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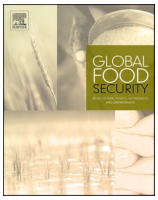

The diverse and complementary components of urban food systems in the global South: Characterization and policy implications

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1. Introduction

As the world is becoming increasingly urbanised, urban food security and provisioning are the focus of growing attention. The inability of current food systems to meet the food demands of urban residents in sub-saharan Africa has been referred to as "the emerging development issue of this century" (Crush and Frayne, 2011, p. 6). While the literature on food security has for long been dominated by discourses on the need to increase food production, the need to consider consumers' access to food is increasingly relevant in an urban environment where most consumers do not produce their food. Food purchased in markets represents more than 80% of food consumption in sub-Saharan African cities, compared with 50% in rural areas (Tschirley et al., 2020).

As demonstrated by Frayne et al. (2022), the literature on urban food security has bifurcated in two foci. The first one relates to supply-side dynamics, including research on urban agriculture, supermarketisation and the informal food economy. The second foci is household food access, related to the food crisis and particularly food deserts. Both areas are seldom considered together. Likewise, food policy is either considered through the lens of productivist approaches focused on innovations to raise agricultural productivity while limiting environmental change, or demand-led approaches bringing to the fore multi-scaled inequitable relations (Sonnino et al., 2019).

As argued by Doherty et al. (2019): 4, "it has become something of a truism in the burgeoning field of food studies to describe food as constituting a 'system' (…). Yet this concept is invoked far more often than defined satisfactorily ». Among the proliferating definitions of food systems, the most challenging ones bring to the fore the interaction between diets, food environments and food chains.[1] It is now acknowledged that the urban food environment, in particular regarding location of retailing and catering capacities, is crucial in determining what food consumers buy and how it translates into outcomes in terms of food and nutritional security. Together with Sonnino et al. (2019), we believe that a systemic approach regarding food issues is useful when it considers interactions between the various private and public actors within the food sector, and between food and other domains, including the employment situation and the environment in terms of natural resources. It should also consider in a dynamic way the resilience of food systems, i.e., the adaptive capacities of the stakeholders in face of various shocks (Doherty et al., 2019). In Australia and France, this resilience is related to four major factors: the geographical scale of supply, the diversity of actors and skills, the cohesion of the chains in terms of intra-network and extra-network collaborations, including the relationships with public institutions and the interactions between food chains (Smith et al., 2016; Chiffoleau et al., 2020).

Most of the literature on urban food systems relates to high-income countries (Zhong et al., 2021). In low- and middle-income countries (LMICs), the poor's access to sufficient healthy food is even more

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[1] "A food system gathers all the elements (environment, people, inputs, processes, infrastructures, institutions, etc.) and activities related to the production, processing, distribution, preparation and consumption of food, and the outputs of these activities, including socio-economic and environmental outcomes"; with "three constituent elements (…): food supply chains; food environments; and consumer behaviour (HLPE, 2014:11). The food environment is *"the physical, economic, political and socio-cultural context in which consumers engage with the food system to make their decisions about acquiring, preparing and consuming food"* (HLPE, 2017:28). Food supply chains (or food chains) are sub-systems of food systems as they relate to the stakeholders and activities involved in sourcing, making, and delivering the products or services to final consumers (Du Toit and Vlok, 2014).

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challenging. While there are now more studies on urban households' food consumption and environments, there is still a lack of insight on how these connect to food provisioning. Urban agriculture in LMICs has been the object of many studies and reviews, yet it it only a small component of urban food provisioning. The governance of urban food systems is also under-researched, in particular the way public and private stakeholders could – or should-combine their actions to achieve sustainability and inclusion. Urban food security is indeed rarely considered with a public policy perspective. This is because food policies are mostly considered with a rural lens, while urban authorities usually put housing and the attraction of business on top of their priorities so that food "is considered as a stranger in the field of urban planning" (Wiskerke and Viljoen, 2012:20).

It is the purpose of this paper to contribute to characterizing the connections between urban food consumption, food environments, food supply chains and their outcomes in terms of employment, food security and environmental preservation. We also aim at guiding the public governance of urban food systems in low-income countries. Drawing from Smith et al. (2016), we consider the following connections: the spatial organisation of food supply, the nature of stakeholders involved in food consumption and chains, and the interactions between these stakeholders. The spatial organisation relates to the origin of food and places where food is exchanged, as these are crucial determinants of costs, availabilty and quality of food. This is the basis of a foodshed approach, i.e. the mapping of food flows from the source of production to consumption at the city level (Karg et al., 206), accounting for local, regional as well as global flows. This analysis goes well beyond the city-region concept, the limitations of which were brought to the fore by Watson (2021). Interactions between stakeholders involve the exchange of information, resources and commitments that are key to matching supply and demand, together with the creation and distribution of value along the chain (Haggblade et al., 2012). We also pay attention to the public governance of food systems, i.e. how public decisions interfere with their functioning. We highlight the diversity of consumers' profiles, consumers' environments and provisioning chains. Such a diversity is key to the resilience of urban food systems (Zhong et al., 2021), yet it lacks public support.

