Potentials to reduce pesticides with an ECO-Scheme – the case of Baden-Württemberg

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***Abstract* - Chemical synthetic plant protection products (CSPs) are increasingly viewed critically by the public. Germany therefore introduces an ECO-Scheme for the abandonment of CSPs within the framework of the CAP 2023. The one-year abandonment of chemical-synthetic plant protection is to be rewarded up to 130 €/ha in certain crops. We analyse the expected application of the ECO-Scheme in Baden-Württemberg on the basis of an economic geodata-based land use model under two different price scenarios. We find that implementation of the ECO-Scheme is highly sensitive to the scenarios. It is applied to a maximum of 23% of conventional arable land under price scenario 1. At the high price scenario 2, reflecting spring 2022, this value is significantly lower with up to 11%. Spring cereals are a beneficiary of the ECO-Scheme. The reduction of CSPs measured with the treatment frequency index is under-proportional, with 8-13% in the first scenario. Hence, the contribution to the reduction of CSPs is questionable. Further steps should also consider biodiversity effects under different landscape configurations, for which the model is predestined due to its high spatial resolution.**

INTRODUCTION AND RESEARCH QUESTION

Chemical synthetic plant protection products (CSPs) are increasingly viewed critically by the public. Therefore, Germany is introducing an ECO-Scheme in the course of the Common Agricultural Policy (CAP) 2023 to abandon the use of CSPs for a one year period. Generally this refers to the term from January to the end of August; plant protection products with approval in organic farming are exempt. The ECO-Scheme is available for the following crops rewarded with 130 €/ha: root crops, summer cereals, corn, summer oilseeds, legumes and field vegetables. In permanent crops, for grass and green fodder, the payment is 50€/ha. Payments in the first group are to decrease to 120 €/ha in 2024 and 110 €/ha in subsequent years. The paper analyses to what extent this ECO-Scheme could be implemented on arable land in Baden-Württemberg (BW) and how it impacts the reduction of CSPs, depending on premium levels and price scenarios. BW aims to reduce the use of CSPs by 40-50% by 2030 (Land Baden-Württemberg 2020). BW is located in the southwest of Germany and has about 730.000 ha of conventional arable land.

METHOD AND DATA

We apply a mixed-integer programming model. The model maximizes the total gross margin by selecting a crop rotation at field level, determining whether and in how many crops in the rotation the ECO-Scheme is implemented. The data on fields are stem from the Integrated Administration and Control System (InVeKoS). The crop rotations are derived using CropRota (Schönhart et al. 2011) based on the proportions of crops in the municipality (LAU2 level). All fields used for conventional arable farming in 2021 are considered. The rotations include the following crops: winter wheat, winter barley, sugar beets, silage and grain maize, winter rapeseed, arable and clover grass, summer barley, oats and potatoes. They accounted for 81% of the considered area in 2021. The model uses various restrictions at the LAU2 level (Table 1).

Table 1 Overview of the constrains at the LAU2-level

Activities	Constraints
Sugar beet, silage maize, potatoes	No increase vs. 2021
Corn maize	≤100% increase vs.2021
Available labour force (in hours)	No increase vs. 2021
Produced Feed (Getreideeinheiten)	No decrease vs. 2021

The total labour force is based on the crops grown in 2021 and calculation data from LEL (2021). The gross margins and yield levels are also derived from calculation data (LEL 2021). Each field was assigned one of three yield levels based on the Flurbilanzkarte, which divides the land into four categories depending on soil quality and slope. The lower two are aggregated. It does not cover all LAU2 areas completely. Hence, 5.2% of the conventional arable land are not considered. Table 2 shows the assumed yield losses when CSPSs are not used. They are based on the assumptions of Röder et al. (2021) and field trials from the NOcsPS project (https://nocsps.uni-hohenheim.de). Gross margins include costs for mechanical weed control when no CSPs are used. Fertilizer costs are calculated after withdrawal and are reduced accordingly if no CSPs are used.

Table 2 Assumed yield loss affiliated with not using CSPSs.

