



Choices and dilemmas on the way to sustainable food systems

How can trade-offs and synergies in food system transition processes be assessed in co-creation with stakeholders? Deriving lessons from three practical cases

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This report is a synthesis of qualitative assessment of trade-offs and synergies in food system transition pathways in dairy sector in Bangladesh and Ethiopia, and charcoal production in Ghana. Applying transition pathway approaches to these case studies shows that stakeholders participation is essential to assessment of trade-offs and synergies in food systems transition pathways, and it is context-specific as the indicators are pathway dependent. Qualitative assessment of trade-offs and synergies as in this study can be strengthened with quantitative indicators in order to better inform decision making.

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Summary

Transformation of food systems in low-and middle-income countries is indispensable for food and nutrition security. To transform the food systems, transition pathways approach can be applied to engage stakeholders in getting to the desired future food outcomes. Inherent in these food system transition pathways are trade-offs and synergies within or between different dimensions of sustainability (social, environmental, economic); between different temporal and spatial scales; and between different types of actors. Understanding and assessment of these trade-offs are important to development of sustainable and healthy food systems. The objective of this study was to co-create a methodology with stakeholders to identify and assess trade-offs and synergies in transition pathways affecting the dairy sector in Bangladesh and in Ethiopia, and charcoal production in Ghana, moving towards sustainable and healthy food systems. Applying transition pathway approaches to these case studies shows that stakeholders participation is essential to assessment of trade-offs and synergies in food systems transition pathways, and it is context-specific as the indicators are pathway dependent. The results also demonstrates the necessity of holistic approach to address all the food system outcomes. Besides, qualitative assessment of trade-offs and synergies as in this study can be strengthened with quantitative indicators in order to better inform decision making.



1 Introduction

Understanding trade-offs and synergies is of paramount importance for the reorientation towards sustainable, healthy and inclusive food systems.

Food system transitions include a wide variety of domains and actions, each with potential positive or negative impacts on other domains and actions. There are diverse ways to assess these trade-offs and synergies of economic, environmental, and social objectives when implementing interventions aimed at better food system outcomes. These differ in their focus on the nature of the simultaneous objectives and how trade-offs and synergies can occur within or between different dimensions of sustainability (human/social, environmental, economic or people-planet-profit); between different timescales (short- and long-term); between different spatial scales (from micro to macro, for example, from farm to landscape scale); and between different types of actors (for example, farmers and consumers). In food system transition processes, the definition of objectives, the path towards them, and contextualization are important to gain insight into the possible effects of interventions on objectives being pursued.

The aim of this project is to co-create and test qualitative methodologies for the assessment of trade-offs and synergies.

Although the importance of identifying trade-offs and synergies in transition processes is widely acknowledged, there is a lack of knowledge on how to conduct these assessments in co-creation with stakeholders involved in the transition process. Particularly, when resources are lacking for quantitative assessments that give insights into potential unwanted effects of proposed actions, it is useful to have access to methods to assess these potential effects together. One of the main aims of this project entitled "Trade-offs and synergies in food systems transition pathways" is to expand and strengthen capacity to assess trade-offs and synergies in the context of supporting multi-stakeholder processes for the development of transition pathways towards sustainable and healthy food systems, by drawing on experience from food system transitions in Bangladesh, Ethiopia and Ghana. The research question is: How can trade-offs and synergies in transition processes be assessed in co-creation with stakeholders?

This synthesis report summarizes the key highlights and lessons learned from three practical cases.

The three cases which form the focus of this synthesis report were livestock and salinity in the Bangladesh delta, doubling consumption of safe milk and dairy products by low-income peri-urban and rural populations in Ethiopia, and transitioning from charcoal production to climate neutral energy sources in Ghana. The analysis of trade-offs and synergies in these cases' transition pathways was largely qualitative with an emphasis on co-creation of methodologies with stakeholders. Each case followed its own trajectory while simultaneously being discussed extensively with the project team, keeping each other informed of the progress. Finally, a synthesis workshop with the project team revealed the key lessons learned and conclusions.

The report is structured as follows. Chapter 2 summarizes current methodologies used at Wageningen University & Research to assess trade-offs and synergies in transition processes. Chapter 3 highlights the results from the workshops and compares the three cases. Chapter 4 provides recommendations for those who aim to assess trade-offs and synergies with stakeholders. Detailed information and the step by step approaches in each case can be found in the Annex.

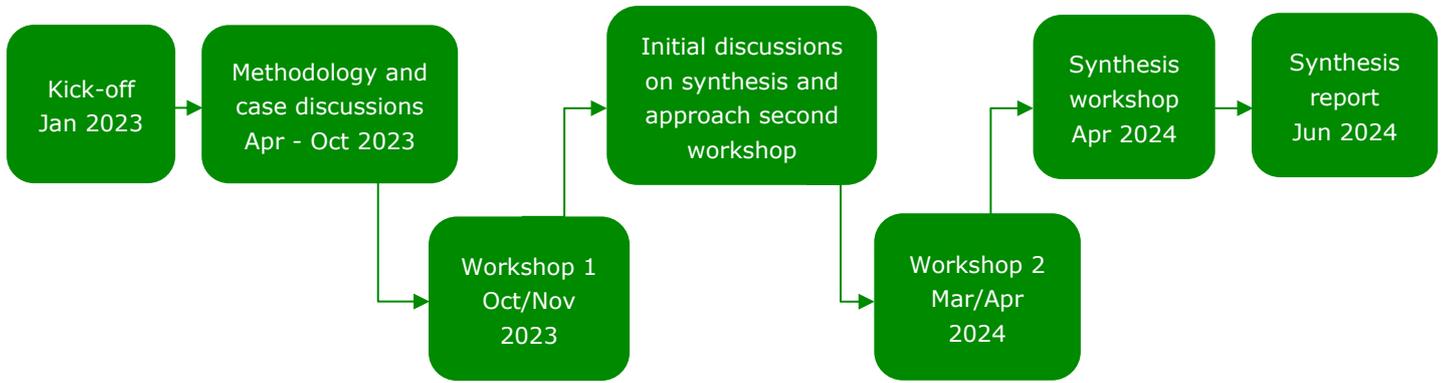


Figure 1.1 Approach.

2 The need for complementary trade-off and synergy assessments in transition processes

Trade-off and synergy assessment is key in inclusive transition processes.

Transitions in food systems are ongoing, and as we are increasingly understanding its dynamics, we are also learning about its positive and negative (side)effects in relation to the goal. Identifying the required trade-offs can help mitigate the negative (side)effects, and identifying the synergies can help to further leverage the positive (side)effects of specific transition pathways. The relevance of trade-off and synergy assessments are related to the specific stage in which a transition pathway is unfolding. It is important to theorize or measure the impact of potential actions on a transition pathway (Dijkshoorn-Dekker et al. 2023; Dijkshoorn et al., 2020; Van Berkum, Dengerink & Ruben, 2018). It is impossible to know all relevant transition pathway dynamics, trade-offs and synergies beforehand, but it is important to identify what can be expected, and adjust actions based on that. Identifying trade-offs and synergies with diverse stakeholders can support the inclusivity of the unfolding transition pathway.

