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Impacts of CAP “Greening” on Polish Farms

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Abstract

After a long debate between political bodies of the EU, the final decision about the shape of the CAP in the next programming period has been made. The initial proposal of the European Commission was very ambitious yet, after the announcement of its final version, there is a common belief that green requirements have been watered down. This paper presents the results of impact analysis based on the most recent proposition of CAP reform with a specific focus on “greening” of direct payments. It evaluates changes in the cropping structure and economic results of Polish farms from the perspective of the year 2020. For the analyses, the authors proposed an original farm typology using data taken from 10890 farms from FADN sampled in 2011. A farm optimization model with PMP technique was used to estimate potential effects of the reform for 218 types of Polish farms. The farm model results have been scaled-up to the country level. Results show that a majority of Polish farms are already complying with the new requirements. Adjustment of the remaining farms to the new requirements leads to only small changes in the cropping structure and has negligible impact on income generated by the Polish farm sector.

Keyword: greening, CAP, farm income, Shannon Index, Positive Mathematical Programming

Introduction

For over twenty years the Common Agricultural Policy (CAP) has been subject to successive reforms, which aimed to increase the market orientation of agriculture while additionally providing income support for farmers, increasing the requirements of environmental protection and taking action to accelerate the development of rural areas across the EU.

One of the most important changes in the CAP organization, which was introduced in earlier reforms, was a transition from product support to producer support with an assignment of existing direct payments to the agricultural area. This fundamental change in the philosophy of supporting farmers took place under the influence of external pressure, mainly from the WTO, because of the pursuit to eliminate distortions in international agricultural and food trade.

The current reform of the Common Agricultural Policy is the most difficult in the whole history of the EU and the final shape of the CAP reform has been reviewed by both the Council and the European Parliament. The CAP reform started in 2010 with a public debate, followed by the publication of the Commission's Communication (EC, 2010) which contained information about the vision for agriculture and the challenges and priorities for the future CAP in the new budgetary period. In June 2013 a political agreement on the reform of the CAP had been reached and finally in December 2013 the Council of EU Agriculture Ministers formally adopted the regulations for the reformed CAP.

The basic objectives of the CAP, presented in those documents are formulated as follows: viable food production, sustainable management of natural resources, climate action and balanced territorial development. In order to achieve these long-term objectives, the existing policy instruments had to be adjusted. Therefore, the reform of the CAP focuses mainly on operational objectives by providing effective policy measures designed to improve the competitiveness of the agricultural sector and its sustainability in the long term.

Contemporary challenges facing the agriculture sector and the CAP are driven by external factors (EC, 2010). They are defined as:

- economic (including food security and globalisation, a declining rate of productivity growth, price volatility, pressures on production costs due to high input prices and the deteriorating position of farmers in the food supply chain),

- environmental (relating to resource efficiency, soil and water quality and threats to habitats and biodiversity),
- territorial (where rural areas are faced with demographic, economic and social developments including depopulation and relocation of businesses).

Giving a high priority to environmental objectives of the reform introduced the various instruments, aiming to provide environmental benefits – this part of the reform is called “greening” of the CAP (Figure 1).