2. Urban food consumers' behavior

Urban food consumption relates to the demographic and economic conditions of cities. These differ considerably in size, and a high proportion of urban growth is happening in secondary and tertiary cities, especially in sub-Saharan Africa where, in 2015, half the population lived in cities of less than 500,000 inhabitants (OECD, 2019). Compared to the rural population, urban populations have more diverse cultural, economic, and social profiles, and this diversity is more marked in primary cities relative to secondary ones. Latin America has the highest income inequality, including in urban areas (BBVA Research, 2017; OECD, 2019). In sub-Saharan Africa, income growth, benefiting urban areas, started in 2000 but has faltered since 2013 (Tschirley et al., 2020 based on World Bank data). Cities in LMICs lack stable employment, which explains why poverty is increasingly an urban phenomenon (Ravaillon, 2016). The informal sector still provides most employment (especially for women), accounting for up to 90% in low-income countries and 67% in middle-income countries (Bonnet et al., 2019). Besides the majority of low-income dwellers, a middle class is emerging, defined as an income of 12–50 US$ per capita/day in Africa, accounting for 13% of the population (Neveu-Tafforeau, 2017).

Patterns of urban food consumption have common and differentiated patterns, mostly according to income or culture. The basic pattern is a combination of starchy staples (cereals, roots, tubers) which represent more than half of expenditure, animal protein (meat, milk, eggs and fish), vegetables, and in varying amonts (lower than the recommended amounts), fruits, legumes and nuts. The consumption of animal products, fruit and vegetables is highly sensitive to income (Tschirley et al., 2020; Pingali and Abraham, 2022; Kovalskys et al., 2018). With rising incomes, urban residents eat more animal-source foods and processed foods, which may be low in micronutrients, high in calories and fat (Yaya et al., 2018; Holdsworth et al., 2020; Rousham et al., 2020). Likewise, the consumption of imported food by urban dwellers is increasing – although the proportion is still limited: only 5% in Africa, mostly imported cereals, according to Bricas et al. (2016) and Tschirley et al. (2014). Consumers commonly combine local and imported products in meals, resulting in a hybridization of cooking (Soula et al., 2020). In Latin American cities, food security improved for many years, partly as result of "zero hunger" strategies first developed in Brazil in the late 1990s and later in neighboring countries. However, food insecurity has started to rise again due to increased social inequality and the Covid-19 pandemic. At the same time Latin America is facing escalating obesity rates, affecting 24% of the regional – mostly urban – population, almost double the global level of 13.2%, which is explained by unhealthy diets and poverty (FAO, RUAF, 2019).

In parallel, food safety has become a major public health issue. Food safety crises are regularly reported in the media, especially in South-East Asia, where consumers' fears are linked to chemical products in fruit and vegetables and antibiotic residues in meat (Figuié et al., 2004; Ortega and Tschirley, 2017; Ferrand et al., 2018). This is due to new industrial and domestic sources of pollution close to agricultural production areas, and the increasing use of chemical inputs by farmers (de Bon et al., 2010; Reynolds et al., 2015). The lengthening of food supply chains and the lack of knowledge about hygiene also creates risks of contamination in the processing, marketing, handling and consumption stages (Jaffee et al., 2018). Consumer concerns about food safety have potential nutritional consequences as they may reduce consumption of fruit and vegetables because of concerns about pesticides, or push consumers towards packaged (often highly processed) foods because they are perceived as safer (Liguori et al., 2022).

3. Urban food environments

In cities, food is sold through a range of food retailers including street mobile vendors, roadside stalls, open/covered markets, shops, kiosks, supermarkets (including mini-marts and hypermarkets) and e-commerce. Urban consumers are mainly supplied by small-scale market vendors, street vendors and neighbourhood shops, even though supermarkets and convenience stores are increasing their market share. This is evidenced by many studies in Africa (Melesse et al., 2019; Wanyama et al., 2019), Asia (Wertheim-Heck et al., 2015; Downs et al., 2019) and Latin America (Guarín, 2013). E-commerce has been spurred by sanitary crises (including SARS/Covid-19) and is developing particularly rapidly in Asian countries, including China, India and Vietnam (Reardon et al., 2021b; Vietnam news, 2021; Dao, 2020).

Together with food retailing, food catering is an essential component of the urban food environment. Food consumption outside the home is increasing. The proportion varies across African cities, ranging from 6% in Freetown and Conakry to 25% in cities of Nigeria/Tanzania, and 30% in Cotonou, Lomé and Abidjan (Tschirley et al., 2020). Street food is especially convenient for urban workers and low-income households who may not have the resources and facilities to purchase raw ingredients and prepare dishes at home, especially in slums (Soula et al., 2020; Pradeilles et al., 2021). In Latin America, between 2000 and 2013, the consumption of ultra-processed foods increased by more than 25%, and fast food consumption by almost 40% (PAHO, 2015).

