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CLIMATE-SMART AGRICULTURE – THE POSSIBILITY OF INTERNALIZATION OF EXTERNAL EFFECTS IN AGRICULTURE

Key words: climate-smart agriculture, external effects, agriculture

ABSTRACT. The aim of the research was to characterize a new concept conducive to the internalization of external effects – *climate-smart agriculture* (CSA). The problem of environmental externalities appearing as a result of agricultural production was taken up. Agricultural production is a complex process which produces diverse products. The range of goods and services offered by agricultural producers goes beyond the limits defined by the market. What is especially important, in this case, is the environment--agriculture relationship, because the environmental impact can result in changes in the quantity and quality of many environmental public goods, the consumption of which is of great interest to society. Considerations have a review character and had to indicate the validity of the implementation of solutions in CSA promoted in the context of the negative impact of agriculture on the environment. It was found that the implementation of CSA assumptions may contribute to eliminating negative stimuli of agricultural origin and limiting social benefits from the consumption of many environmental public goods.

INTRODUCTION

The development of civilization makes business processes pose a growing threat to the environment. The proper management of natural resources, so that future generations can use it, is a necessity and responsibility of present generations. Agriculture has an impact on the natural environment through activities related to plant and animal production. Farmer decisions regarding the structure of arable land, cultivation techniques and tools, stocking density and fertilizer management, etc., affect the quality of the natural environment and their effects, both in the short and long term, also affect the quality and availability of a range of public goods consumed by society. The subject of the study was to present the concept of Climate-Smart Agriculture in the context of reducing pressure on the environment by reducing negative externalities generated by agriculture.

MATERIAL AND METHODS OF RESEARCH

The paper discusses the possibility of solving problems related to the appearance of environmental externalities in agriculture. It has been assumed that agriculture can simultaneously affect other market entities both positively and negatively by impacting the natural environment. An analysis of literature sources was used to present the principles of a new concept enabling the internalisation of external costs/benefits to the perpetrator's account. The analysis of literature sources was used to indicate the possibility of solving the problem of external effects of agricultural origin based on the modern concept of Climate-Smart Agriculture. The role of the state in the development of the CSA idea in Poland is also presented in this paper, and the possibilities of supporting farmers in taking action that could contribute to reducing pressure on the natural environment were indicated.

EXTERNAL EFFECTS GENERATED BY AGRICULTURE

The OECD report characterizes areas of the environment exposed to the negative effects of inappropriate activities related to agricultural production. It was found that pressure on the natural environment may relate to:

– the quality of natural resources, mainly the physical, biological and chemical states of air, soil and water;
– the composition and functioning of terrestrial, aquatic and marine ecosystems, taking biodiversity and habitat quality into account;
– other environmental impacts, such as public odour nuisance from livestock buildings [OECD 2008].

The wide range of agriculture's impact on individual elements of the natural environment, from the quality of resources through the biodiversity of agricultural areas, at a genetic, population and ecosystem level, to the quality of environmental public goods consumed by society, gives a picture of the complexity of the phenomena of scientists dealing with issues of agricultural economics, agronomy, agricultural sciences and animal sciences, etc. Adam Harasim pointed out that pollution emitted by agriculture is an important element limiting social welfare especially in terms of public goods of an environmental nature [Harasim 2015a]. Such a position is also taken by Agnieszka Brelik, stressing the importance of environmental public goods provided to the public, next to typical agricultural production [Brelik 2011]. Similar views on the impact of agriculture on the environment, in the context of the quality of public goods, can be found in the works of authors, including Henryk Runowski [2000], Adam Harasim [2015b], Barbara Gołębiewska and others [2016] and Agnieszka Brelik [2016].

Agricultural activities also cause positive externalities desired by society, which, according to Joseph Stiglitz, include benefits provided to others, for whom the operating entity does not receive direct remuneration [Stiglitz 2004]. Tomasz Pajewski and Barbara Gołębiewska write about the beneficial and undesirable effects of agricultural activities from the perspective of the multifunctionality of various agricultural systems. According to them, "Production carried out in various agricultural systems causes a depletion of resources or their devastation, e.g. soil erosion, which leads to costs. At the same time, the processes