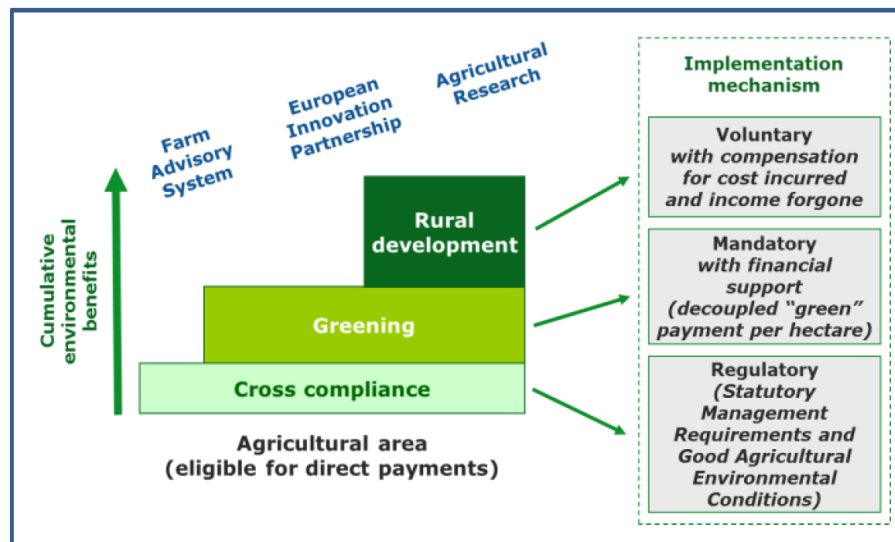


Figure 1. The new “greening” architecture of the CAP

Source: DG Agriculture and Rural Development

The main aim of this article is to determine the impact of finally implemented CAP reforms on the economic performance of Polish farms taking into account their production type and the degree of adaptation to the requirements of “greening”. In addition, the article presents changes of crop structure in Poland after the introduction of “greening”.

“Greening” of the CAP

The idea of “greening” the CAP has given rise to numerous controversies, mostly due to ambiguously defined objectives whose effects were difficult to estimate. Introduction of “greening” may affect the size and structure of crop production, and thus may cause changes in the level of agricultural income. This is due to the following basic requirements of “greening”:

- **CROP DIVERSIFICATION**, which set up the minimum number and share of crops in arable land area for the farm. The instrument is applicable depending on the size of arable land. On farms with more than 30 hectares of arable land at least three different crops shall be grown on that land. The share of the main crop should not exceed 75 % of arable land and the two main crops together must not exceed 95 % arable land. On farms covering between 10 and 30 hectares of arable land there shall be at least two different crops grown and the main crop shall not exceed 75 % arable land. Farms below 10 ha of arable land are excluded from the obligation of crop diversification. For the purpose of this requirement "Crop" is defined as a “culture of any of the different genera defined in the botanical classification of crops or culture of any of the species in the case of Brassicaceae, Solanaceae, and Cucurbitaceae or land lying fallow or grasses or other herbaceous forage” (EC, 2013). Winter crops and spring crops shall be considered to be distinct crops even if they belong to the same genus.

- MAINTAINING THE EXISTING AREAS OF PERMANENT GRASSLAND, with the right to reduce the area by not more than 5% compared to the base year;
- MAINTAINING AN ECOLOGICAL FOCUS AREA (EFA), which includes ecological land such as land left fallow, terraces, landscape features, buffer strips and afforested areas. The minimum area is set at 5% of arable land but, starting from 2018, may be increased to 7 %. The regulation provides also a “greening equivalency” system to acknowledge certain farming practices beneficial for the environment and the climate which can be considered equivalent to the EFA. Farm’s below 15 ha are excluded from this requirement.

In order to avoid penalizing those farmers that already farm in an environmentally-friendly manner a number of farms are excluded from fulfillment of the “greening” requirements: organic holdings, farms with significant areas of permanent grasslands or other herbaceous forage and fallow land, and finally farms North of the 62nd parallel.

For farmers not meeting “greening” requirements a penalty system is introduced. Those not meeting “greening” in 2015 and 2016 would lose 100% of the “greening” payment, which is 30% of the direct payment. In 2017 the maximum penalty would be 120% of “greening” payment, rising to 125% in 2018.

Impacts of the CAP post 2013 reform

There are so far only a few studies which have analysed the potential impacts of the CAP reform after 2013 on various environmental and economic aspects of agriculture. Since the final shape of the reform has been announced only very recently, the results of available studies refer to the original EC proposal of October 2011 (EC, 2011a).

Studies by Helming and Terluin (2011) and Van Zeijts et al. (2011) show that the reform will largely improve agricultural incomes in the new Member States, while in the EU15 they will remain almost unchanged. The combination of direct payments and environmental requirements will improve incomes in regions dominated by extensive agricultural production, for example with permanent pasture systems, and will worsen results in regions dominated by intensive agricultural production.

Matthews (2011) concluded, based on an analysis by Directory General Agriculture and Rural Development (EC 2011b), that the implementation of “greening” will cause an increase of production costs in the EU in the long run and a reduction in agricultural incomes in the short run. It is estimated that the cost of “greening” could reach 33 € per ha in 2020 as EFA will displace arable land, reduce agricultural supply, and trigger price increases for agricultural products. Matthews predicted significant price increases for wheat and sugar beet (3%), barley (12%) and live cattle. It is estimated, however, that the increase in prices and the expected increase in yields does not fully compensate for higher production costs, resulting in a decline in agricultural income by 2% on average (Matthews 2011).

