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IMPACT OF "GRENING" THE COMMON AGRICULTURAL POLICY ON SUSTAINABILITY OF EUROPEAN AGRICULTURE: FROM PERSPECTIVE OF THE BALTIC SEA COUNTRIES

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Abstract. This paper examines the potential impact of the EU Common Agricultural Policy (CAP) decision – for the budget perspective 2014-2020 – known as 'greening of the CAP' which aims to improve the environmental performance of agriculture and hence, its sustainability. The reform established environmental measures that European farmers need to introduce in order to receive direct payments under the CAP. Using the well-established CAPRI model with its new extension by regional Computable General Equilibrium models, the economic and environmental consequences of the reform on agriculture are estimated. The calculations are carried out for the countries which signed so called Baltic Sea Action Plan (BSAP) – an ambitious programme to restore the good ecological status of the Baltic marine environment by 2021. The results are presented in form of agricultural, economic and environmental effects of the reform against a baseline scenario for 2020 in the analysed countries. They indicate that "grening" causes a decline in the area of the main crops, increase crop prices and slightly intensified production on the remaining areas. Farm income would increase, but due to the low intensity of agriculture in the Baltic countries this increase would be rather limited.

Key words: greening; sustainability of agriculture, Common Agricultural Policy reform, CAPRI model, Baltic Sea and agriculture

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INTRODUCTION

The CAP's original purpose was to boost domestic production through market price support. That policy was so successful that it turned subsidised EU agriculture into a net-exporter on global markets, however with exploding budgetary costs, welfare losses for consumer and increasing negative environmental externalities. This initiated a continual reform process. Within Pillar I focusing on market support, the reforms included milk quota introduction in 1984, then an introduction of decoupled (from production) payments in combination with reduced intervention prices for key agricultural commodities as part of the McSharry reform in 1992. Further reforms included more uniform coupled payments for crops and further intervention price decreases with the Agenda 2000. This culminated in the 2003 reform which introduced new decoupled Single Farm Payments (SFP) combined with new environmental and animal welfare requirements. The Agenda 2000 reform saw the creation of a Pillar II of the CAP focusing on rural development which included a larger range of agri-environmental measures. Some smaller amendments have integrated since 2003 all agricultural sectors under the umbrella of the SFP, while coupled support has been drastically removed. According to the current legislation in 2015 milk quotas will be abolished and in 2016 sugar quotas.

The European Commission (EC) proposal for the reform of the CAP after 2013 [Regulation... 2013] focused by far more on sustainability and the environmental performance of agriculture than the former reforms. There are at least three reasons behind it. Firstly, the problems around the CAP such as budgetary instability and incompliance with World Trade Organization (WTO) rules have been rather successfully resolved already within the earlier reforms so new goals are justified. Secondly, there is a growing societal recognition of environmental externalities caused by agriculture whereas environmental goals set by the European Commission such as preventing bio-diversity loss are unlikely to be met. Thirdly, there is a wide-spread critique that the CAP direct payments are not well targeted [Ferrer and Kaditi 2008]. Hence, the EC proposed replacing existing direct payments under Pillar I with a basic payment topped up by an additional payment conditional on farmers respecting certain "agricultural practices beneficial for the climate and the environment" financed from 30% of the national Pillar I envelope [Regulation... 2013].

The post 2013 CAP reform introduced three mandatory "grening" activities which have to be implemented at farm level: permanent grassland, crop diversification, and ecological focus areas [Regulation... 2013]. The requirements related to them are as follows:

i) permanent grassland (PG): Member States shall designate permanent grasslands that are environmentally sensitive and that need strict protection including in peat and wetlands. The ratio of the land under permanent grassland in relation to the total agricultural area declared by the farmers may be reduced but not more than 5% compared to a reference ratio to be established in 2015.
ii) crop diversification: if arable land of the farmer covers between 10 and 30 hectares there shall be at least two different crops on that arable land and the main crop shall not cover more than 75% of that land. For more than 30 hectares there shall be at least three different crops and the main crop shall not cover more than 75% of that arable land and the two main crops together shall not cover more than 95%. Farms up to 10 ha are exempted.

iii) ecological focus areas (EFA):, i.e. areas equivalent to at least 5% (after 2016 increase to 7% will be considered) of a farmer's eligible land is used for ecological purposes. Habitats and features that would be eligible to fulfil the EFA requirement may include: fallow land, terraces, landscape features, buffer strips, and areas afforested under Pillar II.

At the same time, the Baltic riparian countries struggle for improving conditions of the Baltic Sea waters. There is a Baltic Sea Action Plan (BSAP) adopted by Helsinki Commission (HELCOM) by all the coastal countries of the Baltic Sea and by the European Community in November 2007 (HELCOM 2007). The novelty of the BSAP approach is the focus on the Baltic ecosystem instead of addressing only the pollution sources, on sector-by–sector bases. However in literature addressing abatement of nutrient load to the Baltic Sea several measures regarding agricultural practices are proposed as economically justified [Wulff et al. 2014]. So improvement in environmentally friendly agriculture would also help in fulfilment of the BSAP.

The main objective of this paper is to present a quantitative assessment, based on a partial equilibrium model CAPRI[1] – of both the economic and environmental consequences of the new "grening" measures in mid-term perspective of the year 2020. Thus it will answer the question if "greening" of the CAP would bring environmental benefits in the Baltic Sea countries which aim to comply with BSAP commitments and if so, who would be the winners and losers. It involves a comparison of a baseline scenario (the continuation of the current CAP) with a "grening" scenario (featuring the requirements of the post 2013 CAP reform). The paper adds to the existing literature on assessing effectiveness of the policy measures which aim to reduce pressures from agriculture on the environment. It is also related to issues of the sustainable development of agriculture, trade-offs between economic and environmental interests, global warming, within the framework of the environmental and economic impact of the post 2013 CAP reform.

Due to growing concern of environmental issues related Baltic Sea region, the paper focuses on the to agriculture of the Baltic Sea countries. The CAPRI model produces the results for all EU27 countries but in order to narrow the analysis, only the largest agricultural sectors in the Baltic Sea riparian countries are presented. The countries in question are: Denmark, Estonia, Finland, Latvia, Sweden, Lithuania and Poland. Germany, however being a Baltic riparian country, has been omitted as its area of the country belonging to the Baltic watershed is marginal.

