ANNALS OF THE POLISH ASSOCIATION
OF AGRICULTURAL AND AGRIBUSINESS ECONOMISTS

Received: 01.09.2021
Acceptance: 14.09.2021
Published: 30.09.2021
JEL codes: Q12, D24, J24

Annals PAAAE • 2021 • Vol. XXIII • No. (3)

DOI: 10.5604/01.3001.0015.2695

TADEUSZ FILIPIAK, LUDWIK WICKI

Warsaw University of Life Sciences – SGGW, Poland

THE STRUCTURE OF PRODUCTION FACTORS IN FARMS AND THEIR PRODUCTIVITY. THE CASE OF VEGETABLE FARMS IN POLAND

Key words: input productivity, structure of production factors, factor substitution, technological change, vegetable farms

ABSTRACT. An increase in productivity in agriculture is achieved thanks to technological progress and changing the structure of production factors into more economically effective ones. The observed directions of changes include: production intensification and an increase in the capital-labour ratio. The aim of the presented research is to determine whether the level of production efficiency in vegetable farms depends on the structure of production factors involved in the farm. In this study, data from the Polish FADN for 2010-2017 were used. It was found that the productivity of inputs and profitability of production were at a similar level in each group of farms, while the profitability of work was the highest in farms with capital-intensive production techniques. It was 60% and 100% more, respectively, than in farms with land-intensive and labour-intensive techniques. On the basis of the obtained results, it can be concluded that an increase in the capital-labour ratio leads to a significant increase in labour productivity. In future, rational support for investments on farms may lead to an increase in the competitiveness of agriculture, as well as an increase in the scale of production and changes in the structure of agriculture.

INTRODUCTION

In world agriculture, the overall rate of productivity growth has slowed down after 2000, especially in developed countries, but the productivity of labour and land has continued to increase [Fuglie 2018]. One of the factors leading to a slowdown in growth is lower research spending, which translates into an ability to innovate through investments and technological changes [Fuglie et al. 2017]. Lack of or a significant slowdown in the productivity growth of employed resources leads to low competitiveness of agriculture in relation to other sectors and an abandonment of production on farms [Giannakis, Bruggeman 2018, Kavoosi-Kalashami, Motamed 2020].

Increase in resource productivity can not only be obtained by their better use, but also by substituting factors involved in agriculture and, as a result, changing the relationship between factors. In recent decades in developed countries, the increase in production resulted from technological progress, changes in the relationship between production factors, as well as changes in the level of inputs [Wicki 2021]. The introduction of progress in agriculture not only occurs through new technologies, but also through investments in new fixed assets, which usually leads to permanent changes in the relationship between work and other factors of production. The need to substitute labour with capital, where possible, also results from rising labour costs and the high share of labour costs in the costs of agricultural production [Ejimakor et al. 2017]. It was found that with a small scale of production, as in Polish agriculture, an increase in the capital to labour ratio in as much as 60% determines an increase in labour productivity and there is no other way to achieve growth than an increase in the capital-labour ratio [Kusz, Misiak 2017, Niezgoda et al. 2018, Gołaś 2019]. It was also confirmed that this opens up the still needed in Poland possibility of increasing farm size [Wójcik, Nowak 2012, Kołodziejczak 2015]. It is also indicated that subsidizing investments in farms aimed at modernization, e.g. under the CAP, significantly accelerates the achievement of higher productivity on farms [Kirchweger et al. 2015, Hlavsa et al. 2017]. Also for Polish agriculture, such a relationship between subsidies for investments and an increase in productivity in agriculture was confirmed [Kusz 2018]. In Polish agriculture, since 1995, much higher dynamics of fixed assets has also been observed, with the stabilization of labour resources and a decline in land resources [Wicki 2016].

