

Kulyk, Piotr; Kowalewicz, Anna; Nowomiejska, Aleksandra

Working Paper

Regional socio-economic determinants of the development of the bio-economy in agriculture

Institute of Economic Research Working Papers, No. 49/2017

Provided in Cooperation with:

Institute of Economic Research (IER), Toruń (Poland)

Suggested Citation: Kulyk, Piotr; Kowalewicz, Anna; Nowomiejska, Aleksandra (2017) : Regional socio-economic determinants of the development of the bio-economy in agriculture, Institute of Economic Research Working Papers, No. 49/2017, Institute of Economic Research (IER), Toruń

This Version is available at:

<https://hdl.handle.net/10419/219872>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.



<https://creativecommons.org/licenses/by/3.0/>



Institute of Economic Research Working Papers

No. 49/2017

**REGIONAL SOCIO-ECONOMIC DETERMINANTS
OF THE DEVELOPMENT OF THE BIO-ECONOMY
IN AGRICULTURE**

**Piotr Kułyk, Anna Kowalewicz, Aleksandra Nowomiej-
ska**

Article prepared and submitted for:

**9th International Conference on Applied Economics Contemporary
Issues in Economy, Institute of Economic Research, Polish
Economic Society Branch in Toruń, Faculty of Economic Scienc-
es and Management, Nicolaus Copernicus University, Toruń,
Poland, 22-23 June 2017**

Toruń, Poland 2017

© Copyright: Creative Commons Attribution 3.0 License

dr hab. inż. Piotr Kułyk, prof. UZ
Uniwersytet Zielonogórski
Wydział Ekonomii i Zarządzania
Katedra Ekonomii Międzynarodowej
e-mail: p.kulyk@wez.uz.zgora.pl

mgr Anna Kowalewicz
Uniwersytet Zielonogórski
Wydział Ekonomii i Zarządzania
Katedra Ekonomii Międzynarodowej
e-mail: a.kowalewicz@wez.uz.zgora.pl

Aleksandra Nowomiejska

Regional socio-economic determinants of the development of the bio-economy in agriculture

JEL Classification: O13, Q01

Keywords: bio-economy, local development, economic and social determinants, the Lubuskie Voivodeship, sustainable agriculture

Abstract

Research background: Bio-economy regional level is essential for the socio-economic impact, especially in sparsely populated peripheral areas. The positive effects of bio-economy in the agro-food sector can be regarded as an increase in em-employment and incomes and security of supply.

Purpose of the article: The purpose of the article was to define and determine the potential of bio-economy in the polish Voivodships. In addition, it attempts to define the role of bio-economy in the agro-food sector, including the environmental aspects.

Methodology/methods: The study covered the period 2005-2015. In order to assess the influence of macroeconomic factors on the development of sustainable agriculture the article used method of panel analysis with fixed effects. The data for the analysis was taken from the statistical data from the Local Data Bank (BDL), the Central Statistical Office and the Chief Inspectorate of Trade Quality of Agricultural and Food (GIJHARS).

Findings: In order to increase the potential of the region it is necessary to recognize the im-portance of local knowledge as a stimulant of competitiveness of regional devel-opment, while taking into account the diversity and complexity of local systems. In order to improve opportunities for bio-economy and green growth

it is necessary to better understand the role of natural capital and related changes. The integration of cross-sectoral dimensions of ecological, social-cultural and socio-economic development in the process of regional management is becoming important. In this context, there is a need for further study of the socio-economic conditions to determine the regional conditions providing a permanently sustainable development with the use of bio-economy in agriculture.