The paper is structured as follows. The following section provides a brief literature review on potential environmental and economic impact of the CAP reform after 2013. Next is a section on the methods used in the study, including the model specification, selection of economic and environmental indicators for interpretation and defined scenarios. The third section presents the results of the impact on agricultural land use (area under various crops, permanent grassland, share of 'ecological focus areas' by countries, Shannon index of specialization/diversification by countries), agricultural production, prices, yields, nutrient surpluses, global warming potential, welfare, tax payers costs, and other. In the final section conclusions are formulated.

[1] CAPRI (Common Agricultural Policy Regionalised Impact) model is an economic partial comparative static equilibrium model for agriculture, which suits for ex-ante impact assessment of agricultural and international trade policies with a focus on the European Union. has All the methodological details are presented on its website: http://www.capri-model.org.

IMPACT OF THE CAP POST 2013 REFORM

There is a lack of ex-ante studies analysing the environmental and economic impacts of European Union post 2013 CAP reform, the first time officially outlined in October 2011 [Legal... 2011 a]. Studies by Helming and Terluin [2011] and Van Zeijts et al. [2011] indicated that the reform would largely improve agricultural incomes in the new Member States, while in the EU15 they would remain almost unchanged. The combination of direct payments and environmental requirements would 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.

A study by Westhoek et al. [2012] analysed the impact of the greening of the CAP on the environment alone and concluded 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 crop diversity, what might commit to biodiversity increase and reduce greenhouse gas emissions in the EU, while increasing emissions outside the EU. These findings on the impact of the greening of the CAP with regard to the crop diversification measures are also supported by other studies, for example by Czekaj et al. [2011].

Matthews [2011] came to the conclusion – based on the Report by EC [Common... 2011] – that the implementation of instruments related to "grening" payments would 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 was estimated, however, that the increase in prices and the expected increase in yields does not fully compensate for higher production costs, resulting with a decline in agricultural income by 2% on average [Matthews 2011].

As for Poland, the impact of "grening" was analysed with the use of a linear farm optimisation model based on a sample of Polish farms selected from the FADN (Farm Accountancy Data Network) [Impact... 2012]. The three requirements of greening – based on EC proposal [Legal... 2011 a] – were investigated individually and jointly. Various types of farms were defined according to the level of compliance with greening criteria related to cropping structure. The results show 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 according to European Commission proposition of ecological focus area (EFA) resulted in a decline of farm incomes by 3.8% on average. Much greater losses of income are in monoculture farms with high quality soils compared to a baseline scenario which assumes the continuation of the current CAP [Impact... 2012].

METHODOLOGY – CAPRI MODEL

The CAPRI model is a global comparative-static partial equilibrium model with a strong focus on Europe, consisting of a supply and a market module [Britz and Witzke 2012]. The former covers EU27 countries plus Norway, Turkey and Western Balkans – comprises independent aggregate non-linear programming models representing approximately 50 crop and animal activities of all farmers, in the version applied in this study it is for 280 administrative units at a regional level (NUTS II[2]). Each programming model maximises regional agricultural income at given prices, subject to technical constraints for feeding, young animal trade, fertiliser use, set-aside, a land supply curve and production quotas. For the EU, the different coupled and de-coupled subsidies of Pillar I of the CAP, as well as major ones from Pillar II – such as Less Favoured Area support, agri-environmental measures, Natura 2000 support – are depicted there in details.

Prices for agricultural outputs in the programming models are rendered endogenous based on sequential calibration [Britz 2008] between the supply models and a market model. The latter is a global spatial multi-commodity model covering 77 countries or country aggregates in 40 trade blocks and about 50 agricultural and important first stage processing products (vegetable cakes and oils, dairy, bio fuels). According to the concept of the supply balance sheets of FAO (Food and Agriculture Organization of the United Nations), market balances and trade flows are expressed in raw product equivalents and thus encompass also processed products. The Armington approach adopted means that the products are differentiated by origin, allowing the simulation of bilateral trade flows and related bilateral as well as multilateral trade instruments [Armington 1969]. Trade instruments are not expressed as ad-valorem equivalents, but as close as possible to the actual implementation, i.e. there are ad-valorem, specific and compound tariffs and minimum import price regimes. The model allows for the simultaneous presence of bi-lateral and multi-lateral tariff-rate quotas (TRQs), filling first the bi-lateral TRQ. The behavioural equations are based on flexible functional forms and their parameterization ensures regularity, which also allows for welfare analysis of the partial equilibrium changes. CAPRI has been widely used for the analysis of the reforms of the Common Agricultural Policy of the EU as well as of bi-lateral and multi-lateral trade liberalisation[3].

In the current study, the baseline captures developments in exogenous variables such as policy changes, population growth, Gross Domestic Product (GDP) growth and agricultural market development for the year 2020. It is aligned with the global Aglink-COSIMO baseline prepared by OECD (Organisation for Economic Co-operation and Development) and FAO and thus includes the expected effects of bio fuel policies in OECD and other countries [OECD/FAO 2011]. Specifically, it integrates simulation results from the PRIMES energy model for the bio-fuel sector [Capros et al. 2010]. The baseline assumes a status-quo policy, with current policies remaining in force while taking into account those future changes that are already agreed and scheduled in the legislation. It therefore covers the CAP Mid-Term Review, the reforms of the sugar markets, and the CAP Health Check, which means further decoupling of direct pay-

[2] NUTS – Nomenclature of territorial units for statistics: http://ec.europa.eu/eurostat/ramon/nuts/basicnuts_regions_en.html.

[3] See CAPRI homepage: www.capri-model.org.

ments, no set-aside obligation, increased modulation phased in gradually by 2012 and milk quota phased out gradually in 2015[4].

IMPLEMENTATION OF THE "GRENING" MEASURES IN THE CAPRI MODEL

In the framework of the CAPRI model the *permanent grass land area* to maintain was set as a weighted average of 2003-2005 base years and of the 2020 baseline, assuming that it would reflect approximately the current areas of permanent grasslands. For the *crop diversity* measure, an analysis of single farm records from Farm Accountancy Data Network (FADN) provided the basis to calculate changes in the Shannon index. Crop diversity measure imposes land use constraints at farm level and is subject to severe aggregation bias if regional or country level model and data are used for simulation purposes. To avoid this problem, the FADN records for 2008 were linked with CAPRI farm types through the Shannon diversity index. The link between the FADN and CAPRI was done in two steps. In the first step, a land optimisation model was run for each FADN farm unit to simulate the effect of the crop diversity constraints. The objective function of the optimization model represented the minimization of the square difference between the actual arable crop area and the simulated area subject to crop diversity constraints (i.e. minimum three crops requirement, 70% upper threshold and 5% lower threshold share of arable crops on total arable land) and land endowment constraint. Then, the Shannon index was calculated for both actual land use data and simulated results. The Shannon index was calculated for CAPRI farm types. The difference between the actual and the simulated values of the Shannon index represents the land allocation adjustments that a farm need to undertake to fulfil the crop diversity requirements. In the second step, the difference between the actual and the simulated Shannon index obtained in the first step was introduced as a land use constraint in the farm type module in CAPRI. For each farm type in CAPRI, crop diversity measure is introduced as an adjustment of the arable crop area represented through the simulated Shannon index relative to the baseline level of the Shannon index.

