

## Extended Abstract

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<b>Paper/Poster Title</b>	<b>Implementing the Green Deal in EU agriculture: Metamodeling the CAPRI model to derive optimal policies</b>
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**Abstract prepared for presentation at the 98th Annual Conference of The Agricultural Economics Society will be held at The University of Edinburgh, UK, 18th - 20th March 2024.**

<b>Abstract</b>	<i>200 words max</i>
<p>The European Green Deal has been designed to transform the European economy to become climate neutral, modern and resource-efficient. To reach the goals in the agricultural sector, the Farm To Fork Strategy has been proposed in May 2020 and is still heavily disputed. As previous research has shown, if implemented as proposed, the Farm To Fork Strategy in connection with the Biodiversity Strategy will have far reaching impacts on the economy and environment not only in Europe but worldwide. Consequently, we aim to fill the research gap in finding alternative, optimal policies that reach the same goals more efficiently than the Farm To Fork Strategy. The results show that the optimal policy set differs from the Farm To Fork Strategy not only in scope but also in the choice of the policy measures. Further, a compromise among EU member states could be realized fairly easily as member states specific optimal policy sets are akin.</p>	
<b>Keywords</b>	Green Deal, Farm To Fork Strategy, Biodiversity Strategy, Metamodeling, Optimisation
<b>JEL Code</b>	Q180 Agricultural Policy
<b>Introduction</b>	<i>100 – 250 words</i>
<p>The Green Deal is Europe's new growth strategy to become the first climate-neutral continent by 2050 and transform its economy to become modern, resource-efficient and competitive. Yet, an effective implementation of the European Green Deal appears to be heavily disputed within and across EU-member states. The Farm To Fork Strategy is designed to implement the goals of the Green Deal in the agricultural sector and defined by the following production restrictions: reduction of mineral fertilizer use by 20%, reduction of pesticide use by 50%, reduction of nitrogen surplus by 50%, share of set-aside are of at least 10% of UAA, share of organic farming of at least 25% of UAA. As previous research has shown, the Farm To Fork Strategy will have drastic impacts if implemented as proposed. Consequently, the question arises whether there are alternative policies to the Farm To Fork Strategy that will reach the same goals more efficiently. Therefore, the objective of this paper is to derive optimal policies for implementing the Green Deal in EU agriculture.</p>	

<b>Methodology</b>	<i>100 – 250 words</i>
<p>The Common Agricultural Policy Regionalised Impact (CAPRI) model is a regional partial equilibrium model focused on the European agricultural sector. It has been used intensively in the past 20 years to analyse the impacts of policies on the economy and environment as it allows for detailed impact assessment in response to policy shocks on a low regional level.</p> <p>Yet, to find an optimal policy, thousands of different scenarios, i.e., combinations of policy measures in various extents, would have to be analysed to pick the one with the most favourable outcomes. Due to the tremendous computational and time resources this approach requires it is not feasible. Instead, we use metamodeling to derive a surrogate model of the original CAPRI model which is much smaller and solves virtually instantly, yet keeps the core relations. As this results also in an analytical form of the model, we apply standard optimization techniques to derive an optimal set of policies to implement the Green Deal goals in the agricultural sector most favourably. In brief, we maximize the weighted sum of ecological and economic indicators to derive policies which realize the Green Deal goals efficiently.</p> <p>As the optimal results may differ for each member state, we do not only optimize from a common EU perspective but from the perspective of each member state to take the decision-making process in the EU in to account.</p>	
<b>Results</b>	<i>100 – 250 words</i>
<p>In addition to the policy measures of the Farm To Fork Strategy, we introduce a price on CO2 emissions in the agricultural sector which has already been introduced in other sectors such as energy and industry. To start with, the metamodels have to be analysed regarding their validity to ensure meaningful results. The central validation criteria (RMSE, AER, Rsquared) suggest a high model validity. Further, we analyse the impact of each policy measure on ecological and economic model outcomes, e.g., water quality, GHG emissions and welfare. Moreover, the optimisation results show that the optimal policy set differs in the selection and scope of policy measures from the Farm To Fork Strategy. As we may also determine the economic and ecologic outcomes of each policy set, we can show that the optimal policy set outperforms the Farm To Fork Strategy set in terms of efficiency and effectivity. The optimisations from the perspective of each EU member state further suggest that a compromise among member states could be reached as the ideal policy sets are akin.</p>	
<b>Discussion and Conclusion</b>	<i>100 – 250 words</i>
<p>The objective of this paper is to derive optimal polices to reach the goals of the Green Deal in the EU agriculture which are more efficient and/or effective than the Farm To Fork Strategy proposed by the European Commission. As the results show, the optimal policies differ from the Farm To Fork Strategy not only in the scale but also in the choice of policy measures. The economic and ecological impacts of the optimal policies are more favourable than those of the Farm To Fork Strategy. Consequently, the Farm To Fork Strategy should be revised.</p> <p>Further research could take member states specific willingness-to-pay for ecological services into account as the importance of environmental protection could differ between EU member states.</p>	