



**Photo 1** Kibera Mr. Gabriel Francis Mwangi

## An editorial of articles meant for a Special Issue on 'Development of Resilient Urban Food Systems—Exploring Synergies and Making Priorities'<sup>1</sup>

Core scientific contributions to the Feeding cities and migration settlement (2019-2022) (KB35-002-001)

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### Background

This concept note gives a snapshot of a series of scientific articles published from the 'Feeding cities and migration settlement project'<sup>2</sup> (2019-2022) of Wageningen University & Research (WUR), funded by the Dutch Ministry of Agriculture, Nature and Food Quality. *The overall goal of this project was to contribute to resilient, sustainable and urban food systems, providing food and nutrition security for all. This project has investigated rural-urban connectedness within the food system with a focus on low-income groups in the Global South, along the cases of Dhaka in Bangladesh, Kampala and Arua in Uganda, and Nyeri and Nairobi in Kenya.* The main aim of this concept note is to provide an overview of different outcomes of rural-urban food systems interactions published in a Special Issue of the scientific journal *Sustainability*. These interactions explored cover issues of urban growth at a general level, as well as zooming in on value creation, with a focus on new opportunities for the midstream, diversities of livelihood factors within informal settlements, and the role of trust (i.e. social-capital) within the rural-urban food systems. This is followed by a more general view of the organic waste issue in urban settlements and on spatialisation and spatial planning as a mechanism within the rural-urban food systems. The 'Feeding cities and migration settlement project' will be followed up by the project 'Food and Nutrition security for low income groups in rural-urban food systems in the global south' (2023-2024), with an emphasis on challenges of water and climate change in relation to food resilience.

#### Financing

Wageningen University and Research, WUR, projects: Feeding cities and migration settlements are research (KB-35-102-001) (2019-2022), as well as Food & nutrition security of low income groups in rural-urban food systems in the global south (KB-35-102-001) (2023-2024), which are subsidized by the Dutch Ministry of Agriculture, Nature and Food Quality.

<sup>1</sup> Special Issue Sustainability: [https://www.mdpi.com/journal/sustainability/special\\_issues/resilient\\_urban\\_food\\_systems](https://www.mdpi.com/journal/sustainability/special_issues/resilient_urban_food_systems)

<sup>2</sup> Feeding cities & migration settlement project: <https://www.wur.nl/en/research-results/research-funded-by-the-ministry-of-lnv/expertisegebieden/kennisonline/feeding-cities-migration-1.htm>

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## 1 Introduction

In the Global South, rapid population growth and urbanisation elevate current and future challenges facing those countries and especially their food systems. The share of global urban population will increase from 56% in 2021 to 68% in 2050, which translates into an increase of 2.2 billion urban residents, living mostly in Africa and Asia (UN\_HABITAT, 2022). The current East African population will more than double to 880 million by 2050, assuming a medium population growth scenario (UN, 2017). It has been estimated that more than 70% of the total urban population in Sub-Saharan Africa currently live in informal settlements or slums. Food and nutrition insecurity is a major concern in rapidly growing urban areas of low- and middle-income countries (LMIC), especially in the slum areas where the most vulnerable people live. The complex interactions between spatial scales, societal changes, role of governance systems and sustainability impacts strongly demand a food systems approach. Urbanisation does not only impact cities and their population, but also rural-urban food systems, in which urban and rural areas are interconnected through, among others, food trade, remittances and migration.



**Photo 2** Kibera Mr. Gabriel Francis Mwangi

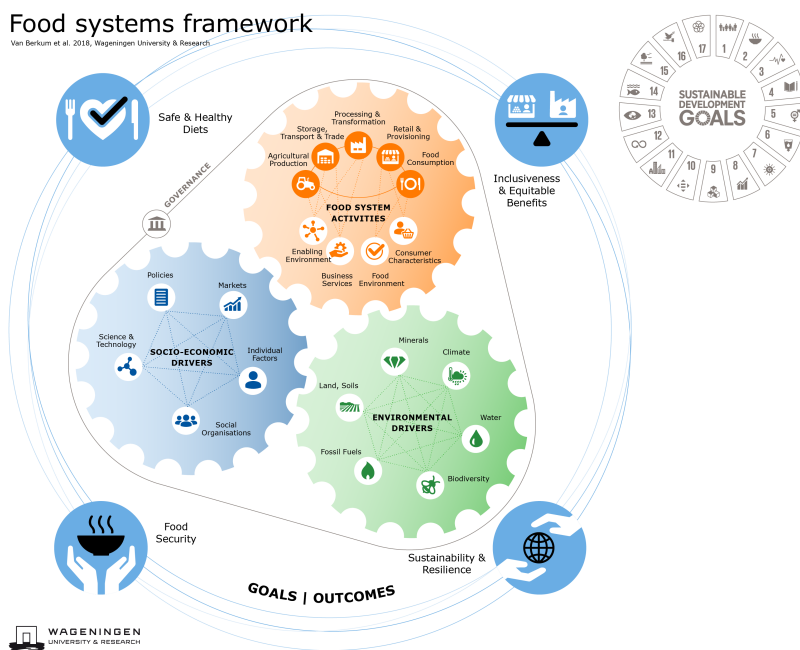
Major drivers such as climate change, ecological degradation, urbanisation pressure and future shocks pressure existing food systems to change. Future systems are already stressed and have proven to be highly vulnerable. The question should be raised whether improving current systems has the future or new systems should be co-created. The development of resilient urban food systems requires processes of exploring synergies and making priorities. On the one hand, the flows between rural and urban areas, with people, ideas, goods, money, services, technologies and waste flows, may change the dynamics for increased resilience. For instance, factors that can strengthen rural–urban interrelationships and the resilience of food systems may include urban immigrants increasing remittances, ideas and knowledge back to family members in rural households. On the other hand, new innovations may require stakeholders in food supply chains to adopt their practices or go out of business. Strategies towards resilient urban food systems can be categorised across three types of interventions: market, technology and governance.

This Concept note provides an overview of scientific contributions of the Feeding cities and migration settlements to the Special Issue on: 'Development of Resilient Urban Food Systems—Exploring Synergies and Making Priorities'. Against this background, **the main aim of this concept note is to explain critical causes and dynamics, which can impact low-income groups in terms of food and nutrition security, safe and healthy diets, inclusiveness and equitable benefits, and sustainable and resilience in rural-urban food system.** The critical causes and dynamics explored cover issues of urban growth, the role of midstream in value-creation, the diversities of livelihood factors within informal settlements, the role of social-capital within the rural-urban food systems, the waste issue in urban settlements and the spatialisation and spatial planning as a mechanism within the rural-urban food systems.

Before introducing the articles one by one throughout Chapters 3 to 10, the rural-urban food system is introduced, explaining the motivation and reasoning of applying it. Chapter 11 gives an overview of activities that will take place in a follow up project to the "Feeding cities and migration settlement" project called "Food and nutrition security of low income groups in rural-urban food systems in the global south". In Chapter 12, concluding remarks and recommendations are provided.