As for the *ecological set-aside*, the greening proposal of the European Commission indicates 5% of land to be designated for ecological purposes. This measure could include fallow land, buffer strips and landscape features and also set-aside areas. In the GREEN scenario for CAPRI it is assumed that farmers are required to allocate at least 5% of arable land, excluding permanent pasture, to ecological use.

RESULTS – FULFILMENT OF "GRENING" CRITERIA

In the CAPRI model the implementation of "grening" policy can be firstly assessed through interpretation of three indicators: i) *Shannon Index* for indication of crop diversification, ii) a percentage share of *sum of fallow land and set-asides* in the total utilised

[4] Our reference point differs from the standard CAPRI baseline due to removing feedstock demand in Germany for biogas production.

agricultural area for indication of ecological focus areas (EFA), and iii) *area of grass and grazing* (intensive and extensive) for indication of permanent grassland. Table 1 shows the values of those indicators under the two scenarios (MTR-baseline scenario,

Table 1. "Grening" indicators under the two scenarios in 2020
Tabela 1. Wskaźniki „zazielenienia" w obu scenariuszach w 2020 roku

Countries Kraje	MTR_baseline Scenariusz bazowy			GREEN_policy Scenariusz „zazielenienia"			Difference (GREEN minus BASELINE) Różnica między scenariuszami		
	1. Shannon index Wskaźnik Shanona	2. Share of Ecological Focus Area Udział terenów proekologicznych (%)	3. Permanent grassland Wieczne pastwiska (1000 ha)	1. Shannon index Wskaźnik Shanona	2. Share of Ecological Focus Area Udział terenów proekologicznych (%)	3. Permanent grassland Wieczne pastwiska (1000 ha)	1. Shannon index Wskaźnik Shanona	2. Share of Ecological Focus Area Udział terenów proekologicznych (%)	3. Permanent grassland Wieczne pastwiska (1000 ha)
EU27 UE27	2.81	5.80	57 861	2.83	6.80	58 584	0.02	0.90	1.20
EU15 UE15	2.76	6.40	44 410	2.79	7.30	44 819	0.02	0.90	0.90
EU10 UE10	2.73	3.50	7 618	2.76	5.10	7 780	0.04	1.60	2.10
Denmark Dania	2.19	5.50	235	2.23	6.60	231	0.04	1.10	-1.80
Finland Finlandia	2.2	16.30	64	2.27	17.50	71	0.07	1.20	10.60
Sweden Szwecja	2.19	13.20	471	2.24	14.40	471	0.06	1.20	0.10
Estonia Estonia	2.14	0.00	230	2.22	3.70	233	0.08	3.70	1.60
Lithuania Litwa	2.32	0.00	865	2.36	3.40	883	0.04	3.40	2.10
Latvia Łotwa	2.22	5.30	621	2.24	5.50	631	0.02	0.20	1.70
Poland Polska	2.57	3.70	3 147	2.61	5.20	3 244	0.04	1.50	3.10

*Shannon index is calculated as $H' = -\sum_{i=1}^{R} pi \ln pi$, where *pi* is the proportion of crops area belonging to the species in the dataset of interest.

Source: own calculations based on CAPRI model.

*Indeks Shannona: $H' = -\sum_{i=1}^{R} pi \ln pi$, gdzie: *pi* – udział powierzchni upraw roślin.

Źródło: obliczenia autorów na podstawie modelu CAPRI.

GREEN-policy scenario[5]) and the differences between the two expressed in absolute values, percentage points and percentages.

The initial values of the "grening" indicators varies among the analysed countries. For example, Poland's agriculture has a good starting position in terms of all three "grening" indicators yet before the reform is implemented. The cropping area is highly diversified in Poland as indicated by a Shannon index of 2.57 – the highest among Baltic countries in the MTR scenario and the fifth in the EU27. It should be pointed out that value of the Shannon Index for the entire EU is noticeably higher than the index values for single countries. This is because at a larger geographical area a higher number of different species is cultivated which results in a lower shares of individual crops. Thus the values for big aggregates EU27, EU15 and EU10 should not be directly compared with country level results. The differences between the Baltic countries and the EU averages can be explained by severe climatic conditions in Northern Europe, which limit the number of available crops, and also by a relatively high level of specialisation and concentration on farms in Denmark and Southern Sweden.

The share of EFA is highly diverse among the analysed countries. On average there is more EFA in the EU 15, than in the EU 10, where agriculture is less intensive. The main reason is large areas in Sweden and Finland, where the EFA share is much higher than required. This could be related to worse climatic conditions and thus limited possibilities for efficient crop growing on all agricultural lands. In Denmark the EFA share is slightly below the EU15 average, whilst in Poland the share of EFA is above the EU10 average. In general, in the case of the Baltic watershed, it should be noted that EFA share is higher in northern countries.

The introduction of the GREEN scenario induces rather modest changes in the Shannon index, however for the Baltic countries they are larger than for the entire EU. This is result of greater extent of needed adjustments in cropping structure. There might be several reasons for that. In some cases the share of cereals is too high, and must be reduced due to biodiversity requirements (e.g. Estonia, Lithuania, Poland) or the EFA share is inadequate (e.g. Estonia, Lithuania) or area of fodder activities is reduced due to lower stocking rate (e.g. Finland). For Poland it is at the level of the EU10 average (0.04) while the biggest changes are in Estonia (0.08) and Finland (0.07). Nevertheless it has to be noted, that these are high aggregates – at a country level. Looking at individual farm levels the observed changes are certainly larger. For example, in Poland, which has the highest Shannon index among the analysed countries, it is estimated based on Polish FADN[6] that still about 9 per cent of Polish farms do not fulfil the criteria for diversification.

