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Identifying pathways for food system transformation: Unusual solutions for improving food system performance

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ABSTRACT

Whereas numerous studies are available that describe the structure and components of food systems, far less attention is usually given to the analysis of drivers for food system change. Since such transformations take place at the interface of multiple stakeholders' interests, involve the use of multiple instruments and may lead to multiple outcomes, it is of foremost importance to understand the underlying dynamics of food system transformation processes.

This article identifies different leverage points for improving dietary outcomes and outlines analytical perspectives on three possible interventions along the food value chain that go further than just 'solving the problem'. Real systems solutions intend to address fundamental interactions within the food system and thus provide unusual solutions to change its dynamics. This opens the way to new insights on appropriate policies and innovative incentives for steering food system transformation processes.

***Keywords**: Food systems; change dynamics; interventions; impact pathways*

1 Introduction

The recent increase in malnutrition in low- and middle-income countries creates space for a renewed discussion on effective food policies. Whereas earlier debates centred around strategies for improving food production, attention is shifting to the identification of opportunities for increasing access of poor people to healthier diets. Based on the emerging understanding of the interlinkages between food production and consumption, current policy discussions increasingly rely on the concept of food systems to identify possible entry points for specific incentives to reach nutritional and distributional outcomes.

There is, however, a growing confusion on the precise definition of the components and boundaries of food systems and their significance for policy identification (Brouwer et al., 2020). Many studies present abundant descriptive information about the structure of food systems, whereas far less attention is usually given to an assessment of the factors that induce changes in the behaviour of food systems stakeholders in such a way that the dynamics of their interactions is improved and thus contributes to better food systems performance outcomes (Marshall et al., 2021; Bene et al., 2018). Others consider the food system approach as 'too complex' to identify concrete possibilities for policy interventions and are anxiously searching for useful leverage points (Ruben & Brouwer, 2021; West et al., 2014).

This article intends to provide new insights into the dynamics of food systems transformation, focussing on the conceptual, methodological and operational challenges for simultaneously addressing multiple – sometimes opposing – goals, involving multiple stakeholders with different interests, and applying multiple resources and incentives that are mobilized to influence and streamline their behaviour (Ruben, 2020). For a better understanding of the dynamics of food system change, we will argue that effective interventions tend to focus on underlying layers of system interaction where fundamental causes of deviating behaviour emerge. Such systems analysis approach can be helpful to identify unusual - albeit highly effective - interventions that offer structural solutions for overcoming food system failures (Ruben et al., 2019).

The remainder of the article is structured as follows. Section 2 outlines the main challenges for food systems analysis that need to be addressed through appropriately designed food systems approaches (as discussed in section 3). Hereafter, section 4 focusses on the leverage points for supporting food system transformation processes, followed by a practical illustration on different impact pathways in section 5. We therefore rely on results from field experiments in Tanzania, Zambia, and Nigeria within the framework of the recently concluded CIGR programme 'Agriculture for Nutrition and Health' (A4NH). Section 6 concludes with implications for designing policies and research based on insights from the dynamics of food systems transformation.

2 Complexity in Food System Analysis

Food system analysis has been developed as an effort to improve our understanding of the structure and dynamics of food and nutrition security programs and to contribute to the identification of more effective policies and programs towards better food system outcomes. The framework for food system analysis is therefore focussed on how different stakeholders organize their interactions for the governance of their transactions, and how their different priorities for reaching multiple outcomes are negotiated and balanced.

Food systems do not always behave in a nice and convenient way and it might be difficult to get them moving into the desired direction. This is mainly due to the fact that the interests of food producers, traders, processors and consumers are not fully harmonized and that each of them might look for a partial optimum in their bilateral transactions instead of a global optimum at system level. Even when stakeholder recognize their interdependence, it still remains difficult to overcome individual interests and short-run goal optimization.

In addition, linkages between food production and consumer nutrition are complex and tend to be non-linear. Whereas for food production attention is focused on efficient organization of supply chains (i.e. bringing the food from farm to fork), healthy diets ask for a particular combination of different food items and thus require adequate complementarities between various food supply chains for satisfying dietary diversity requirements at household level.