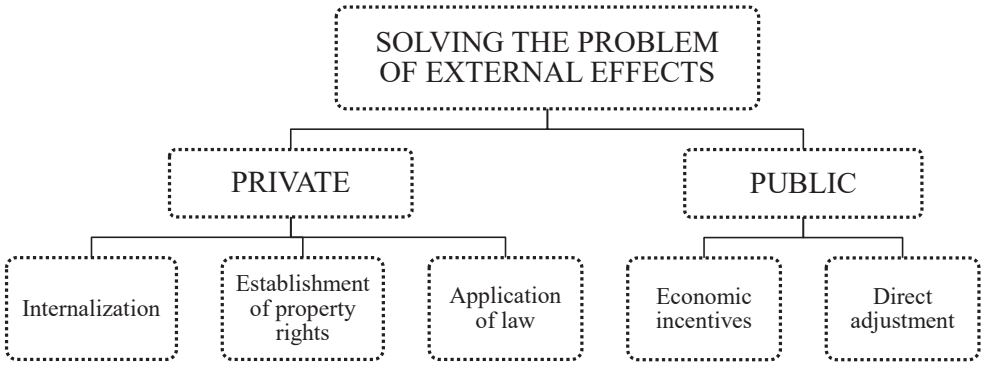

Figure 1. Ways of solving the problem of externalities
Source: own study based on [Stiglitz 2004, p. 257-291]

occurring in agricultural activities lead to the absorption of carbon by the soil, contribute to the creation of public goods, by mediating climate change, and private goods, by improving the state of soil. Similarly, a system that protects beneficial animal species on a farm (e.g. pest control) contributes to biodiversity. The multifunctionality of agriculture indicates that it can also perform positive functions other than food production, many of which cannot be produced by other sectors of the economy" [Pajewski, Gołębiewska 2018, p. 25]. According to Jodeph Stiglitz, the possibilities of solving problems arising from the appearance of externalities can be divided into two main groups: private and public (Figure 1).

The basic instrument among private solutions contributing to reducing the negative impact of an external effect is its internalization. According to Bogusław Fiedor, internalisation should be called typing external costs in the costings of the perpetrator [Fiedor 1990]. This would mean that the pollutant emitter would bear the total costs (private and social) associated with production externally affecting other entities. It would, however, draw attention to the positive effects of the activity, including agriculture, that are not valued by manufacturers and confer an advantage to society. Speaking of internalising external effects, attention should also be paid to external benefits associated with production. Such a holistic view of the problem of external effects is particularly important in the case of agriculture. We have a situation in which farmers produce food, thus fulfilling its primary role in relation to society. In the production process, various types of events may occur which limit or positively affect the possibilities of public consumption of public goods. The reference is i.a. water quality, circulation, soil, biodiversity and landscape quality. Therefore, in the case of the internalisation of externalities in the account of the perpetrator, adjusting the cost function with a balance of externalities, i.e. benefits minus social costs, should be included.

The establishment of property rights and the application of law are other methods of solving problems of external effects mentioned by Joseph Stiglitz. The problem of defining and respecting property rights was also raised by Hal R.Varian, saying that "Practical problems with externalities appear mainly because of poorly defined property rights" [Varian 2002, p. 595]. According to him –without well-defined property rights, exchanges of goods between entities will not lead to an efficient allocation of resources.

External effects, generated in an effective solution, will depend on the method of attributing property rights and the precise and observed legal rules governing the principles of private property. Clearly defined rules of functioning of entities on the market as well as rights and obligations resulting from the possessed property would give the possibility of fully internalizing costs and benefits arising during the production of goods and services. However, this is a very difficult task to realize due to the specific nature of goods.

Economic incentives and direct regulation are public methods of solving the problem of externalities. Economic incentives are to indicate the course of action for market entities in accordance with the principles of social efficiency, e.g. financial penalties for environmental damage may make issuers aware of the real amount of social costs associated with their activities, thus limiting the tendency to pollute the environment with impunity. The second group of measures are administrative provisions (direct regulations), which aim to directly limit the scale of negative externalities, e.g. emission standards.

CLIMATE-SMART AGRICULTURE

Agriculture secures the basic needs of the population, which is why the protection of this sector should be of particular interest to the state, especially in terms of food safety and food security. The development of science and new technologies significantly increases the efficiency of agricultural production, but nothing can replace dependence on agricultural land [Nersh, Munaswamy 2019]. As stated by Eugeniusz Otoliński and Witold Wielicki, agriculture and the countryside concern more than just food production and non-food products, it is a natural environment, a landscape, a place of living and working, a place of rest, a place of current and future housing; these are natural resources as well as industrial and service investments [Otoliński, Wielicki 2003].