In the GREEN scenario, in all Baltic countries the EFA share is increasing. The highest increase could be observed in countries with a low share in MTR scenario, but even in countries with an average EFA share above requirements some increase could be observed, due to the fact that some farm types are not complying (Fig. 1). In the most of the Baltic countries a modest increase of permanent grassland area could be observed. The growth of grasslands area in Poland, Lithuania, Latvia and Estonia is twice

[5] In the CAPRI model the two scenarios are named respectively: MTR_RD and MTR_GREEN, but we use shorter names here.

[6] Source of the data used for the estimation was the Polish Farm Accountancy Data Network (FADN) for the year 2009.

higher than the EU average. The only Baltic country with decreasing permanent grasslands is Denmark. Swedish grasslands remains at the same level, while in Finland a relatively high increase of grasslands area would be observed, due to a very low initial level.

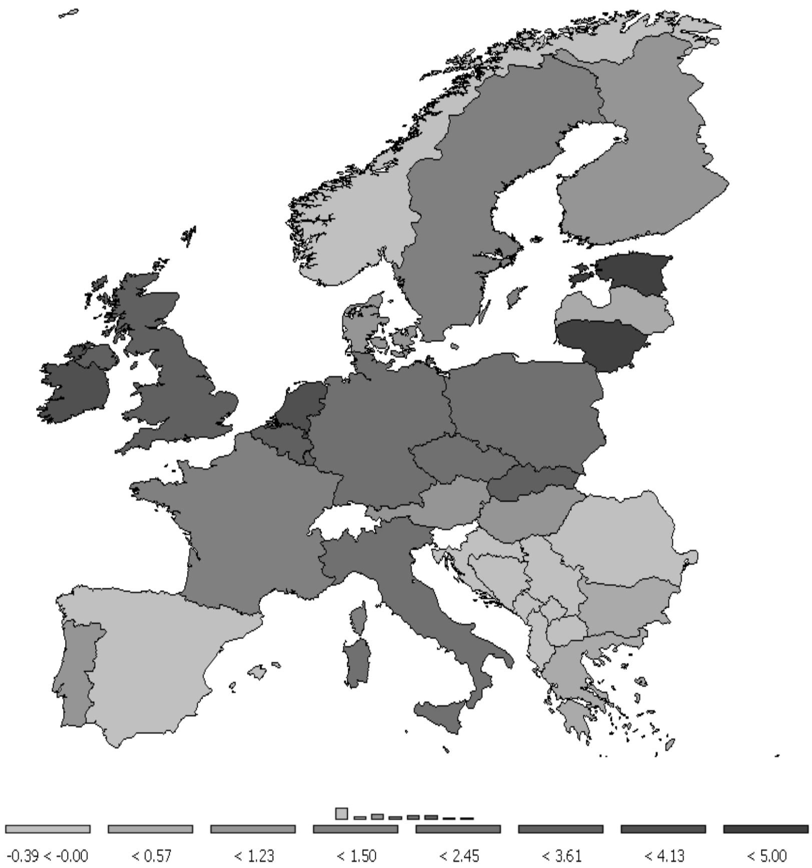

Fig 1. Changes in shares of the Ecological Focus Areas (EFA) in arable land under the GREEN scenario (in percentage in 2020).
Source: own calculations based on CAPRI model.
Rys. 1. Zmiany udziału obszarów proekologicznych w gruntach ornych w scenariuszu GREEN (w procentach, dla 2020 r.)
Źródło: obliczenia autorów na podstawie modelu CAPRI.

An increase of EFA and pastures causes a negative change in land utilised for arable crop production. This shift is not evenly distributed among crops. In old the EU member Baltic countries, an increase of EFA takes place at the expense of fodder crops. The total share of cereals in Denmark and Finland decreases slightly, while in Sweden it even grows. In new EU Baltic states an increase of EFA causes a reduction in the share of cereals (Table 2).

Table 2. Changes in the share of main crops in the cropping structure (percentage points of arable land share), in 2020
Tabela 2. Zmiany w udziale głównych upraw w całkowitej strukturze upraw (punkty procentowe w odniesieniu do gruntów ornych) w 2020 roku

	Denmark Dania	Finland Finlandia	Sweden Szwecja	Estonia Estonia	Lithuania Litwa	Latvia Łotwa	Poland Polska
Cereals Rośliny zbożowe	–0.79	–0.33	0.62	–4.45	–3.7	–0.26	–1.85
Soft wheat Pszenica miękka	–0.66	–0.19	0.2	–1.21	–1.12	–0.49	–0.5
Rye and Meslin Żyto i pszenżyto	0.24	0.2	0.07	–1.91	–0.91	0.1	–0.38
Barley Jęczmień	–0.63	–0.42	0.12	–1.06	–1.08	0.05	–0.26
Oats Owies	0.19	0.06	0.14	–0.26	–0.29	0.04	–0.32
Grain Maize Kukurydza na ziarno	–	–	0.01	–	–0.02	–	–0.06
Other cereals Inne rośliny zbożowe	0.07	0.01	0.09	–0.01	–0.28	0.03	–0.33
Oilseeds Nasiona oleiste	0.08	0.09	0.07	–0.33	–0.26	0.04	–0.03
Pulses Rośliny strączkowe	0.06	0.03	0.02	–0.02	–0.35	0.01	0
Potatoes Ziemniaki	0.01	0.02	0.03	0	–0.01	0.02	–0.01
Sugar Beet Buraki cukrowe	0.01	0.01	0.01	–	0	–	0
Fodder activities Czynności z uprawami paszowymi	–0.75	–0.78	–2.04	0.3	0.45	1.13	0.84
Set aside and fallow land (EFA) Ziemia odłogowana lub ugór	1.18	1.23	1.39	5.04	5	0.35	1.94

Source: own calculations based on CAPRI model.
Źródło: obliczenia autorów na podstawie modelu CAPRI.

The necessity for diversification causes a shift towards pulses and oilseed rape, so even in countries with significant reduction of crops area the declines of those shares are very small. Changes in share of cereals and fodder crops are likely to induce some changes in animal production. However in most of the Baltic countries, these effects are limited. Even in Sweden where the fodder crop area shrinks by 4% the total herd size of cows decreases only by small number. The number of beef animals is declining in all countries except Poland. This might be related to an increase of fodder crops area in Poland.