Matthews (2012) analyzes the potential consequences of introducing elements of “greening” and presents a number of options for consideration by Member States whose introduction should improve the impact of “greening” on the environment and to reduce the administrative complexity of the new system, and thus improve cost efficiency by reducing the cost of implementation.

The potential impact of a greener CAP on developing countries has been the subject of studies by Nicola Cantore (2013). She points out that in the short term, the “greening” of the CAP will reduce production in the European Union, which may lead to increase in prices of agricultural products. This will stimulate exports from developing countries (up to 3% in regard to some countries and commodities), but at the same time hurt countries, which import food. In the medium and long term emission of CO₂ will be reduced as well as climate change damage in developing countries.

Other authors focus only on one of the “greening” components, which makes the EFA considered to have the greatest potential to solve environmental problems.

A study by Westhoek et al. (2011) focuses on the impact of the “greening” of the CAP on the environment alone. The authors conclude that the introduction of the obligation to diversify cropping patterns would not have a significant impact on improving the quality of the natural environment due to the fact that, according to the estimates, the need to comply with this requirement applies only to 2% of the arable area in the EU. According to these authors, only the introduction of EFA as a kind of compulsory setting-aside can help to increase biodiversity and reduce greenhouse gas emissions in the EU, while increasing emissions outside the EU.

The effects of the CAP reform were also analyzed by the authors of this article (Czekaj et al., 2011). In their previous work they presented the impact of the introduction of an earlier version of “greening” of the CAP on the financial situation of Polish farms. For Poland, the impact of “greening” was analysed with the use of a linear farm optimisation model based on a sample of farms selected from the FADN (Farm Accountancy Data Network) data base. The three requirements of “greening” - based on EC proposal (EC 2011a) - were investigated individually and jointly. The results showed that “greening” of the CAP leads to changes in the cropping structure especially in monoculture and duo-culture farms. The required diversification of the cropping structure and obligatory withdrawal of 7% of arable land to establish ecological focus area (EFA) results in a decline of farm incomes by 3.8% on average. Much greater losses of income are projected for monoculture farms with high quality soils compared to a baseline scenario which assumes the continuation of the current CAP (Wąs et al., 2012).

It should be emphasized that all the above mentioned studies refer to the out of date EC proposal from 2011. The recently adopted regulation mitigates requirements imposed on farmers and, most likely, reduces the negative impact of the reform on production and farm incomes.

Methodology

Agricultural farm model

To determine the potential effects of CAP changes, the Farm – Opty optimization model expanded with a non-linear cost function from the method of Positive Mathematical Programming (Howit, 1995) was used.

The main assumption on which the model is based, is the rational, from an economic point of view, behavior of farmers, who want to maximize their profits. The objective function assumed maximization of farm income. The general form of objective function is shown in the following equation:

Provided that $Ax \leq B$,

$$DR = \mathbf{p}^T (\mathbf{x} \bullet \mathbf{y}) + \mathbf{s}^T \mathbf{x} + fs - fc - \mathbf{d}^T \mathbf{x} - \mathbf{x}^T \mathbf{Q} \mathbf{x} \quad (1)$$

$x_i \geq 0$

where:

DR - agricultural income (numerical value of objective function); p - vector of prices ($n \times 1$); y - vector of yields and productivity ($n \times 1$); x - non-negative vector of optimum levels of production ($n \times 1$); $\mathbf{x} \bullet \mathbf{y}$ – Hanamard product; s - vector of payments for production activities ($n \times 1$), c - vector of input prices ($z \times 1$); T -matrix for consumption expenditure for individual activities ($z \times n$); fc - value or fixed costs; fs - value operational subsidies relatively independent of the level of production; A - resource utilization coefficient matrix ($m \times n$); B - vector of available resources ($m \times 1$), $\mathbf{d}^T \mathbf{x} - \mathbf{x}^T \mathbf{Q} \mathbf{x}$ – nonlinear element of the objective function determined during model calibration.