Informality, i.e. absence of registration and licensing is a major characteristic of market, shop and street vendors in low-income countries. These are major providers of food and livelihoods to poor urban residents, especially women, in Africa and Asia (Vorley, 2013). Yet they lack public support, are regularly harrased by police and may have their goods confiscated (Young and Crush, 2020) based on alleged traffic and visual nuisances, non compliance with licensing and food safety laws (Turner and Schoenberger, 2011; Ogunkola et al., 2021; Giroux et al.,

2021). Yet, as argued by Giroux et al. (2021:3), « vendors are not merely surviving but are actively engaged with operating a business, drawing on multiple types of resources to do so and creating additional economic links in the city in the process ». Informal vendors serve consumers who are not able to travel to central market-places, farmers' markets or supermarkets.

4. Urban food chains in relation to food environments and consumption

4.1. The distinctive features of chains

One important determinant of food provisioning chains' organization is the distance between production and consumption. At one extreme lies subsistence agriculture, with global food chains at the other. In between are local market-oriented chains, which come from urban/peri-urban areas and are short in terms of distance and number of intermediaries; and from rural areas, which come together with longer chains. Another distinctive feature is who governs the chain in terms of the distribution of value, which is closely linked to the control of processing and quality standards. Cities are largely supplied by what may be called conventional agriculture and chains, where quality – food safety in particular – is not labeled or rewarded, versus chains with some elements of quality differentiation. « Quality chains » may be driven by supermarkets, but also by farmer organisations, small and medium enterprises (SMEs); and recently by e-commerce companies. Hence, urban food systems involve a combination of at least six urban food chains (see Figs. 1 and 2): subsistence, short conventional relational ('short relational'), long conventional relational 'long relational'), value-oriented SME-driven, value-oriented supermarket-driven, and value-oriented e-commerce-driven. The three first types mostly belong to the informal sector when defined as including businesses which are not formally registered nor licensed. The term « informal » may be misleading because these businesses/chains contribute to the public resources through various taxes collected during transport and in market-places (Fafchamps, 2004; Young and Crush, 2020).

4.2. Six types of urban food chains

4.2.1. Subsistence/non-market chains

This refers to the involvement ofurban residents in food production, mostly for their own consumption. Examples include home gardens, community gardens, cultivation of maize on idle land, or raising poultry in backyards. Even though subsistence agriculture is of minor importance in terms of total urban food consumption, it can play an important role in livelihoods and social inclusion of vulnerable inhabitants, as shown in Tamale and Ouagadougou (Bellwood-Howard et al., 2018), Cape Town (Olivier and Heinecken, 2017), Hanoi (Pulliat, 2015), Quito and Rosario (Renting and Dubbeling, 2013). Urban gardens also have important pedagogical functions, e.g. through schooling programmes or community gardens (Hou, 2017). Direct provisioning enables resilience at times of crisis when market provisioning is unreliable, as observed in Cuba (Buchmann, 2009) and Sri Lanka (Dissanayake and Dilini, 2020). More generally, non-market food provisioning makes a crucial contribution to food security of the urban poor, be it from relatives in rural or other urban areas (Crush and caesar, 2020). Likewise cash remittances from migrant relatives may represent important contributions to the food security of the urban poor (Buchmann, 2009; Dissanayake and Dilini, 2020). The contribution of wild food and meat to the livelihoods of the poor has been mostly documented in rural areas (Wunder et al., 2014), but it is also observed in urban areas, e.g. collecting wild plants contributing to dietary diversification of low-income dwellers in Kampala (Mollee et al., 2017).