The concept of ecosystem services includes more functions than supplying food production. Regulatory, support and cultural services can also be mentioned. The approach to environmental issues, from the point of view of ecosystem services, serves the rationalization of the use of environmental resource processes by humans [Mizgajski, Stępniewska 2009]. The classification of ecosystem services is presented in Figure 2.

Currently, Climate-Smart Agriculture (CSA) is a very interesting concept promoted in the world. According to the FAO report, this is an innovative approach to agricultural production focused on the farmer-producer. Action being undertaken aims at seeking ways to increase farmer productivity and income with the simultaneous implementation of climate change adaptation solutions [Scherr at. al. 2012]. The CSA concept also assumes the development of agriculture based on technologies that reduce greenhouse gas (GHG) emissions. The importance of farm heterogeneity is also emphasized, and therefore the need to look for individual solutions for farmers [FAO 2018].

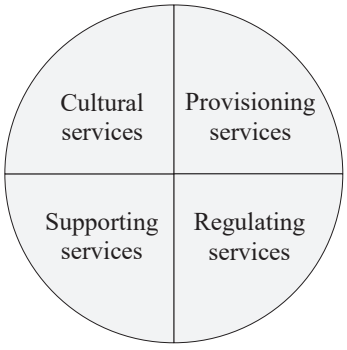

Figure 2. Ecosystem services

Source: own study based on [Mizgajski, Stępniewska 2009]

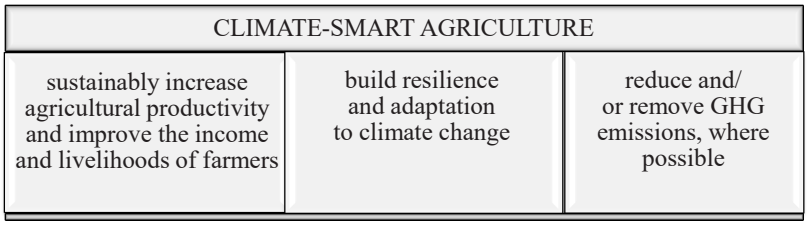

Figure 3. The concept of Climate-Smart Agriculture
Source: own study based on [FAO 2018, p. 3]

The CSA idea is based on three pillars (Figure 3), representing the improvement of the quality of life of agricultural producers, building strategies and solutions to increase the resistance of agricultural production to climate change and the implementation of solutions reducing GHG emissions from agriculture. The implementation of the assumptions presented on the three pillars is to lead to economic, social and environmental benefits – *triple wins*.

Amin and co-authors [2015] define Climate-Smart Agriculture (CSA) as sustainable in terms of efficiency and income growth, at the same time subject to adaptation processes to a rapidly changing climate in terms of crop resistance and reduction of greenhouse gas emissions. It is assumed that achieving greater efficiency while maintaining quality of environmental values is achieved by increasing the technical level and introducing innovation in agriculture, implementing an environmentally-friendly policy and increasing investment in environmental protection. According to FAO, the implementation of the CSA concept at a national, regional and local level will be key in the context of agricultural development and food security [FAO 2018].

To achieve the complexity of the CSA concept, many innovative activities are being introduced. They are associated with animal and plant production, land use, forest management and other fields related to the use of natural goods by agriculture. [Maciejczak at. al. 2018, p. 118-120]

In the report, the Inter-American Institute for Cooperation on Agriculture presented practices that may contribute to the development of the concept of CSA. Organic farming practices and permaculture are listed here as effectively using natural resources and increasing soil fertility and composition. It highlights the role of recycling grey water and shows the need to manage the landscape in the context of resource consumption efficiency. The need for reforestation of land was expressed. Attention was also devoted to the use of renewable energy and reducing the use of chemical plant protection products. An important issue was also minimizing greenhouse gas emissions and carbon sequestration in agriculture. The need to use modern technology to improve production and adaptation processes in agriculture has been associated with emerging signals of climate change, such as elevated temperatures, changes in rainfall patterns, an increase in flood frequency, long periods of drought in areas where such problems have not occurred before [ICCA 2016]. It should be emphasized that the implementation of the presented solutions should not have negative effects in terms of food security, since often less intensive agricultural activity is characterized by lower productivity.