To capture appropriate market effects, which are exogenous factors in the farm model a CAPRI model was used (Britz and Witzke, 2012). For the purpose of this study changes of prices and yields under the scenarios considered were calculated using a CAPRI modeling system. CAPRI is a partial equilibrium (PE) model for the agricultural sector. In contrast to other PE models CAPRI estimates supply in a way similar to farm models, however at a higher level of aggregation (NUTS 2). Observed supply responses are compared to forecasted demand in the market module, which includes market support measures like tariffs, quotas ect. Import and export streams are estimated in CAPRI using the Armington approach.

To maintain specific characteristic of delimited farm types the relative change of yields and prices for analyzed scenarios in comparison to base year has been calculated in CAPRI at the country level. Then it was extrapolated to model parameters of each optimized farm type.

According to the initial assumption and guided by the European Commission's proposal four agricultural policy scenarios were constructed for modelling:

A. Base Scenario [Base_2011] and Baseline_2020 scenario

This scenario assumes continuation of the current CAP. The base scenario is used to calibrate models constructed on the basis of FADN data as of 2011. Baseline scenario will provide a benchmark for other scenarios of the reformed CAP. Baseline scenario assumes no change to the existing mechanisms of the CAP.

B. Scenario GREEN_2020

In the rate of the post-2013 direct payments estimated for Poland (219,05 euro/ha) 30% of "green payments" assuming the implementation of the requirements under the "greening" of the CAP is included. In this scenario it is assumed that existing agri-environmental payments per average farm, which will be the subject of modelling, will be reduced by 50% due to the inclusion of the "greening" component and the likely reduction in financing for environmental measures of the second pillar.

C. Scenario NO_GREEN_2020

The scenario assumes the resignation from 30% of direct payments as a result of not meeting the conditions of "greening". Farm holdings, which will be unsuited to the new requirements would be "punished" by reduction of direct payments by 125% of the value of green payments, which is 82,31 euro per ha. Thus, the direct payment rate 136,74 euro per ha would be paid. Accordingly it was assumed, that the agri-environment payments for "no-green" farms are not reduced.

Under this scenario, regardless of the key assumption on the reduced payment, farms which are exempt from "greening" or meet all requirements will receive direct payments equal to payments in scenario Green_2020.

In reality, it is almost unlikely that all farmers with unadjusted farms will resign from "greening" payments. Therefore, the solution for the scenario No_Green_2020 can only be treated as a reference point to compare with the maximum loss of farm revenue caused by carrying out planned reforms of the CAP.

In all scenarios, optional payments (related to the production and LFA) were adopted at the current level.

Data source

The main source of data for modeling was the Polish FADN data base. Data from the year 2011 were used to develop a typology of farms and to calculate parameters for farm models. There were 10890 farm holdings in the 2011 FADN sample. The entire population of farms was divided into production types, after adopting the criteria consistent with the Community Typology for Agricultural Holdings of 2009 .

The standard output (SO) , which is defined as "the average of the five years of the value of production in specified plant and animal production obtained from 1 ha or 1 animal within 1 year in average production conditions for the region" (Goraj et al., 2011) was used to determine the economic size and type of production.

According to the Polish Central Statistical Office there were 1,651.7 thousand individual farms with an area above 1 ha of agricultural land operating in Poland in the year 2011. The FADN population (farm represented by the FADN sample) includes 735.5 thousand households, which account for 45% of all farms in Poland. Farms from the field of observation of the Polish FADN cover 89,5% of total SO in Poland and their share in the total area of arable land in Poland is at the level of 79%.

Farm typology

The process of distinguishing types of farms for modeling has been carried out according to three basic criteria:

- farm area in hectares (of arable land),
- type of farming (by NTF 14),
- the degree of adaptation to the “greening”.

Regarding farm size, the farms have been divided into 4 clusters:

- the smallest farms (below 10 ha) which are exempt from fulfilling any “greening” requirements;
- farms above 10 ha but not more than 15 hectares, in which at least 2 crops have to be cultivated,
- farms above 15 ha, but not more than 30 hectares, additionally needs to introduce 5% of EFA;
- farms over 30 hectares in which at least 3 crops have to be cultivated and 5% of arable land is to be transferred to EFA.

Regarding farms by type of production, according to the Community Typology for Agricultural Holdings of 2009 (Goraj et al., 2011) farms have been divided into 5 categories: field crops (TF 14,TF 15,TF 60) , cattle (TF 41), pig (TF 50), mixed (TF 70, TF 80) and other activities (remaining TF's).