The multi-stakeholder environment of food systems is considered to be appropriate for simultaneously contributing to multiple goals in terms of dietary diversity, environmental sustainability and inclusivity. This requires an active search for potential synergies and a realistic recognition of potential trade-offs between these objectives. In practical terms it may imply some prioritization of goals (hierarchy) through a sequential approach (of adaption & learning) for reaching key goals.

Finally, this analytical framework for food system analysis with multiple stakeholders and multiple objectives severely limits opportunities for linear thinking on food policies. Instead of focussing on particular incentives that are able to

changes individual stakeholder behaviour, we are now searching for an adequate policy mix that contributes to a better alignment between the interests of various stakeholders involved.

We can take as an example the range of strategies for supporting dietary diversity (see Figure 1). There is general agreement that dietary diversity can be considered as a major pathway for improving health and reducing (micro)nutrient deficiencies, thus addressing the triple burden of malnutrition (Verger et al., 2021; Mekonnen et al, 2020; Kennedy et al., 2007)). Most strategic analyses look at the supply of a sufficiently diverse basket of food products and tend to focus on technical solutions, such as better seed varieties and production diversity as the key instrument for promoting dietary diversity (Sibhatu et al., 2015).

There are, however, also less conventional strategies that use other entry points to enable households - as consumers or labourers - to access the required diversity in food products. These can either be based on a more diversified pattern of income sources (e.g. from both farm and nonfarm/off-farm activities) or on better access to different retail outlets (e.g. open fresh market, corner shops and supermarket) for purchasing a variety of food items (Raneri & Wertheim-Heck, 2019). These alternative approaches thus focus on widening the options for food choice or strengthening access to market opportunities for reaching a more diverse dietary intake beyond just technological fixes.

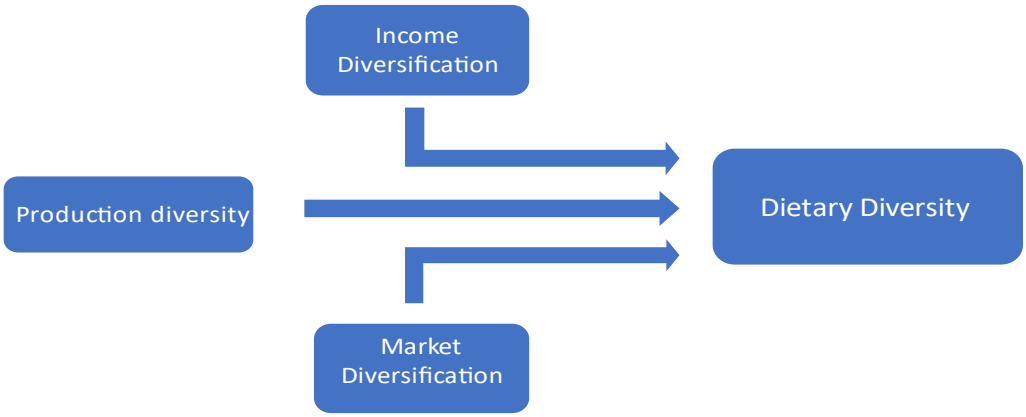

Figure 1. Different pathways to dietary diversity

The fact that there are multiple pathways for reaching a particular goal complements the well-known Tinbergen-rule (1952) that states that we need for each particular outcome a separate instrument. But at the same time different instruments can be used to support the same goal, and therefore the choice of instruments can vary according to specific local circumstances, depending on the farm-household resource base and/or on their linkages with markets.

An important criterion for making choices between most appropriate policy incentives to support a particular dietary outcome depends on the scope of influence of the instruments and the decision-making power of key stakeholders involved. Since decisions on diets and nutrition are usually mainly made by women, it is particularly important to evaluate their opportunities for contributing to production, income or market diversification. Since land resources are mostly male-owned, the income- and market-led strategies may offer more opportunities for women. Otherwise, only when household income is managed as a common pool, a focus on production diversity might become feasible for reaching dietary diversity.

