrick and Zier, 2011). Our research, however, showed very similar labour input quantities across organic and in conventional farms. It can be explained by undesirable crop structure in organic as well as in conventional farms: more than two thirds of UAA is allocated for cereals. It reveals a lack of sustainability in both farming practices in Lithuania.

Toma and Mathijs (2007) identified the factors underlying farmers' propensity to participate in organic farming programmes in a Romanian rural region that confronts non-point source pollution. The results of their research showed that "environmental risk perception" as the strongest determinant of farmers' propensity to participate in organic farming programmes (Toma and Mathijs, 2007). In Lithuania, however, technological and economic factors prevail, as has already been indicated by Kriščiukaitienė *et al.* (2013). The logit model confirmed that farm size in terms of utilised agricultural area, labour input, livestock units, land quality, farmer's age, and the book value of buildings and machinery are the significant factors affecting propensity to opt for the organic farming in Lithuania.

Tiedemann and Latacz-Lohmann (2013) considered the contribution of production risk and technical efficiency as two possible factors of output quantity change in German organic and conventional farming. Their results indicated that output quantity change observed across the two farming practices is mainly related to production risk. The risk-inducing inputs included land and labour irrespectively of the farming practice, whereas higher capital endowment, seed costs and soil quality appeared as the risk-reducing variables (Tiedemann and Latacz-Lohmann, 2013). Our research did not aim to quantify production risk and technical efficiency as two possible sources of production variability, but we can assert that the patterns in the land, labour and variable costs across the different farming practices can be related to findings of Tiedemann and Latacz-Lohmann (2013). For instance, the imposition of organic farming requirements affects the land use and cause differences between organic and conventional farming in this sense.

## 5. Conclusions

The possibilities of implementation of sustainable development goals in agriculture can be improved via the effective support policies. This paper, therefore, attempted to look into the effects of the EU CAP. Among the measures supported by the CAP, those related to promotion of organic farming are especially important in regards to farming sustainability.

The literature review indicated that high-input consumption induced by resource-intensive farming systems might damper the sustainability of food and agricultural production. Innovative systems protecting and enhancing natural resources, while increasing productivity are needed. Accordingly, the goals of food security (which is related to agricultural output levels and production prices) and sustainability (which is related to environmental and social impacts) need to be achieved simultaneously. A combination of the aforementioned goals requires development of environmentally friendly farming practices based on innovative technologies, knowledge of local conditions and traditions. However, such practices are often related to certain trade-offs.

In the EU, the importance of sustainable agriculture is likely to increase in upcoming programming period. This is likely to be reflected in the shifts of CAP measures. Specifically,

the future CAP (beyond 2020) should put more focus on the environment and climate. As the rural population is highly dependent on agricultural activities, supporting the transition towards a more sustainable agricultural sector and the development of vibrant rural areas should be considered as the major objectives of effective agricultural policies under the CAP.

Organic farming can be considered as an important avenue for mitigating environmental impact of agricultural activities. Indeed, the development of organic farming often faces economic barriers as the CAP payments do not fully compensate losses occurring due to less intensive farming. An additional issue in EU and Lithuania is the shortage in organic fertilizers supply. This can be addressed by ensuring both adequate cropping patterns and development of organic livestock.

In this paper, we focussed on Lithuania as a new EU MS with relatively low average farm size. For such farms, the promotion of organic farming and short supply chains might allow generating higher value added and maintaining agricultural activity. Indeed of organic land area increased six-fold in Lithuania during 2004–2017 whereas the number of organic farms fluctuated at around 2.5 thousand. This indicates that addition farms are not prone to adopt organic farming practices in general, but the extent ones are eager to expand their operation scale. We address the issue of the effectiveness of CAP payments of the organic farming measure by exploiting farm-level FADN sample for 2007–2013 (i.e. a single programming period).

After considering the three most common methods used in the literature of counterfactual analysis – PSM, DID and a combined approach (PSM-DID) – PSM has been selected for the analysis, as PSM analysis does not necessarily require baseline survey. Application of PSM and FADN data allowed us to estimate ATE on the performance indicators of the farms participating in the organic farming measure in Lithuania.