Regarding the degree of adaptation to the “greening” requirements farms have been divided into 5 groups:

- “Excluded”– farms assumed to be green by definition (e.g. organic) and with area of arable land below 10 hectares;
- "Green farms" – meeting all the requirements of the new CAP reform;
- “Not diversified” – farms which do not meet the requirement of crop diversification,
- “Lacking EFA” – farms which have not sufficient share of ecological focus area;
- “Not adjusted” – farms which do not meet both of the above requirements.

In total there were 218 farm types distinguished for modeling. In order to enrich conclusions, typology of farms has been developed for all, four geographic FADN regions.

Crop diversification measurement

In order to verify the requirement of crop diversification requirement in different types of farms the Shannon-Weiner index was used (Shannon, 1948). It was developed in 1948 and it is one of the most frequently used indicators of biodiversity. It most often acquires a value between 1.5 and 3.5, sometimes exceeding the value of 4.5. It is calculated with the use of the following formula:

$$H = - \sum \frac{n_i}{N} \ln \frac{n_i}{N} \quad (2)$$

where:

n_i – the area of a particular crop

N – the total area of arable land

This ratio was calculated for each farm from the FADN sample in the Baseline scenario. Then the individual values of the index were averaged for each farm type - the result can be termed an “observed” level of the Shannon index.

In the next step, if it was required, in each farm necessary modifications in crop structure were made in order to adjust it to the criteria of crop diversification. Modified values of the ratio were averaged giving a “target” level of the index. For types of farms, which don't meet the requirement of diversification (in scenario Green_2020) additional restrictions forcing the target level of Shannon's index were introduced in the model.

Results

The results presented in this paper have been divided into 3 parts. The first part presents proportion of farms currently fulfilling “greening” requirements. Then, based on the results of farm optimization models, the effects of adjustments needed in the scenarios considered are presented. The final part describes the economic results of those adjustments.

It is important to remark that the presented results are average values for selected groups of farms. In order to avoid identification of particular farms participating in the FADN, it is forbidden to publish averaged results data from a set comprised of fewer than 15 farms. Therefore, it should be noted that in the process of aggregation, results obtained for selected groups of farms have been averaged.

It should also be emphasized that results presented in the tables apply only to farms from the FADN population. Due to the exclusion of farms with less than 10 hectares of arable land from fulfilling “greening” criteria, it can be assumed that small holdings, outside the field of FADN observation will not be forced to adapt to the new requirements.

Taking into account that farms from a FADN sample represent 90% of the agricultural sector in terms of production and 87% of cultivated land, it can be assumed that the results of modeling reflect with a high degree of accuracy the direction and scale of changes in the most significant groups of farms, from the point of view of agricultural policy.

The “greening” will have no impact on performance of small farms. Thus, impacts of “greening” in the scale of the entire agricultural sector will be slightly less than presented in this paper for the FADN sample.

Fulfillment of the “greening” criteria

In the base year 2011 a majority of Polish farms (77%) was already complying with the requirements of the new CAP (Table 1). The main reason for this is a deficiency of ecological focus areas. In the case of crop diversification it can be stated, that almost all Polish farms are already fulfilling “greening” criteria.

Table 1. Structure of farms according to production types in the FADN farm population with regard to fulfillment of the “greening” criteria

	„Excluded”	„Green farms”	Not diversified	Lacking EFA	Not adjusted
Poland	57%	20%	21%	1%	1%
According to production types in the FADN farm population					
Field crops	35%	23%	37%	0,9%	4,1%
Cattle	58%	20%	20%	0,8%	0,7%
Pig	34%	18%	45%	0,1%	3,1%
Mixed	59%	21%	18%	1,1%	0,7%
Other	93%	3%	2%	0,9%	0,6%

Source: Own study based on FADN data.

Because of the low degree of compliance with the greening criteria the CAP reform will have the greatest impact on farms specialized in field crop cultivation and also on pig farms. At the same time, in these groups the percentage of farms characterized by insufficient EFA area and too low a degree of diversification of crops is the highest.