3 Food Systems Approach: Looking for Unusual Interventions

Conducting food systems analysis within a bargaining arena of multiple stakeholders that are looking for strategic choices from a portfolio of activities asks for a particular framework that is able to provide insights in both the drivers of change as well as the pathways for reaching the desired outcomes. These complex input-output relationships take a particular shape in a system transformation environment where dynamic feedback effects become more important for unlocking bottlenecks.

We therefore need a food systems approach that looks further than just the individual components (i.e. production, processing, distribution and consumption) and devotes major attention to their interlinkages and interaction mechanisms (i.e. through prices, information exchange, attitudes and relationships). Changes at the level of market (value chain) and governance (institutions) are critical interfaces that may fundamentally influence the balance between production and consumption of food and the composition of diets. Understanding the structural connections

between such policy drivers and behaviour change responses is required to acquire key insights into the dynamics of food system transformation processes.

This implies that a major focus of food system approaches is on multi-level analysis of the structure of interactions between the different components and the dynamic responses of different stakeholders to changes in these interlinkages. Such an analysis takes the food system as a framework for identifying the potential for food transformation processes. It is meant to broaden the solution space and to provides an endogenous explanation of the system interactions characterizing the problem at stake in terms of the underlying causal structure of the system (Brezina et al., 2016). This is helpful to escape from single technological solutions and to broaden the scope to behavioural and social interventions that eventually result in fundamental adjustments in food system interactions and performance.

There is increasing evidence that so-called 'unusual interventions' may provide most interesting leverage points for improving system performance. Instead of just 'repairing the failures' key attention is given to identifying and understanding the root causes behind these failures. This implies that interventions try to modify behavioural constraints that block potentially fruitful response mechanisms and thus open opportunities for durable change. Many of these interventions may be outside the original scope of the problem and therefore need to be identified through an in-depth understanding of the behavioural drivers that ultimately cause the persistence of the identified problem.

There are several illustrative examples of such behavioural change strategies that start at another level of the result chain. Miguel and Kremer (2004) show that investments in deworming of children have the highest impact on reducing absenteeism and improving school attendance in Kenya. Their experiment shows that a change in domestic health care behaviour can have a strong effect on the effectiveness of collective educational facilities (even while academic school results did not differ very much).

In a similar vein, Banerjee and Duflo (2015) use randomized experiments to understand the problem of high absenteeism of female students in primary schools in Kenya. The absence of gender-sensitive sanitation facilities in schools has a large negative effects for school attendance by girls. Girls tend to stay at home during their menstrual period. The introduction of separate female-friendly toilets in a context of extreme poverty proved to be a substantial contribution for fighting absenteeism with infrastructure improvements as an unusual type of intervention that is implemented from outside the educational system.

Another example of using RCTs for the diagnosis of underlying problems in the field of dietary deficits is found in the appraisal of different nutrition-sensitive interventions in Bangladesh (Quisumbing et al., 2020). Common incentives, such as agricultural training and nutrition behaviour change communication only had limited effects, but their impact became more significant if combined with gender sensitization activities. Moreover, combining trainings to husbands and wife together contributed to women empowerment and improved gender parity at household level, thus controlling for unintended negative impacts. This illustrates that nutrition-focussed interventions become more effective if they start at the intra-household domain to create the conditions for shared beliefs.

These different examples illustrate the importance of looking for solutions outside the area where the original problems become manifest, and to search for understanding of the underlying behavioural mechanisms that can create space for adaptive change through interactive processes. Such interventions are characterized by three main features:

- They recognize the **multiple levels** and linkages between the stage where the incentive is applied and the stage where the output is expected;
- They combine material changes with behavioural changes in order to guarantee **multiple incentives** for adequately anchoring the transformation process;
- They guarantee the exchange of information amongst upstream and downstream activities to support the involvement of **multiple stakeholders** (particularly women).