There are diverse approaches for trade-off and synergy assessment.

Trade-off and synergy assessment is key, but no approach or methodology is perfect. Each assessment typically has its advantages and disadvantages, and an aim within our project is also to further improve our learning about the right applicability of available approaches. Simplified, there are approaches that apply quantitative methodologies to establish trade-offs and synergies, and qualitative approaches. The first can for example include simulation modeling where one or multiple scenarios are quantified and compared, such as comparing crop growth in two different growing systems, and the implications for water and fertilizer use. Qualitative approach can include participatory mapping of scenario's with groups of stakeholders, for example about how their region can look like with major and with minor adjustments to climate change. There could be synergies between the climate change adaptation measures and opportunities for youth participation, but there could also be trade-offs between the climate change adaptation measures and space for housing. It is important to note the limitation of each approach; not everything can be quantified, and both quantitative and qualitative trade-off and synergy assessments include subjective perceptions of perceived realities.

Each approach has its purpose, and a strategic combination of approaches likely strengthens the overall understanding of relevant trade-offs and synergies in practice.

The limitations of each general (quantitative/qualitative) approach simultaneously indicate why applying a combination of approaches can be worthwhile. The key aim is then to understand the strengths and limitations of each approach. Typically, when researchers work with stakeholders on trade-offs and synergies, there are requests for 'factual' inputs, while at the same time each stakeholder wants to share their concerns and priorities. An example of how quantitative and qualitative approaches can supplement each other is a previous project in which the Dutch province of Overijssel was supported in its transition process by a team of WUR researchers and other stakeholders (Dijkshoorn-Dekker, Kortstee & Linderhof, 2019). In this case, impacts of different scenarios for the future of the province were estimated, after which experts and other stakeholders could provide input on those. This led to interesting insights on the data and (the underlying assumptions of the) scenarios. For example, in some cases experts indicated that certain indicators were missing, or that certain stakeholders were missing in the conversation. In subsequent sessions, the scenarios and stakeholder group were updated according to the input from the previous session. Based on this experience the research team underlined the importance of learning and adjusting while doing, and being open to the different approaches taken in the cases, which is reflected in the following chapter.

3 Learning from three cases

Three practical case examples on trade-off assessment in co-creation with stakeholders are used to derive lessons.

This synthesis report draws on lessons from three practical case examples on trade-off assessment in transition processes. Two of these cases (Ethiopia and Bangladesh) are already on-going projects on transition pathway development. The third case, Ghana, was included as a new case and as such not based on previous pathway development, but deliberately put together a stakeholder group for the purpose of this project. The three cases have their similarities and differences, a summary of which can be found in Table 1. Given the specific contexts of each case, the project team decided it would be best to keep this diversity to allow for learning across different case contexts. The next sections highlight the methodologies used in the three cases, other notable similarities and differences, and finally the general conclusions that came out of the synthesis workshop with the project teams of the three cases.

Table 1 Summary of information from the three cases.

	Bangladesh	Ethiopia	Ghana
Topic	Salinity and livestock	Dairy production and consumption	Charcoal production
Scope/goal	Testing a tool for visualizing trade-offs	Establishing trade-offs for future actions	Transition pathway development and trade-offs
Methodology	Tool development based on food systems concept, using available data, combined with expert judgement in face-to-face meeting at the first workshop and online meeting for the second workshop.	Feedback loops, heat maps, pre- and post-survey of the importance of identified trade-offs to the transition pathways	Feedback loops, pre- and post-survey, heat maps
Stakeholders involved	First workshop around 15 participants with general interest on the topic; second workshop 5 experts	30	13
Existing project	Yes	Yes	No
Number of workshops	2	2	2
Same group of stakeholders in workshops	No	Yes	Yes
Stakeholders knew each other	Yes	Yes?	No, partly
Workshop live/online	Live (1 st), online (2 nd)	Live (1 st), online (2 nd)	Online

For detailed descriptions of each case, see Annex.

3.1 Methodologies

Causal loops were explored in early stages of the project.

Early discussions with the project team revealed the need to visualize the complicated systems dynamics that lead to the identification of trade-offs and synergies. We therefore tested the use of *causal loops*, which visualize the different variables related to the issue, the links between them, how they are linked, and the type of system behaviour this produces (Lannon, 2018). Figure 2 shows an example of this process in the case of charcoal production in Ghana. For the key variables (such as deforestation and toxic smoke inhalation) the impacts on other variables were visualized. After careful consideration of this method and potentially scaling it up to a dashboard, the project team jointly decided this was not the way to go in this particular project, as this would still require detailed quantifications of the selected variables and impacts in each case. The method itself can be useful in stakeholder discussions, but holds little space for stakeholders to provide their own inputs, which is the aim of this project. The designed causal loops were therefore used to inform further design of the workshops.

