All-encompassing analysis of reaching food waste reduction targets: A model-based assessment of reducing food waste in the EU

Introduction

The Farm to Fork Strategy adopted as part of the European Green Deal aims to accelerate the transition to a sustainable food system by reducing the environmental and climate footprint of the EU food system and by facilitating the shift to healthy and sustainable diets (European Commission, 2020). The Strategy also addresses food waste generation, and includes a target to halve per capita food waste at the retail and consumer levels by 2030. This goal is also in line with the Sustainable Development Goals (SDGs) target 12.3.

With this exercise, we aim to explore the impacts of a set of food waste reduction scenarios throughout the whole supply chain in the EU member states (MSs). We assess the economy wide impacts of food waste reduction at different stages of the supply chain and with different target levels. In our lowest target scenario, we assume a target of 15% food waste at the retail and distribution and household level, and 10% reduction at the processing level. Our highest target scenario assumes halving food waste at the retail and distribution and household level, 25% reduction at the processing level, and adds a target of 10% for the primary production sector. In our results, we focus on a set of sustainability aspects to analyse economic, social and environmental impacts of food waste reduction. We also aim to highlight the impact of possible rebound effects through the interlinkages of different markets.

Methodology

This study employs and further extends the Modular Applied GeNeral Equilibrium Tool (MAGNET). MAGNET is an economy-wide dynamic global computable general equilibrium (CGE) simulation model (Woltjer and Kuiper, 2014), and it is built on the Global Trade Analysis Project (GTAP) model and data structure. One of the key specifications of MAGNET is its modular design, and multiple adaptions and extensions can be added to the model. For the assessment of food waste reduction at both the industry and the consumption side, the model is further extended with an advanced waste module (Bartelings et al., 2021). With the extended module, waste generation along the full supply chain from primary production to processing, retail and consumption is considered. Then, the targeted food waste reductions are simulated by increasing the cost of generating waste.

For this study, version 10 of the GTAP database with a benchmark year of 2014 and completed with 65 tradable sectors, eight primary factors and 141 regions, is used (Aguiar *et al.*, 2019). Food waste amounts for Member States are taken from ESTAT (2022) and are disaggregated to the product level by using the Material Flow Analysis model developed by Joint Research Center of the European Commission (De Laurentis et al. 2021).

The baseline follows the time path from 2014 to 2030, and assumes a continuation of current policies, regulations, and market trends on the future situation of the wider bioeconomy. The European Commission's Global Energy and Climate Outlook reference is used for the baseline shocks (Keramidas et al., 2021).

Results

The highest gains from food waste reduction occur at the household level as more than 60% of food waste is generated at the household level. Given the smaller share of total food waste attributed to production, processing and the retail stages of the supply chain, their reductions of food waste at these stages have more limited impacts. At the sector level, largest reductions in food waste are expected to happen in sectors where food waste generation is the highest at the household level such as vegetables and fruits sector, which constitute over 40% of food waste by households.

From an economic perspective, food waste reduction at the consumer level decreases the demand as more food now can be recovered for human consumption. This demand changes are reflected in slight production and price drops. On the other hand, food waste reduction in general is leading to an improvement in EU's agrifood trade balance due to increasing exports of the EU for the products that local demand is decreasing such as horticulture sector. Overall, food waste reduction scenarios have marginal macroeconomic impact on the real GDP of the EU and non-EU countries. Even in the most advanced reduction target scenario, reductions don't exceed more than 0.02% for the EU. In general, market impacts of food waste reduction increase with higher target rates of food waste reduction.

From a social perspective, reducing food waste generally leads to a decrease in employment in the agrifood sector. The magnitude of the decrease depends on the level of the food waste reduction target; however, it does not exceed 4% in the most advanced scenario. While the overall income remains unchanged, with food waste reduction we observe decrease in farm income due to lost demand.

At the environmental side, our results show that reducing food waste, at any stage of food supply chain have significant positive environmental impacts - emissions in particularly in agrifood and waste treatment decrease. However, increase in emissions in the rest of the economy is observed due to rising non-food expenditure as rebound effect. Our scenarios also lead to a reduction of the land footprint associated with household food consumptions of the EU and of all MSs, while it leads to an increase of the land footprint in non-EU region.

Conclusion

Food waste is a global problem that occurs at all stages of the food supply chain. At the moment, total food waste generated in the EU nearly amounts to 57 million tons (ESTAT, 2022). Finding the optimal reduction rates are difficult, and there are trade-offs that come with food waste reduction that entail costs both to the industry and the consumers. While environmental gains from reducing food waste are significant, some negative impacts on the economy are possible. Hence, an all-encompassing assessment of reaching food waste reduction targets are necessary for a thorough cost-benefit analysis.

References

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