In Polish agriculture, the productivity of production factors is several times lower than that observed in more developed EU countries [Jabłońska et al. 2017, Cyburt, Gałecka 2020]. In addition, as much as 16% of the professionally active population works in agriculture in Poland, which causes a very urgent need to find such directions for the development of agriculture that will lead to an economically effective improvement in the capital-labour ratio and in the land-labour ratio [Szuba-Barańska et al. 2019, Bereżnicka, Wicki 2021]. Higher labour productivity in agriculture can also be achieved at a higher education level of farmers [Nowak, Kijek 2016, Giannakis, Bruggeman 2018]. Ryszard Kata [2018] confirmed in his research that there is a gradual substitution of labour and land with capital in the scale of the entire Polish agriculture, and Piotr Bórawski et al. [2019] confirmed that a large increase in labour productivity resulting from the improvement of the capital-to-labour ratio has been observed for several years on farms focused on milk production in EU-13 countries. In order to obtain higher labour productivity, it is also necessary to increase the size of farms with given labour resources. On Polish farms with 25 ha of land per working person, labour productivity was twice as high as that observed on farms with 10 ha of land per working person [Wicki 2019]. Therefore, one of the areas of interest is the assessment of what combination of production factors in agriculture is the most effective in a given period and place, and what is the dynamics of change.

The analysis of agriculture development and the process of agricultural production intensification shows the existence of general regularities in terms of which the proportions of basic production factors (land, capital labour) change. Basic factors of production can be substituted, and the amount of production produced depends on the interaction of their quantity and quality. Over time, the effective combinations of factors tend to change due to technological progress.

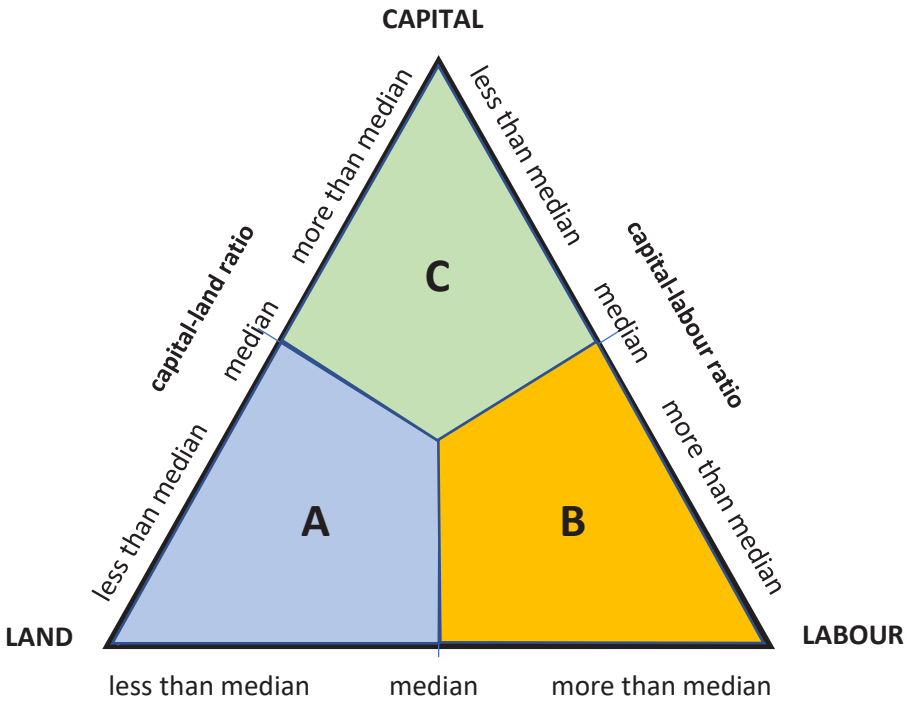
This study assesses the efficiency of farms engaged in vegetable production, which were characterized by a different structure of factors involved in production. Due to similar production technology, a group of farms representing one production direction (vegetable production) was selected for analysis. At a farm level, the optimal relations of production factors strongly depend on the direction of production and are different, for example, in farms producing cereals, and different in fruit-growing farms.

MATERIAL AND METHODS

The aim of the research was to determine whether the level of production efficiency in vegetable farms depends on the structure of production factors involved in the farm. The analysis covered a group of farms focused on the production of vegetables, participating continuously in the Polish FADN system in the period 2010-2017. This research period was adopted due to the fact that the data for the previous years are incomparable due to a change in accounting methodology. Source data came from the Polish FADN database.