## 2 Why a rural-urban food system approach?

Exploring a rural-urban food systems approach, this Special Issue offers a holistic perspective on food and nutrition security by broadening the focus from food security and food system activities to social and environmental drivers and outcomes of the food system activities. Importantly, a food system approach shows how food systems interact with other (ecological, economic or political) systems, providing excellent opportunities for analysing how each element within a system interacts with the others in producing food system outcomes. The connectiveness of food system elements is depicted in a conceptual food system model (van Berkum et al. 2018; van Berkum et al. 2020). A food system approach covers knowledge about value-chain dynamics, factors influencing population movement, governance and market-related activities, and environmental and climate conditions, which can all contribute to increased understanding about how to shape future food systems. (Figure 1). In a rural-urban food system, the movements of people, money, products and knowledge causes extra dimensions of causes and consequences to the system.



**Figure 1** A food system with safe, healthy diets, food security, inclusiveness and equitable benefits, as well as sustainability and resilience as main outcomes, impacted by causes and interrelationships among and across food system activities, socio-economic and environmental drivers



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In a food system approach, the outcomes can be observed along all of the Sustainable Development Goals (SDGs) introduced by the United Nations General Assembly (UN-GA), for which food security, safe and healthy diets, inclusiveness and equitable benefits, as well as sustainability and resilience, are the immediate outcomes. The dynamics of food system activities related to, among others, the value chain with production, trading and consumption, as well as banking, laws and regulations' facilities, are highly interlinked with the dynamics of socio-economic and environmental drivers. While the socio-economic drivers include specifications of the policy regime and levels of conflicts, the dynamics of the environmental drivers define the quality of water, climate adaptability, biodiversity and soil conditions, among others (HLPE, 2014). The drivers have strong influences in context-specific food systems. While it is generally acknowledged that the food systems are complex, it is not possible to analyse every single causal relationship in every study.

While migration to urban areas is a cause of urban growth, urban growth has consequences for rural livelihood opportunities, such as agricultural production and primary agricultural livelihood opportunities, as well as for resource use of land, water, soil, etc. (van Berkum, 2023) (Figure 2, Chapter 3). These dimensions of causes and consequences eventually impact all the four rural-food system outcomes (Figure 1). While this is a qualitative analysis at a more general level, seven articles meant for the Special Issue investigate context-specific factors in a specific location in Kibera, Nairobi, Kenya (Chapters 4-10), focusing on:

- Chapter 4: research leading to implementation of new fish value-chain in the informal settlement, by means of identification of core bottlenecks in co-creation living lab (CC-LL) settings (Soma et al. 2021),
- Chapter 5: fish consumption among consumers in the informal settlement (Ayua et al. 2021),
- Chapter 6: urban – rural connectivity, a variety within an informal settlement (Soma et al. 2022),
- Chapter 7: the role of social capital (e.g. trust) in this informal settlement, which is one of the largest in Africa (Termeer et al. 2022).
- Chapter 8: the problem of organic waste in the informal settlements of Dhaka, Bangladesh, as potential to convert into a resource for use (Pedrotti et al., *accepted*).
- Chapter 9: a regional level, investigating the processes of spatialisation, spatial planning as strategies for enhanced rural-urban food system outcomes (van Haren et al., *accepted*), and
- Chapter 10: Multi-Stakeholder Platforms as a means to food system transformation (Pittore and Debons, *accepted*).

### 3 Urban growth and food systems outcomes (van Berkum,2023)

#### Article

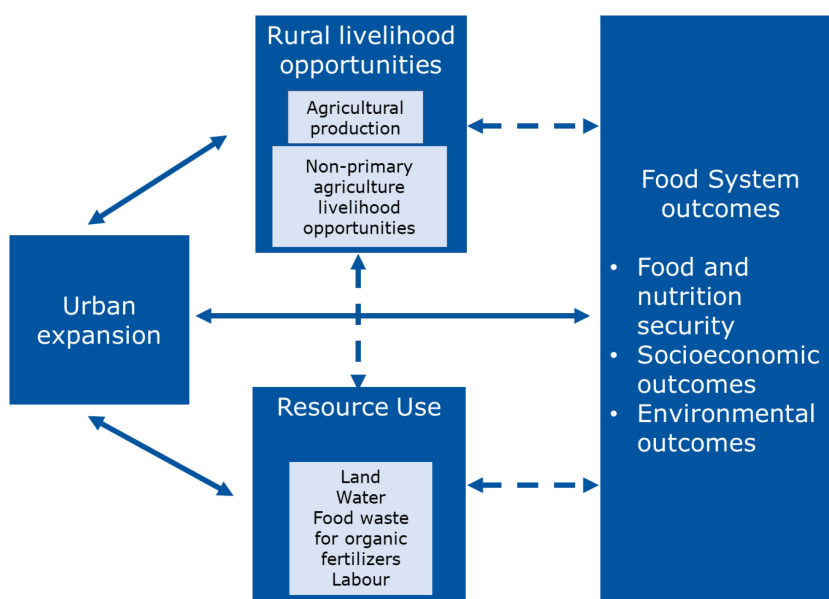
van Berkum, S. (2023). How Urban Growth in the Global South Affects Agricultural Dynamics and Food Systems Outcomes in Rural Areas: A Review and Research Agenda. *Sustainability*, 15(3), 2591. <https://doi.org/10.3390/su15032591>

This study investigates scientific literature addressing impacts of urban expansion (planned or unplanned) on rural livelihoods, with the main aim to explore the expansion of urban developments on agricultural land near urban areas and on food system outcomes in rural areas. Figure 2 illustrates the interactions between the components of analysis: urban expansion, agricultural resource uses, agricultural production and food system outcomes in rural areas in developing countries. The interactions can be described as follows. High urban expansion causes changes that affect the competitive use of natural resources in the vicinity of the city. Consequently, food system actors adapt or transform agricultural production, reorganising their activities in response to the pressures of urban expansion. The outcomes of this transformative process are reflected in the ability of rural food system actors (farmers, agricultural workers, food traders, processors and input suppliers), taking advantage of changing food needs of the expanding nearby city, and adapting and/or mitigating environmental impacts associated with urban sprawl and agricultural intensification. Agricultural transformation as a result of urban expansion also changes the activities of the food value chain, creating employment both in and outside the food value chain, thereby contributing to rural livelihoods in rural areas. A typical feature of urban-rural relations is that there are reciprocal influences: urban sprawl influences rural livelihoods, and conversely, rural livelihood opportunities affect urban expansion (e.g. through migration). This study



mainly focuses on how urban sprawl affects rural livelihood opportunities, primarily through increased competition for land, water and other inputs, while remittances of rural-to-urban migrants bring capital to the countryside.

A range of empirical studies confirm the hypothesis that urbanisation impact agricultural transformation, pointing at increasing competition for land near growing cities that lead to more intensive land use and a shift of production towards high-value products such as horticultural production. However, other studies claim that the spatial continuity of land use around cities (i.e. the most intensive farming is closest to the city centre and the more extensive farming further away) is more nuanced because farmers' decisions to abandon or intensify farming around cities depend on more than purely economic motives, while connectivity (in terms of distance and accessibility) and the polycentric pattern of urbanisation (with associated opportunities for alternative employment) also determine how farmland is used around large cities. The literature shows several examples where urban sprawl and marginalisation of agriculture in rural areas are at the expense of ecologically sensitive areas, such as forests or wetlands. Urban expansion can have a major impact on smallholder farmers who are particularly vulnerable when land pressure increases and land claims are contested, given that informal arrangements for land dominate in urban and suburban areas.