A much smaller share of farms requiring adaptation to the “greening” can be observed in the type specialized in breeding cattle, because of specific nature of their activities, they are characterized by a relatively diversified cropping structure, very often maintaining permanent pasture and cultivating grass on arable land. A small area of arable land simultaneously with a large share of grassland releases these farms from the need to implement the “greening” or automatically classifies these farms as “green”. A similar situation can be observed for mixed farms. The “Other” group of farms includes mainly horticultural holdings, which due to the significant share of permanent crops and small area (less than 10 hectares of arable land and organic) are excluded from “greening”.

Shannon Index

As described above, most of the farms in Poland can be perceived as diversified. That is why the Shannon Index after adopting diversification criteria shows practically imperceptible changes in the Green_2020 scenario, with the exception of “not diversified” and “not adjusted” farms (Table 2).

Table 2. Diversification of crop structure in considered scenarios (Shannon index)

Shannon Index	Baseline_2020	Green_2020	No_Green_2020
POLAND	2,07	2,10	2,08
<i>According to the degree of adaptation to the "greening"</i>			
„Excluded”	1,93	1,95	1,95
„Green farms”	2,12	2,13	2,12
Not diversified	1,09	1,13	1,09
Lacking EFA	2,21	2,24	2,20
Not adjusted	1,44	1,49	1,43

Source: Own study based on FADN data.

Modeled farm types growing just one crop show significant changes in the index value (increase in the Green_2020 scenario by 0,3-0,5), but due to their marginal participation in the farm population it does not translate to an average value of aggregates. The biggest change in

the average value of the Shannon Index due to the CAP “greening” could be observed in “Not adjusted” farms which are not diversified enough and have too small an EFA share in the base year. Similar increase of the Index value characterizes "not diversified" farms.

Ecological Focus Area

Polish farms on average are above the required 5% share of the Ecological Focus Area in the Base year which is due to the high percentage of the EFA in farms considered as "excluded" and "green". Other farm types are below the threshold to a different extent (Table 3).

Table 3. Average share of Ecological Focus Area in considered scenarios [% arable land]

Share of EFA [%]	Baseline_2020	Green_2020	No_Green_2020
POLAND	5,5	6,3	5,3
<i>According to the degree of adaptation to the “greening”</i>			
„Excluded”	8,0	8,0	7,9
„Green farms”	5,3	5,3	5,1
Not diversified	3,8	4,6	3,7
Lacking EFA	4,4	5,1	4,1
Not adjusted	2,6	5,2	2,5

Source: Own study based on FADN data.

Transferring the required amount of arable land to the EFA in the Green_2020 scenario results in a slight increase of an aggregated EFA share in the country (6,3% compared with 5,5% in the base year).

In the cluster of “Not adjusted” farms the share of the ecological focus area is the lowest, and in order to fulfill the "greening" requirement a significant area of arable land has to be withdrawn from production.

A large number of “not diversified” farms is not obliged to establish 5% of EFA because farms of 10-15 hectares dominate this cluster. Despite this, the share of the EFA is increasing because in some of the farms crops considered as EFA (eg. herbaceous forage crops) are used to diversify cropping structure. Due to the same reason, farms which need to establish new EFA are, on average, slightly overlapping 5% requirement.

On the contrary, assuming conditions of No_Green_2020 scenario a small decrease of the EFA could be noticed compared to the baseline scenario by 0,1-0,3 percentage point depending on the cluster of farms. This is mainly due to turning the fallowed land back to cultivation in the model solutions.

Results confirm that exclusion of the smallest farms was, at least in Poland, the right decision made by the European legislator as they are both diversified and have a high share of the EFA, above the required 5% limit.

Changes of cropping structure

One of the features of the Polish agriculture is a predominant share of cereals in cropping structure, that might be considered as leading to negative environmental consequences (eg. decrease of organic matter content in the soil).

Model results show that “greening” of the CAP and introducing diversification criteria do not address this issue. Introduction of all restrictions leads to a drop of cereal share in Poland by 0,4 percentage point (Table 4).

Table 4. Share of cereals in crop structure in considered scenarios

Share of Cereals [%]	Baseline_2020	Green_2020	No_Green_2020
POLAND	70,9	70,5	72,4
<i>According to the degree of adaptation to the “greening”</i>			
„Excluded”	62,8	63,4	64,5
„Green farms”	76,2	76,8	77,9
Not diversified	75,8	75,9	77,6
Lacking EFA	73,8	72,9	75,2
Not adjusted	72,4	64,1	73,3

Source: Own study based on FADN data.