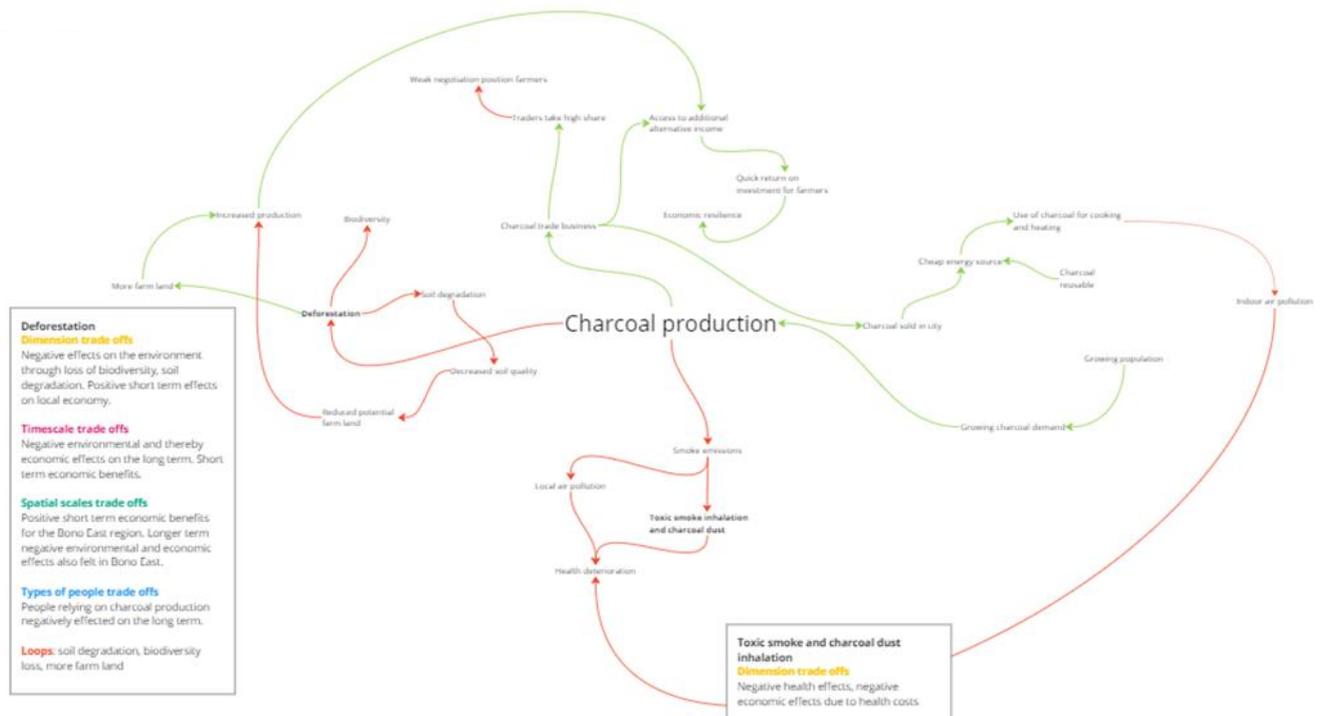


Figure 2.1 Exploratory causal loop for Ghana.

In Ethiopia and Ghana, pre- and post-assessment surveys and heat maps were used.

Stakeholder engagement and discussions were prioritized in the next stages of the project and in workshop design. We were interested in gauging stakeholders knowledge, expertise and personal opinions about aspects of each case. To do this, we developed a survey tool to ask participants prior to the workshop about different aspects of the case (see Annex 2 for the surveys). The results of this exercise were summarized in *heat maps*, a colour coded grid that shows high and low values, in this case assigned importance or priorities of different variables, ordered by stakeholder 'group' or 'role' or individual in the case of Ethiopia. These heat maps were used as a basis for further discussion with the stakeholders during the first workshop. After the workshop, participants were asked to fill out the survey again to see if their assessment had changed. In Ethiopia, stakeholders were asked about their assessment of the importance of specific trade-offs that had been identified in an earlier stage of the project. In Ghana, participants were asked about their assessment of different variables and their importance. Figure 3 shows an example of Ethiopia's heat map. Notable conclusions in Ethiopia were that the assigned importance overall was higher after the workshop, which makes sense as workshop highlights important issues.

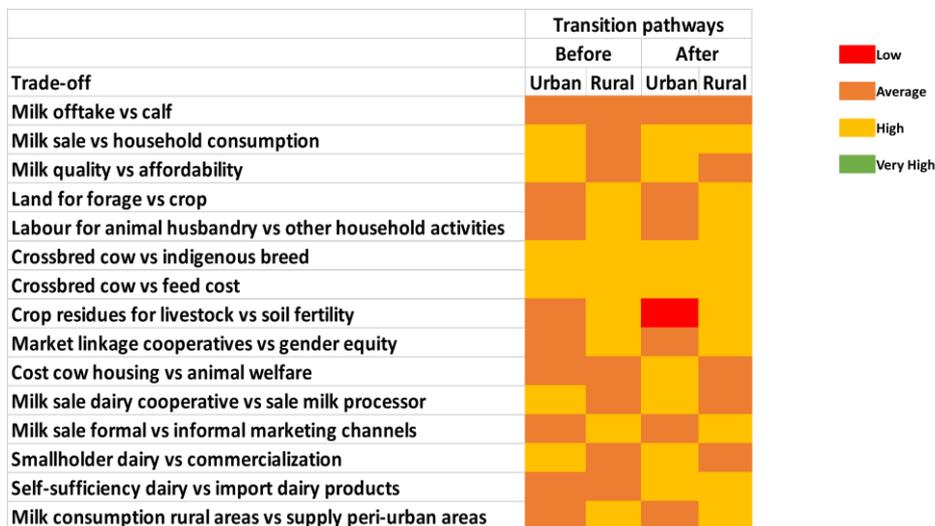


Figure 2.2 Heat map results before and after the first workshop in Ethiopia.

In Bangladesh, a tool was developed and tested in the first workshop.

The tool was made based on the goals of the food system (van Berkum et al, 2018): food security, safe/healthy food, livelihoods/reducing inequalities and resilience/climate change. For each of the four goals, an indicator was selected related to dairy development/livestock production and climate change (especially salinity intrusion), based on available information (online) and expert judgement of the researchers. These four indicators were then presented as graphs in one slide, as a kind of 'dashboard'. It showed that if production goes up, health goes up too (increased consumption of milk), income increases, and methane emission increase. The first 3 can be considered synergy, the last one is a trade-off from a food systems perspective.

All cases made use of existing data, literature or quantitative analyses where possible.

All three cases based the assessment of trade-offs on existing literature and data. In Ghana, the first workshop started off by presenting the findings of a literature review into the impacts of charcoal production. After the presentation, stakeholders were asked to add and react to the findings. In Ethiopia, most of the trade-offs in the two transition pathways to double the consumption of milk came from the literature but the information was validated by the stakeholders during the first workshop. Data from FAOSTAT on food security and nutrition were used to provide background on the nutritional challenge in Ethiopia, particularly relating to low consumption of animal source food. In Bangladesh, open data were used, as well as analysis of the food system in coastal Bangladesh and the role of livestock and salinity (Terwisscha van Scheltinga et al, 2023; Verburg et al, 2024).

3.2 Reflections on differences and similarities

All three cases shared the same objective, but had different starting points.

Joint learning and engagement with stakeholders was the key objective for all three cases. However, the cases all had different points of departure, as the Ethiopia and Bangladesh case were based on existing processes and the Ghana case was new. This also meant that the stakeholders in Ethiopia and Bangladesh were already familiar with each other, which was not the case in Ghana. Bangladesh and Ethiopia both already had transition pathways developed, so based the assessment of trade-offs on the existing trajectories of those pathways basing it on important choices to be made in that context (for Bangladesh see Terwisscha van Scheltinga et al, 2023, for Ethiopia see Snel et al., 2022). In Ghana, there was no transition pathway established so the first workshop started with the establishment of a joint future vision, after which trade-offs were identified on the way to that future vision given the priority actions of the stakeholders.

There was a mix of online and live workshops in each case.

