Sustainable Agriculture for a Sustainable Food System: A discussion of synergies and trade-offs within the SDGs framework



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Introduction

In this article, sustainable agriculture for a transition to a sustainable global food system will be explored and positioned in the Sustainable Development Goals framework. The prime question is – ***How realistic is the path to sustainable agriculture?*** Possible synergies and trade-offs in the achievement of the SDGs are shown in an analysis. In the following, the potential of sustainable agriculture for global food system transitions will be looked at, as well as its embeddedness

with the SDG framework unravelled.

The current food system is responsible for one-third of greenhouse gas emissions, which is mostly ascribed to agricultural production (Vermeulen, Campbell & Ingram, 2012). The target of keeping the global temperature to 1.5 C above preindustrial levels set in the Paris Agreement can only be achieved if greenhouse gases emitted in the food system are reduced drastically (Clark et al., 2020). The key problems to be faced are the urgency of advancing in the achievement of Sustainable Development Goal (SDG) 13 – Climate Action while simultaneously progressing in other SDGs, especially SDG 2 – Zero Hunger. One of the promising solutions for actions that promote synergies between these two goals is sustainable agriculture. This approach strives to enhance or maximise the food production to meet the needs of a growing population while being resource-saving and safeguarding the soil's capacity to regenerate and maintain high biological quality. ***But how realistic is the path to sustainable agriculture and will it be enough to meet the needs of future generations while avoiding heating up the planet even further?***

Conceptual Background

According to the study of Piñeiro et al. (2020), the aim of sustainable agricultural policies is to ensure environmental sustainability and farm productivity. The authors draw a direct positive link from implementing sustainable agriculture to several SDGs. Despite these positive synergies stemming from the introduction of sustainable agriculture, one must closely observe possible negative consequences on other SDGs resulting from the practices of sustainable agriculture and how these affect the achievement of other SDGs.

Rockström et al. (2017) argue that it needs a paradigm shift towards sustainable intensification of agriculture to sustain the growing human needs and develop resilience in the face of a changing climate. However, a shift towards sustainable intensification of agriculture entails technological challenges, linking to SDG 7 – Industry, Innovation and Infrastructure. According to Campbell, Hansen, Rioux, Stirling and Twomlow (2018), SDG 12 – Responsible consumption and production plays a key role in balancing out trade-offs and building synergies between SDGs.

In all research, the need for sustainable transitions in food systems is unquestioned, however, approaches and their emphasis on how to achieve and

progress towards it remain various. It needs more than sustainable agriculture to achieve sustainable food systems and it needs simultaneous progress in some SDGs to advance in SDG 2 and SDG 13. The system must be designed in a way that advancements in SDG 2 or 13 support the achievement of SDG 2 or 13, while not impeding the achievement of others.

Analysis

This section presents three measures for sustainable food systems, which were defined and categorised into the synergies – positive outcomes for SDGs associated with the factor and into trade-offs – negative outcomes for SDGs associated with the factor. These are assumptions made based on literature findings and hypothesis. The tables shown do not claim to be exhaustive. This presents further research opportunities.

Dietary changes towards a plant-based diet

Only adopting a plant- rich diet globally would account for a 50% chance of achieving the limit of 1.5 C temperature increase according to the study of Clark et al. (2020). Table 1 shows the possible and expected positive and negative outcomes of implementing a global plant-based diet. This choice of diet is likely to have a positive impact on the achievement of SDG 3 and SDGs 13, 14 and 15 due to a decrease in meat production, which is a major emitter of greenhouse gas emissions. A dietary change to this extent would on the other hand possibly have temporary negative impacts on SDG 8 caused by the changing requirements in the meat industry. Most importantly, the feasibility of such a global diet is questionable and might even have negative implications for SDG 2 in some geographical spheres. The agricultural land conditions and capacities in such contexts imply that they can hardly be used for plant production. Removing meat and fish from the diets can have negative impacts on food security and the health of household members.