The largest decrease of the share of cereals could be observed in “Not adjusted” (8,3 p.p.). However, because this group represents only 1% of Polish farms it has no impact on the country's aggregate.

Under assumptions for the No_Green_2020 scenario there is even a noticeable increase of the share of cereals in the model solutions. The model tries to compensate reduced payments increasing size of activities with a relatively high gross margin.

Economic results

It might be expected that changes in cropping structures, the likely changes of prices of commodities, yields and direct payment regime must have an impact of economic results of farms. Table 5 illustrates the relative changes in the level of farm income in farms divided by type of production and the degree of adaptation to the “greening” of the CAP.

Table 5. Changes in farm income in the policy scenarios considered

FARM INCOME Baseline_2020 = 100	CAPRI 2020 prices	
	Green_2020	No_Green_2020
POLAND	99,94	97,15
<i>According to a production types</i>		
Field Crops	101,10	96,33
Cattle	99,91	97,75
Pig	99,83	98,95
Mixed	99,54	96,99
Others	98,90	99,10
<i>According to the degree of adaptation to the “greening”</i>		
„Excluded”	97,83	96,50
„Green farms”	100,12	99,80
Not diversified	97,72	94,24
Lacking EFA	101,13	96,40
Not adjusted	98,42	98,35

Source: Own study based on FADN data.

Results show that on average “greening” of the CAP has a very low impact on economic performance of Polish farms. On the one hand a rise of prices forecasted by the CAPRI model compensates for the costs related to implementation of the “greening”. On the other hand, relatively high decrease of farm income in unadjusted farms do not influence the result for Poland due to the small share in the total population of farms.

There are, however, some varied results of the model solutions in different groups of farms.

In all cases, the mechanism behind the decrease of financial results appears to be similar. Assumed reduction in the area of cultivated crops due to the increased share of the EFA, according to the results of the CAPRI model, causes an increase of prices of basic agricultural commodities.

Predicted price increase influences to a greater extent the revenues of large farms, intensely organized, which have closer contact with the market. This applies mainly to intensive, field crop farms, which benefit mainly from the increase of prices of cereals, and pig farms, where the feed price increase is compensated by the higher price for pig meat.

A small increase in milk prices hardly compensates for the cost of “greening” in cattle and mixed farms. In farms with other types of production, even though the vast majority of them is adjusted, the necessity to reduce the area of profitable horticultural crops causes on average a decline in farm income.

A separate comment is required to explain a relatively large decline in the level of income of farms excluded from the requirements of “greening”. These are mainly small, extensively organized farms (with a small area of arable land). In these farms, income decrease is caused by assumed reduction of payments from agri-environmental programs by 50%, due to the inclusion of some of the previously implemented actions to “greening” practices. Losses due to reduction in payments, can not be compensated for by the increase in prices, because of the relatively small volume of production.

In the case of No_Green_2020 scenario, assuming farmers decide not to adopt the new CAP requirements, the economic results of Polish farms decrease by nearly 3% in the year 2020. Similarly, as described above, a relatively high drop of income could be observed in farms excluded from “greening”. The small size of units and thus the very low sales level do not provide enough compensation for the reduced agri-environmental payments.

A relatively high drop of income could be observed in farms with not diversified cropping structure, but due to its very low share it is not relevant for the sector results. The small size of those units also does not provide a basis to gain from price increase.

Regarding production type, the highest drop in income in case of No_Green_2020 scenario could be observed in field crop farms. It is caused by the relatively high share of unadjusted farms in this group and high share of plant production, which is mainly affected by “greening” on sales revenues.

Generally it could be stated that for a majority of farms scenario No_Green_2020 is not an economically justified option. For most of farms adjusting to the CAP requirements costs much less than the penalty of lowering the direct payment rate. However, for some very intensive farms of different types rejecting of the “greening” could be an attractive solution, offering higher farm incomes if losses of revenues would exceed reduced payment.

“Other farms” is the only group of farms that achieve increase of aggregated farm income in the No_Green_2020 scenario. This is because this group is dominated by horticultural farms, with highly profitable crops in the production structure. Loss of the revenues due to reduced area of arable land to create the required share of EFA can not be compensated for by green payments and would inevitably lead to the income decrease.