Introduction

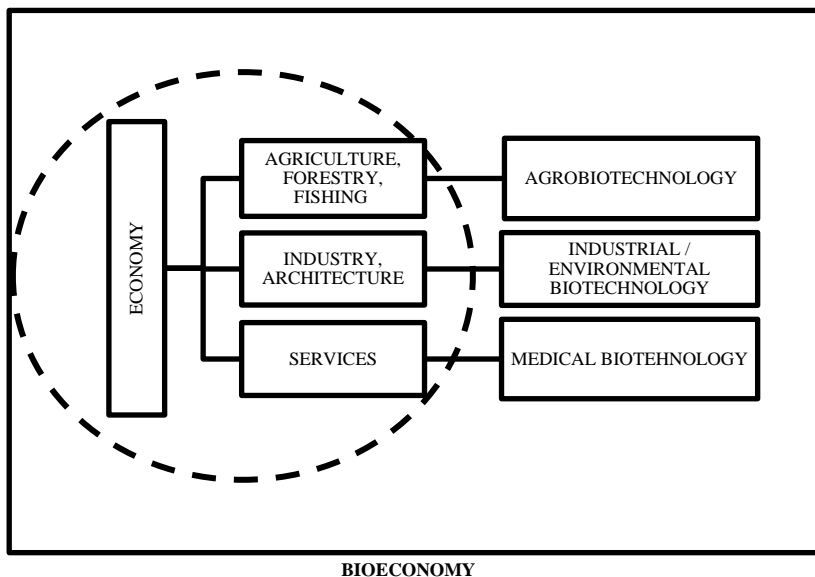
Globalization, industrialization, urbanization and consumerism have given rise to the need to reflect on the problem of sustainable, in a spatial and subjective time perspective, use of resources in the economy. This is a de facto process of continuous search for the appropriate economic system to achieve the social, economic and environmental goals of a socio-economic development path that can be considered globally, nationally or regionally. An increasingly restricting access to natural resources is in many cases a serious barrier to the achievement of these aims. It is therefore justified to use them rationally. Because of its inadequate over-exploitation it forces the search for new solutions, including the intensification of the use of renewable resources in production processes. One of the attempts to find the answer to this problem is the concept of bio-economy, based on raw materials produced on the basis of soil, water, air and biodiversity of plants and animals (Maciejczak, Hofreiter 2013).

The essence of bio-economy

Bio-economy as a new concept of development has come to many approaches depending on the scope of the concept, its main components or the expectations it should fulfil. In scientific considerations it is possible to see some ambiguity in the way of defining this term and at the same time the sector of economy with simultaneous multiple definitions. The literature on the subject emphasizes resource aspects (in this context it is assumed that it is production using biological resources) or process approach (use of biotechnology) (McCormick, Kautto, 2013, Ratajczak 2013, Chyłek, 2014). Considering the process of defining bio-economy, it is worth paying attention to its differentiation in the context of a micro, mezo and macro approach. In microeconomic terms, bio-economy includes the production of products and services related to living organisms. On the other hand, from the point of view of mezo-economics, bio-economy is the sector producing these products together with the regional production and consumption systems. A macroeconomic approach is a reference to economic structures and processes that sustainably, with the use of biological

processes and renewable resources, produce products and services that respond to the global challenges of energy, food, health security, in accordance with the principles of environment protection and restrictions concerning water, farmland and carbon dioxide emission (Adamowicz, 2014, p. 6). From a critical analysis of the literature of Mariusz Maciejczak and Karen Hofritter (2013), it can be stated that taking into account the different approaches, it can be stated that the basis for this term is the sustainable use of renewable biological resources by innovations derived from agronomy and environmental education. These resources in products that will satisfy both private and public expectations. A number of authors argue that bio-economy covers traditional sectors of the economy that using biotechnologies produce bio products and offer bio-services (Figure 1). The lack of clear and common terminology, mentioned earlier, results in a wide variety of interpretations by various actors. It is also becoming increasingly difficult to classify the sectors involved in bio-economy sector due to the European Statistical Classification of Economic Activities in the European Community (Typa, 2014, p. 33).