**Figure 2** Interactions between the main components of analysis; urban expansion, agricultural resource use, rural livelihoods opportunities through agricultural production or other economic activities, and the socioeconomic, environmental and food and nutrition security impacts in rural areas

The article sets out a three-track research agenda: 1) farmers' decision-making processes under increased competition for factors of production due to urban sprawl; 2) the role of urban-rural connectivity, city size and urbanisation pattern in agricultural dynamics around the city; and 3) the analyses of the socio-economic and environmental effects of urban sprawl on agricultural development opportunities around cities.

**Article**

Soma, K., Obwanga, B., and Kanyuguto, C.M. A New Rural-Urban Fish Food System was Established in Kenya—Learning from Best Practices. *Sustainability* 2021, 13(13), 7254. <https://doi.org/10.3390/su13137254>

Kibera, the largest slum in Nairobi, Kenya, is increasing in size and complexity due to migration from rural areas. Reaching the objectives of zero hunger (SDG2) and sustainable cities and communities (SDG11) are urgent to future development. In this light, a new fish value-chain has been set up between a rural area in the Nyeri County and the informal settlement of Kibera, to supply small-sized affordable and accessible fish. The main aim of this article is to investigate this successful example to assist future initiatives to overcome the complex challenges and discuss reasons why it was successful. The methods applied to obtain information can be referred to as 'Co-creation Living Labs', for which solutions are searched through engagements of local community leaders. A community leader is a trusted person within a large networks, and have deep understanding about the contextual factors. To ensure a resilient rural-urban food system in the future, it is critically important to understand context-specific institutional mechanisms, which in Kenya are based in communities run by strong community leads with capacities to motivate and influence other actors in the network to improve and make changes.



**Figure 3** Assumed friction between an external circle of institutional capacities, and more trusted community institutions in the inner circle are illustrated for further discussion. The Sub-Saharan African institutional setting at a glance. The social capital may be judged strong within communities, and weak on the broader imposed institutional system of national unity, public management and bureaucracy, multinationals roles of influence, and external relationships in Sub-Saharan Africa

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This article reports on successful co-creation that resulted in an innovative new fish value chain, established between Nyeri and Kibera in Kenya in August 2020 (Feeding cities and migration settlements, see videos and documentation for more information).<sup>3</sup> Since August 2020, one to two tonnes of fish is brought weekly to Kibera. Emphasising the midstream women entrepreneurs of the fish value chain, a total of 56 vendors are involved in the Kibera co-creation activities, eager to process and sell the fish in Kibera. Moreover, the co-creation living lab includes a total of 1,000 farmers in Nyeri. These events go hand in hand with frequent co-creation dialogues among the community leads in Kibera and Nyeri, in dialogues with Wageningen University and Research (WUR) in the Netherlands and Laikipia and Egerton Universities in Kenya. The new fish value chain was not generated overnight, but many practical issues had to be solved, including the logistics in Nyeri collecting fish among the 1,000 farmers, cleaning, freezing, and transporting to Kibera. In Kibera, a series of licences had to be arranged by the public sector (e.g. health certificate per worker, Covid-19 certificate, single business permit, facility/office certification, food hygiene licence for food handlers, company registration technicalities, PIN certificate and Tax compliant Certificate). Figure 3 gives clues about where to put efforts to reach real impacts, referring to communities in the inner circle refers to communities as a core contributor to making real change.

## 5 Informal settlements – fish consumption (Ayuya et.al., 2021)

### Article

Ayuya, O., Soma, K., and Obwanga, B. Socio-Economic Drivers of Fish Species Consumption Preferences in Kenya's Urban Informal Food System. *Sustainability* 2021, 13, 5278. <https://doi.org/10.3390/su13095278>

In an effort to contribute to resilient food and nutritional security in urban slums, a food system approach was applied to understand the key socio-economic factors driving fish species consumption in Kibera, the largest informal settlement in Africa located in Nairobi, Kenya. Data were collected from 385 randomly selected households using a structured questionnaire. A multivariate probit model was applied to estimate the relationship between the variables in order to determine the socio-economic drivers of preferences for different fish species.

Out of the 385 respondents, 92.5% were fish consumers. See picture with consumers of fish in Kibera (August 2020). Figure 4 presents the household preferences for fish species, which, through the findings, indicate that consumers prefer more than one variety of fish. The most preferred (73%) fish species is the Lake Victoria sardine (*Rastrineobola argentea*) because of its availability and lower price compared with other fish. This is convenient for low-income households in informal settlements, where the majority of households fall into the low-income category. Lake Victoria sardine is closely followed by Nile tilapia (*Oreochromis niloticus*) (70%) and Nile perch (*Lates niloticus*) (23%), respectively, which are noted for their acceptable tastes. Other fish species, such as African catfish, common carp, marbled lungfish, fulu and tuna (*Clarias gariepinus*, *Protopterus aethiopicus*, *Cyprinus carpio*, *Haplochromine cichlids* and *Thunnus sp.*, respectively), are preferred by 12%. Further, the results show that the demand for the Lake Victoria sardine increased with household size, while higher income influenced preference for Nile tilapia and Nile perch positively, implying that when more income is available, Nile tilapia is the preferred fish over other fish species. Increased fish prices positively influenced preference for Nile tilapia, which is explained by the willingness to pay extra for quality and origin, for instance, to avoid the cheaply cultivated Chinese fish. In the case of the Lake Victoria sardine, lower prices positively affect the fish demand. Figure 5 presents the findings related to the location where the households purchase their fish. Mainly, consumers have multiple sources of fish, but our findings reveal that consumers purchase most of their fish from the street/roadside, where vendors sell the prepared fish either in or outside the neighbourhood.

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<sup>3</sup> Video S1: Nyeri-Kibera fish food system:

[https://www.youtube.com/watch?v=2MYOUZdjKVs&list=PLz\\_ZBMIqwkG6dqXtrekICZdRMfTJ5ffj](https://www.youtube.com/watch?v=2MYOUZdjKVs&list=PLz_ZBMIqwkG6dqXtrekICZdRMfTJ5ffj)

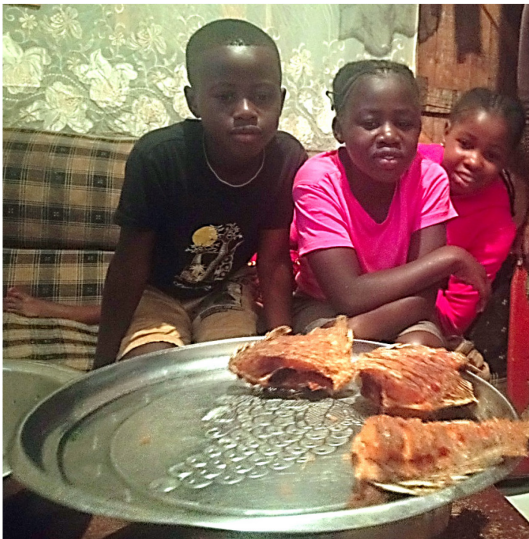
Video S2: Kibera (Kibra) documentary: [https://www.youtube.com/watch?v=K\\_goJu2encg](https://www.youtube.com/watch?v=K_goJu2encg)