4.2.2. Short relational chains

We refer to short urban food chains relative to elements of distance

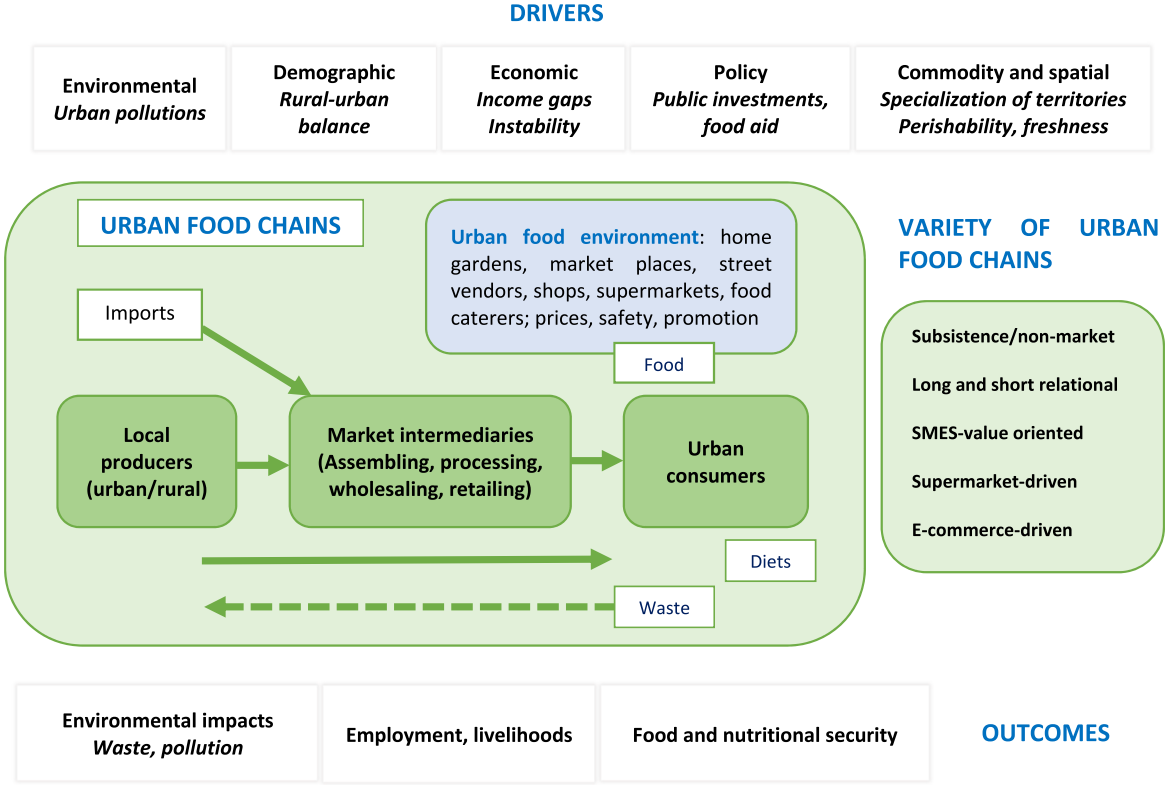

Fig. 1. The characteristics of urban food systems in the Global South.
Source: Adapted from HLPE (2017) and David-Benz (2022).

