Supply Chain Management in a Rapidly Urbanising World

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Abstract. Our world is rapidly urbanizing. By 2050, two thirds of humanity will live in cities. Increasing rates of urbanisation are putting more pressures on resources; influencing what foods we eat, where and when we eat them; the way our food is grown, processed and delivered to consumers; and impacting on our health and nutrition. Worldwide, interest in urban food systems and the increasing engagement of municipal government in food issues is growing rapidly as cities are largely dependent on external food sources. Food chains are growing longer, global trade is increasing and the diversity of food available to consumers is increasing. However, while urbanization presents many opportunities for smallholder producers, the lack of knowledge, resources and infrastructure continues to limit their participation in modern urban food systems. Furthermore, poverty, food insecurity and malnutrition are shifting from a rural problem to an urban problem. Urban food systems are being challenged to be more inclusive, responsive and resilient. This impacts on the need for greater investment in wholesale marketing and distribution systems, food quality and safety, transport and logistics, and improved food waste management.

1. Introduction

For the first time in history, the majority of mankind now reside in an urban environment, with that figure expected to reach two thirds by 2050 [1][2]. Increasing rates of urbanisation are putting more pressure on water and land resources; influencing what foods we eat, where and when we eat them; the way our food is grown, processed and delivered to consumers; and impacting on our health and nutrition [3].

While increasing urbanisation presents abundant opportunities for food producers, it also presents a number of significant challenges. Cities occupy only 3 percent of the land area and yet they are responsible for 70 percent of global GDP, 60 percent of the energy consumed, 70 percent of greenhouse gas emissions and 70 percent of global waste [4]. With the demand for food generally exceeding the capacity of the adjacent agricultural region, cities are largely dependent on external food sources. With increasing imports, while the diversity and range of food available to consumers increases, food chains become longer and with that, cities become more susceptible to climate induced food shortages, food price hikes, breakdowns in logistics and failures in food safety management systems [5].

Furthermore, with increasing urbanisation, both as a result of urban migration and natural population increase, poverty, food insecurity and malnutrition are shifting from a rural problem to an urban problem. Today, more than one billion people reside in informal, low income settlements, where diets are often deficient in terms of calories, diversity and nutrients [1]. As poor households spend scarce resources to buy more affordable, calorie-dense, micronutrient-poor food with high levels of fat, sugar and salt, the incidence of malnutrition and obesity are increasing, often within the same household.

It is also well understood that urban growth directly impacts on the increasing demand for natural resources [3]. Urbanisation contributes to climatic change, modifying hydrologic and biogeochemical...
cycles, changing precipitation patterns, increasing pollution and reducing biodiversity [1]. Regrettably, the increasing demand for food is not climate neutral, with an estimated 20 percent of greenhouse gas (GHG) emissions being generated by agriculture, forestry and land use change. Agriculture and food production, while contributing directly to climate change, is also directly impacted by a changing climate, with yields projected to fall by as much as 7 percent as a consequence of global warming [6]. Post production, the food system is thought to be responsible for another 6 percent of GHG emissions, arising both from the need for refrigeration to preserve food and the mounting cost of food waste.

Collectively, these issues have led to a renewed focus on food systems, their sustainability and resilience, the potential to create viable employment and livelihoods, and the ability to provide access to affordable, safe and nutritious food [1]. While a more systematic consideration of urban food systems will naturally focus attention on the downstream portions of food value chains, helping to enhance their productivity and competitiveness, to improve both the efficiency and sustainability of urban food systems, significantly greater investments in wholesale marketing and distribution systems, food quality and safety, transport and logistics, and improved food waste management must occur in parallel.

2. Food systems

Food systems to cities are a complex combination of activities, functions and relationships. Aragranfe and Argenti describe urban food systems as the complex combination of activities (production, handling, storage, transport, process, package, wholesale, retail) operated by a myriad of dynamic agents (actors) that enable cities to meet their food requirements [7].

FAO consider food systems to encompass all the people, institutions and processes by which agricultural products are produced, processed and brought to consumers [8]. This also includes all the public officials, civil society organisations, researchers and development practitioners who design the policies, regulations, programmes and projects that shape our food system. Every aspect of the food system influences the availability and accessibility of diverse, nutritious foods and thus the ability of consumers to choose healthy diets. However, the linkages from the food system to nutritional outcomes are often indirect, mediated through incomes, prices, knowledge and cultural factors. Furthermore, if the food system is to be both efficient and sustainable, the many actors participating in the many activities to bring food from the paddock to plate require infrastructure, facilities, services and both formal and informal regulations to govern their business decisions [9]. Because of the complexity of the system, the number of actors and the relationships between actors, where each actor influences and in turn is influenced by other actors, a holistic systems-based approach is required.