CSA is not a typical conventional concept assuming the greening of agriculture leading to a reduction in the production volume and an increase in prices of products offered in exchange for the implementation of environmentally-friendly production techniques. CSA is also not a set of universal practices and tools or manufacturing techniques to protect the environment. It is an idea characterized by a triple-based approach (triple-wins) to identify existing production systems that can best respond to the effects of climate change. CSA's assumption is to look for suitable production systems to adapt to climate change and, if possible, reduce GHG emissions. It also assumes the possibility of regulatory bodies impacting the scale of responding to challenges related to climate change in specific locations. Particularly, due to the organization of financial resources at a local, national or international level, its aim is to contribute to the implementation of agricultural strategies that are easiest to adapt to specific climate conditions [FAO 2017].

Implementing the assumptions of Climate-Smart Agriculture may contribute to reducing negative environmental externalities arising as a result of agricultural production. By implementing innovative solutions in plant and animal production, contributing to a more precise use of production means related to, e.g. chemical plant protection, fertilization, monitoring of gas emissions such as methane, ammonia or carbon dioxide, animal nutrition etc., farmers, without losing income from production, can contribute to improving the quality of the environment. The implementation of pro-environmental innovation on farms is, in a sense, a form of internalisation of external effects in the cost account of the perpetrator according to the assumptions presented in Figure 1. The role of the state seems to be very important here, as it can support farmer decisions on investments in innovation through e.g. a reimbursement of a part of investment costs incurred, preferential loans or other solutions that fall within the group of public possibilities of solving problems resulting from the appearance of external effects. Actions taken by the state to promote solutions that fall under the CSA concept are twofold. Firstly, they bring about the internalisation of negative externalities into the perpetrator's account through investments made, while, on the other hand, the allocation of public funds to farmers also promotes the creation of positive externalities, which can be seen as compensation for the production of "better quality public goods".

SUMMARY

Reflections on externalities remain a very complex matter. The phenomenon in question plays a particularly important role in agriculture, where part of costs / benefits resulting from agricultural production is transferred to society without appropriate compensation. The complexity and specificity of agricultural production, with particular emphasis on its relationship with the natural environment, causes that, at the same time, both benefits and disadvantages arise that affect the level of social well-being, but remain outside market regulation.

The presented concept of Climate-Smart Agriculture is a new approach related to the search for alternative solutions to problems related to agricultural production. The triple-win assumption puts farmer income, care for the climate and social well-being at the same level. The innovative approach to the use of environmental resources on farms promoted here is aimed at the better use of production factors, associated with minimizing costs incurred and care for the quality of natural resources in the context of concern for future generations.

In addition, preference is given to an individual approach that matches the right solutions to a specific case – the farm. This gives a lot of flexibility in the selection of measures to achieve CSA objectives. The leading role in implementing CSA assumptions is played by the policies of countries that should be geared to supporting activities through various types of incentives inducing producers to implement innovative solutions in production processes The assumptions of Climate-Smart Agriculture allow to state that the implementation of appropriate innovative techniques in agricultural production will allow for the better internalization of external costs and benefits arising during agricultural production.

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CLIMATE-SMART AGRICULTURE – MOŻLIWOŚĆ INTERNALIZACJI EFEKTÓW ZEWNĘTRZNYCH W ROLNICTWIE

Słowa kluczowe: climate-smart agriculture, efekty zewnętrzne, rolnictwo

ABSTRAKT

Celem badań było scharakteryzowanie nowej koncepcji sprzyjającej internalizacji efektów zewnętrznych – *climate-smart agriculture* (CSA). Podjęto problem środowiskowych efektów zewnętrznych pojawiających się w wyniku produkcji rolnej. Produkcja rolnicza jest złożonym procesem, w wyniku którego powstają zróżnicowane produkty. Zakres dóbr i usług oferowanych przez producentów rolnych wykracza poza granice określane przez rynek. Szczególnie ważna jest tu relacja rolnictwo – środowisko, ponieważ to właśnie oddziaływanie na środowisko naturalne może skutkować zmianami w ilości i jakości wielu środowiskowych dóbr publicznych, których konsumpcją zainteresowane jest społeczeństwo. Rozważania miały charakter przeglądowy i miały na celu wskazanie zasadności implementacji rozwiązań promowanych w ramach CSA w kontekście negatywnego oddziaływania rolnictwa na środowisko naturalne. Stwierdzono, że realizacja założeń CSA może przyczynić się do niwelowania negatywnych bodźców pochodzenia rolniczego, ograniczających społeczne korzyści z konsumpcji wielu środowiskowych dóbr publicznych.

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