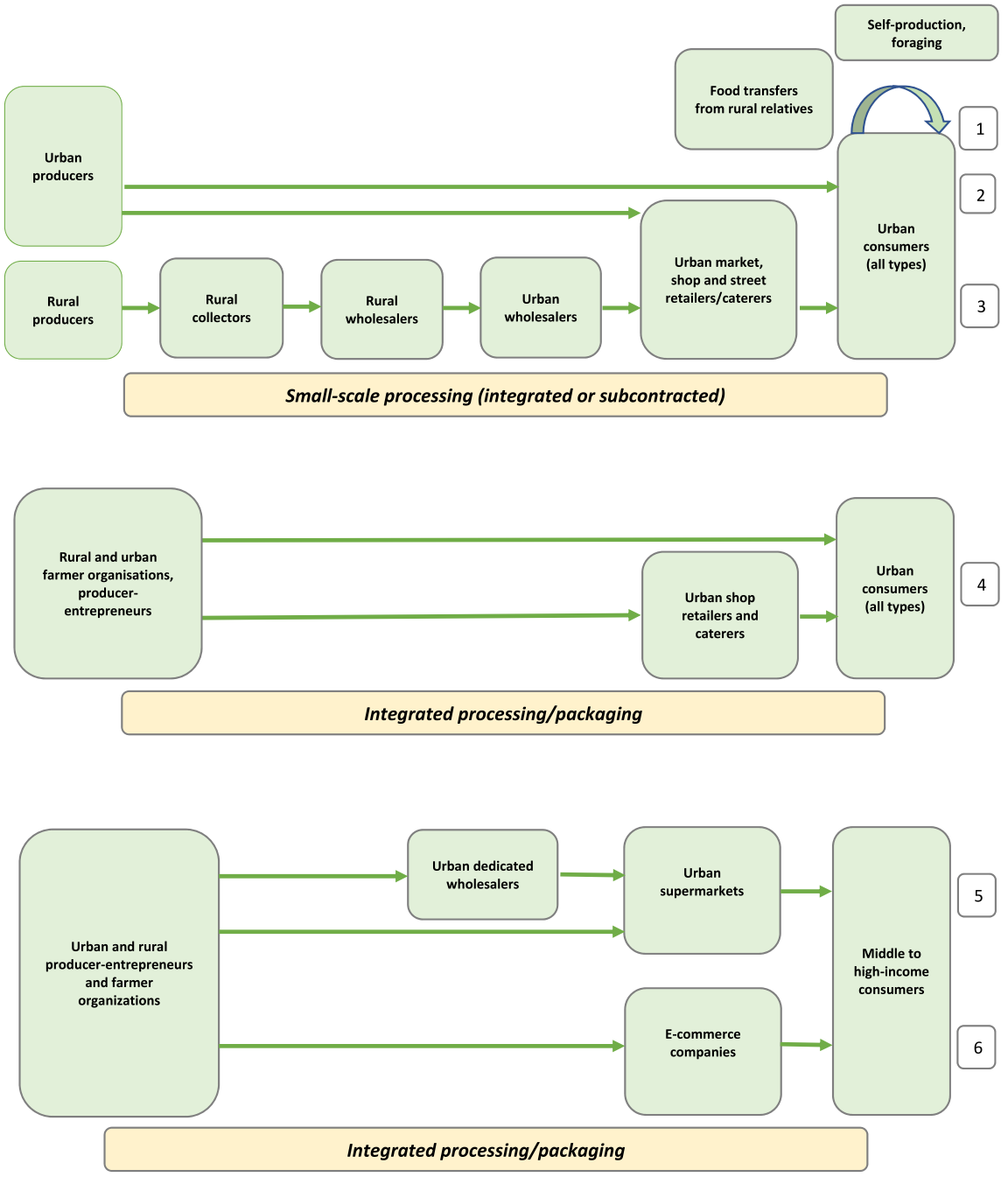

Fig. 2. A simplified representation of six urban food chains.

and chain organisation. These are food systems originating from, urban and peri-urban agriculture, with one or two intermediaries between farmers and consumers, e.g. market retailers and wholesalers. The farmers themselves or one of their relatives are frequently involved in wholesale and/or retail distribution. In line with the Von Thünen model which has some relevance when rural-urban transportation is poor, short food chains predominate in the supply of perishable produce, e.g. leafy vegetables, milk, eggs and chicken (Moustier, 2017a). These commodities are nutrient-dense and commonly under-consumed relative to nutritional recommendations. The relationships between farmers, wholesalers and retailers are characterised by long-term acquaintance and regular interaction. The shortness of chains in terms of distance and intermediaries may lead to lower final prices (and environmental costs) than longer chains but this is not systematically the case because long chains may enable economies of scale (De Cara et al., 2017).

Urban and peri-urban agriculture may generate problematic outcomes in terms of food safety and environmental pollution. The urban environment is responsible for major air, water and soil pollution (Amegah and Agyei-Mensah, 2017; Adimalla, 2020; Douglas, 2017; Pervin et al., 2020), Farmers may be pushed to use excessive amounts of chemicals on their small plots. At the same time many public and

international programmes support agro-ecological or organic agriculture in cities, and, if handled safely, waste can be recycled within agriculture (De Bon et al., 2010). The multi-functionality of urban agriculture means it is a 'cheap' producer of public goods, including greening of cities, limiting floods, providing employment and food (Moustier and Danso, 2006). However, systems based on urban and peri-urban agriculture, are threatened by land insecurity (Hatab et al., 2019).

4.2.3. Long relational chains

These chains originate from local or regional rural areas, and also from global markets. Local long chains involve rural collectors, rural wholesalers, urban wholesalers and urban retailers who supply all types of urban consumers (Moustier, 2017a; Karg et al., 2019; 2019; Lemeilleur et al., 2020). Urban wholesalers may also import food from neighboring or global markets. For local products, transactions take place in wholesale and retail markets located to minimise traders' and consumers' transport costs (Blekking et al., 2017; Lemeilleur et al., 2019; Balineau et al., 2021). Some processing may take place in SMEs at an artisanal scale (Tschirley et al., 2020) in various locations within and outside cities. With the development of transport, credit and mobile phones, these chains may be shortened, and the roles of rural collectors and wholesalers reduced. This transformation is termed the 'quiet revolution' in agrifood value chains in LMICs by Reardon (2015).

Long relational chains of staple food crops are characterised by long-term acquaintanceship and reciprocity, together with competition between hundreds of vendors resulting in a certain degree of price homogeneity, even though oligopolies of wholesalers are observed because of limited access to credit and storage facilities (Fafchamps, 2004). This provisioning system is dominant, as it relates to the majority of staple crops including cereals, tubers, pulses, and vegetables that can be stored (either fresh or processed) and some animal products. This type of chain is also observed for the marketing of wild meat originating from forests.

Rural-based long chains are primarily influenced by the public investments in transport and market infrastructures, which are commonly inadequately maintained and generate high marketing costs and risks. Badly maintained lorries are also responsible for air pollution as well as food losses. Long chains were particularly affected by the covid crisis because of transport restrictions, and also when urban markets were closed (Dury et al., 2021).