Video S3: Nyeri fish farm documentary: <https://www.youtube.com/watch?v=xH3itzOKWOY>

Video S4: Lake Victoria fish farm documentary: <https://www.youtube.com/watch?v=VYPnQQ1UwXw>

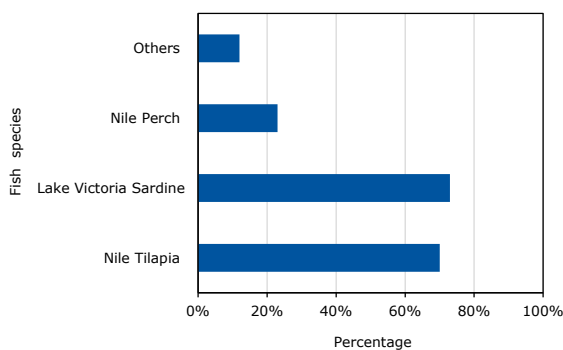
Video S5: WEBINAR: Food-system-transitions-in-Nairobi-slums-FOOD-FUTURES: <https://www.wur.nl/en/activity/WEBINAR-1-Food-system-transitions-in-Nairobi-slums-FOOD-FUTURES.htm>



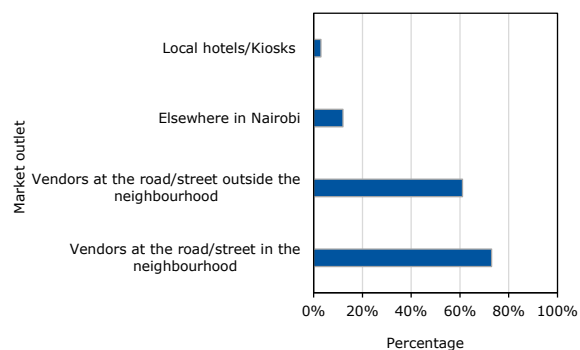


**Photo 3** Kibera Dr. Oscar Ingasia Ayuya

Furthermore, it was showed that religious and cultural practices and beliefs influenced preference for species and consumption of fish. Residents who migrated from western Kenya had a higher preference for the Lake Victoria sardine, while residents born and raised in Kibera prefer Nile tilapia. Neighbourhood effects reduced the consumption of Nile perch. These findings provide insights into future market opportunities for specific target groups. For instance, given that small-sized fish like the Lake Victoria sardine is highly demanded, in order to increase resilience in food and nutrition security, small-sized cheap Nile tilapia will have a large potential in the future, with ever higher demand specifically from the residents born and raised in Kibera.



**Figure 4** Household preferences for fish species (%) in Kibera, August 2020



**Figure 5** Location of purchase of fish by households (%) in Kibera, August 2020

## 6 Informal settlement – livelihood welfare factors (Soma et.al., 2022)

### Article

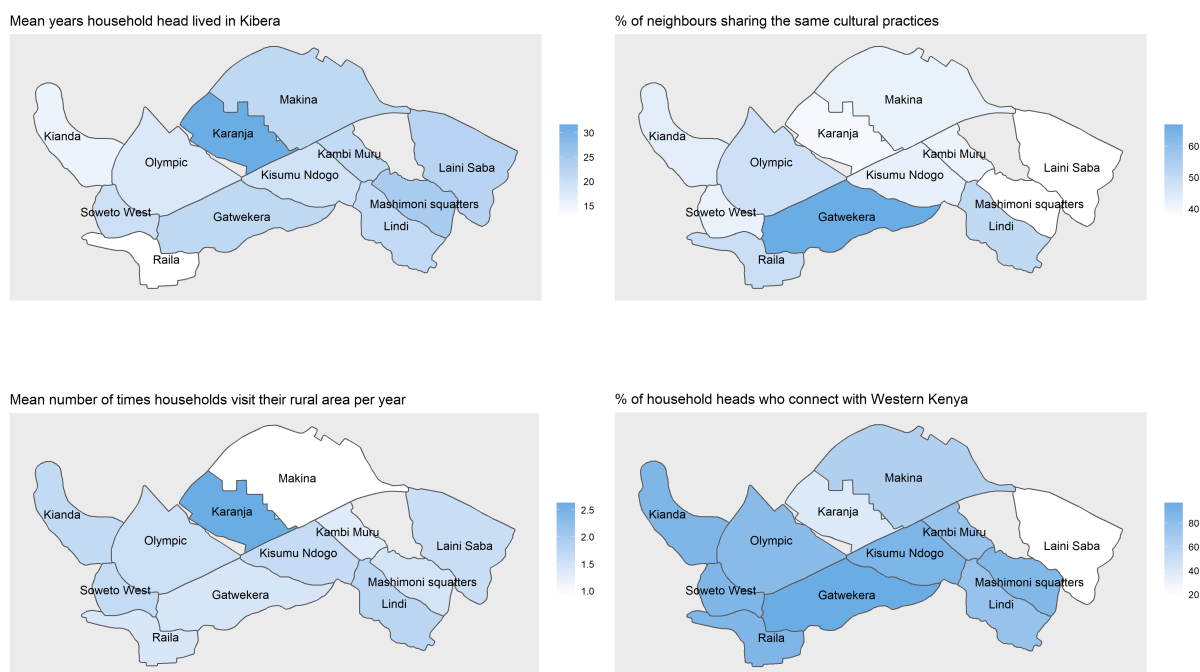
Soma, K., Janssen, V.C.J, Ayuya, O.I., and Obwanga, B. Food Systems in Informal Urban Settlements— Exploring Differences in Livelihood Welfare Factors across Kibera, Nairobi. Sustainability 2022, 14, 11099. <https://doi.org/10.3390/su141711099>

The number and sizes of informal settlements in Sub-Saharan Africa are expected to increase drastically in the future, where migration from rural to urban areas is increasing, and poverty and food insecurity threaten livelihoods. Data sources explaining livelihood factors in informal settlements are scarce, and

often highly disputed. The main aim is to analyse differences in livelihood factors across the villages in Kibera, and to explain some of the existing discrepancies in food security levels among its population. In particular, livelihood factors such as tribe, welfare and trust can explain some of the variation in food security across 12 of the 13 villages located in Kibera. The analyses inform of significant differences across the villages when it comes to, among others, income, food insecurity, ownership of land in rural areas, tribal background and trust levels in strangers and community leads. Figure 6 presents some of these results, particularly on household practice differences across the villages.

On average, the number of years a household head has lived in Kibera is 21 years. The share of household heads indicating they adopt the same practices as their neighbours was estimated to be 45% on average. On average, a household head visited the rural area of belonging 1.6 times a year, and the share of household heads who feel connected to Western Kenya was as high as 75% on average. Actually, there is a large diversity of tribes in Kibera. Overall, based on the random sample of this study, the selected households consisted of 34% representing the Luhya tribe and 33% representing the Luo tribe, which are the most prevalent tribes in Kibera, followed by a total of 11% of the households representing the Kisii tribe, and only 8% representing each of the Nubian and Kamba tribes. Only 5% belonged to the tribe Kikuyus.