The number of granivores – grain consuming livestock – is related to changes in area of cereal production. A strong decrease in the number of animals could be observed in Estonia, but also in Latvia and Lithuania where the number of fattened poultry is decreasing (Table 3). These effects are even more triggered by price increases for cereals, due to slight decrease of supply in the EU-27 countries The only exception is slight increase of number of pigs in Denmark in spite of a decrease in the area of cereals. This might be explained by long traditions of pig industry in Denmark and its' strong competitive position.

Table 3. Changes in the number of animals and fodder cropping area in GREEN scenario, in 2020
Tabela 3. Zmiany w liczbie zwierząt i obszarach upraw paszowych w scenariuszu GREEN w 2020 roku

	Denmark Dania	Finland Finlandia	Sweden Szwecja	Estonia Estonia	Lithuania Litwa	Latvia Łotwa	Poland Polska
Cereals (% of area) Zboża (% powierzchni)	–1.16	–1.02	1.32	–6.32	–8.86	–1.42	–3.21
Fodder cropping (% of area) Uprawy paszowe (% powierzchni)	–1.87	–3.09	–4.04	0.8	–0.18	0.51	2.09
Dairy Cows (% of heads) Krowy mleczne % pogłowia)	–0.085	–0.075	–0.41	–0.36	–0.31	–0.13	–0.135
Beef meat activities (% of heads) Czynności na rzecz pozyskania mięsa wołowego (% pogłowia)	–0.76	–0.97	–0.79	–3.71	–0.96	–0.98	0.16
Pigs fattening (% of heads) Tucz świń (% pogłowia)	0.23	–0.13	0.22	–2.37	–0.21	–0.59	–0.42
Pigs breeding (% of heads) Hodowla świń (% pogłowia)	0.41	–0.16	0.41	–2.25	–0.3	–1.14	–0.31
Poultry fattening (% of heads) Tucz drobiu (% pogłowia)	0.02	–0.01	0.05	–1.17	–1.42	–1.22	–0.23

Source: own calculations based on CAPRI model.
Źródło: obliczenia autorów na podstawie modelu CAPRI.

The simulated area of cultivated crops decreases resulting with supply reductions and thus price increases (see Annex, Table A1). Prices in the New Member States increase more than in the old members states. The highest increase could be observed in case of extensive cereals (rye, oats, other cereals) in the EU 10 countries. Prices of rapeseed grow at a lower rate, similar to prices of cereals in the EU 15 countries, the pattern of change is similar among all countries. There is also very little change in potato and sugar beet prices. In general, the highest increase of prices due to GREEN scenario is observed among the extensive crops with low gross margin values. This could be explained both by using the poorest land for EFA and limited possibilities of importing oats, rye and mixed cereals. It is expected that higher prices will induce a slight increase of yields (see Annex, Table A2). In the EU-10 countries the yields of cereals increase slightly more than the average of EU27 which is probably due to lower initial values.

In the old member states yields are growing in Demark, whilst in Finland and Sweden the model reports some reduction in case of selected crops. As a result of a decline in main crop areas and only minor increases in yields the changes in supply of main crops are negative (Annex, Table A3). In Poland this decline is especially pronounced in the case of cereals, reaching over 3%. An even greater loss in the supply of cereals could be observed in Estonia and Lithuania, where area of cereals production was reduced strongly. Although the production of cereals in Sweden is rising, the total supply of cereals in Baltic region is declining in the GREEN scenario. Changes of other crops production are not unidirectional. Rape, potato and sugar beet production is increasing in old Baltic EU members, whilst in the new member states, especially Poland, a decrease of supply can be observed.

AGRICULTURAL INCOMES

Increase of prices due to reductions in supply has notable impact on farm incomes. Despite a decline of the harvested area agricultural incomes are increasing, even in countries where reductions in payments occur (Fig. 2). The highest income increase might be observed in Denmark. One of the reasons might be increase of pig meat prices,

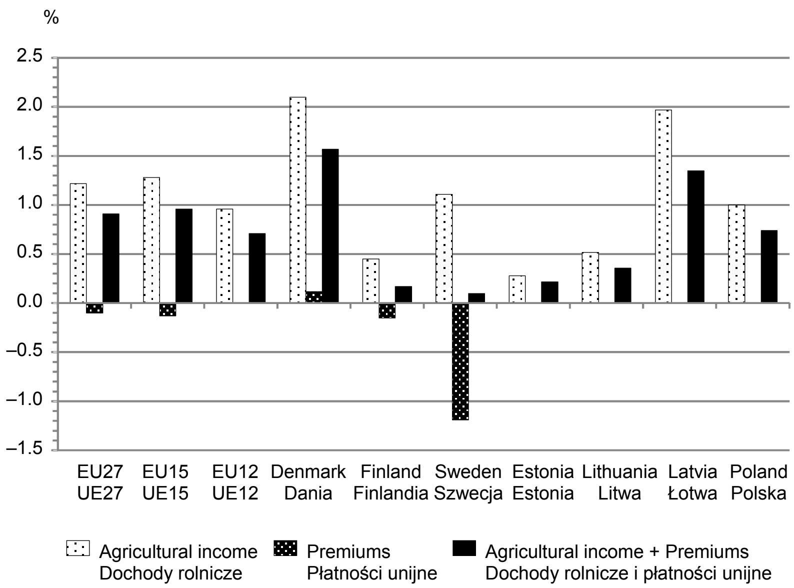

Fig. 2. Changes in agricultural incomes and premiums under the GREEN scenario in 2020
Source: own calculations based on CAPRI results.

Rys. 2. Zmiany w dochodach i płatnościach unijnych dla rolników w scenariuszu GREEN, stan na 2020 rok
Źródło: obliczenia autorów na podstawie modelu CAPRI.

whit in spite of cereals price increase is committing to higher farm income in Denmark, where pig production is more efficient than in other countries. On the other side it could be explained by price increases of crop commodities, which have the highest influence on income in regions with high yields. For comparison, it is worth mentioning, that the same effect could be observed in France, Germany and Spain, where farmers would gain mainly due to large utilised agricultural areas with high yielding potential. This is also the case in Sweden, however, the net effect is very small due to a decrease of payments.

In Latvia the increase in farm income could be explained by the low costs of introducing the GREEN scenario – EFA share increases only by 0.35%, so nearly all benefits from price increases are converted into farm income. Estonian and Lithuanian farmers who experience similar natural conditions have to cover the cost of creating the EFAs, thus their income increase is very limited. In Poland the existing share of EFA in the baseline scenario and a relatively diversified cropping structure causes revenues to grow less than in countries with intensive agriculture, and the larger part of that increase remains in the farmers' pockets.