The intention of all three cases was to hold live workshops with the stakeholders, as this was considered important for relationship building and creating an open environment for knowledge sharing. In Ethiopia, the first workshop was held live while the second workshop was held online. In Ghana, the two workshops were

held online as the different locations of the stakeholders complicated the choice for a convenient location for the workshop. Although the two workshops were a success and stakeholders indicated they enjoyed the process, reflections by the team afterwards led to the conclusion that a live meeting is always preferred with stakeholders that do not know each other yet or are put together in new groups. Online spaces do not allow for spontaneous exchange between people and can restrict some stakeholders participation in the discussions. In Bangladesh, the first workshop was held live and the second workshop online.

Each case made different choices in the stakeholders that were invited to participate.

Given the different context of each case, different stakeholders were invited to participate in each case, with varying degrees of knowledge and engagement in the topic. More information per each case on how stakeholders were identified and selected are available in the annexes. In Ethiopia, stakeholders were already familiar with each other as they had been involved in the process of establishing the transition pathways before. This was a clear benefit in the assessment of trade-offs and synergies, as discussions could be held based on information that was already known to participants. This was different in Ghana, where the stakeholders had not been involved in a previous process and some were unfamiliar with each other. This meant that the first workshop aimed mostly at building joint understanding and knowledge base to continue discussions on in-depth topics. In the end, stakeholders from the health and consumer perspective were missing in Ghana, which meant that those topics were covered less in the workshops. In Bangladesh, the two workshops were held with different stakeholders. In the first workshop, a group of policy makers was invited to reflect on the usefulness of the tool. In the second workshop, content experts were asked to reflect on the trade-offs themselves.

Determining the relevant trade-offs was either done before the workshop, together with the stakeholders or in a mix between the two.

As mentioned before, each case had a different starting point. Ethiopia and Bangladesh based the assessment of trade-offs and synergies on existing transition pathways, while Ghana had yet to establish its transition pathway on the way to a future vision that was shared by the stakeholders. This meant that in Ghana, the team prepared for the first workshop by collecting information on different aspects of charcoal production in Ghana to gain initial insights into the potential trade-offs for different transition objectives. The final trade-offs to assess, however, were determined together with the stakeholders, as this depends greatly on the aim and desired outcome of the transition objective. In Ethiopia, these transition objectives were already determined, which allowed for prior determination of potential trade-offs for the two transition pathways. Together with the stakeholders, these trade-offs were further specified and ranked in order of importance. In Bangladesh, the trade-off was brought into the picture by the researchers, and the research focused on the interaction with the stakeholders on the tool for visualization, whether the right indicators were selected for that and if the trade-off and synergies became clear.

3.3 Conclusions and lessons learned

Sharing of information and expertise between stakeholders is considered very important and highly valued.

One of the main aims of all three cases was to facilitate knowledge exchange between stakeholders about different transition objectives and the potential trade-offs and synergies between them. This knowledge exchange was highly valued among the participants of the workshops in all cases, who indicated they had learned new things and that the discussions sparked new ideas for connections. From the research team side, stakeholder input brought new insights to the table on the topics for discussion, highlighting knowledge gaps in some cases. An important lesson was that the research team needs good preparation of facts and available data, but that these should always be validated or preferably even defined together with experts.

The level of required detail highly depends on the stage of the process and the stakeholders at the table

When a discussion on transition pathways, trade-offs or synergies is at its beginning stages, such as in the case of Ghana, it is important to build a solid knowledge base together with the stakeholders that you can base further discussions on. This means that at the beginning of this process, discussions on trade-offs and synergies will likely be more general. If you are further along in the process, such as in the case of Bangladesh and Ethiopia, discussions will require a greater level of detail, often also requested by the stakeholders, to bring the process further.

The process needs trust, commitment and constant reframing.

When working with diverse stakeholder groups on complex issues, learning processes take time and need a flexible approach, both towards the content and the stakeholders themselves. Discussions can lead to new insights or knowledge gaps that require a different course of action or focus. Or stakeholders might not agree on the data or trade-offs presented. This makes it a constant process of looking at what is needed in a given situation: is it more data, different data, more discussions, different stakeholders or going back to the transition pathway or future vision?

The mix of stakeholders and the way they think dictate the outcome.

It matters for the process who the stakeholders are that are involved. However, it matters just as much who the researcher or facilitator is that engages with the stakeholders. Different stakeholders provide different discussions and perspectives. For example, experts are more likely to want to discuss more detail and next steps. It is important to consider the needs of the different stakeholders. Then you can decide if the discussion should be more around trade-off awareness or operationalization of next steps, requiring continuous evaluation if the right stakeholders are on board for the purpose. It also matters if stakeholders and researchers are able to think outside the box.

The term 'trade-off' can be difficult for stakeholders that are unfamiliar with this language.

Adapting the language used in trade-off assessments to the types of stakeholders at the table is an important precondition for a successful process. When talking with experts or policy makers, it might already be known what is meant by trade-offs and synergies. Those that are unfamiliar with the term might be more engaged with terms like 'choices' or 'dilemma's'. This was evident in Ghana, where the trade-off language did not resonate with all stakeholders. In Bangladesh, stakeholders were not familiar with food systems analysis, and transition pathways was also new to them. However, the wording trade-off and synergies was very easily understood, though it was not immediately clear at which level and how to formulate it.

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Annex 1 Ghana

In previous work by Wageningen University & Research in landscape approaches in Ghana, charcoal production frequently comes up as an important consideration in environmental and health concerns (Van Oosten et al., 2022; Linderhof et al., 2023). However, environmentally friendly alternatives for charcoal are scarce, and maintaining availability and affordability of charcoal is important to mainly low-income households. Moving to alternatives requires a good assessment of trade-offs together with relevant stakeholders, to be able to identify feasible and agreeable pathways for action. Together with Asdev Consult, we set up a workshop with a wide range of stakeholders related to charcoal production in Ghana’s Bono East region, to co-create a methodology to uncover potential trade-offs and perspectives on the future of charcoal together. The stakeholders were identified through a consult’s network, supplemented by re-engaging participants from previous projects on related topics. Subsequently, a snowball sampling approach was employed to capture additional expertise and stakeholder categories that may have been initially overlooked.

In preparation for the workshop, the project team reviewed literature on charcoal production in Ghana to set the scene for further discussions on alternatives and trade-offs. In Ghana, charcoal is primarily made in the area between the southern tropical forests and the savanna woodlands in the north. They gather fresh wood and also create charcoal from leftover wood generated by logging and sawmills. While there are now forests specifically grown for wood used in export production, this accounts for less than 2% of the entire charcoal industry in Ghana. The industry is mainly managed by small-scale, informal operators who use traditional kilns made of earth.



Figure A1.1 Charcoal production in Bono East. (Photos: Seth Kankam Nuamah)

The reviewed literature provided a good basis for establishing trade-off categories for the case of charcoal production in Ghana. These are the key areas where trade-offs emerge when considering charcoal alternatives or changing production practices. The trade-off category classification is based on Adolph (2020):

Table A1.1 Trade-off categories and decisions in the case of charcoal production in Ghana.