According to the methodology and operational guide of the FAO [7], an urban food system can be divided into two main subsystems: (i) food supply to cities, and (ii) food distribution within the urban area. The food supply to cities subsystem includes all those activities that generally take place outside the urban area: production (which includes urban agriculture), storage, marketing, processing and the transport of food to the urban area (either to a wholesale market, to food processors or directly to institutional users). The urban food distribution subsystem consists of all those activities required to distribute food within urban areas. These range from wholesale markets to intra-urban transportation to formal and informal retailing (Figure 1).

However, the primary driving force in any food market is the consumer [10]. Income growth, lifestyle changes brought about by urbanisation and the changing structure of the family are resulting in significant dietary changes worldwide. With the increase in consumer purchasing power and the increasing opportunity cost of time to prepare food, the demand for high value ready-to-eat and ready-to-heat food products is expanding. In parallel, the consumption of coarse grains, roots and tubers are decreasing with a commensurate increase in the consumption of higher value food products including meat, dairy products, fats and oils, and in most markets, fresh fruit and vegetables [11]. However, the growth in the consumption of more convenient, highly processed food is of concern, for the increasing consumption of sugar, saturated fat and salt is known to contribute to health problems like obesity, type 2 diabetes, hypertension and other diet-related non-communicable diseases [12]. Addressing obesity and
other non-communicable food related diseases is an urgent and immediate issue [11], for today, six of the top eleven diseases affecting mankind are diet related [2].

Figure 1. The urban food system. Source: Argenti and Aragrande [7]

3. From food systems to supply chains
To understand food systems and their impact on society and the environment one needs to embrace the concept of food supply chains. A food supply chain describes the means by which food gets from the paddock (or padi) to plate, including who is involved and how these processes are structured [13]. Simplistically, food producers transform food production inputs into basic foodstuffs which are either consumed or transferred to food processors, institutional users and market intermediaries for distribution to consumers. In the process, the supply chain produces numerous social and environmental impacts, which, in turn, are influenced by numerous environmental and social factors. Collectively, all of these elements working simultaneously and together comprise a food system.

Globally, food systems are highly differentiated, even within countries and territories [13]. Food supply chains vary depending on geography, environment and the socio-economic characteristics of producers, market intermediaries, food processors and consumers. Food supply chains are linked to and influenced by market systems, the political system, the natural environment, farming systems, infrastructural systems, legal and regulatory systems, the financial system, global trade systems, social systems and many other subsystems [9].

World Bank/FAO recognise three types of food systems in urban and peri-urban areas: (i) the traditional food system; (ii) a rapidly emerging modern and globalised food system; and (iii) an informal food system, which caters mostly to those people residing in the informal, low income settlements [1]. All three systems co-exist to varying degrees in most cities.

3.1 The traditional food system
Traditional urban food systems are characterised by vibrant urban wholesale markets that are connected to rural areas through a diverse group of rural-based traders including collector agents, aggregators and assemblers [1]. Terminal wholesalers in larger urban centres service a diverse range of retailers,
restaurants and food service operators. Located in dedicated structures or in open markets, wholesale markets are generally operated by public or private entities that manage the space, oversee and regulate the market, and collect fees. Wholesalers receive food from a variety of sources, including smallholder producers, farmer cooperatives, rural based traders, other regional wholesalers and importers.

Open or wet markets, together with small, independent family-run stores, represent the two main retail options for urban consumers in the traditional food system [1]. Open markets generally involve the retail sale of fresh food in covered, open buildings or open-air stalls. They are typically managed by public authorities such as municipalities or public-private companies, who collect fees from vendors for the rental of space, garbage disposal, utilities, security and facility maintenance. In most of the transitional economies, these traditional wet markets are the dominant actor in promoting the sales of staple foods, fresh fruit and vegetables, fresh meat and fish. Open markets appeal to urban consumers for many reasons including: the ability to buy fresh produce (without refrigeration); proximity to the home or office; lower prices; the ability to bargain on price; knowledgeable and personalised service; social engagement and trust; and particularly for meat products, the ability of local vendors to assure the consumer that the product will satisfy any cultural or religious needs [14]. However, the majority of traditional retail markets are wet and dirty, smelly, congested and overcrowded, poorly ventilated and often unsafe.