A constant group of farms in the entire period was adopted for the analysis. These were those for which it was found that they had the same production technique throughout the analyzed period. Three basic production techniques were adopted: land-intensive, labour-intensive and capital-intensive, and on this basis farms were divided into three groups according to the dominant production technique defined by the relation of production factors. The group includes farms in which the relation of a given factor to other factors was higher than the median of these relations for the researched group of farms (Figure 1). It should be noted that the above division applies to a situation where a given factor is the dominant production factor in relation to the other two. It should not be related to the intensity of the use of a given factor. From a group of 102 farms, three separate subgroups with a dominant technique were obtained: group A – land-intensive (29 entities), group B – labour-intensive (28 entities) and group C – capital-intensive (26 entities). 19 farms were excluded from the analysis because in the analyzed period they were classified into different subgroups in the following years.

For selected groups of farms, the following were determined: input productivity (P/TC) (where P is total production and TC is total costs), the ability to generate gross value added (GVA/P), as well as the ability to generate income from work (Income/AWU). All data



A – farm with a land-intensive production technique
B – farm with a labour-intensive production technique
C – farm with a capital-intensive production technique

Figure 1. Identification of groups of farms according to the relationship of production factors on a farm

Source: own study

are in PLN, only the annual work unit (AWU) was taken as the number of workers. The level and dynamics of indicators were determined, which shows the relative advantages between the groups and changes over time. This made it possible to indicate the most effective technique in terms of a given indicator.

In the study, the methods of descriptive statistics were used, and the techniques of linear and exponential regression analysis were used to describe the dynamics.

CHARACTERISTICS OF THE ANALYZED FARMS

Table 1 shows the resources of production factors in the period 2010-2017 in farms separated due to dominant production technique. The largest area of agricultural land was characteristic for farms included in groups A and C. In both groups, it was about 25 ha with some changes over time. Farms from group B – with a labour-intensive production technique were much smaller, on average about 6 ha. The number of persons working per farm was the lowest in farms with land-intensive production techniques, in other groups it was almost twice as much. With regard to capital equipment, farms with capital-intensive techniques had over four times more capital than in farms from other groups. It is worth emphasizing that only farms from group C were characterized by an increase in the resources of all production factors, including labour by 24% and capital by 42% (23% in real constant prices). In the remaining groups, no significant changes in the amount of resources were observed.

Table 1. Production factor resources in the analyzed groups of vegetable farms in 2010-2017

Year	Land [ha]			Labour [AWU]			Capital (nominal prices) [thousand PLN]		
	resources in groups								
	A	B	C	A	B	C	A	B	C
2010	23.6	5.7	22.7	2.1	3.6	3.5	1,219.9	959.5	3,401.4
2011	24.5	5.7	23.4	2.3	3.7	3.5	1,592.5	1,010.7	3,651.2
2012	25.8	5.8	23.6	2.2	3.6	3.7	1,224.1	938.1	3,909.9
2013	23.7	5.8	24.0	2.2	3.6	3.7	1,230.3	1,293.1	4,193.5
2014	23.3	5.8	24.3	2.0	3.4	4.3	1,207.9	895.4	4,458.8
2015	23.3	5.9	25.0	2.1	3.4	4.4	1,209.2	874.9	4,602.9
2016	23.7	6.1	25.0	2.1	3.4	4.3	1,230.7	879.9	4,771.9
2017	23.7	6.1	25.0	2.2	3.4	4.4	1,223.6	880.3	4,830.5
Annual growth rate [%]*	-0.6	0.9	1.4	-0.8	-1.3	3.7	-1.6	-2.2	5.2
Dynamics 2010 = 100	100.6	105.6	109.9	100.4	93.3	124.0	100.3	91.7	142.0
Annual growth **	-0.13	0.05	0.34	-0.02	-0.05	0.14	-22.0	-21.4	213.7

* Based on the exponential regression function

** Based on the linear regression function, A, B, C explanation as in Figure 1

Source: own calculation based on Polish FADN data

PRODUCTION EFFICIENCY IN VEGETABLE FARMS WITH DIFFERENT PRODUCTION TECHNIQUES

In the study, the productivity of inputs and factors of production was determined using categories of total production value, gross value added and farm income. In FADN accounting methodology, the gross value added category is calculated according to the formula in which the total production value is reduced by direct costs and general production costs. Depreciation and external factor costs (hired labour, interest and rentals) are not subtracted. The results obtained for groups of farms are presented in Table 2.