ENVIRONMENTAL INDICATORS

Since the aim of "grening" is an improvement of the environment it could be expected that there would be larger changes in environmental indicators than for economic ones. The main CAPRI environmental indicators relevant for this study are: nitrates provided by mineral fertilisers, nitrogen surplus at soil level and global warming potential (Table 4).

The model simulations show that "grening" of the CAP has a positive impact on the first two indicators – both fertiliser use and nitrogen surpluses are lower in GREEN scenario than in the baseline. Changes in mineral fertiliser use are negatively correlated to the increase of EFA. The only exemption is Sweden, where changes in the cropping structure causes an increase of fertiliser use in spite of a growing EFA. The reason for that is decrease of animal production activities due to higher feed costs. This leads to replacing part of extensive fodder crops by more intensive cereals in cropping structure. Additionally decreasing availability of natural fertilizers increase demand for mineral substitutes.

A surplus of nitrogen (N) in soil levels is related to changes in mineral fertiliser use. In Sweden an increase use of fertiliser adds to agricultural pressure on the environment. However in Latvia, where EFA remains stable, the change in the surplus of N at the soil level is positive, the use of mineral fertiliser slightly decreases. In Poland nitrate levels caused by mineral fertilisers declined by 2%, which resulted in decline in nitrogen surplus by 0.6%. Based on other publications [Andersen et al. 2013 a, b] it should be stated that negative effect of a nitrogen surplus for Baltic Sea ecosystem is stronger in case of riparian areas with very low water retention. From this point of view increase of nitrogen surplus at soil level in Sweden and Latvia are strong arguments against proposed greening measures of the CAP.

Table 4. Environmental indicators in GREEN scenario in comparison with Baseline (MTR), in 2020
Tabela 4. Wskaźniki środowiskowe w scenariuszu GREEN w porównaniu ze scenariuszem bazowym (MTR), w 2020 roku

	GREEN scenario Scenariusz „zazielenienia”			Difference to BASELINE (%) Różnica między scenariuszami (%)		
	Nitrate (N) used on farms by mineral fertiliser Azotany (N) używane w gospodarstwach w nawozach mineralnych (kg N ha^{-1})	Nitrogen Surplus at soil level Nadwyżka azotu (N) na poziomie gleby (kg N ha^{-1})	Global warming potential (amount per ha) Potencjalne ocieplenie globalne (na ha)	Nitrate (N) Import by mineral fertiliser per ha Azotan (N). dostarczany przez nawóz mineralny/ha	Surplus at soil level per ha Nadwyżka na poziomie gleby/ha	Global warming potential per ha Potencjalne ocieplenie globalne/ha
EU 27 UE27	63.58	37.65	2 027.78	–1.67	–0.66	–0.86
Denmark Dania	73.79	65.82	4 124.17	–1.78	–0.31	–0.28
Finland Finlandia	62.16	42.25	1 643.87	–2.12	–1.33	–0.97
Sweden Szwecja	61.23	40.44	1 826.25	0.77	0.13	0.09
Estonia Estonia	49.95	21.1	1 235.44	–5.55	–1.74	–2.19
Lithuania Litwa	49.96	17.76	1 195.86	–6.82	–1.53	–2.11
Latvia Łotwa	33.72	16.54	972.03	–0.71	0.07	–0.19
Poland Polska	89.88	44.89	1 638.96	–2.1	–0.66	–0.56

Source: own calculations based on CAPRI model.
Źródło: obliczenia autorów na podstawie modelu CAPRI.

Changes in a global warming potential under the GREEN scenario are highly correlated (Pearson 0.93) with changes in nitrogen surpluses. However an exceptional high value could be observed in Denmark. This is a result of very high level of animal production, thus greening of CAP has a very limited impact in this case. Conversely an increase of EFA and a decrease in animals number in Estonia and Lithuania causes over a 2% reduction in warming potential, which shows the potential of the presented reform.

WELFARE

As discussed above, our results indicate that price increases due to reduced production might outweigh the costs of implementing the new "grening" measures. The costs of the reforms are then mainly at the expense of the consumers (measured by the money metric, as explained below). The burden of these costs is not evenly distributed between the countries, as shows Figure 3.

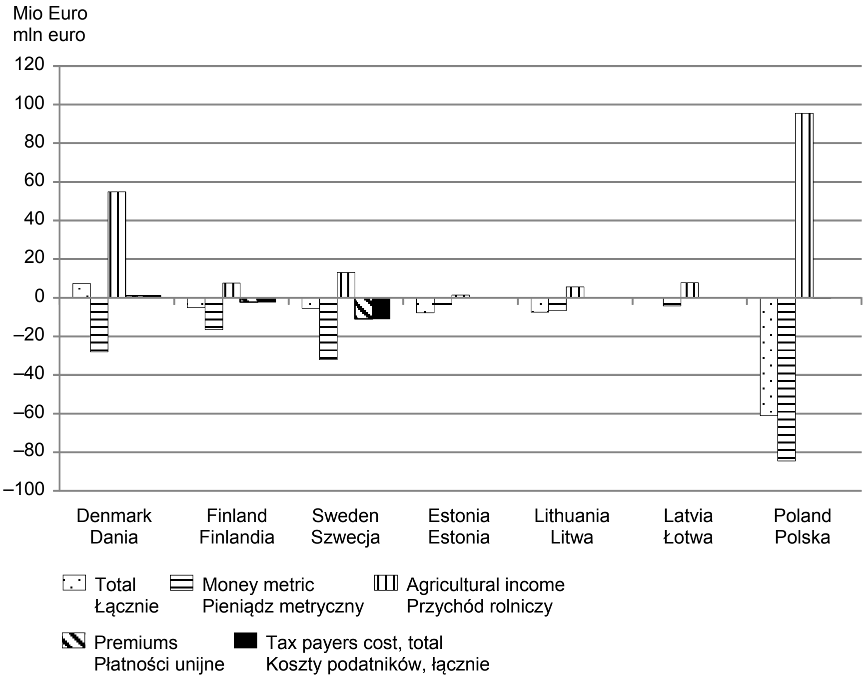

Fig. 3. Economic welfare changes due to introduction of GREEN scenario in selected countries, in 2020
*Note: Money metric is a measure of the change in consumer welfare, it shows how much money the consumer would need in GREEN scenario to be as well off as in the baseline (MTR). The negative change means a consumer welfare loss in millions of euros due to price increase.
Source: own calculations based on CAPRI model.

