

Reviews – Polemics

BOGDAN KLEPACKI

Marcin Wysokiński:
**ECONOMIC CONDITIONS FOR ENERGY MANAGEMENT
IN AGRICULTURE**

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Today, we are becoming more and more aware of the importance of energy in the economic development of individual sectors, units and people. One of the sections of national economy that plays an important role and may potentially be significant in the future energy sector is agriculture. In this field, a monograph by Marcin Wysokiński entitled *Economic conditions for energy management in agriculture* was published in 2019. This is a paper in which the author undertakes the issue of economic and energy efficiency of energy management in agriculture and its conditions.

The undertaken research issue is extremely important and up-to-date. The author deals with this issue, which plays and will particularly play an important role in the scale of the whole national economy of Poland and the world's economy. The author is well prepared for making an attempt to draw up a synthesis of this issue, as he has consistently conducted studies in this field and is a specialist in both energy issues and the development of agriculture and agricultural production. Therefore, the monograph is a kind of a synthesis, a summary of energy efficiency problems, with a particular consideration given to the place and role of agricultural economy.

The monograph begins with an introduction in which the author substantiates the fact of undertaking the analysed issue, indicates the most important aspects of the study and its potential usefulness. The author dedicated chapter one to the presentation of research

goals, hypotheses and methodologies. As a major objective, he considered the identification of factors differentiating the economic and energy efficiency in agriculture and the measurement of its level depending on the type and scale of production.

In chapter two, the author presented the issue of natural resource management in theoretical terms. He discussed the definitions of resources, including natural resources, presented models of their classification proposed by many authors, representatives of various economic trends. What should be highlighted is a review of opinions on economic growth and on the common goods economics in the conditions of limited resources. The author states here that the common good is not only a resource, but also a social relation associated with its management. The perception of natural resources as common goods can be a development of theory of common goods economics. He proves that natural resources cannot be excluded from consumption, they are essential to modern humanity and determine its development.

The author dedicated chapter three to the economics of sustainable development in natural resource management. He presented the problem areas and criteria used in this economics as well as a pyramid of sustainable development. He discussed various concepts adopted in political and legal documents in historical terms. At this point, he highlighted the importance of natural resources in the economics of sustainable development. The chapter is complemented by a critical discussion of two issues, namely the relation of sustainable energy development and such development in agriculture with a reduction in natural resources. He identified Poland's energy targets and analysed changes in the renewable energy structure of the country in the years 2010-2017. He concluded that a key aspect in agriculture is the limitedness of environmental resources directly involved in the agricultural production process, as well as climate change and biodiversity affecting the efficiency of transforming inputs into agricultural products. The author stated that the issue of depleting non-renewable natural resources and depletion of many renewable resources is important for the development of civilisation. The economic development requires more and more energy, which, so far, has been provided at the lowest cost by energy minerals and raw materials necessary for production of useful products. Agriculture can make a significant contribution by optimising the consumption of resources subject to depletion and replacing such resources with renewable biomass production.

In chapter four, the author presented the efficiency of management in the theory of economics. As partial problems, he presented the problem of management, its efficiency in theoretical terms, as well as methods of measuring this efficiency. He concluded that, in the context of allocation efficiency, treating energy as a limited resource had significant economic consequences. We can talk, in fact, about the energy efficiency or economic and energy efficiency as a notion related to the efficiency of using energy as a resource. Thus, the monograph is an extension of the theory of energy efficiency as an element of economic efficiency.

The author also presented methods to measure the efficiency such as synthetic efficiency indicators: ranking, unitarisation, aggregate indicator or development pattern indicator. He also discussed methods based on efficiency curves, with identification of parametric and non-parametric approaches, including SFA (Stochastic Frontier Approach), TFA (Thick Frontier Approach) and DFA (Distribution Free Approach), as well as the Balanced Scorecard or Performance Prism. He reviewed the methods to measure

the economic efficiency proposed by various authors, including those involved in agriculture. He concludes with an overview of results of selected studies on the energy management efficiency.

The author pays particular attention to analysing accumulated material and energy inputs for the agricultural production. He points to a need to aggregate (accumulate) material and energy inputs incurred for the agricultural production using appropriate conversion rates and rolling costs, while taking into account direct energy carriers, consumable fixed assets and materials for their repair, mineral fertilisers and other agrochemicals, consumed agricultural raw materials of plant and animal origin, as well as labour of humans and animals (horses). He also mentions and analyses the pattern of links among basic paradigms of energy and technological analysis of food economy systems (ENTASGŻ) developed by T. Nowacki.

Chapter five deals with the issue of importance of energy in the economy. The author discussed in detail the history of energy and energy industry. Other issues undertaken are sources, production and consumption of energy. The author presented here a lot of information about the level of reserves, extraction, resources of crude oil, natural gas, coal in various countries and regions of the world. The information is interesting, maybe a bit too detailed.

In chapter six, the author discussed the use of energy in agriculture. At the beginning, he presented the importance of agriculture in the national economy. What matters here is the author's conclusion that the energy potential of Polish agriculture is not fully tapped. Agriculture will play an important role in achieving renewable energy targets. Energy raw materials can be processed in rural areas and used at the place of their emergence. Energy in agriculture is a strategic problem affecting energy, food and environmental security as well as the functioning of the economy and living conditions of all rural residents. Thanks to possibilities of obtaining energy from agricultural production and its importance in energy security, a new sector of agriculture, known as energy agriculture, is developing very dynamically.