Trade-off category	Decision
Within dimensions	Producing charcoal for cash or produce food for own consumption?
Between dimensions	Reduce charcoal production to reduce emissions, or protecting an available and affordable cooking fuel for households?
Between timescales	Produce charcoal for economic benefits, or invest in the landscape and tree regeneration for the long term?
Between spatial scales	Informal charcoal production by individual farmers, or collective benefits from the sustainable management of the forest or woodland?
Between types of people	Protecting charcoal production as a livelihood strategy, or protecting health of consumers?

The aim of this project was to qualitatively assess trade-offs and synergies with local stakeholders, to co-create a methodology of trade-offs and synergies assessment that accounts for local stakeholder expertise. Apart from the contribution that the stakeholders would make to the workshop, we were interested in how the workshop – in particular connecting with different stakeholders on the topic – would contribute to stakeholders’ consideration of trade-offs and synergies. Therefore, we proposed the following methodological steps:

1. Pre-assessment: to gather input for the workshop and determine stakeholders’ understanding and consideration of certain aspects of charcoal production and its impacts, we developed a pre-assessment survey in Kobo (see Annex 1). The results of this survey were analysed per stakeholder type (research, policy, production, etc.) to determine potential differences and commonalities.
2. Workshop: the workshop focused on two aspects: (a) joint development of a future vision for the charcoal sector in Ghana; (b) steps needed to reach that future vision and trade-offs and synergies that emerge between or within those steps. Moreover, the results of the pre-assessment survey were presented to the stakeholders present at the workshop.
3. Post-assessment: at the end of the workshop, participants were given the opportunity to fill in the post-assessment survey. The majority of the questions in this survey were the same as in the pre-assessment. The results of this survey were analysed to determine if any changes in consideration had taken place.

Before the workshop, participants were asked to fill in a preassessment survey to gather their perceptions of charcoal production and consumption and the associated impacts. During the workshop, the findings of this survey were presented in the form of a heat map(see below) to identify commonalities and differences between stakeholder groups. Stakeholders perceived the impacts of charcoal production and consumption similarly, apart from the issue of health impacts. Researchers perceived the impact of health considerably more negative than the other stakeholders.



Figure A1.2 Results of the pre-assessment.

At the end of the workshop, the perceptions of participants were gathered again, to see if the discussions during the workshop had changed their considerations. Charcoal production has been representing an economic opportunity both in the pre and post-assessment. However, the workshop influenced the perception of other priorities. There was a positive re-evaluating of the importance of the socioeconomics and health categories (i.e. availability and affordability for consumers and healthy living environment) over environmental priorities. This was confirmed by all stakeholder groups, with emphasis on the importance of charcoal production to the Ghanaian economy and to farmers livelihoods. This was further supported by the perception of the lower potential for alternative cooking sources by the business community.

The first workshop took place via Zoom on November 2nd . Almost half of the participants joined via their own computer or laptop, the other half joined in a room together via one screen. As there was not yet an envisioned future in place based on earlier work, part of the objective in this case was both to uncover a shared vision for the charcoal sector in Ghana, as well as determining some of the key trade-offs on the way to this shared vision. Due to its importance for rural livelihoods and as cooking fuel, it was agreed that making charcoal production more sustainable should be the key focus for the future. A number of actions were considered key to make this future vision a reality:

Education and technical support to producers to make production more efficient. It was considered to incentivize producers to form cooperatives together. This would make it easier to deliver educational, technical and economic support to them. Also considered important was finding the support from local and traditional authorities, as charcoal production is an important practice in communities.

Promoting efficient cook stoves for households, which is an effort that was already invested in around a decade ago, but was halted for some reason. Important to this is working on acceptance and take up attitudes of consumers, and prioritizing affordability of the improved stoves.

Focus on implementation of existing policies that are currently on the shelf. Many policies and good ideas around sustainable charcoal production already exist and have been attempted before. Follow up of these policies and activities is important.

The focus of the second workshop was to revise the future vision and look in detail at the opportunities for change in the charcoal sector that were identified in the first workshop. Three additions to the future vision and the challenges on the way to the future vision were made, namely:

Coconut husk as an alternative raw material to tree producing charcoal. This option is still quite limited and only for the export market currently. There are opportunities to scale this up.

Local manufacturing is missing currently. This would help to increase access and affordability.

Technological innovations are currently not available to the rural communities.

From the first workshop, the following pathways for change were identified:

1. Use of improved cooking stoves
2. Invest in more efficient charcoal production
3. Implement already present policies
4. Education and technical support to producers
5. Forming producers cooperatives
6. Invest in alternatives (electricity, coconut husk, gas, etc.)
7. Develop alternative livelihood programs

After discussion on these pathways, the following three were added by the participants of the workshop as additional pathways:

8. Use of logging residues (efficient use of timber waste streams)
9. Establishment of wood lots
10. Certification mechanisms to ensure compliance in standards and incentivize sustainable production

Next, participants were asked to prioritize the different pathways. The second pathway, investing in more efficient charcoal production, came out as the clear number one priority for almost all stakeholders. The fourth pathway, education and technical support to charcoal producers, came out as the second highest priority. These two pathways were investigated in more detail. For each pathway, it was identified who the beneficiaries would be and how they would benefit, what challenges the pathway poses, and what the resulting trade-offs would be.

Investing in more efficient charcoal production

The rationale behind this pathway is not to scale down the production of charcoal, but to invest in more efficient, and more sustainable, production practices. This would not only boost charcoal production and benefit the livelihood of producers, but also avoid waste and provide ecosystem benefits. As producers earn more, chiefs, landowners and communities benefit by collecting more taxes.

However, there are a number of challenges with this pathway. The adoption of new technologies is a challenge and there would be a strong need for education and technical support given low literacy levels. Investments in new technologies would need to be financed, either by producers themselves or institutional players. It might also be necessary to acquire new species of trees, which need time to grow and become profitable.

Education and technical support to producers

This pathway strongly relates to the one above, as education and technical support is needed for those farmers that would like to apply sustainable practices in charcoal production. This would benefit charcoal producers and the environment, but also the wider chain of traders, transporters and consumers. There are, however, a number of

challenges to this pathway. First, there is a lack of available resources to educate farmers, as well as unclarity as to who would be providing this educational support. The new charcoal production material and technology would need to be supplied to farmers, of which there is a current scarcity. There may also be high cost to mobilize farmers to be trained, and as they are not organized in groups they may be difficult to reach at scale. Last, there is a multiple local language barrier that need high resources to be overcome.