In terms of the productivity of inputs, the results observed in individual groups were similar and ranged from 1.2 to 1.6 in the following years. There were annual deviations, which result from the relation of prices in a given year. Vegetable production is more exposed to price risk than other agricultural sectors [Parlińska, Wicka 2019]. It is worth

Table 2. Productivity of inputs, production profitability and labour profitability in the researched vegetable farms in 2010-2017

Year	Productivity of inputs (P/TC)			Production profitability (GVA/P)			Labour profitability (Income/AWU) [PLN/AWU]		
	results for groups								
	A	B	C	A	B	C	A	B	C
2010	1.50	1.33	1.82	0.57	0.47	0.60	23,163	17,436	41,485
2011	1.60	1.51	1.39	0.57	0.54	0.48	23,022	11,753	34,754
2012	1.55	1.69	1.50	0.56	0.57	0.53	23,399	14,542	46,179
2013	1.46	1.45	1.38	0.51	0.51	0.48	26,233	20,739	36,462
2014	1.28	1.31	1.25	0.43	0.44	0.46	25,322	19,592	36,812
2015	1.52	1.38	1.33	0.52	0.48	0.50	27,534	21,293	43,795
2016	1.24	1.45	1.29	0.43	0.53	0.48	24,163	25,455	40,184
2017	1.25	1.35	1.27	0.44	0.48	0.46	24,266	21,493	40,447
Annual growth [%]*	-3.3	-1.0	-4.0	-4.2	-0.7	-2.3	1.2	7.6	0.5
Dynamics 2010 = 100	83.3	101.0	69.6	77.5	103.5	78.0	104.8	123.3	97.5
Annual growth **	-0.05	-0.02	-0.06	-0.02	0.00	-0.01	297	1,381	156

P – value of production, TC – total costs, GVA – gross value added, AWU – annual work unit
* Bsed on the exponential regression function
** Based on the linear regression function, A, B, C explanation as in Figure 1

Source: own calculations based on Polish FADN data

noting that the productivity index decreased in each group during the analyzed period. The strongest decline, by as much as 4% annually, was observed in the group of farms with a capital-intensive production technique, than in the group of farms with a land-consuming technique (3.3%). The obtained results indicate, on the one hand, a decrease in the profitability of vegetable production, and, on the other hand, no relative advantage for any of the production techniques adopted.

As in the case of input productivity, no significant differences were found between groups of farms in terms of production profitability. The GVA/P ratio was similar in all groups and was approximately 0.5. It should be noted, however, that the profitability of production decreased in all groups of farms, the most in the group with a land-intensive production technique – as much as 4.2% annually, and in farms with a capital-intensive production technique the decrease amounted to 2.3% annually. A stable level of production profitability was observed in farms from group B. On the basis of the available data, it is not possible to explain the reason for this situation, but it can be assumed that in this group of farms the share of means of production purchased from outside the farm was lower, and the share of labour in inputs was higher, so the impact of changes in the prices of means of production on the result was smaller.

The last of the compared indicators is labour profitability measured by income per working person. It is a very important indicator on the basis of which it can be assessed whether work on a farm can be attractive in relation to work outside agriculture. The highest labour profitability index was observed on farms with capital-intensive production techniques. It amounted to about PLN 40 thousand (ca. EUR 10 thousand) per working person and increased by 0.5% on an annual average. With inflation in this period at a level of about 2%, it means that the level of work profitability in this group of farms actually decreased by about 1.5% annually.

Much lower profitability of work was observed in other groups of farms (A and B). In group A it was about PLN 25 thousand per year, and in group B – PLN 21 thousand per year. In relation to the results in the group of farms with capital-intensive production techniques, it was 40% and 50% less, respectively. It is worth emphasizing that the dynamics of changes in the labour profitability index was the highest in the farms from group B, where it exceeded 7% per year, thus significantly above inflation.