Another issue is energy in agriculture. Here, the author presents, in historical terms, how the role of various sources of energy used in agriculture (except for solar energy itself) has evolved. He also discusses the reasons for the increased energy intensity of agricultural production. He points out that along with the socio-economic development, agriculture has shifted to more and more energy-intensive production technologies. Modern agriculture is dependent on industrial energy sources. The high level of mechanisation, production technologies based on industrial production factors such as fertilisers, plant protection products and feed, the need to keep high levels of production results necessitate the use of external energy sources. At the same time, agricultural raw materials used for producing biofuels compete with food raw materials produced in the world. This applies, in particular, to maize, rapeseed and sugar cane. The author stresses that biofuels are the largest source of growth in the cultivation area of cereals and oilseeds.

An important part of the study is the analysis carried out as part of subchapter concerning the economic and energy efficiency of Polish agriculture against a background of selected EU countries, as well as depending on the type and scale of production. In addition to providing "raw" source data, the author uses for analysis the Global Relative Economic Efficiency Index (GWWE) which allows to determine the agricultural

efficiency when compared to the efficiency of the whole national economy. On this basis, he concludes that gross value added per tonne of equivalent oil, achieved by EU agriculture, was lower by 25% than the EU economy as a whole. This index has even deteriorated, which means that the agricultural efficiency, when compared to the economy as a whole, is decreasing.

To determine the economic efficiency of agriculture in various countries, the author used the DEA method – an input-oriented CCR model. He stated that the average technical efficiency of agriculture in the EU was quite high and that agriculture in five of 24 analysed countries was fully efficient. Based on the DEA method, he identified optimal technologies and efficiency patterns (benchmarks). On this basis, he determined a combination of technologies to achieve the same results with smaller inputs. He concluded that Polish agriculture would be efficient if it involved 83% fewer workers, its area of UAA was smaller by 73% and the energy consumption was lower by 74%. These conclusions are innovative and there have never been such results in the Polish literature.

In his further studies, the author attempted to identify the impact of the national socio-economic development on the economic and energy efficiency of agriculture. To this end, he used three methods: Z. Hellwig's Taxonomic Measure of Development (TMR), HDI (Human Development Index), as well as GDP *per capita* (USD *per capita*). Based on these analyses, he concluded that in EU countries the economic and energy efficiency of agriculture was growing along with the socio-economic development. This is an important statement confirming the importance of economic development for better management of available energy sources.

One of the more important targets set in the studies was to seek factors differentiating the economic and energy efficiency in agriculture. The author dedicated two subchapters to this issue, the first of which concerns this differentiation depending on the type and scale of production. Using data from the Polish FADN (Farm Accountancy Data Network) for 2016, he made calculations for a total of 6,261 farms across Poland. The study objects have been classified as five agricultural types specialising in: cultivation of cereals, oilseeds and protein crops for seeds, pig rearing, dairy cattle rearing, slaughter cattle rearing and cultivation of fruit trees and shrubs. According to the FADN methodology, they were divided into three groups by economic size (small, medium and large). At the beginning, the author presented the characteristics of the farms analysed in terms of features likely to affect their energy and economic efficiency, such as the UAA, number of tractors, labour inputs, hiring of workers. He also presented the structure of assets, capital-land ratio and capital-labour ratio, as well as the economic performance of farms. An important part of this chapter is the analysis of energy costs and the structure of energy invested. The author stated that the largest share was that of mineral fertilisers, direct energy carriers (motor fuels and lubricating oils, electricity, heating fuels) and machinery and equipment. Energy inputs accumulated in buildings and energy of labour were relatively low. There were some differences between farm types. For example, mineral fertilisers had the highest share on cereal farms, direct energy carriers – on fruit farms, etc.

One of the most important objectives of the studies was to calculate the EROI ratio, i.e. the energy return on energy invested ratio. The ratio should be above one, which means that more energy has been generated than incurred in a form of inputs. It turned out that

only the production of cereals and pigs showed a surplus regardless of the scale of production. Dairy farms had the most favourable EROI ratio, with the biggest losses suffered in the production of slaughter cattle and fruit. Here, it is important to make a general conclusion that the EROI ratio decreases as the production scale increases, which results from the lower increase in energy when compared to growing energy inputs (mineral fertilisers, machinery and equipment on farms with the larger production scale).

An essential place in the monograph is taken by the analysis of economic and energy efficiency determined using the methodology proposed by the author. As a result of the calculations, he stated that: “by far, the highest ratio was achieved by farms specialised in the production of cereals (...). The result above zero was also achieved by pig producers and the smallest dairy farms.” This finding is not much highlighted, but it should be used in formulating conclusions from the whole studies.

The second approach with regard to studies on factors differentiating the economic and energy efficiency in agriculture is related to the use of linear regression models for each farm type, where the endogenous variable is the economic and energy efficiency determined according to the proposed WEE index. 15 exogenous variables were adopted and stepwise regression was used. The author presented five models, from which it appears that the set of exogenous variables is very diverse and different, virtually, in every farm type.

The last substantive part of the study is the *Summary and conclusions*. It is composed of two parts; in addition to general statements, the author presented conclusions that can be grouped into several problems regarding energy prices and their impact on food prices, economic and energy efficiency in agriculture, development and economic and energy efficiency, agricultural efficiency, level and structure of energy inputs and farm efficiency.

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