Both workshops revealed interesting pathways to reach a more sustainable future for charcoal for the participants. For the project team, it also led to key insights on how to deal with the assessment of trade-offs and synergies with stakeholders, leading to the following lessons learned:

- Stakeholder expertise provides much needed insights into contextual factors that are not always captured by literature or data. An example of this are the relationships and dynamics surrounding the policy environment.
- It is important to take the time to establish a future vision. Thinking outside of the box can be a challenge, particularly for experts who have a natural focus on details. However, imagining a future vision is a crucial part of a transition process.
- In assessing trade-offs and synergies with stakeholders, a live meeting is preferred over a hybrid or online one. It allows participants to share more openly and establish relations with each other. For some stakeholders, particularly those not used to online environments, hybrid or online workshops may pose barriers to their participation and willingness to speak up.
- In both workshops, the language around trade-offs was difficult for some stakeholders to grasp. One way to deal with this is to use simpler language and discuss 'choices' and 'options', or take steps in determining benefits and challenges with each transition pathway discussed.
- Linked to the previous two points, a workshop on trade-offs and synergies is best conducted in the local language to avoid communication issues.

Annex 2 Ethiopia

Sustainable and inclusive food system transitions are indispensable for food and nutrition security in the global South. Inherent in these food system transition pathways are trade-offs and synergies within or between different dimensions of sustainability (social, environmental, economic); between different temporal and spatial scales; and between different types of actors. Understanding and assessment of these trade-offs are important to the development of sustainable and healthy food systems. This project entitled “Trade-offs and synergies in food systems transition pathways” aims to expand and strengthen capacity to assess trade-offs and synergies, in the context of supporting multi-stakeholder processes for development of transition pathways towards food system transformation. The Ethiopian case focuses on dairy sector transformation. The envisioned future for dairy sector transformation in Ethiopia is doubling of dairy consumption in 15 years (2022 to 2037) by low-income peri-urban and rural populations. The current food and nutrition security situation in Ethiopia is bad. According to FAOSTAT (2023) for 2019 to 2021, 22.6% of the population were severely food insecure and 64.7% moderately food insecure while 35.3% of children under 5 years were stunted. In addition, consumption of animal protein is very low (average 3.83 g/capita/day in 2020; FAOSTAT, 2023) compared to the recommended intake of 20 – 30 g/capita/day by WHO. From these statistics, Ethiopia may not attain SDG 2 Zero hunger target by 2030. To address this food and nutrition security challenge, the Government has initiated programs to address undernutrition in children through the School Feeding program. “Building Rural Income through Inclusive Dairy Growth in Ethiopia (BRIDGE)” project has also started School Milk Program to boost consumption of animal protein by children.

This case on trade-offs and synergies in dairy sector transformation in Ethiopia is building on previous KB35 project carried out in Ethiopia on exploring transition pathways for Ethiopia’s dairy sector. The focus of this case study is on dairy sector transformation through doubling of milk consumption in 15 years (2022 to 2037) by low-income peri-urban and rural populations in Ethiopia. At the multi-stakeholder workshop held in April 2022 in Addis Ababa, Ethiopia, four transition pathways were identified for the vision of increased consumption of safe milk and dairy products in Ethiopia (Snel et al., 2022) under the previous KB35 project on exploring transition pathways for food systems. For this case, the focus is on two transition pathways from the four identified at the two multi-stakeholder workshops in 2022. The two transition pathways (slightly modified) for increased consumption of safe milk and dairy products in Ethiopia were:

- 1) Pasteurized milk for low-income consumers in peri-urban areas of Ethiopia. This could be sold in packages such as sachets or cups and by milk vending machines.
- 2) Locally boiled (pasteurized) milk for the rural population with focus on vulnerable household members (pregnant and lactating women, and children under 7 years).

There are two reasons for focusing on these two transition pathways for the future vision of doubling dairy consumption in 15 years. First, these two transition pathways address majority of the Ethiopian populations whose diets are deficient of animal sourced protein. Second, these two consumer categories (low-income peri-urban and rural populations) form the main targets of the Ethiopian nutrition policy of transitioning away from the current focus on cereal dominated diets towards more diversified diets with increased consumption of nutrition dense foods such as animal sourced foods. This case study is being carried out under SNV-led project entitled “Building Rural Income through Inclusive Dairy Growth in Ethiopia (BRIDGE)”.

For the two identified transition pathways for this case on dairy sector transformation in Ethiopia, fifteen trade-offs were identified at farm, regional and national levels, and within/between different food system dimensions (environment, socio-economic, policy/institutional) from literature and expert opinions. The identified trade-offs and synergies are presented in the Table below.

Table A2.1 Identified trade-offs in doubling dairy consumption in Ethiopia.

Trade-off	Scale	Trade-off type
1. Milk offtake vs milk for calf	Farm/household	Within socio-economic dimension
2. Milk for sale vs household consumption	Farm/household	Between economic and human health dimensions
3. Milk quality vs affordability by vulnerable populations	Region, national	Within socio- economic dimension
4. Land for forage vs crop (food-feed competition)	Farm/household	Within socio-economic dimension
5. Household labour for animal husbandry production vs labour for other household activities	Farm/household	Within socio-economic dimension
6. Use of crossbred cows vs indigenous breed (genetic diversity)	Region, national	Within environmental dimension (biodiversity)
7. Use of crossbred cows vs feed costs	Farm, region	Within economic dimension
8. Crop residues for livestock feed vs soil fertility	Farm/household	Between socio-economic and environmental dimensions
9. Market linkage through dairy cooperatives vs gender equity	Region	Within socio-economic dimension
10. Cost of cow housing vs animal welfare	Farm/household	Between socio-economic and health dimension
11. Sale of milk by dairy cooperative vs sale by milk processor	Region	People
12. Sale of milk through formal vs informal marketing channels	Region	Within institutional dimension
13. Smallholder dairy production vs commercialization of dairy sector	National	Within policy and institutional dimensions
14. Self-sufficiency in dairy production vs import of dairy products	Region, national	Within policy and institutional dimensions
15. Consumption of milk in rural areas vs supply to peri-urban areas	Region, national	People (rural vs peri-urban consumers)

Using food systems framework by van Berkum et al (2018), and interactive scenario building and participatory back-casting methods, we explored the future vision for dairy sector transformation in Ethiopia by doubling dairy consumption by low-income peri-urban consumers and vulnerable groups in rural areas of Ethiopia. A qualitative assessment of trade-offs was then conducted for the two identified transition pathways.

The two transition pathways (slightly modified) for increased consumption of safe milk and dairy products in Ethiopia that formed the focus of Ethiopian case were:

1. Pasteurized milk for low-income consumers in peri-urban areas of Ethiopia. This could be sold in packages such as sachets or cups and by milk vending machines.
2. Locally boiled (pasteurized) milk for the rural population with focus on vulnerable household members (pregnant and lactating women, and children under 7 years).