As outlined in section 2, food systems analysis needs to be based on an integrated understanding of system interactions that (a) respect the interconnectedness of activities, (b) recognize the interaction between incentives, and (c) support the engagement of critical stakeholders in coordinated action. This implies that strategies for food system transformation should be based on a thorough analysis of potential interventions and impact pathways and require a deep understanding of the mechanisms that enable to modify stakeholder relationships and food supply chain interlinkages in such a way that better food system outcomes can be reached.

4 Leverage Points for Food System Transformation

These experiences from multi-level and interactive approaches of food system analysis provide interesting lessons for a more strategic analysis of food system transformation processes. Instead of just relying on a rather straightforward selection of suitable instruments for generating stakeholder responses – such as price support, information provision

and better access to resources – it now becomes more relevant to identify the underlying drivers that influence behavioural responses to these incentives.

This brings us to the traditional structure-agency debate on the interactions between the social structure and (individual or collective) human behaviour. Giddens (1979) tried to overcome this dichotomy by emphasizing how shared behavioural intentions could eventually modify rules and arrangements of agency interaction. Structures can be adapted by the exercise of agency.

This reasoning may be used for the identification of leverage points ('game changers') that can accelerate food system transformation processes. Even while many policy documents start with an in-depth analysis of the 'root causes' of current problems in the fields of poverty, malnutrition, environmental degradation and lack of inclusion, they usually stay within geographical and functional boundaries for finding possible solutions (Metabolic, 2017; West et al., 2014).

Unusual entry points to food system change only come to the surface when the analysis is broadened towards an understanding of the drivers of human behaviour and the motivations for agency interactions that enable to trigger turning points for overcoming food system thresholds (Werners et al., 2013). Sometimes small changes in agency relations and/or a rearrangement in stakeholder cooperation networks can pave the way for larger adjustments at the food production-transformation-consumption interface.

The critical interfaces for steering food systems transformation are related to the interactions between three food system domains: (a) food production and supply chains, (b) food environment and (c) food consumption behaviour. This is not only related to the material flow of food items ('from production to consumption' or 'from farm to fork') but also to the procedures to guarantee stakeholder welfare ('from dietary needs to food security'). The interactions between these domains are governed by a set of behavioural relationships that guarantee the agency responsiveness to changes in other (upstream or downstream) parts of the food system (Brouwer et al., 2021). Important behavioural drivers that facilitate the adoption of food system innovations are particularly based on reliability and mutual trust (for enabling collective action), information exchange and reciprocity (for risk sharing purposes), and repeated exchange and building reputation (for extending stakeholder's time horizon).

Lichtenstein et al. (2021) discuss the role of experiments for assessing the impact of behavioural change on dietary choices and food system transformations, and emphasize the importance of an appropriate sequence of interventions for reaching relevant outcomes and for a better understanding of the efficacy and effectiveness of different types of incentives. Comparative studies under different conditions and in different settings can be particularly helpful to understand how stakeholders react to policy incentives in terms of adaptation of their behaviour (Lane et al., 2023). Deaton and Cartwright (2018) argue, however, that we put too much trust in field experiments and that we should conceptualize more about the - observed and unobserved - covariates that explain 'why things work' (and not only: 'what works').

Policy attention should be devoted to the identification of behavioural interventions that have promising perspectives for changing the internal dynamics and functioning of the food system. Targeted interventions that are intended to influence tipping points can accelerate change across socio-technical, ecological and socio-economic domains. It is therefore important to understand how investment decisions by specific food system stakeholders influence the interactions between stakeholders in the agri-food supply chain, while societal boundaries and environmental thresholds are respected.

5 Different Food System Transformation Impact Pathways

The identification of suitable entry points for initiating food system transformation processes remains the most critical decision for starting effective intervention strategies. It is therefore of vital importance to understand the drivers of the underlying behavioural mechanisms that cause or contribute to the initial problem. Since there usually is a long distance between the original behavioural choices and the final manifestation of the problem, we need to focus on different kinds of linkages between food production and food consumption within the food system environment.