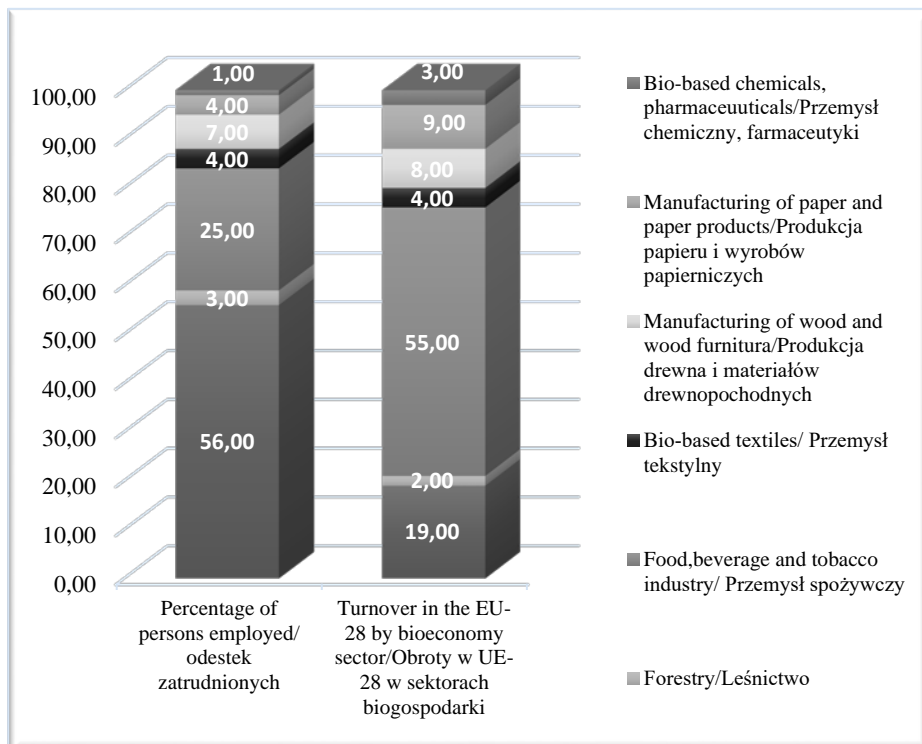
Figure 1. Diagram showing the effect of bio-economy on the traditional economy



Source: Gralak K. (2015). Biogospodarka jako obszar inteligentnej specjalizacji regionalnej. Polityki Europejskie, Finanse i Marketing 14(63), p. 65.

In Poland the bio-economy sector involves the entities of the national economy classified by sections and divisions of PKD 2007 into sections A-basic activities: agriculture (crop and animal husbandry), forestry, horticulture, fisheries and aquaculture, section C- industrial activity: food industry, wood-based industry, leather industry, textile industry, some chemical, pharmaceutical and biotechnology industries and part of the energy sector, section E-waste management section, section M-research and development. In 2013, according to the data indicated in the report published by BECOTEPS - „The Euro-pean Bio-economy in 2030 Delivering Sustainable Growth by address-ing the Grand Societal Challenges”, the total turnover in the EU's bio-economy sector amounts to 2.1 trillion euro annually (about 17% of total turnover). Half of the turnover was in the food and beverage sec-tor and 25% in the agriculture and forestry sectors. The employment in the bio-economy sector reached 18,3 million employees. More than 50% of employees work mainly in agriculture, forestry and fisheries (Figure 2). In Poland, these values are estimated at around 411 billion PLN of total turnover and almost 3,2 million places of labour (Ratajczak, 2013).

Figure 2. Turnover by bio-economy sector and percentage of persons employed in the EU-28



Source: Own study based on: Ronzon, T., Santini, F. and M'Barek, R. (2015). The Bio-economy in the European Union in numbers. Facts and figures on biomass, turnover and employment. European Commission, Joint Research Centre, Institute for Prospective Technological Studies, Spain, p.4

It can therefore be concluded that the agriculture and food industry that emerge as smart specializations in the Polish regions are key sectors of the bio-economy both in the EU countries and in Poland. The agricultural sector, seen as a producer of food and non-food goods, is by nature a place to continually seek compromises between sustainable exploitation of the environment and the provision of adequate levels of society feeding (Pajewski, 2014, p. 41). Among the important determinants of the development of bio-economy for the agricultural sector is the endogenous potential of the regions (Bogdan et al., 2014). The authors will later point to the links between bio-economy and its spatial embedding. In addition to globalization, local, regional determinants of economic development are important.