In the early discussions with the project team, we tested the use of causal loops, which visualize the different variables related to the issue for each transition pathways, the links between them, how they are linked, and the type of system behaviour this produces. For the key variable milk supply to peri-urban areas in Ethiopia, the impacts on other variables were visualized and shown in the figure below.



Figure A2.1 Feedback loops for milk supply to peri-urban areas and the impacts on other variables.

To co-create methodologies for assessment of trade-offs and synergies in doubling dairy consumption in Ethiopia within 15 years, two stakeholders' workshops were organized on 20th October 2023 and 27th March 2024. The stakeholders' workshop in October 2023 built on previous workshops held in April and September 2022 on food systems transition pathways for dairy sector transformation in Ethiopia. The focus of the workshop was to look more closely at the trade-offs and synergies in two of the identified food system transition pathways from the previous workshops of last year. The stakeholders' workshop organized on 20th October 2023 was held in Addis Ababa, Ethiopia to co-create methods for assessment of trade-offs and synergies for the two identified food systems transition pathways. The overall goal of this workshop was to engage stakeholders in co-creation of methodologies for assessment of trade-offs and synergies in dairy sector transformation in Ethiopia. Specific objectives of this workshop were: (i) To share key insights from literature on assessment of trade-offs and synergies in food system transition pathways. (ii) To validate identified trade-offs and synergies in dairy sector transformation in Ethiopia from literature and expert opinions. (iii) To score and rank the importance of different elements of the identified trade-offs at the beginning and end of the workshop. Capturing the opinions of the participants at the end of the workshop gave us insights into how a co-creation process influenced the opinion of stakeholders.



Figure A2.2 Participants at the stakeholder workshop on 20 October 2023 in Addis Ababa.

The stakeholders involved in this case were producers, producer organizations, rural and peri-urban consumers, dairy cooperatives, dairy processors, agro-input dealers, knowledge institutes, development partners, and public authorities. At the beginning of the workshop, each participant will fill in their opinion about the importance of trade-offs identified from literature for the two transition pathways for doubling dairy consumption in Ethiopia. For each transition pathway, the participants scored the importance of each identified trade-offs on the Likert scale of 1= Low; 2=Average (moderate); 3=High; and 4=Very High.

The follow-up workshop was held virtually on 27th March 2024 with the following specific objectives: (i) To share and discuss key results of the assessment of trade-offs and synergies in food system transition pathways from the stakeholder workshop of October 2023. (ii) To identify key missing issues from the results and areas for improvement. (iii) To identify potential for application of the results from the assessment. Eleven participants were involved in the follow-up workshop. To guide the discussion, the following questions were asked: 1. What are the strengths and weaknesses of qualitative assessment of trade-offs and synergies on increasing milk consumption in Ethiopia? 2. What are the important trade-offs and synergies missing from our assessment? 3. How could we apply these results of the trade-offs and synergies to an evaluation at food systems level in Ethiopia? 4. Which group of stakeholders may be interested in this assessment? Key points from the follow-up workshop were: 1. The missing trade-offs included milk production vs greenhouse gas emissions, crossbred cow vs housing cost, multi-functionality of cow vs tangible benefits, production cost vs milk selling price, and market outlet vs profit margin. 2. The participants agreed that the qualitative assessment should be validated with quantitative indicators and published literature. 3. The ultimate target of the assessment should be on how to mitigate or reduce trade-offs through concrete intervention. The project should look more closely at this. 4. The participants also pointed out the need to look in-depth on crossbred cow and indigenous breeds. Have we really explored the milk production potential of the indigenous breeds? 5. The results of the assessment of trade-offs in food system transition pathways could be useful to other dairy projects in the country in terms of priority intervention areas to mitigate trade-offs in food system transitions. 6. Policy issues on milk prices need attention and milk prices should be jointly agreed with producers, cooperatives and processors.

The outcomes of the qualitative assessment of trade-offs in terms of lessons learnt from the co-creation processes are:

- Stakeholder participation is central to co-creation processes of methods for assessment of trade-offs and synergies in food system transitions. Hence, it is important to have the right mix of stakeholders for a meaningful assessment.
- The importance of trade-offs is dependent on the transition pathways, which implies trade-offs will vary depending on the pathways.
- Co-creation processes influence the opinions of the stakeholders regarding the importance of different trade-offs for the identified transition pathways. Different scores by the stakeholders for the same trade-offs before and after presentation and discussion on trade-offs in food system transition pathways suggest that learning has taken place through the co-creation processes.
- Trade-offs in food system transition pathways tend to be the focus of both quantitative and qualitative assessments compared to the synergies aspect which is less obvious compared to trade-offs.
- There is a need to quantify the identified indicator(s) for each trade-off to strengthen the qualitative assessment to reduce subjectivity and or validate the results of the qualitative assessments with quantitative data in the literature.

Annex 3 Bangladesh

In the context of changing agriculture and food systems it is important to think about the directions and pathways for change, and how to reach a balanced approach, to achieve the sustainable development goals (SDGs). How are developments in water, agriculture and food systems balanced in the case of Bangladesh. Which ways do we use to get information on this?

In Bangladesh, agriculture is developing rapidly, under influence of growing numbers of people in the cities, increasing GDP (and related dietary change) and other development and climate change related pressures. The demand for milk is increasing. Increasing numbers of cattle will require fresh water, which, especially in the period April-June is problematic in southwest coastal Bangladesh due to salinity intrusion (Terwisscha van Scheltinga et al, 2023). In some places, farmers started to grow fodder. Grass is more salt tolerant than rice and could be a good alternative.

The primary objective of the meetings was to discuss the trade-offs and synergies of intensive dairy farming in coastal regions in light of increasing salinity. Additionally, the meetings aimed to test a visualization tool for balancing food system pathways, where the increase in cattle numbers would provide employment and health benefits (synergies) but also lead to higher methane emissions (trade-off).

Two meetings were organized—one in-person and one online—with invited experts. Prior to the meetings, researchers prepared a tool focused on assessing the impacts of increasing salinity on dairy development. They chose indicators for each of the four food system goals, as suggested by Van Berkum et al. (2018). The tool was designed to offer a clear overview of trade-offs related to these goals.

The tool aimed to raise awareness of the trade-offs between different food system goals and the potential impacts of various future transition pathways. Experts selected the indicators based on their judgment and data availability, ensuring that the indicators captured the key aspects of the food system's trade-offs. Researchers quantified the selected indicators using available data, employing inter- and extrapolation methods where necessary. During the workshops, the estimated and projected values of these indicators were validated by the participants to ensure alignment with real-world conditions.

Milk production was chosen as the indicator for the "Production" goal. Data on milk production was gathered from the Department of Livestock Services (DLS) in Bangladesh. Past trends were analyzed, and future production was estimated by assuming similar trends would continue.