To reach the millions of people living in informal settlements now, and increasingly so in the future, it is advised that research and implementation go hand in hand, with enhanced understanding of the complexities within rural-urban food systems to ensure solutions that are affordable and accessible to low-income groups. On this pathway to fight poverty and hunger in the future, policies and programmes must take such complexities into account to positively contribute to strengthening the resiliency and sustainability of rural-urban food systems by ensuring an increase in welfare levels with zero climate impact.

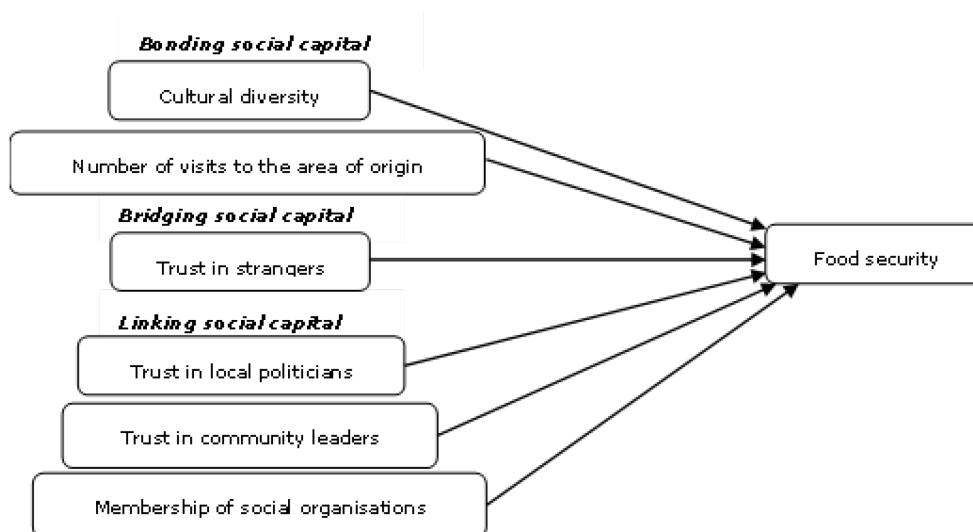


**Figure 6** Household practices across 12 villages in Kibera, August 2020

**Article**

Termeer, E.E.W., Soma, K., Motovska, N., Ayuya, O.I., Kunz, M., and Koster, T. Sustainable Development Ensued by Social Capital Impacts on Food Insecurity: The Case of Kibera, Nairobi. *Sustainability* 2022, 14, 5504. <https://www.mdpi.com/2071-1050/14/9/5504>

The expectation is that Africa's population will double by 2050, with two-thirds of this increase happening in urban areas (OECD/SWAC, 2020). African countries have the highest urbanisation rate globally, as well as an increasingly growing number of people that live in slums where food and nutrition security are highly challenged. Social dimensions are increasingly considered in the scientific literature in understanding the incidence of food insecurity on the household level. These social dimensions are referred to as social capital: the networks and relationships between and within groups of people that they rely on and that complement other forms of capital (e.g., economic or human capital); for example, shared values, norms and trust. The aim of this study is to disclose the social factors of sustainable development goals by exploring the links between three types of social capital (bonding, bridging and linking) and food security in Kibera, an informal settlement located in Nairobi, Kenya. Although several studies have addressed links between food security and social capital, there is a lack of theoretical approaches exist in the literature, which concern the sustainable development theory devoted to urban areas taking into account the sustainable development goals. This study applies a linear regression model on data from 385 households in Kibera (August 2020) to analyse the connection between food security and three types of social capital (bonding, bridging and linking) (Figure 7). The study included several variables that represent the subtypes of social capital, such as cultural diversity and visits to area of origin (for bonding social capital), trust in strangers (for bridging social capital), and trust in local politicians, trust in community leaders and membership of social organisations (for linking social capital) (Figure 7).



**Figure 7** Independent variables of social capital in Kibera, August 2020

This study shows that for people living in informal settlements, such as Kibera, a large social network and tight bonding with rural communities and relatives provides more opportunities to access food. More precisely, our results demonstrate that, on the one hand, people with shared ethnic backgrounds are more likely to share food, making households more food secure, and on the other hand, cultural diversity in a neighbourhood can increase food security by bringing in different products from different places, with increased opportunities to fill gaps when, e.g., the fish supply to Kibera is low. In addition to the neighbourhood in informal settlements and the relatives in rural areas, trust relations with the community leader in the slum contribute towards enhanced food security. This explains the important role that the community leaders have in supporting their neighbourhood with enhanced wellbeing. Food



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security has not been demonstrated to increase as a result of increased trust relations with local politicians, or with membership of organisations, which may imply that informality is not easily replaceable by formality. The results demonstrate that insight into social capital can inform of household food insecurity in vulnerable urban settlements. In the picture are 10 of the 56 women vendors we have worked with in this project, participating in a workshop in May 2020, and among the households interviewed.



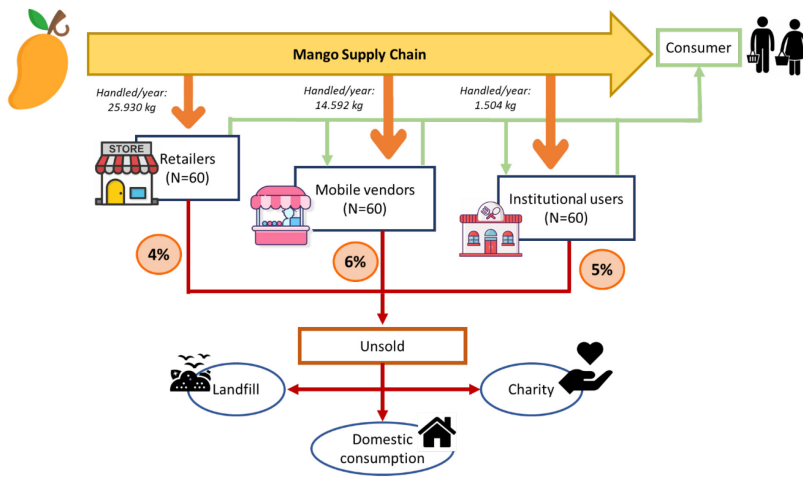
**Photo 4** Nairobi, Mr. Charles Mbauni Kanyuguto

## 8 Urban food waste in informal settlements (Pedrotti et.al., *accepted*)

### Article

Pedrotti, M., Fattibene, D., Antonelli, M., and Castelein, B. Approaching urban food waste in low and middle income countries: a framework and evidence from case studies in Nairobi and Dhaka. *Sustainability*, *accepted*.