Wet markets are so described because of the frequent use of water to rehydrate foods (and floors) to keep them clean and moist. The increased humidity and lower temperature enables the food to stay fresh for longer. However, in the absence of appropriate waste disposal and the lack of potable water, the frequent application of water may lead to the contamination of the products by a number of pathogens including Escherichia coli, Salmonella and Shigella. In those markets where livestock and poultry continue to be slaughtered, the separation of live animals and raw meat is often minimal and there are seldom any refrigeration facilities. Similarly, the proximity of fresh fruit and vegetable retailing to the fresh meat and fish sections greatly increases the possibilities of cross contamination, which can present a serious threat to human health.

The second mode of retailing are the small informal, low cost retail outlets that generally maintain low inventories and usually pay no taxes or license fees [1]. They generally sell a wide variety of packaged food products and a limited selection of fresh produce. For consumers, the main benefits are the convenient location; low prices; the availability of credit; personal service; flexible hours; easy return and exchange systems; and the ability to respond flexibly to consumer demand – to sell, for example, one egg or a dozen eggs depending on the consumer demand and ability to pay.

3.2 The modern food system
Modern urban food systems are generally characterised by extended international supply chains that source food products from large corporate food producers and manufacturers through integrated cold chains, state-of-the-art logistics and embedded quality assurance systems. In urban areas, food products are distributed to consumers through a variety of modern retail outlets (including convenience stores, supermarkets, hypermarkets and e-commerce) and food service outlets (including the multi-national fast food chains). Local government and institutional procurement (e.g. schools, hospitals, offices, prisons) may also play a major role in the modern food system [1].

Wholesale operations tend to be more specialized than those found in traditional food systems and usually operate on a much larger scale [1]. Often acting as category managers, wholesalers transact with global commodity suppliers under quality assured supply contracts to ensure the year-round availability of fresh produce which will meet the quality expectations of downstream customers, including an evolving set of value driven preferences, which include health and wellness, social and environmental impact and animal welfare. Through the use of preferred supplier systems and integrated logistics, quality can be maintained and transaction costs reduced, with the cost savings passed onto consumers in the form of more competitive prices.

Modern retailing comes in a variety of forms and scales. Modern grocery retailing is generally a self-service format, appreciated for its competitive prices; attractive store layout; range of products;
quality of products; convenience (include car parking); comfortable, safe and hygienic shopping environment; and the availability of additional services [14]. However, modern retail is also diversifying with a variety of new formats emerging including small grocery stores in service stations, mini-markets and specialist retail stores [1]. Furthermore, the rapid development of online sales is changing how shoppers interact with modern retail stores. Most of the modern retailers now offer a “click & collect” option, whereby customers shop online and either pick up their items at a nearby store or opt to have their purchases delivered directly to their home [15].

3.3 The informal food system

The informal food system caters predominantly to the urban poor through informal street food vendors and restaurants that are not generally registered businesses [1]. These businesses are largely cash-based and characterised by small volume transactions. Food products are generally purchased from wholesale or retail markets in the traditional system.

Informal street vendors or hawkers sell the majority of the food consumed by the urban poor, whether through small retail stores or roadside kiosks, stands and pushcarts [1]. They operate primarily in the open air in makeshift structures. As they seldom pay rent and are not registered, they are often subject to harassment by law enforcement officers.

In most cases, informal street vendors offer a limited range of fresh food items and an even smaller range of safe, healthy, nutritious processed food products [1]. While many street food vendors are aware of the desired hygiene practices, their ability to provide safe food is limited by daily exposure to health hazards arising from poor sanitation, poor waste collection and limited access to potable water.

In addition to the retail purchasing of food, many urban households are supported by their rural-based families [1]. While some households are able to produce a proportion of their own food, others may receive food at subsidised prices from government managed stores, or food handouts through various social safety nets supported by both government and NGOs.

