Climate mitigation policy options: modelling the potential impact on agriculture of Poland

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Abstract

Achievement of climate neutrality in agricultural sector is becoming increasingly important and difficult. Importance is driven from the fact of the ongoing global warming and the share of agriculture in the negative anthropogenic impact upon the environment, while agriculture itself is expected to suffer intense negative impact of the climate change processes through increased occurrence and strength of extreme weather events, shifts in vegetation patterns, and thus - drastic changes in farming specialisations and production capacities of particular countries and regions. Under these conditions, it is also becoming increasingly difficult to maintain the necessary yields and production outputs, and thus contributing to achievement of global and regional food security. A balance needs to be ensured and maintained, which would allow efficient merger of environmental protection (including climate mitigation) and food security goals.

The conducted study aims to analyse the possible directions of transformation in agricultural sector of Poland, based on current climate policy and future potential development scenarios. These scenarios are a continuation of earlier analyses carried out by the LIFE Climate CAKE PL project[1] team and presented in the document "Poland net-zero 2050: The roadmap toward achievement of the EU climate policy goals in Poland by 2050" (Pyrka et al., 2021a and 2021b). The modelling toolbox utilised for the analyses includes a set of interconnected models, among which are: the core d-PLACE model (Boratyński et al., 2022) – a global computable general equilibrium (CGE), as well as three sectoral models: MEESA for energy (Tatarewicz et al., 2022), TR^{3}E for transport (Rabiega et al., 2022), and EPICA for agriculture (Wąs et al., 2022).

The paper attempts to assess possible variants of implementation of restrictions resulting from the climate policy on the economic and organizational aspects of the farm sector in Poland in the 2050 perspective, as well as to verify the possibility of fulfilling GHG reduction commitments in the Polish agricultural sector in accordance with the assumptions of the European Green Deal and draft legislation contained within the Fit for 55 package.

Thus, two key policy scenarios are modelled, while within each of them four policy options are being analysed (reflecting varying measures to achieve the goals within the policy scenarios). The two scenarios include: 1) NEU, reflecting implementation of the reduction target for agriculture established as a result of the iterative procedure of the sectoral models and the d-PLACE model, using a set of currently used production activities and techniques; 2) NEU+, assuming application of additional measures reducing GHG emissions in the agricultural sector, which are, i.a. a) the use of afforestation on agricultural land, b) raising the level of groundwater on utilised organic soils, and c) use of biogas plants to reduce GHG emissions from manure management.

Agriculture, especially in Poland, is a sector of economy characterised by low level of concentration and is being systematically supported within the EU's Common Agricultural Policy. Agriculture also performs crucial social functions, both as a provider of food and employment for hundreds of thousands of inhabitants in rural areas. For this reason, instruments leading to the achievement of the

[1] The project "The system of providing and disseminating information in order to support the strategic implementation of climate policy (LIFE Climate CAKE PL, https://climatecake.ios.edu.pl/life-climate-cake-pl-project/?lang=en)" is co-financed from the EU LIFE programme and the resources of the National Fund for Environmental Protection and Water Management.

reduction target should be carefully selected. Thus, achievement of potential climate effects from each of the two aforementioned policy scenarios for agricultural sector of Poland were analysed within the following policy options: 1) GHG emission fees based on carbon pricing (CPRICE), 2) administrative limits for GHG emissions at farm level (LIM), 3) subsidies for GHG emission reduction at farm level (SUBS), and 4) a combination of the two latter approaches (MIX).

Modelling results show that all defined policy scenarios and options for their achievement allow for gradual reduction of greenhouse gas emissions from Polish agriculture, reaching 9.3 Mt $CO_{2\ eq.}$ by 2050, thus manifesting a 70% reduction compared to the model baseline of 2015 (30.8 Mt $CO_{2\ eq.}$). The only exception is the CPRICE policy option within the NEU+ scenario, which allows lowering the GHG emissions all the way to 0.4 Mt $CO_{2\ eq.}$

While within the NEU scenario implemented in the current analysis changes in utilised agricultural area (UAA) are not being traced, application of defined additional farming practices (afforestation, watering the organic soils, development of biogas plants) is expected to lead to reduction in UAA by 14.8% in the NEU+ LIM policy option, by ca. 22% in NEU+ MIX and SUBS options, and to the greatest extent – in the NEU+ CPRICE policy option – by 25%. The latter is due to the high taxation of the GHG emissions and increased farmer motivation to turn to these additional farming practices instead of continuing cultivating these areas under crops.

Key conclusion arising from all the tested policy options within both scenarios – production volumes will decline and food prices are expected to increase. Decline in agriculture production is caused by farmer motivation to avoid carbon taxation and optimise farming activities to achieve highest income. Growth of food prices is originated both from supply-demand relation, as well as by increased costs of agri-food production. Yet, the depths of these changes will differ depending on the way of implementation, namely the approach adopted within a particular policy option. The NEU+ scenario overall allows keeping higher production volumes compared to NEU, with the least decline within the mixed policy approach (NEU+ MIX), which simultaneously utilises GHG emission limits and subsidies. In this case the output volumes by 2050 decline only by 17%. While the use of subsidisation of farm emission reduction (NEU+ SUBS) leads to decline in production by 33%, and the most drastic decline is foreseeable in case of carbon pricing implementation (NEU+ CPRICE) – by 44%. Average prices of agricultural commodities, on the other hand, increase the most in case of NEU+ CPRICE policy option – by 85%, and the least in NEU+ LIM and SUBS options – 40% and 41% accordingly. In the NEU scenario, prices' growth is higher compared to any of the NEU+ policy options.

Conclusions show that the use of additional instruments limiting the GHG emissions from agriculture strongly aids the achievement of climate mitigation goals, while allowing less drastic impact upon the structure of agricultural sector and its output, thus easing the potential burden placed on the society/consumers.

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