In the last decades, the world urban population has surpassed the rural population, with more than 4.3 billion of people currently living in urban areas. By introducing a shift in dietary and food consumption habits, improved wealth and an expansion of the food supply chains, this urbanisation trend is exacerbating some of the world's sustainability challenges including the ones related to urban food waste (FW). While the global narrative around food loss and waste in LMIC has mainly focused on postharvest losses, recent evidence shows that food waste is also a major issue in those countries. However, little is known about food waste in urban food systems in terms of volumes, drivers and possible interventions to prevent it. The aim of this paper is to characterise and discuss urban food waste in LMIC and possible tools/frameworks for monitoring and reducing urban FW. First, a three-step approach for analysing urban food systems, identifying FW hotspots, and designing and implementing effective FW prevention/reduction intervention is presented. Then we present the results of four different urban FW case studies based in Nairobi (Kenya) and Dhaka (Bangladesh). The study in Nairobi focused on quantifying and understanding possible drivers of household FW in a slum and in characterising FW disposal. The other three case studies examined FW at retail, food service and institutional levels for three supply chains (onion, mango and beef) in Dhaka. The results from the case studies are then discussed through the presented food system approach to understand FW hotspots, the main drivers and possible interventions are proposed. For instance, looking at the mango value chain in Dhaka, it appears that a total of 4%, 6% and 5% are unsold by retailers, mobile vendors, and institutional users, respectively, as an average per actor (Figure 8).

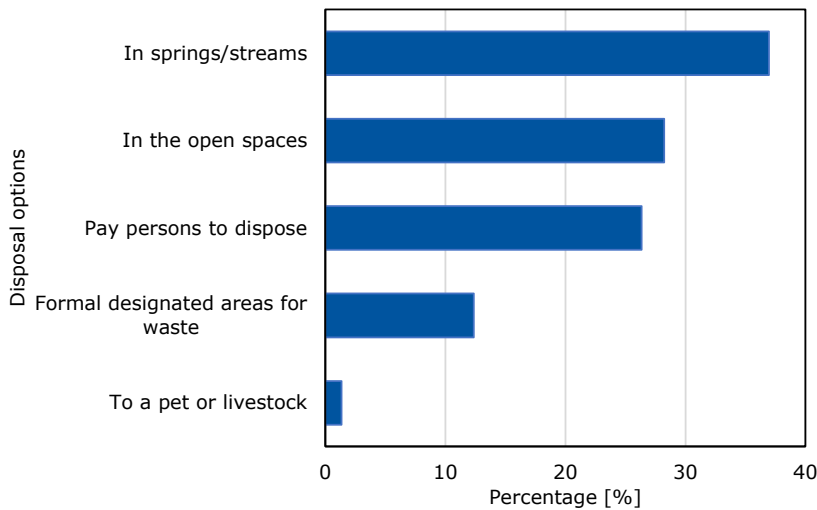


**Figure 8** Mango food waste visualisation, Dhaka, Bangladesh. The handled values per year represent an average per actor

Also, it was estimated that the main waste disposal place in Kibera resulted to be the springs/streams (37%) and/or in open spaces around Kibera (28%, n=210), while 26% reported to pay a person to dispose their waste with the municipal solid waste system, and/or dispose their waste in formal designated areas (13%) (Figure 9). Only 1% of the participants used their solid waste for feeding livestock (mainly chickens). Other options that were mentioned were burning the non-decomposing wastes such as plastic bags, while the kitchen waste was also used for composting.



**Photo 5** Kibera Mr. Benson O Obwanga



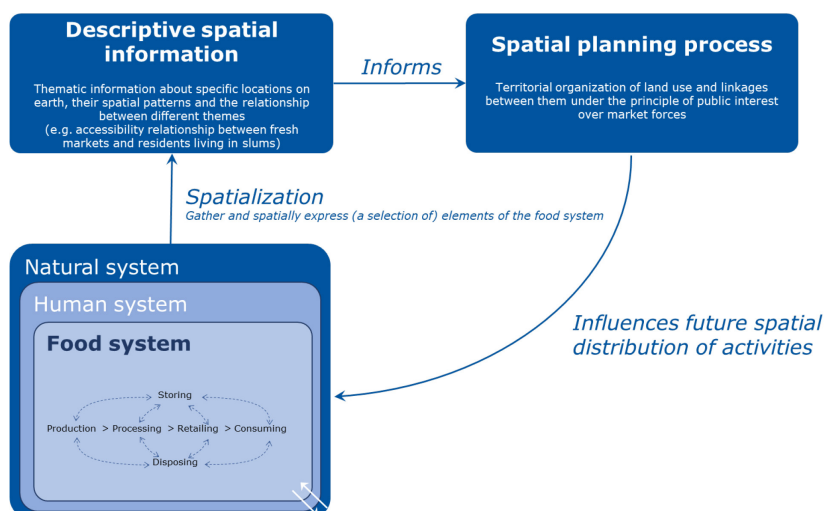
**Figure 9** Disposal strategies for solid waste in Kibera, August 2020

## 9 The role of spatialization (van Haren et al., *accepted*)

### Article

Van Haren, C., Kumar, I., Cormont, A., Terwisscha van Scheltinga, C., De Rooij, B., Islam, S., and Verweij, P. The role of spatialization and spatial planning in food systems: insights from the fast-growing city of Dhaka, Bangladesh. *Sustainability*, *accepted*.

Cities are growing rapidly. It takes a chain of activities to get food from farms to cities. In developing cities around the world, spatial planning for food systems proves challenging. The Dhaka Metropolitan Area (DMA) in Bangladesh for example, is one of the fastest-growing metropolises in the world. With a population of over 22 million residents, it is one of the most densely populated areas on the planet with 23,234 people per km<sup>2</sup> within its geographic area of 300 km<sup>2</sup> (World Population View, 2022). Access to nutritious and healthy food is a significant challenge for the sky-rocketing urban population and especially for the urban poor in the DMA. To include the food system into spatial planning, it must be mapped to understand how the local food system functions, this process is known as spatialisation (Kasper et al. 2017). By doing so, it informs the spatial planning process, which in turn influences the future spatial distribution of activities (Figure 10).



**Figure 10** The role of spatialisation and spatial planning in food systems



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This paper explores the role of spatialisation and spatial planning in the food system of the fast-growing DMA using three different approaches: urban footprint, mapping and semi-structured interviews.

The spatialisation of the urban food print (the calculated agricultural demand in hectares to fulfil the consumption need of DMA) and of spatial maps along six narratives on the Dhaka food system illustrates and supported the learning process of understanding and solving issues related to the food system through a spatial perspective. It emphasises the potential for the use of spatialisation and spatial information in understanding food systems.

To establish spatial planning practices for food systems, a central role for spatial planning in governance is required. Spatial planning informed by descriptive spatial information of food systems should play a leading role in guiding the way to become an upper middle income country by 2031, and steering market-driven initiatives towards favourable opportunities for society at large. The interviews revealed that stakeholders are unaware of spatial aspects that are present in DMA's food system and therefore do not consider it while developing spatial plans. The currently available planning instruments for Bangladesh are limited to land-use zoning and there is an absence of integration of the food system herein. There is no policy framework available, and implementation tools and instruments for spatial planning are lacking. A reason for the above findings might be found in the perceived limited freedom for communication across ministerial boundaries. This may prevent actors to develop planning instruments related to the food system at least on a national level. At the same time, awareness exists about spatialisation and the role of maps in food systems for some groups, for instance, among the so-called city cooperation stakeholders. Though their awareness has not yet resulted in spatial planning for food systems as they are reliant on the unaware implementing actors. To establish the spatial planning practice for food systems, a more central role for spatial planning in governance is required.