Methodology of the research

The aim of the paper was to present the development of the bio-economy in the agricultural sector in Poland taking into account regional conditions. In order to determine the impact of selected economic, social and environmental factors on bio-economy in agricultural, a fixed-effect regression model was applied, which assumes that individual effects are not accidental and can express specific and directly unobservable features in the region (Baltagi, 2003, p. 57).

The validity of the adopted model was examined through the Hausmann and Breusch-Pagan tests.

The panel model allows to evaluate the occurrence of differentiation of individual effects in regions, which may be important information in the analysis of the development of bio-economy in the agricultural sector in the regional space. The model included economic, social and ecological variables, which are cross-temporal data from GUS, BDL and GIJHAR-S. The time range covers the years 2005-2015. The analytical form of the model used was expressed by the following equation (Maddala, 2007, p. 66):

$$y_{it} = \alpha_i + \delta_t + \beta'x_{it} + \varepsilon_{it},$$

where:

i – index of an object (voivodeship),

t – period (year),

α_i - individual effect, fixed over time, different in space for individual voivodeships in the panel,

δ_t - constant periodic effect, having the same value for all units in the panel during the same period but different in each period,

β' - vector of coefficients of variables,

x_{it} - cross-sectional variables

For the explained variable, the area of certified organic farms was adopted, with four explanatory variables (expenditure in voivodeships on agriculture, GDP per capita, turnover of organic products' entities, marketing of organic products), which were selected on the basis of analysis of previously discussed literature and theoretical assumptions made (a set of potential explanatory variables) and then they were selected. As a result, the hypothetical form of the model adopted the formula:

Area of certified organic farms

$$= \alpha_0 + \alpha_1 \text{Expenditure of voivodeships on agriculture} \\ + \alpha_2 \text{GDP per capita} + \alpha_3 \text{Processing of organic products} \\ + \alpha_4 \text{Marketing of organic products} + \beta' DU + \lambda' DV,$$

where,

β - vector of zero-one variables for the individual effects of voivodeships
DU,

λ - vector of zero-one variables for time T.

The consistency of the model with fixed effects compared to the classical model was verified using the Wald test. The verified hypothesis assumes that all the free words introduced to the model are equal regardless of the object and time. The alternative solution is to omit the constant in the model and one of the effects set in time. In order to compare the model with random effects with the classical model, a Breusch-Pagan statistical test was used to verify the assumption about the constancy of the variance of the random component. LM statistics at the level of 172,799 and p equal of 1,81096e-039 dictated the rejection of the null hypothesis (using the MNK panel method) for the alternative that a more reasonable estimator is the estimator with random/fixed effects. The Hausman test was used to examine the accuracy of the choice between the fixed and random model, for which the null hypothesis means the validity of the model with random effects. Statistics H were 12,3844 at p value of 0,0886042, which allowed the null hypothesis to be rejected for the alternative, indicating that the model with the fixed effects was more appropriate.

Findings

The results of the MNK panel estimation using 93 observations in 16 cross-sections are presented in Table 2, and the model fit assessment and statistical tests are presented in Table 3.

Table 2. Estimation of model parameters

Independent variable	Coefficient	Standard error	t-Student	p-value	
const	-4,08832	1,55770	-2,625	0,0106	**
Expenditure of voivodeships on agriculture	0,156936	0,0583618	2,689	0,0089	***
GDP at current prices per capita	1,48640	0,405847	3,662	0,0005	***
Processing of ecological products and fodder and yeast production	0,158669	0,0663677	2,391	0,0194	**
Introducing organic products to the market (excluding imports from third countries)	0,119849	0,0286608	4,182	7,95e-05	***
Dolnośląskie	-0,366317	0,0467105	-7,8423	<0,0001	***
Kujawsko-pomorskie	-0,64324	0,0451688	-14,2408	<0,0001	***
Lubelskie	-0,109241	0,0844335	-1,2938	0,1998	
Łódzkie	-0,861594	0,0485888	-17,7324	<0,0001	***
Małopolskie	-0,476509	0,0539716	-8,8289	<0,0001	***
Mazowieckie	-0,662193	0,0950777	-6,9648	<0,0001	***
Opolskie	-1,03	0,0433971	-23,7343	<0,0001	***
Podkarpackie	-0,157583	0,0767236	-2,0539	0,0436	**
Podlaskie	0,139069	0,0458573	3,0326	0,0034	***
Pomorskie	-0,398272	0,0470769	-8,4600	<0,0001	***
Śląskie	-1,00719	0,0582918	-17,2783	<0,0001	***
Świętokrzyskie	-0,365229	0,0444132	-8,2234	<0,0001	***
Warmińsko-mazurskie	0,378596	0,051872	7,2987	<0,0001	***
Wielkopolskie	-0,419588	0,0621207	-6,7544	<0,0001	***
Zachodniopomorskie	0,312598	0,054161	5,7716	<0,0001	***