We can illustrate that an interactive analysis of the food supply chain may provide useful insights into the diversity of entry points where behavioural change at one level/stage is required for reaching material change at other levels/stages of the food system. Therefore, four different types of interlinkages that rely on particular food system interactions deserve attention (see figure 2).

First, upstream (backwards) linkages focus on the impact of changing delivery outlets and sales arrangements for the organization of input supply and their impact on primary production systems. This is particularly the case in settings when the quality and reliability of inputs is critical for articulating processing and retail activities in line with food system transformation requirements. A typical example is found in the emerging poultry value chain in Tanzania, that requires stable supply of soybean as chicken food from local smallholders (Pamuk et al., 2022). Whereas in the beginning suitable soybean seeds were rather scarce and farmers were reluctant to adopt soya production, the

interactions took shape when the poultry industry agreed on contractual purchase arrangements to reduce the market risks of farmers.

Convincing female farmers proved to be particularly important, and therefore membership of village savings and loan associations (VSLAs) turned out to be a key mechanism for reinforcing these upstream (backwards) interlinkages.

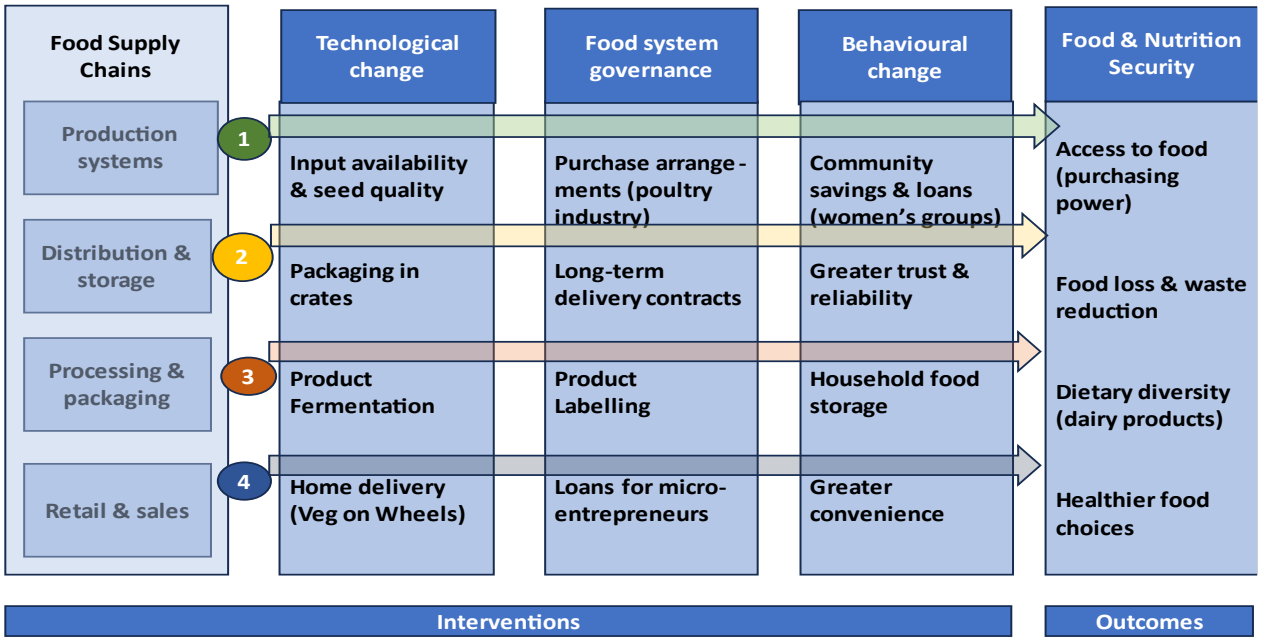

Figure 2. Agri-food supply chain interventions that enhance food system interactions