4.2.4. Value-oriented SME-driven urban food chains

These chains originate from rural, urban and peri-urban farms, driven by small-scale farmer organisations or entrepreneurial medium-scale farmers who upgrade their technologies and improve product quality in response to consumer expectations in terms of food safety and convenience. At the same time, they create new chain organisation patterns with increased interactions and different forms of vertical integration regarding direct sales or contracts with their customers (Moustier and Renting, 2015; de Brauw et al., 2019; Tefft et al., 2017). This is the case of farmer organisations that sell food grown without or with limited chemicals in shops or farmer markets in Laos, India, Ecuador, Colombia, Brazil, or Kenya, or by subscription in Dakar and, in some South African cities (FreidbergGoldstein, 2011; Joshi et al., 2012; Renting and Dubbeling, 2013). Entrepreneurial producers, e.g. *le Terroir* in Abidjan, can sell dairy products and cold cuts to wealthy urban consumers thanks to processing and cold storage (Neveu-Tafforeau, 2017). Caterers, both private companies, restaurants, and school canteens are developing strategies to ensure food safety and promote local products by signing contracts with local producer groups (Moustier and Renting, 2015). Food caterers and processing SMEs also innovate to supply processed local food to urban dwellers (Ferré et al., 2018; Reardon et al., 2021a). These initiatives come together with concerns for consumers' health and environment commonly translated into good practices and some form of certification.

Municipalities and regional governments may be involved in supporting these initiatives to promote provisioning of safe food to vulnerable households and to promote agro-ecology. This is the case for public programmes targeting the urban poor, e.g. the food purchase programme in Brazil (Berchin et al., 2019) or farmers' organic markets in Laos. Without such public support, these initiatives are precarious because of the cost of access to shops, lack of product diversity and of guaranteed food safety.

4.2.5. Supermarket-driven food chains

Supermarkets source food from global, regional and local sources. They carry both local and international brands and develop strategies for quality control and guaranteed origin, including using dedicated wholesalers and contracts, but they still face difficulties concerning quality control and traceability. Overall, supermarkets vary in their supply strategies, including whether they favor linkages with local food chains, in their pricing and in the payment conditions offered to local farmers, as well as in the training and logistics they may provide to farmers (Minten et al., 2017).

Modern distribution systems, driven by supermarkets, are characterized by labour-saving and capital-intensive technologies in terms of logistics, refrigeration, self-service, packaging, cash registers (Hagen, 2002). They are judged to be efficient in terms of logistics and quality (Reardon et al., 2010), but with potential negative effects on nutrition because they supply a wide range of highly processed food rich in fats and sugar (Demmler et al., 2018; Gómez and Ricketts, 2013; Wertheim-Heck and Raneri, 2019). Regarding affordability for the poor, modern systems are usually presented as less poor-friendly because of higher prices and transport constraints. Modern systems also create less employment per unit of product (Moustier et al., 2009; Wertheim-Heck et al., 2015). Regarding differences in prices between supermarkets and traditional vendors, when controlling for quality differences, results are country-specific. When supermarkets gain a substantial market share, they can reduce their logistic costs and provide food at lower prices, especially food that can be stored (Reardon et al., 2010; Nuthalapati et al., 2020). Prior to that stage, food is usually cheaper and more accessible in open markets and small shops than in supermarkets (Moustier et al., 2009; Wanyama et al., 2019). Moreover, supermarkets favor the use of plastics for wrapping fresh food, which is a major environmental concern (Letcher, 2020). However, supermarkets are usually supported by city and national governments on the grounds of modernity and hygiene.

4.2.6. E-commerce-driven urban food chains

New large-scale capital-intensive e-commerce companies have developed their activities related to food provisioning in Asia, Latin America and some African countries since the 2000s, which has accelerated due to covid. Their sourcing strategies are similar to those of supermarkets. Middle and high-income consumers order food from their platforms that is delivered at home, mostly for processed or prepared food. This is the case of *Alibaba*, which started its business in China and then expanded to South-East Asia. The development of these firms is spurred by policies that favor foreign direct investment and communication investments (Reardon et al., 2021a). As they are based on capital-intensive technologies, they are less favorable to employment than other forms of food distribution. The balance between environmental costs and benefits of digitalization is subject to debate (Coronoa and Mattern, 2019).

5. Interactions between food systems

There are patterns of competition but also interactions and complementarities between the various food provisioning systems, bringing dynamism and resilience to the overall food system. Consumers commonly combine purchases from open markets especially for fresh food, with less frequent purchases in supermarkets for groceries (Tran and Sirieix, 2020 for Hanoi; Skinner, 2019 for East Africa; Si et al., 2019

for Nanjing). Informal vendors source their food from a variety of places, including wholesale markets, grocery shops and even supermarkets in Windhoek, Namibia (Nickanor et al., 2019). There may be some symbiotic relationships between supermarkets and street vendors, as street vendors may sell around supermarkets (Battersby and Watson, 2019); or between e-commerce and shops: in India, Amazon uses shops as delivery points (Reardon et al., 2021a). Farmers' commonly combine selling to collectors without a price premium and selling to supermarkets with a price premium, because supermarkets have limited ordering capacity or have stringent quality requirements. It has been documented in the case of tomato in Colombia that the complementarity of farmers' outlets helped reduce waste (Chaboud and Moustier, 2020). Innovations spread from one type of food chain to the other. This is not necessarily from the so-called 'modern' to the other types. For instance, supermarkets benefited from innovations brought by farmer organisations selling 'safe vegetables' to small shops in Vietnam (Moustier et al., 2010).