level of significance: * 0.1, ** 0.05, *** 0.01

Source: own study using GRET 2016d.

Table 3. Evaluation of matching and statistical tests.

The arithmetic mean of the de-	4,230596		Standard deviation of dependent variable	0,431823
--------------------------------	----------	--	--	----------

pendent variable			
Sum of residual squares	0,277365	Standard error of residues	0,062067
LSDV R-square	0,983832	Within R-square	0,979341
Logarithm of credibility	138,4372	Akaike information criterion	5,15e-15
Criterion of bayes. Schwarz	-181,6898	Hannan-Quinn criterion	-234,8743
Autocorrelation of residues - rho1	0,224560	Durbin-Watson statistics	1,143208

Source: own study based on GUS data and reports on the state of agriculture GI-JHAR using GRETL 2016d

In the model with fixed effects, analysed regressors, such as GDP per capita, expenditure of voivodeships on agriculture, marketing of organic products showed a significance level of 1%, while the introduction of organic products proved the significance level of 5%. The conducted analysis using the panel method with fixed effects allowed to point out that the socio-economic determinants significantly affect the development of the area of certified organic farms and have their regional character.

A significant increase in the area of organic farms was also driven by an increase in demand for organic food, expressed by the number of organic products and processed organic products. Fundamental importance on the demand side was attributed to the level of per capita income. Due to the higher cost of purchasing these products, only a change in wealth level allows to run increased demand for them. The changes in consumer incomes translate into consumption level and, consequently, changes in dietary style. This is a prerequisite for creating an adequate demand. Demand side factors were also the volume of turnover of entities from the processing of organic products and the marketing of organic products. The first refers to the creation, within the framework of bio-economy, a suitable base at voivodeship level to ensure the processing of agricultural products and to provide consumers with not only regional products from the sphere of bio-economy. It is necessary because of the complexity of the development of this sphere. On the other hand, the second of these factors refers to the activity of entities in that area. It is not just the existence of entities in the processing segment, but their innovative activity, understood as the ability to introduce new products to the market. The existence of such entities at this stage of development (dynamic growth phase) of this market is of particular importance.

On the supply side, the expenditure on agriculture broken down by particular voivodeship turned out to be significant. Turning farms into or-

ganic activities requires incurring suitable capital investments. However, due to low profitability of agricultural production, the external support is required in the form of financial transfers.

Obviously, due to the relatively short period and a small number of data, the obtained results should be treated with caution, although they are consistent with the expectations and conclusions of the theory (Kułyk, Kowalewicz 2016). Structural parameters for voivodeships are given in relation to the base voivodeship, which is the Lubuskie Voivodeship, showing a significance level of 1%. Negative values indicate a lower impact of organic farms in 13 voivodeships.

Conclusions

The conducted analysis showed that the development of the bio-economy sector in agriculture remains influenced by regional conditions. There is a clear disproportion in the specific voivodeships resulting from the location factor. The local character of agro-ecosystems was emphasized, with a different level of human intervention, because the used methods of agricultural production can promote or adversely affect the environment depending on the agricultural practices applied. The strong territorial and functional conditions of agriculture derive from its specific nature of use in the natural environment and its strong interaction with nature and the threats of civilization.