Discussion of results

The assessment of the financial impacts of greening for the farming sector is ambiguous in the opinions of different authors. This results mainly from making varied assumptions, particularly regarding the possible reaction of farmers to the requirements of the reformed CAP.

The likely reaction of markets of agricultural commodities in the EU and at the global scale is also important for predicting the effects of the greening. In our analysis it was assumed, that restrictions imposed by greening will result in a reduced supply and as a

consequence, a slight increase of prices. Such an assumption, supported by CAPRI model, may be questioned, arguing that changes in the structure of agricultural production in the European Union will not have an impact on the global market and world prices, which will in turn shape also the EU prices. In a diverse scenario of price developments, under the assumption that the current prices will not change in the period considered in the analysis (Czekaj et al., 2014), farm incomes in Poland could fall by more than 4 percentage points, compared to the scenario of an increase of prices as applied in this paper.

There were also unavoidable simplifications made in the modelling approaches, related mainly to duplication of the base year model constraints and production techniques in the model for the final year considered in the analysis. In reality, farmers in different clusters of production farm types may take different adjustment paths. The non-linear costs function assessed using the PMP method for all agricultural activities in the model takes into account the base year conditions for agricultural production in each farm type which do not reflect possible adjustments.

A bias of the final results is also possible due to the aggregation procedure in which a fixed farm structure has been assumed. Allowing the model to change production techniques and considering likely structural changes in the farming sector would require making several assumptions in the model construction phase, and would make interpretation of results very complex. Such a methodological approach might be advisable when considering a long period. In the analysis of short-term consequences of the CAP greening simplifications made seem to be defensible.

Despite the shortcomings of the possible methodological approaches and model assumptions it is clear, that greening will not have a significant impact on the financial situation of farmers on average. It should be emphasized, however, that regardless of the price scenario considered there will be types of farms, such as monoculture or cereal farms, specially located on good soils, that will undoubtedly face a noticeable reductions in farm incomes. It is important to mention, that the CAP will not compensate losses generated by the greening, as pointed out by Tangerman (2013).

Summary

The original proposal of the CAP reform submitted by the European Commission in the year 2011 raised much controversy, especially in relation to the requirement of the exclusion of 7% of arable land for the EFA. It could result in a reduction of EU agricultural production, and thus to be in conflict with one of the fundamental objectives of the CAP, which is ensuring food security. Likely decrease of farmers' incomes as well as rising costs associated with the greater complexity of direct payments scheme would also be in contradiction to other objectives of the CAP, probably undermining competitiveness of EU agriculture.

During the legislative process, however, the justification for the greening of the CAP remained unchanged, but the requirements formulated in relation to farmers were gradually mitigated.

In effect, as confirmed by results of our study, the current version of “greening” has a very limited, and almost negligible, on average, impact on the economic results of Polish farms. Restrictions resulting from the implementation of the “greening” mechanism put more pressure only on relatively small groups of very large farms, mainly specialized in field crops and pig farms with an area above 30 ha of arable land. However, the reduction of farm incomes in these farm types is still not significant.

Price increases predicted by the CAPRI model, due to reduced supply of agricultural products in Europe as a consequence of “greening” compensates for the costs resulting from the additional requirements imposed on farmers.

The results indicate also that not fulfilling new CAP requirements, thus leaving out some subsidies, is a much less favorable option. Adoption of such a scenario has a much larger impact on reducing the level of farm income than those arising from the need for appropriate adjustments.

Relative decrease in farm income level can affect small size (slightly above 10 ha), extensively organized farms, which have benefited from support under Agri-Environment schemes. The results also confirm that exclusion of the smallest farms (<10 ha of arable land) was a right decision, as they are both diversified and have a high share of the EFA.

The initial "greening" criteria proposed by the European Commission could be considered very ambitious. Now, after the announcement of its final version there is a common belief that the "greening" of the CAP is purely propaganda and serves to legitimate financial support for farmers in the European Union. Such a statement can be supported by the probably very limited environmental effects of the "greening", which is discussed by many authors (Hart and Little, 2012), (Matthews, 2013).

The economic impact of the reform discussed in this paper indicates a slight, almost negligible effect from the point of view of Polish farms, while likely increasing transaction costs related to implementation and control of the new direct payment system.

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