Rys. 3. Zmiany w dobrobycie ekonomicznym z tytułu wprowadzenia scenariusza GREEN w wybranych krajach, stan na 2020 rok
*Pieniądz metryczny jest miernikiem zmian w poziomie dobrobytu konsumentów. Pokazuje, ile pieniędzy potrzebowałby konsument w scenariuszu ZIELONYM, żeby być na poziomie dobrobytu równym temu opisanemu w scenariuszu bazowym (MTR). Negatywna zmiana oznacza stratę poziomu dobrobytu konsumenta, wyrażoną w milionach euro, uwarunkowaną wzrostem ceny.
Źródło: obliczenia autorów na podstawie modelu CAPRI.

The winners of the policy are agricultural producers located away from Baltic Sea. Farmers from France, Spain, Germany are gaining the most of the policy, and mainly due to large utilised agricultural areas with high production. Comparing the situation around the Baltic Sea the biggest winner is Denmark – the only Baltic country with positive total welfare effect of "grening" the CAP. For Latvia the net effect is neutral while the rest of the countries encounter overall economic losses. The biggest economic cost will be paid by Poland which will account for two thirds of EU-10 losses caused by "grening".

DISCUSSION

Our results for Baltic countries are largely consistent with findings presented in the literature review. The implementation of the farm scale "grening" measures in more aggregated models such as CARPI provides a challenge to avoid an aggregation bias. For permanent pasture maintenance it is not a highly relevant problem as most farms will have a tendency to reduce permanent grass lands, and such controlling of the grass land area at a farm group level gives similar results, probably, to an analysis at single farm level. That obviously does not hold for the crop diversification measure in which we used an indirect measure via the Shannon index derived from single farm records, these give more indicative results.

The highest level of uncertainty is linked to the EFA requirement, especially if farmers would be allowed to update their entitlement to include existing landscape elements such as hedge rows, rivers or streams or lines of trees. There is no data at the EU level available to quantify how much existing EFA area could be declared by farmers. This forces us to assume that farmers would need to fallow existing arable land. Especially in regions with fragmented landscapes and small plots, we would certainly overestimate the impact of the measure if entitlement would be updated. Thus, our findings delineate rather the maximum effect of that measure on production, prices, welfare and the analysed environmental indicators. Generally it can be concluded that the "grening" measures will to a certain extent only prevent a further degradation of environmental status, especially in more extensive regions were enough EFA elements could be included in the area eligible for the single farm payment.

The study is unable to analyse the global leakage effects on bio-diversity if arable lands in the riparian Baltic countries decreased. There are also some, limited price increases simulated for world markets which trigger moderate supply responses both at the extensive margin, i.e. an increase in cropped land and thus possibly reduction in managed forest or natural vegetation and at the intensive margin. This will certainly be to the detriment of bio-diversity in non-EU regions.

CONCLUSIONS

The main effect of "grening" – a measure which aims to increase the sustainability of the EU agriculture – is a reduction of arable lands, both due to an increase of fallowing land to fulfil the EFA requirements, and sharper control of grassland conversion. The arable area reduction decreases crop supply, which in turn increases prices in the EU markets. The latter leads to limited intensification effects seen by very moderate yield increases. Due to limited import substitution with domestic sales (due to the still high border protection of the EU in some key markets and the relatively inelastic demand for agricultural products, the price increase offsets the negative effects of reduced output for farmers such that in most regions agricultural income increases. This consequently means that the costs of the regulatory instruments are to a large extent carried by the final consumer in form of a higher food bill. However, compared to total consumer spending, the effect is very limited. Greening can therefore be understood as a type of supply control measure working across all agricultural sectors.

The results for the EU are adequate also for most of the Baltic countries. However due to less intensive agricultural production benefits from prices increase are lower than in other European countries. On the other hand, the cost of greening is seen to be transferred to those countries based on the number of consumers experiencing higher prices.

There are a number of general conclusions for most of Baltic countries. "Grening" measures reduce the main crops area which, despite a slight increase in yields, will cause the decline in production and increase in prices of agricultural products. The price increase is greater than the decrease in yields which, combined with a slight decrease in the production inputs, increases the income generated by the farm sector. Agricultural price increase causes a loss to the consumers, but the relative change of 0.02% in their welfare may not be noticed by them. The scenario is in the most countries virtually neutral for taxpayers.

Key environmental indicators show some improvement of the environmental status. Although "grening" of the policy helps to some extent in lowering the pressure stemming from farming onto environment, due to the reduction in the main crop areas and hence a lower input use (such as fertilisers). Only in Sweden it seems to induce a number of opposite effects, which is not favourable for Baltic Sea ecosystem. The magnitude of the impact that "grening" has on bio-diversity is not straightforwardly measured in CAPRI model so cannot be assessed more comprehensively in this study. All in all, it could be concluded that the CAP reform has limited impact on EU agriculture. It is even more limited in countries with relatively extensive agriculture. Generally it is rather unlikely that this reform would support realization of Baltic Sea Action Plan.

ANNEX

Table A1. Change in prices due to the introduction of the GREEN scenario (% in 2020)
Tabela A1. Zmiany w cenach na skutek wprowadzenia scenariusza GREEN (% w 2020 roku)

	Soft wheat Pszenica miękka	Rye and Meslin Żyto i pszenży-to	Barley Jęczmień	Oats Owies	Grain maize Kukury-dza na ziarno	Other cereals Inne zboża	Rape seed Rzepak	Potatoes Ziemnia-ki	Sugar beet Buraki cukrowe
EU 27 UE 27	1.81	2.53	1.76	1.67	1.58	1.69	1.85	0.48	0.23
EU 25 UE 25	1.91	2.53	1.79	1.72	1.67	1.68	1.8	0.53	0.23
EU 15 UE 15	1.78	2.39	1.65	0.9	1.56	0.91	1.74	0.5	0.2
EU 12 UE 12	1.87	2.56	2.17	2.3	1.61	2.43	2.03	0.49	0.29
EU 10 UE 10	2.33	2.55	2.44	2.48	1.96	2.45	1.95	0.61	0.26
Denmark Dania	1.78	1.71	1.61	0.93	1.5	0.71	1.72	0.31	–0.14
Finland Finlandia	1.79	1.71	1.62	0.93	1.5	0.71	1.72	0.31	–0.03
Sweden Szwecja	1.78	1.71	1.63	0.94	1.5	0.7	1.72	0.31	0.07
Estonia Estonia	2.3	2.57	2.36	2.39	1.95	2.39	1.93	0.37	0
Hungary Węgry	2.3	2.58	2.36	2.38	1.94	2.4	1.93	0.36	0.03
Lithuania Litwa	2.29	2.57	2.37	2.39	1.94	2.39	1.93	0.35	0.23
Latvia Łotwa	2.29	2.57	2.36	2.39	1.95	2.39	1.93	0.36	0
Poland Polska	2.3	2.57	2.37	2.39	1.95	2.39	1.93	0.37	0.28

Source: own calculations based on CAPRI model.
Źródło: obliczenia autorów na podstawie modelu CAPRI.