A comparison of the obtained values shows that the productivity of inputs and the profitability of production were at a similar level in each of the separated groups of farms. This means that no advantage of any of the production techniques was revealed during the period considered. Very large differences were observed in terms of labour profitability. In farms with capital-intensive production techniques, labour profitability was about two times higher than in other groups. This means that an increase in the capital-to-land and capital-to-labour ratio in vegetable farms significantly contributes to obtaining higher labour productivity and higher income from work, and work in such farms may be competitive in relation to work outside agriculture.

CONCLUSIONS

Changes in the relationship between production factors used on farms resulting from changes in the level of inputs, introduction of progress and investments should lead to an increase in the productivity of factors involved, and, in particular, an increase in labour productivity is expected. The most important direction of change is the substitution of labour with capital. Numerous studies indicate that this is the main way to achieve an expected increase in productivity in agriculture as well as favorable changes in the scale of production, farm structure, production costs and competitiveness of agriculture as a workplace.

In the undertaken study, production efficiency in vegetable farms in Poland was analyzed depending on the relationship of the involved production factors. The study covered only one type of farming, because farms of different types are characterized by a different structure of involved production factors, and an effective combination of factors is also different.

The results of farms with land-intensive, labour-intensive and capital-intensive production techniques were analyzed separately. Regardless of the group, farms were characterized by a similar level of input productivity and production profitability. In relation to these indicators, the same direction of changes was also observed in all groups. These indicators worsened by 0.7% to 4% annually.

However, with regard to the labour profitability index, significant differences between groups were observed. The highest level of profitability was observed in the group of farms with a capital-intensive production technique. It was 60% higher in this group than that achieved in the group with a land-intensive production technique and over 100% higher than in the group with a capital-intensive production technique. An important observation is also that in each of the separated groups, an increase in the level of work profitability was observed. Average annual growth dynamics was from 0.5% in capital-intensive farms, to even 7.6% in farms with labour-intensive production techniques.

On the basis of the comparison made, it can be concluded that the most beneficial, from the perspective of farm efficiency is increasing the capital-to-land and capital-to-labour relations. This is because farms with capital-intensive production techniques were characterized by a similar productivity of inputs and profitability of production as in other groups of farms, and about twice as high profitability of work. Higher profitability may lead to a desired increase in the scale of production and a change in the area structure of farms in Poland.

The conducted analysis has several limitations. It should be pointed out here that the assessment was only made for one production type of farms and the fact that the research period covered only 8 years, which does not provide a basis for assessing the dynamics of changes in the long term. Possible further analyzes should first of all be extended to all major production types of farms.

BIBLIOGRAPHY

Bereżnicka Joanna, Wicki Ludwik. 2021. Do farm subsidies improve labour efficiency in farms in EU countries? *European Research Studies Journal* XXIV (2B): 925-937. DOI: 10.35808/ersj/2315.

Bórawski Piotr, Beata Kalinowska, Zdzisław Kochanowicz. 2019. Zróżnicowanie czynników produkcji w gospodarstwach rolnych specjalizujących się w chowie bydła mlecznego w regionach FADN w Polsce w latach 2006-2017 na tle UE13 (Differentiation of production factors in agricultural farms specializing in dairy cattle in FADN Regions in Poland in the Years 2006-2017 *vis-à-vis* the EU13). *Zeszyty Naukowe SGGW w Warszawie. Problemy Rolnictwa Światowego* XIX (3): 5-15. DOI: 10.22630/PRS.2019.19.3.41.

Cyburt Agnieszka, Agnieszka Gałecka. 2020. The Efficiency of Production Factors on Agricultural Farms of the Visegrad Group. *Scientific Journal of Warsaw University of Life Sciences – SGGW. European Policies, Finance and Marketing* 24 (73): 70-80. DOI: 22630/PEFIM.2020.24.73.28.

Ejimakor Godfrey, Obed Quaicoe, Fafanyo Asiseh. 2017. Agricultural factor use and substitution in the south-eastern United States. *Studies in Agricultural Economics* 119: 156-159. DOI: 10.7896/j.1715.