## 10 Multistakeholder platforms (MSPs) (Pittore and Debons, *accepted*)

### Article

Pittore, K., and Debons, P. Operationalizing Food Systems governance: the case of Fort Portal Food Change Lab. Sustainability, *accepted*.

The need for food systems to be transformed is widely acknowledged. In order to transform food systems towards those which are better able to deliver healthy and sustainable diets, food systems governance is necessary. This paper focuses on a local level, civil society led MSP initiated by the Sustainable Diets for All project in Fort Portal, Uganda. Seeking to complement more global reviews of MSPs for food systems governance, the paper empirically test the five food systems governance principles proposed by Termeer et al. (2016).

*System-based framing:* While there is wide recognition that food systems transformations will only be possible by working with a system based framing, applying systems level thinking in real-world settings remains challenging. Boundaries quickly expand, making it difficult to develop implementable solutions. In the Food Lab, this complexity was tackled by focusing on production and consumption. This could be a critical oversight as evidence from multiple contexts illustrates the power of the relators and traders is much greater than the consumer, raising questions about how far a food system can transform when key actors are left out.

*Boundary spanning structures across both levels and sectors:* An effective food systems governance structure must be able to bring together many actors, including from government, private sector, research and civil society. The extent to which actors are able to influence or govern food systems differs in distinct cultural and political contexts and historical moments. Finding a governance structure which has both the mandate and the authority to convene actors and come to a shared vision remains a critical challenge in identifying food systems governance.

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*Adaptability and monitoring allowing for flexibility and learning:* Effectively steering a food system requires the governance structure to have adequate capacities. A five capabilities (5Cs) framework has been developed to identify key capacities. These include capacity to 'commit and act', 'relate and attract', 'balance diversity and coherence', 'create results' and 'adapt and self-renew'. Although civil-society led MSPs can be adaptable and flexible in prioritising issues, informal MSPs are limited in their ability to balance diversity and create coherence. Reliance on external funding also threatens the ability to adapt and self-renew.

*Inclusiveness especially of marginalised voices:* Local level MSPs led by non-state actors can have the greatest influence by supporting inclusiveness, especially of marginal voices such as youth, female farmers and informal actors. Legitimacy with these groups as well as stronger networks can increase their influence in formal governance structures. By creating a structure for these groups to come together, they may also provide a channel for greater inclusion in formal governance discussions.

*Transformative capacity to overcome path dependency:* Given that transformative capacities will require convening diverse actors and developing consensus around challenging issues, civil society led governance structures may not be the best placed to negotiate tensions as they do not have the mandate or authority. However, in other contexts, such groups have been able to gather wide spread support for alternative food systems visions and promote these visions in the context of framing the directions of the future food system.



**Photo 6** Arua. Ms. Marleen Roefs

While civil society led MSPs supporting food systems governance at the local level are likely not able to achieve food system transformation alone, they do play a key role in engaging with marginalised groups, supporting improvement of less controversial issues of the local food system and promoting alternative food system visions.

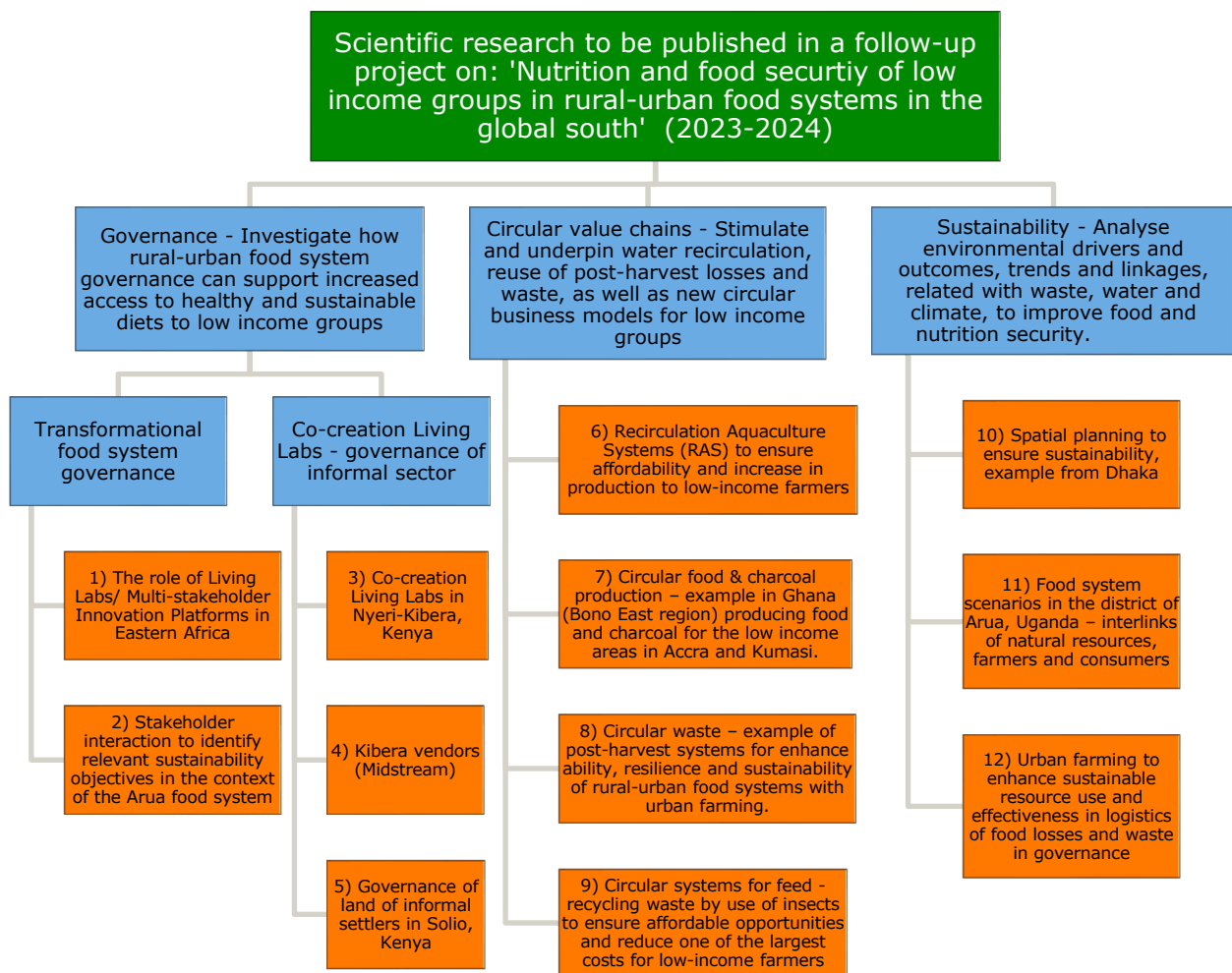
## 11 Upcoming research

The current project has led to valuable insights. The follow-up project 'Food and Nutrition security for low income groups in rural-urban food systems in the global south', planned for 2023 and 2024, will build on the current insights. Specifically, more attention will be given to the challenges of water and climate change in terms of sustainability and resilience. Within the follow-up project, a total of 12 studies have been planned (Figure 11). These studies are linked under the umbrella of three main fields of expertise;

- Governance – to investigate how rural-urban food system governance can support increased access to healthy and sustainable diets to low income groups. This category is further distinguished into two topics; 1) transformational food system governance, and 2) co-creation Living Labs of the informal

sector. Whereas the former category will conduct research on the role of Living Labs/Multi-stakeholder Innovation Platforms and stakeholder interaction to identify relevant sustainability objectives, the second category will focus on vendors (Midstream) and governance of land of informal settlers.