Considering the matched groups of organic and conventional farms, we identified that major differences in structural indicators across these two groups of farms featuring similar propensity to switch to organic farming. The carried out analysis suggested the organic farms lagged behind the conventional ones in terms of their growth. Specifically, the economic size of organic farms has went up by a margin of 17 per cent, while the economic size of conventional farms saw a more robust increase of 47 per cent. This indicates that agricultural policy support could be further improved in the sense of promotion of organic farming in Lithuania. However, lower growth rates might be expected for organic farms if they pursue value-oriented business.

Further on, the analysis revealed a substantial increase in herd size (as measured by livestock units) was observed in both organic and conventional farms with growth rates of 84 and 72 per cent, respectively. Besides, the area of meadows and pastures has increased in organic (3 times) and in conventional farms (by 13 per cent) during the same period. Even both farming practices showed an increase in the area of meadows and pastures, organic farms followed a clearly upward trend, whereas the conventional ones followed a rather volatile trend during the same period. Such trends can be explained by high elasticity of conventional farms decisions in response to the market conditions if opposed to the organic farms, which must follow the regulations regarding crop rotation and other means contributing to sustainability. Given Lithuanian organic farms are relatively large they require higher amounts of organic fertilizers. In this sense, the expansion of herd size is desirable. The analysis also indicated that the use of fertilizers needs to be improved in the organic farms, yet the lower support rates per unit of land area might pose a threat for following this direction.

It is obvious that organic farming is less profitable due to restrictions on input use and output production. The results indicate that the gap between farm income in organic and conventional farms has increased during the period of 2007–2013. This suggests the increase of opportunity costs associated with organic farming practices. We estimated these costs by applying the concept of ATT. Considering the case of Lithuanian organic farms, organic farms generated lower income per hectare of UAA with a margin of €293 (if compare to matched conventional farms). Differences in the yields across organic and conventional

farms can be considered as the major factor determining the differences in farming results. The obtained ATT can be used as yardstick value for designing effective agri-environmental measures and, thereby, promoting sustainable farming in Lithuania. One should note that the obtained ATT does not account for transaction costs. Therefore, the compensatory payments should be further adjusted in the presence of non-negligible transaction costs. Transaction costs might be mitigated by reducing the administrative burden, or introducing dedicated advisory services.

The opportunity costs associated to organic farming practices could be reduced by promoting short supply chains, which would allow farmers extracting higher value added. This would increase the revenue of organic farms and reduce the performance gap with respect to the conventional ones. In this regard, creation of online and off-line platforms of organic farmers can be considered as an appealing direction for development. In case the income gap between organic and conventional farms persists or even increases, further development of the compensatory payment system will be topical in Lithuania.

In our research, we have encountered some issues which can be considered as limitations. First of all, Lithuanian FADN database includes rather low number of observations with pre-programme baseline data. Accordingly, we were not able to apply DID and, consequently, PSM-DID methods. The second limitation is also related to Lithuanian FADN database. As the latter database includes commercial farms, the average size of organic farms in the database is higher than that of the average organic farms in Lithuania (as measured in UAA). Therefore, farming results reported in the FADN database and those observed in all the organic farms in Lithuania may differ. However, it should be noted that FADN database remains the most comprehensive data source for economic farming indicators in Lithuania and the EU. One more limitation of this research is that fully converted organic farms, farms under conversion to organic farming and farms with both fully converted and under-conversion organic farming area were assigned to the organic farms group. This problem may be resolved in the future research by improving FADN data collection and systemisation. More detailed research would reveal differences among three farming practices: conventional, under conversion to organic and organic farming. Nevertheless, this research indicates important signals on sustainable farming development in Lithuania and provides valuable insights to the policy makers.

#### Note

1. In this paper, the organic farming measure is defined as sustainable farming practice, supported under the Lithuanian Rural Development Programme. During the period of 2007–2013, organic farming practice was supported under the programme Organic Farming of Agri-environmental Measure; later on, it was excluded from the agri-environmental measure and, during the period of 2014–2020, exists as a self-contained measure.

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