Table 1: Synergies and Trade-offs among SDGs in Diet Change

Synergies		Trade-offs	
3 GOOD HEALTH AND WELL-BEING	Better health (Federal Center for Nutrition, 2021)	2 ZERO HUNGER	Feasibility of plant-based diet not given in all geographic contexts → could lead to (temporary) food insecurity (Tagesschau, 2020)
6 CLEAN WATER AND SANITATION	Decrease in meat production → Less water resources needed or polluted	8 DECENT WORK AND ECONOMIC GROWTH	Changed employment requirements → training required → costs
12 RESPONSIBLE CONSUMPTION AND PRODUCTION	Questionable: Dependent on how food is produced, packaged and consumed More biological waste due to increase in consumed plants	12 RESPONSIBLE CONSUMPTION AND PRODUCTION	Shift in food production, possibly increased import of fruits and vegetables to meet the growing demand → GHG emissions
13 CLIMATE ACTION	Less animal feed, more green spaces, less GHG emissions	13 CLIMATE ACTION 15 LIFE ON LAND	Risk of monocultures due to increased demand in plant products
14 LIFE BELOW WATER	Less fish consumption → lower risk of overfishing		
15 LIFE ON LAND	Less meat consumption → lower risk of animal abuse		

Agricultural precision through optimal nitrogen use

SDG 12 plays a crucial role in the identification and implementation of optimal nitrogen levels in agriculture (Campbell et al., 2018). If an optimal amount can be identified and applied, this has major positive effects for various SDGs (Table 2). In Sub-Saharan Africa, nitrogen use must be increased to come to better agricultural yields and in other spaces like Europe, nitrogen use must be reduced to avoid groundwater contamination, soil acidification, degradation, and loss of biodiversity (Campbell et al., 2018). In this example, the synergies clearly outweigh the trade-offs, however, the same question applies here as above. How feasible is the implementation of optimal nitrogen amounts?

Table 2: Synergies and Trade-offs among SDGs in Nitrogen Use

Synergies		Trade-offs	
12	KEY SDG: The sustainable production leads to the identification and implementation of the optimal amount of N (Campbell et al., 2018)	4 8	More education, training and capital needed Feasibility? How do we assess the optimal N use?
1	More N use in Sub Saharan Africa → increased yields, less soil nutrient mining (Campbell et al., 2018)		Risk for  if optimal N amount cannot be defined or implemented
2	More N use in SSA → increased yields, less soil nutrient mining (Campbell et al., 2018)		
3	More N use in SSA → increased yields, less soil nutrient mining (Campbell et al., 2018)		
6	Less N use in Europe → Less groundwater contamination (Campbell et al., 2018)		
13	Less N use in Europe → Less soil acidification and degradation, more biodiversity (Campbell et al., 2018)		
14	Less N use in Europe → Less eutrophication of freshwater and ecosystems, more biodiversity (Campbell et al., 2018)		
15	Less N use in Europe → Less soil acidification, and degradation, less atmospheric pollution (Campbell et al., 2018)		

Agricultural precision through closing yield gaps

Agricultural efficiency can likewise be obtained by closing yield gaps, improving crop genetics, and implementing agronomic practices (Clark et al., 2019). In Table 3, one can see that the potential synergies resulting from the implementation of this approach outweigh the potential trade-offs by far. Precision farming and improved crop genetics can lead to more yields, which supports the achievement of SDGs 1, 2 and 3. Furthermore, crop genetics can be modified to be needing less water resources, which has positive implications for SDG 6 and 13. In the achievement of SDG 15, trade-offs could be identified. Genetically modifying crops entails a risk for the natural biodiversity outside the farm space. Crops' genes are known to get mixed through winds between modified and unmodified farmlands.

Table 3: Synergies and Trade-offs among SDGs in Closing Yield Gaps

Synergies		Trade-offs	
1 NO POVERTY	More yields → more food security (Clark et al., 2019)	15 LIFE ON LAND	Modified crop genetics intervene in the natural ecosystem, loss of biodiversity is a risk
2 ZERO HUNGER	More yields → more food security (Clark et al., 2019)		
3 GOOD HEALTH AND WELL-BEING	More yields → more food security, better health (Clark et al., 2019)		
6 CLEAN WATER AND SANITATION	Crop genetics modified to require less water resources → saving water resources (Rockström et al., 2017)		
13 CLIMATE ACTION	Same amounts of crops on less ha agricultural land, more efficiency		

Conclusion

Drawing a line back to the research question, it becomes apparent that sustainable agriculture must be a driver in the transition to sustainable food systems, however that its potential should not be overrated, or its feasibility challenges underestimated. No approach in sustainable agriculture or in any other field is without trade-offs. It is about identifying those trade-offs and internalising the outcomes so that all negative impact on the achievement of SDGs can be dealt with.

On a closing note, it is suggested that more attention is paid to the negative effects of interventions in agriculture and to form more efficient policies and create more holistic, sound systems. There is no one size fits all method, which can lead the way to sustainable food systems, however, small and carefully made steps in consumption and production changes will constitute the sustainable transition.

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