Crop	Yield loss
Grass	5%
Maize	15%
Oat	20%
Potato	50%
Sugar beet	40%
Summer barley	20%

A scenario based on three-year calculation data (2018-2020) from the LEL and a scenario based on the high price level in spring 2022 are considered. The price increases, shown in Table 3, are based on LfL (2022) forecasts for the harvest of 2022, as well as price differences of current forward contracts compared to the three-year average of 2018-20.

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Table 3 Core Assumptions in the higher price scenario.

Input/Output	Price chance
Silage maize, sugar beet, grass	+20%
Grain, corn maize	+50%
Rapeseed	+100%
Nitrogen fertilizer	+300%
Phosphorus fertilizer	+265%
Potassium fertilizer	+160%
Diesel	+75%
Pesticides	+25%

Results

Figure 1 shows the share of conventional arable land on which the ECO-Scheme is applied, depending on the payment level. At 130 €/ha, the ECO-Scheme is implemented on about 23% of the area. However, the results also show that a reduction in the payment level, as intended, would result in a disproportionate reduction in application. At 110 €/ha, the expected share drops to 13%.

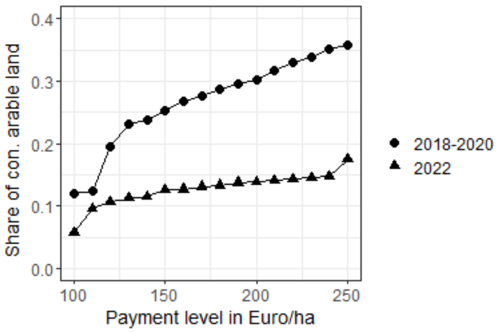

Figure 1 Percentage of arable land in BW used for the ECO-Scheme depending on the amount of the payment per ha

Implementation is lower in the second scenario and amounts to 11% at 130 €/ha or only 9.5% at 110 €/ha. Figure 2 shows the shift in crop shares depending on the payment level in the first scenario. In general, the ECO-Scheme mainly increases the cultivation of spring cereals. Root crops, which are also eligible for payments, can hardly benefit. Winter cereals lose the most significant area shares.

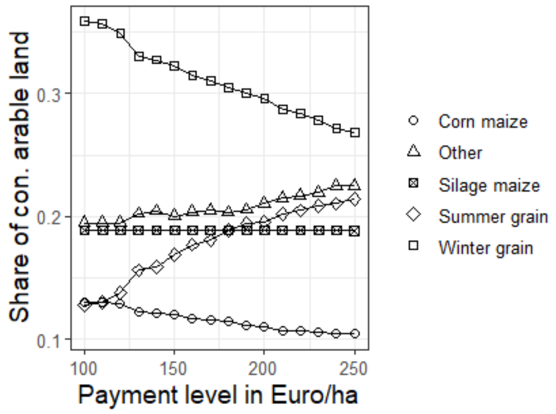

Figure 2 Percentage of arable land in BW used for different crops depending on the amount of the payment per ha

CSPs intensive crops are more likely not to be substituted. Thus, the reduction of CSPs is under-proportional to the area used for the ECO-Scheme. In scenario 1 at 130 €/ha, the treatment frequency index (TFI) is reduced only by 13%. At 110 €/ha, the total TFI is 8% lower than in the baseline.

Discussion

The analyses show that the application of the ECO-Scheme is possible on a significant area. But its contribution to the reduction of CSPs is questionable. Furthermore, the implementation is price sensitive. However, some limitations of the model approach should be considered when interpreting the results. This applies to system boundaries and the decision level of the model. In reality the application of the ECO-Scheme is subject to restrictions on the farm level, which are reflected in a simplified manner by restrictions on the LAU2 level. The present c. p. consideration also does not account for a possible increase in organic farming or an opt-out from direct payments by farmers. Non-economic motivations as well as acceptance by farmers are not considered Additional risks due to possible higher yield variations of the non-use of CSPs could limit acceptance of risk averse farmers and therefore lead to a considerable reduction in the actual application of the ECO-scheme. Subsequent questions are possible ecosystem services, especially a higher biodiversity, which could follow from a CSPs abandonment and reduced nitrogen fertilizing. However, biodiversity effects strongly depend on the landscape configuration (Tscharntke et al. 2005). So spatial distribution of the ECO-Scheme would matter. This and other metrics for CSPs reduction, especially in terms of risks to humans and the environment, could be assessed using our model in the following steps.

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