The development of organic farming is conditioned by the shaping of the agro-food processing area. It is important not only the size of this sector, but also at the current stage of development of the organic food market in Poland the ability to produce and market new products. It is a factor stimulating the creation and expansion of organic production in agriculture. This segment of bio-economy remains also under strong influence of sustainable economic improvement of households. This is a fundamental determinant creating domestic demand. Due to the expected GDP growth per capita, the growth in demand for organic products should be expected to continue in the immediate future. On the other hand, the necessary transformations in agricultural holdings, including the certification process, must be stimulated at this stage by transfers under the common agricultural policy.

References

- Adamowicz M. (2014). Europejska koncepcja biogospodarki i jej przełożenie na działania praktyczne. *Studia Ekonomiczne i Regionalne*, 7 (4), s. 5-21.
- Baltagi B. H. (2003), *Econometric Analysis of Panel Data*, John Wiley & Sons, LTD, England, s. 65–71

- Bartoszczuk P. (2014). Perspektywy rozwoju biogospodarki. *Zeszyty Naukowe Wyższej Szkoły Humanitas*. Zarządzanie 1, s. 357-364
- Buszko A. (2014). Pojęcie i zakres biogospodarki, W: H. Godlewska-Majkowska, A. Buszko (red.), *Uwarunkowania rozwoju biogospodarki na przykładzie województwa warmińsko-mazurskiego*, Warszawa: Oficyna Wydawnicza SGH
- Chyłek E. (2014). Strategiczny program Biostrateg i jego znaczenie dla realizacji celów biogospodarki, *Studia Ekonomiczne i Regionalne* 7 (4), s. 43-53.
- Górka K. (2014). Zasoby naturalne jako czynnik rozwoju społeczno-gospodarczego. *Gospodarka w Praktyce i Teorii*, 3 (36), s. 35-52.
- Gralak K. (2015). Biogospodarka jako obszar inteligentnej specjalizacji regionalnej. *Polityki Europejskie, Finanse i Marketing*, 14(63), s. 65-73
- Kułyk P., Kowalewicz A. (2016). Ocena poziomu oraz możliwości rozwoju rolnictwa ekologicznego w województwie lubuskim., *Roczniki Naukowe Stowarzyszenia Ekonomistów Rolnictwa i Agrobiznesu*, T. 18, z. 4, s. 151-156
- Maciejczak M., Hofreiter K. (2013). How to Define Bioeconomy?, *Roczniki Naukowe SERiA*, t. XV, z. 4, s. 245-246
- Maddala G.S. (2006). *Ekonometria*. Warszawa: Wydawnictwo Naukowe PWN
- McCormick K., Kautto N. (2013). The Bioeconomy in Europe: An Overview, *Sustainability*, No. 5, s. 2589-2608
- Pajewski T. (2014). Biogospodarka jako strategiczny element zrównoważonego rolnictwa, *Roczniki Naukowe SERiA*, XVI (5), s. 179-184
- Ratajczak E. (2013), Sektor leśno-drzewny w zielonej gospodarce, Wydawnictwo Instytutu Technologii Drewna, Poznań
- Stack, M., Gartland, M. (2003). Path Creation, Path Dependency, and Alternative Theories of the Firm. *Journal of Economic Issues*, Volume 37, Issue 2, pp. 487-494, DOI: <http://dx.doi.org/10.1080/00213624.2003.11506597>
- BECOTEPS (2013). The final White Paper THE EUROPEAN BIOECONOMY IN 2030 Delivering Sustainable Growth by addressing the Grand Societal Challenges, BECOTEPS - Bio-Economy Technology Platforms, February 2013, <http://www.plantetp.org/index.php/about/reportsonevents>, (18.01.2017)
- Typa M. (2014). Biogospodarka jako sektor gospodarki regionalnej. W: red. H. Godlewska-Majkowska, A. Buszko, *Uwarunkowania rozwoju biogospodarki na przykładzie województwa warmińsko-mazurskiego*,. Oficyna Wydawnicza SGH, Warszawa, s. 32-40
- Valéri V., Prins W., Nolte S., Van Huylenbroeck G. (2011). How to measure the size of a biobased economy, *Evidence from Flanders. Biomass and Bioenergy* 35, s. 4368-4375