Filipiak Tadeusz. 2014. *Zmiany na rynku warzyw i w gospodarstwach warzywniczych w Polsce po integracji z Unią Europejską* (Changes on the vegetable market and vegetable farms in Poland after integration with the Community Union). Warszawa: Wydawnictwo SGGW.

Fuglie Keith. 2018. Is agricultural productivity slowing? *Global Food Security* 17: 73-83. DOI: 10.1016/j.gfs.2018.05.001.

Fuglie Keith, Matthew Clancy, Paul Heisey, James MacDonald. 2017. Research, productivity, and output growth in US agriculture. *Journal of Agricultural and Applied Economics* 49 (4): 514-554. DOI: 10.1017/aae.2017.13.

Giannakis Elias, Adriana Bruggeman. 2018. Exploring the labour productivity of agricultural systems across European regions: A multilevel approach. *Land Use Policy* 77: 94-106. DOI: 10.1016/j.landusepol.2018.05.037.

Gołaś Zbigniew. 2019. Przemiany i uwarunkowania wydajności pracy w rolnictwie Unii Europejskiej w latach 2005-2016 (Changes and Conditions of Labour Productivity in the Agriculture of the European Union in the Years 2005-2016). *Roczniki Naukowe Ekonomii Rolnictwa i Rozwoju Obszarów Wiejskich* 106 (1): 22-35. DOI: 10.22630/RNR.2019.106.1.2.

Hlavsa Tomáš, Martin Hruška, Edita Turková. 2017. The impact of investment support from the Rural Development Programme of the Czech Republic for 2007-2013 on the economic efficiency of farms. *Studies in Agricultural Economics* 119: 11-17. DOI: 10.7896/j.1014.

Jabłońska Lilianna, Lidia Gunerka, Tadeusz Filipiak. 2017. Efektywność ekonomiczna gospodarstw ogrodniczych w wybranych krajach Unii Europejskiej (The economic efficiency of horticultural crops in selected European Union countries). *Roczniki Naukowe Stowarzyszenia Ekonomistów Rolnictwa i Agrobiznesu* XIX (2): 77-82.

Kata Ryszard. 2018. Agricultural productivity in Poland in The context of structural changes in the sector in 2002-2016. *Economic Sciences for Agribusiness and Rural Economy* 2: 109-115. DOI: 10.22630/ESARE.2018.2.13.

Kavoosi-Kalashami Mohammad, Mohammad Karim Motamed. 2020. Productivity analysis of sericulture in Northern Iran. *Studies in Agricultural Economics* 122: 44-50. DOI: 10.7896/j.2004.

Kirchweger Stefan, Jochen Kantelhardt, Friedrich Leisch. 2015: Impacts of the government-supported investments on the economic farm performance in Austria. *Agricultural Economics – Czech* 61 (8): 343-355. DOI: 10.17221/250/2014-AGRICECON.

Kołodziejczak Małgorzata. 2015. Efektywność wykorzystania czynników produkcji w rolnictwie polskim na tle Unii Europejskiej (Efficiency of production factors in agriculture of Poland and European Union). *Wieś i Rolnictwo* 2: 169-192.

Kusz Dariusz. 2018. Level of investment expenditure versus changes in technical labour equipment and labour efficiency in agriculture in Poland. *Economic Sciences for Agribusiness and Rural Economy* 1: 315-320. DOI: 10.22630/ESARE.2018.1.44.

Kusz Dariusz, Tomasz Misiak. 2017. Wpływ technicznego uzbrojenia pracy i postępu technicznego na wydajność pracy w rolnictwie (Influence of work technical equipment and technical progress on labour efficiency in agriculture). *Roczniki Naukowe SERiA* XIX (2): 145-150. DOI: 10.5604/01.3001.0010.1177.

Niezgoda Dionizy, Anna Nowak, Ewa Wójcik. 2018. Efektywność substytucji pracy strumieniem kapitału w towarowych gospodarstwach rolnych o różnym potencjale produkcyjnym (The effectiveness of substituting capital stream for human labour in commercial farms with different production potential). *Roczniki Naukowe SERiA* XX (3): 114-119. DOI: 10.5604/01.3001.0012.1504.