Second, transversal linkages that bridge information on transactions throughout the food supply chain are efforts to bring input use and retail outlet decisions better in line with each other. This is a particular challenge for perishable fruit and vegetables that are critical for enriching diets and provide important micronutrient, but also suffer from considerable food losses during transport and storage. A typical example comes from long-distance supply chains of perishable products such as of tomatoes in Nigeria, where the choice of seed material and the packaging of tomatoes in plastic crates by smallholder farmers substantially reduces post-harvest losses at the retail end of the supply chain (Plaisier et al., 2019). In order to enforce the required cooperation of farmers (who need to invest labour time for tomato selection and careful packaging in crates) and traders (that need to return empty cates back to the farmers) it is necessary to convince retailers to return part of the value added – on a contractual base - back to these other supply chain stakeholders. This implies that efforts to reduce behavioural uncertainties in the supply chain (for establishing mutual trust and reliability) eventually pay-off in terms of more efficient material transactions and higher rewards.

Third, downstream consumer-oriented value chain linkages pay most attention to opportunities for dovetailing production practices with consumer choices. This implies that particular types of products are developed that align with dietary preferences and household abilities. A good example is derived from the transformation of dairy supply chains in rural Zambia (Moonga et al., 2019), where most households have no possibilities for cooling (due to lack of electricity) and therefore prefer fermented milk products (*mabisi*) that can be better preserved. The opportunities at the end of the food supply chain thus ask for investments in processing and packaging at midstream level that are harmonized with household preferences and opportunities.

Fourth, chain integration programs intend to reduce transaction costs for consumers through shorter linkages with market outlets. The basic intention is to provide an easily accessible supply of fresh products to low-income households that have no cool storage options, offering regular small portions by trusted suppliers close to their homes. This approach was explored in the Veg-on-Wheels program in Nigeria, where ready-to-cook, washed and pre-cut green leafy vegetables were kept cool and sold by mobile traders at convenient locations near workplaces and on the open market (Snoek et al., 2022). Changes towards healthier food choices are mainly supported by improving the equipment of the traders (bicycles and pushcarts that included cool boxes) and strengthening the reliability of their relationships with consumers.

These examples illustrate that most effective interventions initiate at other levels of the agri-food supply chain than where the original problem is detected or where the final result is achieved. Therefore, they only can be identified

through active involvement and cooperation of stakeholders at upstream, midstream and/or downstream levels of the food supply chain. In most cases, changes in stakeholder behaviour are accompanied by the emergence of new governance arrangements that reinforce multi-stakeholder interactions throughout the food chain (Schifferstein, 2020). When technical solutions go hand-in-hand with behavioural and/or institutional changes, their adoption tends to become easier, wider and faster (Reisch, 2021; Omwezen et al., 2019). Open information exchange may provide additional incentives for systems adaptations that harmonize different stakeholder's interests.

6 Implications and Outlook

Food systems are based on many simultaneous and complex interactions and therefore solutions to improve their performance ask for deep insight into the underlying drivers for its dynamics. We showed that simple 'problem solving' strategies hardly change the structural constraints that food systems are facing. Therefore, it is important to broaden our thinking towards 'out of the box' approaches that are capable to address both technical and behavioural change

Reverse thinking about food systems dynamics proves to be very useful to identify such unusual solutions. It relies on backcasting from the desired (health and nutrition) outcomes to the policies and programs that are required to move the system into this direction. This provides room for imagination and enables a constructive dialogue amongst key stakeholders.

Food system transformations always involve a combination of material and behavioural change. In some cases, the process starts with technological changes (such as opportunities for fermentation) that call for new governance arrangements to facilitate their adoption and diffusion. In other circumstances, changes in stakeholder behaviour (such as engagement in collective action) create room for a shift to more effective governance regimes.

Food system transformation policies should aim for dovetailing societal and behavioural tipping points (Aschemann-Witzel and Schulze, 2023) by tailoring short-term incentives to long-term drivers in such a way that upstream or downstream interlinkages are mobilized for anchoring dynamics of change. This asks for a policy mix that mobilizes the opportunities for technological and/or social innovation and create alternatives for interactive food system governance.

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