- Circular value chains – to stimulate and underpin water recirculation, reuse of post-harvest losses and waste, as well as new circular business models for low income groups. This category will target low-income groups conducting research on: Recirculation Aquaculture Systems (RAS), circular food and charcoal production, circular waste based on post-harvest systems with urban farming, and circular systems for feed based on recycling waste by use of insects.
- Sustainability – to analyse environmental drivers and outcomes, trends and linkages, related with waste, water and climate, to improve food and nutrition security. Regional perspective of energy, water, food production, this research will investigate; spatial planning to ensure sustainability, food system scenarios with interlinks of natural resources, farmers and consumers, and urban farming to enhance sustainable resource use and effectiveness in logistics of food losses and waste in governance.



**Figure 11** Planned research contributions for follow-up of the Special Issue on 'Development of Resilient Urban Food Systems—Exploring Synergies and Making Priorities' (2023-2024)

## 12 Concluding remarks and recommendations

Rapid population growth and urbanisation elevate current and future challenges to food systems in the Global South. This concept note contributes to addressing urgent issues by means of an editorial of articles meant for a Special Issue on 'Development of Resilient Urban Food Systems—Exploring Synergies and Making Priorities'. The articles are core scientific contributions to the Feeding Cities and Migration

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Settlement at Wageningen University & Research (WUR), (2019-2022) (KB35-002-001). The overall project goal was to contribute to resilient and sustainable urban food systems providing food and nutrition security for all. Within this scope, this concept note aims at explaining critical causes and dynamics, which can impact low-income groups in terms of food and nutrition security, safe and healthy diets, inclusiveness and equitable benefits, and sustainable and resilience in rural-urban food system, have been investigated in a series of a total of seven scientific publications.

The critical causes and dynamics explored cover issues of urban growth, the role of midstream in value-creation, including women fish vendors and fish consumers in Kibera, Nairobi, the diversities of livelihood factors within informal settlements, the role of social-capital (e.g. trust) within the rural-urban food systems, the waste issue in urban settlements and the spatialisation and spatial planning as a mechanism within the rural-urban food systems. Some main messages include:

- **Urban growth** impacts agricultural production and livelihoods around cities through increased competing claims on resources (van Berkum, 2023). For instance, urban development and marginalisation of agriculture in rural areas are at the expense of ecologically sensitive areas, such as forests or wetlands. Also, rising costs of water and organic fertilisers (i.e. food waste from cities) for farmers around growing cities have distribution effects. Moreover, remittances sent by migrants have positive effects on rural development. Moreover, labour migration is shown to lead to high social costs such as children growing up without their father. However, this literature review shows that little attention provided to social (distribution) and/or environmental effects. This needs more attention in future research.
- Often projects aiming at humanitarian help, poverty alleviation or fighting hunger fail. To understand factors of success, the new successful Nyeri-Kibera rural-urban fish food system implemented in this project has been investigated (Soma et al. 2021). With new logistics of fish value-chain, the **midstream**, including the women vendors preparing the fish for sale in Kibera were empowered. The community structures and community leads have shown to be the core influencing parties and are highly needed for transitions that can enhance institutional resiliency in the future. Integrated research and implementation efforts can have large impacts.
- The **consumers** in informal settlements can impact resiliency in food and nutrition security. Ayuya et al. (2021) investigates fish consumption and reveals that larger households highly demand nutritious, affordable fish, served in small portions, allowing everyone to have a share of the protein rich fish. A link is confirmed between fish-eating patterns in Kibera and fish-eating habits of their rural homes, as well as religious and cultural beliefs and practices are affecting choices of species and level of fish consumption.
- Misunderstandings exist about food and nutrition security outcomes in urban informal settlements. A food system approach is useful to investigate **discrepancies in livelihood factors** in a typically densely populated informal settlement, such as Kibera (Soma et al. 2022). Complexities involve challenges such as high levels of poverty, food insecurity, insecure land tenure, lack of adequate housing, poor infrastructure and drainage, frequent threats of violence, high crime rates, poor environmental conditions and inadequate access to basic goods and services that include sanitation, health care and education and frequent outbreaks of water-borne diseases. Discrepancies of food security among the inhabitants are explained by, among others, differences in tribes, income levels, ownership of land in rural areas, access to electricity, and trust.
- People living in informal settlements, such as Kibera, with a large social network and tight bonding with rural communities and relatives (i.e. high **social capital**), have more opportunities to access food (Termeer *et al.*, 2022). For instance, shared ethnic backgrounds are more likely to share food, and cultural diversity in a neighbourhood can increase food security by bringing in different products from different places. Besides, trust relations with the community leader in the slum contribute to enhanced food security. However, food security does not necessarily increase as a result of trust to local politicians, or with membership in organisations, which may warn that informality is not easily replaceable by formality.
- The informality of most of the actors involved in the urban supply chain should be taken into consideration when designing and implementing **food waste intervention** (Pedrotti et al., *accepted*). Whereas a first step would be to analyse and characterise supply chains, a second step would be to design an effective food waste intervention. A third step should give guidelines on how to effectively implement and monitor the intervention. To deal with the ever growing sustainability challenges in



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cities, cooperation among national policy makers, municipalities, NGOs, private institutions and research organisations are highly needed for future waste management.

- The spatial distribution of activities in the food system is in various ways influenced by **spatial planning** (van Haren et al., *accepted*) or the absence of it. Bangladesh is in a transformative process, coming from being a low income country and in the last years having established itself as a lower middle income country, for which the DMA gets the spotlight at a global level due to its skyrocketing population. Spatial planning informed by descriptive spatial information of food systems should play a leading role in guiding the transformation towards resiliency and sustainability, and steering initiatives towards favourable opportunities for society at large.
- **Multi Stakeholder Platforms** (MSPs) have capacities to transform towards generating new structures representing alternative voices in the food system (Pittore and Debons, *accepted*). Notably, capacities of these structures to change path depend on resource allocation, especially in resource poor environments.

This project will be followed up by a project called 'Food and Nutrition security for low income groups in rural-urban food systems in the global south' (2023-2024), for which more attention will be provided to the issues of water and climate change. A total of 12 studies have been planned (Figure 11), to fit into the main categories of:

- Governance – to investigate how rural-urban food system governance can support increased access to healthy and sustainable diets to low income groups.
- Circular value-chains – to stimulate and underpin water recirculation, reuse of post-harvest losses and waste, as well as new circular business models for low income groups.
- Sustainability – to analyse environmental drivers and outcomes, trends and linkages, related with waste, water and climate, to improve food and nutrition security.

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**Photo 7** Kibera Mr. Benson O Obwanga

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