Table A2. Changes in yields of main crops due to the GREEN scenario (%, in 2020)
Tabela A2. Zmiany w wydajności głównych upraw na skutek wprowadzenia scenariusza GREEN (%, w 2020 roku)

	Soft wheat Pszenica miękka	Rye and Meslin Żyto i pszenży-to	Barley Jęczmień	Oats Owies	Grain maize Kukury-dza na ziarno	Other cereals Inne zboża	Rape seed Rzepak	Potatoes Ziemnia-ki	Sugar beet Buraki cukrowe
EU 27 UE 27	0.56	0.3	0.48	0.82	0.47	0.03	0.48	0.03	0.02
t/ha	6.38	3.46	4.82	3.35	7.79	4.2	3.53	35.64	74.77
EU 25 UE 25	0.66	0.3	0.47	0.78	0.66	0	0.43	0.04	0.01
EU 15 UE 15	0.49	–1.01	0.33	0.5	0.59	–1.14	0.35	–0.04	0.01
EU 12 UE 12	0.53	0.66	0.82	0.85	0.37	0.65	0.55	0.06	0.07
EU 10 UE 10	0.79	0.66	0.84	0.84	0.64	0.62	0.49	0.21	0.04
Denmark Dania	0.68	1.04	0.65	0.35	–	0.06	0.34	0.04	–0.08
Finland Finlandia	0.54	–1.11	0.48	0.37	–	0.9	0.19	–0.33	–0.02
Sweden Szwecja	–0.03	–0.6	0.81	0.28	–0.33	0.24	0.16	–0.98	0
Estonia Estonia	0.87	1.23	0.82	1.11	–	0.78	0.5	0.1	–
Lithuania Litwa	0.96	1.66	1.34	1.01	0.71	0.85	0.52	0.15	–0.11
Latvia Łotwa	0.78	0.98	0.83	0.75	–	0.71	0.43	0.07	–
Poland Polska	0.73	0.67	0.76	0.8	0.7	0.57	0.37	0.14	0.06

Source: own calculations based on CAPRI model.
Źródło: obliczenia autorów na podstawie modelu CAPRI.

Table A3. Change in main crops supply due to introduction of the GREEN scenario (%, in 2020)
Tabela A3. Zmiany w podaży głównych upraw na skutek wprowadzenia scenariusza GREEN (% w 2020 roku)

	Soft wheat Pszenica miękka	Rye and Meslin Żyto i pszenży-to	Barley Jęczmień	Oats Owies	Grain maize Kukury-dza na ziarno	Other cereals Inne zboża	Rape seed Rzepak	Potatoes Ziemnia-ki	Sugar beet Buraki cukrowe
Denmark Dania	–1.41	17.45	–1.86	8.21	–	3.43	2.5	0.64	0.93
Finland Finlandia	–1.41	17.21	–1.78	0.57	–	11.94	1.79	1.52	0.75
Sweden Szwecja	1.23	6.56	1.16	1.68	15.24	3.65	2.09	1.75	–0.09
Estonia Estonia	–4.57	–12.85	–2.65	–6.46	–	–1.02	–1.96	–0.62	–
Lithuania Litwa	–5.45	–26.64	–11.25	–8.98	–4.49	–3.03	–2.92	–2.57	–0.98
Latvia Łotwa	–1.74	4.16	0.67	0.53	–	1.56	–0.04	0.25	–
Poland Polska	–2.59	–2.4	–2.18	–2.51	–2.14	–3.05	–0.92	–1.24	–0.7

Source: own calculations based on CAPRI model.
Źródło: obliczenia autorów na podstawie modelu CAPRI.

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WPŁYW „ZAZIELENIENIA" WSPÓLNEJ POLITYKI ROLNEJ NA ZRÓWNOWAŻENIE EUROPEJSKIEGO ROLNICTWA: Z PERSPEKTYWY KRAJÓW BAŁTYCKICH

Streszczenie. Artykuł analizuje potencjalny wpływ reformy Wspólnej Polityki Rolnej (WPR) Unii Europejskiej wprowadzonej w perspektywie budżetowej 2014-2020 w wybranym aspekcie noszącym nazwę „zazielenienie WPR". Jego celem jest poprawa oddziaływania rolnictwa na środowisko i jednocześnie zapewnienie jemu zrównoważonego rozwoju. Reforma wprowadza nowe wymogi pro-środowiskowe, które europejscy rolnicy muszą spełniać, aby otrzymywać płatności bezpośrednie w ramach I filara WPR. Posługując się znanym modelem CAPRI wraz z jego nowym rozszerzeniem o regionalne modele równowagi ogólnej, zostały policzone potencjalne konsekwencje ekonomiczne i środowiskowe tejże reformy dla rolnictwa. Obliczenia zostały przeprowadzane dla wybranych krajów, które podpisały tzw. Bałtycki Plan Działania Komisji Helsińskiej (BSAP), tj. ambitny program mający na celu przywrócenie dobrego stanu środowiska morskiego Bałtyku do 2021 roku. Przeprowadzona analiza kontrfaktualna dotyczyła potencjalnego wpływu tej reformy dla rolnictwa w aspekcie ekonomicznym i środowiskowym w porównaniu ze scenariuszem bazowym do 2020 roku. Wyniki wskazują na to, że „zazielenienie" spowoduje spadek powierzchni głównych upraw, wzrost ich cen oraz nieznaczną intensyfikację produkcji na pozostałych obszarach. Dochody będą rosnąć, ale z powodu niskiej intensywności rolnictwa w krajach bałtyckich wzrost ten będzie raczej ograniczony.

Słowa kluczowe: „zazielenienie", zrównoważone rolnictwo, reforma wspólnej polityki rolnej, model CAPRI, rolnictwo krajów bałtyckich

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