Milk consumption was used as the indicator for the "Safe, nutritious, and healthy food" goal. It was noted that milk consumption contributes to reducing the risk of child obesity, type 2 diabetes, cardiovascular disease, and supports bone mineral density (Thorning et al., 2016). Consumption data from the FAO and World Bank were combined to estimate total milk consumption, with assumptions that population growth and consumption rates would continue in the same pattern.

Revenue from milk production was selected as the indicator for "Inclusiveness and equal benefits (livelihoods)." This was calculated by multiplying the price of milk (from Uddin et al., 2011) by the total production. It was assumed that future trends in pricing and production would remain consistent.

Methane (CH₄) emissions were chosen as the indicator for the "Sustainability and resilience" goal. Data from Das et al. (2020) was used, including both enteric emissions and emissions from manure, with projections extending to 2050.

The collected data were then used to develop an interactive tool that allowed participants to explore trade-offs among the food system goals across various scenarios and transition pathways.

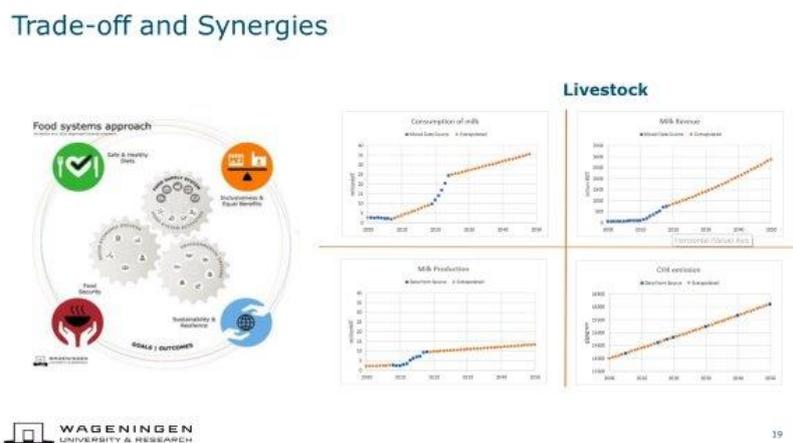
The first meeting was organized on 11 October, and around 15 experts from the Department of Agricultural Extension, academics and other professionals attended. The second meeting was organized on 8 April 2024, with 5 participants from a livestock project. Food system thinking was introduced, and after that the tool was presented and discussed. The audience provided feedback on the prepared example case.

The first workshop was held on 11 October 2023, at the Department of Agricultural Extension from 3 to 4 pm. The director of the Department welcomed all participants and gave an introductory speech. All participants to the meeting introduced themselves. Then, the team lead for Wageningen University & Research gave a presentation titled 'Water, agriculture and food systems in Bangladesh – visualizing trade-offs and synergies', introducing food systems thinking. She focused on dairy development and salinity intrusion, and presented the tool to visualize food system developments over time for salinity and dairy. Then questions were asked and discussion followed.

Discussion points about the tool and more general discussion points are listed below:



Figure A3.1



About tool for exploring trade-off and synergies:

- At national level, such a tool to explore TO&S is useful. However, the estimations and numbers presented need to be supported by published articles, reliable and measured data and surveys.
- The presentation of TO&S among different components is useful for decision makers
- The set of indicators are important and needs to be representative. About the presented set of indicators on livestock and milk production the audience stressed not being experts on livestock and encouraged the researchers to discuss with livestock experts. In general, the tool and the indicators were found ok: well-chosen and informative. It was noted that other sources of methane emissions exist, entailing that maybe a more precise indicator than 'emissions' could be relevant and other than cow-milk, there is also goat, sheep and buffalo milk, and imported milk.

General discussion:

- Agricultural governance in the country needs to be improved. A World Bank funded PARTNER programme is already starting. Technical support is required regarding the assessment of demand, production, water availability and climate change.
- An action plan for agriculture in light of delta plan is needed which will include objectives, challenges and projections. Water availability, demand and production in 2050 as well as value chain system need to be investigated. Scenarios of delta needs to be linked with agriculture transformation.
- A framework is required to monitor the progress of delta plan, a tool like this could be useful in that regard.
- How to address the water crisis in the future needs to be explored and governance needs to be part of the plan.

The second workshop was held online on 8 April 2024, with 5 livestock experts, ACDI/VOCA Bangladesh staff of the Bangladesh Climate Smart Livestock (BCSL) project, funded by U.S. Department of Agriculture while implementation is lead by ACDI/VOCA Bangladesh.

Observations from the discussion:

- Participants deemed the developed visualization tool as useful for planning projects, setting initial targets, making visions for the future, to test hypothesis in research, for the farmers to make decision on crop selection, facilitate dialogues between farmers, NGOs and Government agencies and track the progress of achieving sustainability goals
- A plethora of indicators were suggested especially to consider meat and milk production which largely depends on data availability
- Practices are needed to be considered to increase the milk but not the fat percentage

Specific observations were made like:

- "Use of concentrated feed increases fat percentage in the milk and methane emission and decreases volume of milk which harms the farmers economically."
- "Indicators should capture the essential aspects of agriculture production, environmental sustainability, economic viability, social equity and nutritional outcome."
- "Simplicity of the model is the strength with a trade-off of not encompassing everything. The model will help to start thinking in a holistic manner and identify the transition. The tool can connect the project officials, donors and government agencies."
- "It's a deterministic model. The farmers doesn't only produce milk but also meat. All three-methane emission sources should be used for methane emission estimation."

Food Systems: Trade-offs and synergies - BD

Food systems approach

The diagram illustrates the 'Food systems approach' as a circular process involving 'Safe & healthy food', 'Nutrition & food systems', 'Sustainable & resilient', and 'Food systems'. It also includes icons for 'Food security', 'Food systems', and 'Sustainable & resilient'.

Goals of the food system

1. Enough food (production)
2. Safe, nutritious and healthy food
3. Inclusiveness and equal benefits (livelihoods)
4. Sustainability and resilience (including biodiversity and climate change)

Reference: Van Berkum et al., 2018; www.wur.eu/food-in-deltas

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Figure A3.2

To explore
the potential
of nature to
improve the
quality of life



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Wageningen Livestock Research creates science based solutions for a sustainable and profitable livestock sector. Together with our clients, we integrate scientific knowledge and practical experience to develop livestock concepts for future generations.

Wageningen Livestock Research is part of Wageningen University & Research. Together we work on the mission: 'To explore the potential of nature to improve the quality of life'. A staff of 6,500 and 10,000 students from over 100 countries are working worldwide in the domain of healthy food and living environment for governments and the business community-at-large. The strength of Wageningen University & Research lies in its ability to join the forces of specialised research institutes and the university. It also lies in the combined efforts of the various fields of natural and social sciences. This union of expertise leads to scientific breakthroughs that can quickly be put into practice and be incorporated into education. This is the Wageningen Approach.