6. Conclusions and recommendations

6.1. Conclusions

The paper has highlighted the diversity of consumers' socio-economic profiles, which results in varying food consumption patterns in terms of the type and sources of food. Such diversity is reflected in consumer environments, with the coexistence of a diversity of retailing and catering points, with varying levels of physical and financial accessibility. According to the nature of food, the type of access to food (market/non-market) and the nature of retailing points (market/street vendors, shops, supermarkets or e-commerce), food chains vary in their organisation in terms of the origin of food, nature of intermediaries, interactions between stakeholders, as well as outcomes (see Table 1). Such a diversity is key to the resilience of urban food systems, yet it is not supported by an adequate public governance of urban food systems. "In the absence of clear urban food policy, urban food system governance is the unacknowledged outcome of the contestations and collaborations of local government with other actors in the urban system, including traders, market associations, and private capital and development agencies" (Battersby and Muwowo, 2018:130). National and urban public authorities commonly favor investments directed towards costly market structures and support to supermarket development, e.g. in terms of land allocation, and have negative perceptions and interventions towards the informal sector. We recommend that national, regional and city governements also support the informal operators and SMEs involved in the chains who supply food to low-income consumers, so that their business becomes more efficient in terms of food safety and income generation. This implies different layers of public interventions, in close collaboration with the private stakeholders targeted by the actions. According to Smit (2016:81), key areas of interventions with impact on urban food systems are: (i) infrastructures; (ii) regulations; (iii) resources and incentives; (iv) education and awareness to which we add (v) institutional capacity.

Table 1
Characteristics and outcomes of the six types of urban food chains.

Type	Description	Outcomes
Subsistence/non market	Consumers' non market provisioning, by own production or foraging or in-kind transfers from rural areas	Variable additional contribution to the food and nutrition security of the poor Possible food safety problems when use of polluted soil, water or waste by urban farmers
Short relational (perishables)	Chain of farmers and retailers in markets or streets Oral commitments All income categories of consumers	Provisioning of nutrient-dense fresh food at low cost Employment of low qualified population Limited quality management
Long relational (non-perishables)	Chain of farmers, collectors, wholesalers, market and street retailers Oral commitments All income categories of consumers	Possible high margins due to wholesalers' oligopolies Employment of low qualified population Limited quality management
Value oriented SME-driven	Chain of farmers-entrepreneurs or collectives, processors, retailers; quality control and labelling Middle and high-income consumers	Employment and value added for low qualified population Rise in quality Rise in price
Supermarket-driven	As above + dedicated wholesalers + contracts Middle and high-income consumers	Rise in quality Rise in price Variable impacts on inclusion of the poor Increased availability of unhealthy food
E-commerce company-driven	Specialized e-commerce companies delivering food to middle and high-income consumers	Overcome risks linked with sanitary crises Higher traceability and trust, support for certification schemes Increased convenience Rise in price Exclusion of consumers with poor internet access

6.2. Recommendations

6.2.1. Infrastructures

The lack of basic market infrastructures and services is an important constraint hampering food quality and traders' business environment. Urban marketplaces are frequently characterized by congestion, difficulty moving around and lack of hygiene. Some past projects to replace urban marketplaces with wholesale markets located outside ofcity boundaries were underused due to limited transport facilities as well as the high cost of market stalls (Moustier, 2017b; Battersby and Muwowo, 2018). We thus recommend municipalities upgrade existing markets, by covering them, concreting the ground and making clean water available. Planning new markets and designing market regulations, e.g. on hygiene, should include in-depth consultation with market users' representatives, especially wholesalers and retailers in traders' associations (Hubbard and Onumah, 2001; Smit, 2016). Food markets can also be combined with a 'food hub' function, thereby creating new market linkages with food producers in the region, as developed in Colombia (Dubbeling et al., 2017).

Rural-urban transportation should be a priority of national and regional governments to improve both food availability and quality and to reduce food losses, especially for long relational chains. Roads between cities and the rural areas, which play a major role in supplying food to cities, need to be expanded and maintained, along with alternative transport routes by rail or water (Popoola et al., 2021).