Nowak Anna, Tomasz Kijek. 2016. The effect of human capital on labour productivity of farms in Poland. *Studies in Agricultural Economics* 118: 16-21. DOI: 10.7896/j.1606.

Parlińska Agnieszka, Aleksandra Wicka. 2019. Evaluation of subsidized crop insurance in Poland. *Annals PAAAE* XXI (3): 502-511. DOI: 10.5604/01.3001.0013.2822.

Szuba-Barańska Ewelina, Aldona Mróczyńska-Kamińska, Walenty Poczta. 2019. Labor resources in agribusiness in Central-Eastern Europe. *Journal of Agribusiness and Rural Development* 2 (52): 179-187. DOI: 10.17306/J.JARD.2019.01114.

Wicki Ludwik. 2016. Zmiany produktywności czynników wytwórczych w polskim rolnictwie (Changes in factor productivity in Polish agriculture). *Zeszyty Naukowe SGGW w Warszawie. Ekonomika i Organizacja Gospodarki Żywnościowej* 116: 149-160. DOI: 10.22630/EIOGZ.2016.116.52.

Wicki Ludwik. 2019. Size vs effectiveness of agricultural farms. *Annals PAAAE* XXI (2): 285-296. DOI: 10.5604/01.3001.0013.2212.

Wicki Ludwik. 2021. The role of technological progress in agricultural output growth in the NMS Upon European Union Accession. *Annals PAAAE* XXIII (1): 82-96. DOI: 10.5604/01.3001.0014.7880.

Wójcik Ewa, Anna Nowak. 2012. Analiza substytucji pracy ludzkiej kapitałem w towarowych gospodarstwach rolnych w pierwszych latach członkostwa Polski w UE (An analysis of labor substitution with capital rural producers farms during first years of EU accession by Poland). *Zeszyty Naukowe SGGW w Warszawie. Polityki Europejskie, Finanse i Marketing* 8 (57): 505-517.

***

PRODUKTYWNOŚĆ W GOSPODARSTWACH WARZYWNICZYCH O RÓŻNEJ STRUKTURZE CZYNNIKÓW PRODUKCJI

Słowa kluczowe: produktywność nakładów, struktura czynników produkcji, substytucja czynników, zmiana technologiczna, gospodarstwa warzywnicze

ABSTRAKT

Wzrost produktywności w rolnictwie uzyskiwany jest dzięki postępowi technicznemu oraz zmianie struktury nakładów na bardziej efektywną ekonomicznie. Obserwowane kierunki zmian to, między innymi, intensyfikacja produkcji oraz wzrost uzbrojenia pracy kapitałem. Celem badań było ustalenie, czy poziom efektywności produkcji w gospodarstwach warzywniczych zależy od struktury czynników produkcji zaangażowanych w gospodarstwie. Wykorzystano dane z Polskiego FADN za lata 2010-2017. Stwierdzono, że produktywność nakładów i dochodowość produkcji były na podobnym poziomie w każdej grupie gospodarstw, natomiast dochodowość pracy była najwyższa w gospodarstwach o kapitałochłonnej technice wytwórczej. Było to 60% i 100% więcej niż odpowiednio w gospodarstwach z techniką ziemiochłonną i pracochłonną. Na podstawie uzyskanych wyników można też stwierdzić, że wzrost uzbrojenia pracy kapitałem prowadzi do znacznego wzrostu produktywności pracy. Racjonalne wspieranie inwestycji w gospodarstwach rolnych może prowadzić do wzrostu konkurencyjności, a pośrednio do wzrostu skali produkcji i zmian struktury rolnictwa.

AUTHORS

TADEUSZ FILIPIAK PHD

ORCID: 0000-0002-9397-7595
Warsaw University of Life Sciences – SGGW
Institute of Economics and Finance
166 Nowoursynowska St., 02-787 Warsaw, Poland
e-mail: tadeusz_filipiak@sggw.edu.pl

LUDWIK WICKI, DR HAB. PROF. WULS

ORCID: 0000-0002-7602-8902
Warsaw University of Life Sciences – SGGW
Institute of Economics and Finance
166 Nowoursynowska St., 02-787 Warsaw, Poland
e-mail: ludwik_wicki@sggw.edu.pl