6.2.2. Resources and incentives

National programmes should improve access to training on food processing and storage, as well as food practices for food safety, targeting food SMEs. Existing small-scale food storage and processing technologies are available to improve the safety and nutritional quality of food, and to reduce food losses (Kitinoja and Thompson, 2010; Tefft et al.,2017; Ferré et al., 2018; Pallet and Sainte-Beuve, 2016). Innovation in the artisanal sector needs to be supported by public programmes providing credit to increase the working capital and to enable investment in semi-industrial processing. Financial literacy and bookkeeping skills should be improved for SMEs (Young and Crush, 2020).

Poverty is the major constraint to the food security of the urban poor

rather than food availability (Frayne et al., 2014). Social programmes allowing households to reduce expenditure on healthcare, education, transport and food are hence recommended, including consumer purchases from local food vendors (Young and Crush, 2020).

6.2.3. Regulations

The major constraint for urban and peri-urban agriculture to provide adequate food and employment is farmers' long-term access to land. If market forces are left unrestricted, urban and peri-urban agriculture is doomed to disappear given the forces of pressure on land and water. This is detrimental to urban food security and livelihoods and may create environmental problems. We consequently recommend municipalities and regional governments protect land for agriculture in areas where it can play a major role in both food supplies and livelihoods, and where pollution is not an issue. Access to land can be secured through regulations (protecting agricultural parks or zoning measures) and formal contracts between municipalities and farmer' organisations. How urban planning is enforced needs to be closely monitored as it has frequently been observed that legal protection of land is regularly trespassed because of the attraction of private investors' urban development schemes (de Bon et al., 2010; Valette and Philifert, 2014; Ayambire et al., 2019; Dao T.A., 2019).

The specific case of informal market mobile vendors should be tackled given their importance in the livelihoods of vulnerable urban populations (especially women), as vendors and consumers. Their business should be acknowledged and supported aiming at "semi-formality", i.e., a self-regulating system with some light third-party regulatory enforcement of agreed-upon specifications (Cross, 2000). Examples of successful integration of street vending in the city can be found in Vietnam (Loc and Moustier, 2016), India (Srivastava et al., 2012), China (Dai et al., 2019) and Thailand (Tangworamongkon, 2014).

The design and enforcement of food safety regulations should be adapted to the characteristics of the informal sector and the SMEs in general, in the sense that they should be at the same time preventing major health risks, not generating unaffordable investments and coupled with educational initiatives and the provision of clean water and disposal facilities (Smit, 2016). The public sector also needs to invest human resources in food quality control, with random checks of food safety and labelling frauds, and graduated sanctions for non-compliance, at various points of the chain, including wholesale and retail markets (Hawkes et al., 2020; Dao, 2020). Trajectories towards formalisation of businesses imply that authorities work on how to make formality more attractive in terms of benefits, including legal protection and insurance (Young and Crush, 2020).

6.2.4. Education and awareness

We recommend collaboration between ministries of health and agriculture to promote local nutrient-dense foods, e.g. fruit, vegetables, nuts and legumes (Wllett, 2019). They may be available to consumers locally, but are not always purchased because consumers may have little knowledge of their health benefits or of how to include them in their meals and dietary practices. Different ways to increase public awareness about healthy food and promote traditional food cultures are discussed in Hawkes et al. (2020).

6.2.5. Institutional capacity

Municipalities can be actors in the development of sustainable food systems, particularly through their governance of urban agriculture, school canteens, and waste management (Bricas, 2019; Fages and Bricas, 2017), together with the convening role that they can play (Haysom, 2015). Through the Milan food policy pact (https://www.milanurbanfoodpolicypact.org/), city officials are invited to commit to 31 actions aimed at sustainable food provisioning and consumption. Governing urban food systems in an inclusive way is facilitated by establishing urban food policy councils/platforms, for example the Belo Horizonte Council for Food Security's inclusion of government and civil society was crucial for its success (Haysom, 2015). Other cities of Latin America have set similar initiatives (see https://ruaf.org/), sometimes on the basis of urban agriculture programmes, like in Quito. The coordination of decisions of the various actors' governing food systems, including local, regional and national governments involved in agriculture, food, health, and employment; farmers, traders and consumers' representatives, and NGOs, is seen as necessary but challenging because of possible antagonistic values, visions and interests (Smit, 2016; Haysom, 2015; Haysom et al., 2019).

6.2.6. Research

We highlight the need for more accurate and updated data on food consumption, food environments, foodsheds and food chains. This requires inter-disciplinary research, including geographers, economists, nutritionistsand statisticians. Data on food consumption should account for food consumed away from home, and seasonal food, including fruit and vegetables (Rousham et al.; 2020). Accurately appraising the role of different production areas and intermediaries in urban food supply requires periodic surveys of wholesale and retail markets, and of the origin and quantities of products traded. With the growing of food imports, a better knowledge of how local food chains interact with global food chains is required. Comparative studies of the varying importance of the different sub-systems across different cities is also recommended to better appraise the comparative advantages and dynamics of each (Zhong et al., 2021).

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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