4. Challenges

Across the globe, the key issues associated with increasing urbanisation are remarkably similar, even although the main drivers and priorities may differ. However, from a supply chain perspective, the key institutional challenges are associated with:

4.1 The exclusion for smallholder farmers

As the urban population continues to expand agricultural productivity will need to improve. Among the 1.3 billion smallholder farmers [16], most of whom reside in the developing countries, significant improvements in yields are expected to arise from the more widespread adoption of improved technology. However, despite the opportunities, the high cost of and limited access to inputs (including credit), limited access to output markets, poor infrastructure, price instability and issues associated with land tenure continue to discourage smallholder farmers from adopting new innovations [17]. Furthermore, there is an increasing recognition that if smallholder farmers are to increase productivity, they must be linked to markets [18, 19].

Indeed, FAO (2009) suggest that facilitating market linkages should receive as much attention as enhancing production [18]. With downstream customers becoming more demanding of quality, food safety and convenience, Shepherd (2007) identifies a number of alternative routes to market [20]. However, irrespective of the mode chosen, if smallholder farmers are to engage meaningfully with downstream customers, there is a need for smallholder farmers to collaborate. It is only through the formation of collaborative marketing groups that smallholder farmers are able to gain access to the resources that they need to engage meaningfully with institutional buyers, but also to deliver the desired quantities and quality of products, reliably and consistently [21].
4.2 Food marketing and infrastructure
In most of the transitional economies, the lack of poor quality roads makes transport and logistics both difficult and expensive. For many smallholder farmers, multiple modes of transport are often required to bring the produce to roadside collection points, which not unexpectedly, results in considerable damage to the product and often the need to both regrade and repack the produce. In other instances, the costs of transport are increased by the need to pay various taxes, both formal and informal, which not only have a direct negative impact on product quality, but which ultimately influence the price that consumers need to pay.

Within the cities themselves, the distribution of food is often negatively impacted by the location of the wholesale markets and traffic congestion. While efforts by municipal authorities to limit the hours when heavy vehicles can enter the city may reduce congestion, in the absence of any refrigerated transport, the need for trucks to park and wait can dramatically accentuate the postharvest deterioration of product in the last mile. Likewise, in the absence of any reliable energy infrastructure, market intermediaries are unable to operate any refrigerated cool storage facilities.

Regrettably, within the community at large, there is a common perception that market intermediaries are extracting inordinately large profits from the wholesale distribution and marketing of food. However, there is mounting evidence to demonstrate that wholesale margins are significantly lower than retail margins. Furthermore, wholesalers perform an important function in the distribution of food. Their primary role is to receive the product from traders (in bulk) and to break that bulk down into quantities that meet the retailers demands. However, wholesalers also perform numerous other value-adding activities including: (i) the creation of assortment; (ii) storage; (iii) after sales service and support; (iv) market intelligence; and of particular importance in many of the transitional economies, (v) wholesalers are the major financiers both for the traders (who must purchase from farmers in cash) and the smaller retailers (who generally pay for the products after they have sold them).

4.3 Food safety
In the modern food system, long complex supply chains and logistics systems can greatly elevate the risk of contaminated food being inadvertently distributed if food safety mechanisms are inadequate [1]. While the greatest concern is associated with biological contamination arising from micro-organisms such as E. coli, Salmonella or Listeria, foods may also be recalled because of contamination arising from foreign materials such as plastic and metal, chemical residues - present within the product itself or from accidental contamination with cleaning products, or the failure of food processing companies to declare the presence of potential allergens, including milk, eggs, soy and nuts. While poor food storage and preparation in centralized food processing companies have been linked to many large-scale foodborne illness outbreaks, fresh produce is not immune. Numerous fatalities have been associated with the consumption of organic bean sprouts, papaya and rock melons in Europe, the US and Australia.

So as not to damage their brand, most of the world’s major retailers now require their suppliers to operate under one or more third party certified quality assurance systems. However, with consumers now demanding greater traceability and competition intensifying within the sector, standards are rising to include issues such as environmental sustainability, fair trade and equity, animal welfare and social inclusiveness. As most smallholder farmers do not have the resources or the capacity to comply, by necessity, most can only supply the traditional market. Here within lies one of the greatest inequities in the food system, for in the absence of any effective training, monitoring and evaluation, and without improving basic sanitation and handling in the traditional wet markets, the health of many millions of urban consumers is potentially compromised each and every day.

A similar situation exists in the informal food market, where most street food vendors are distributing processed food products or preparing ready to eat meals with little or no training in basic hygiene and limited access to electricity and potable water [5]. Without appropriate monitoring and evaluation, other actors in the food industry may purposefully, but often unknowingly, adulterate food with chemicals to enhance the shelf life (such as formaldehyde), its protein content (melamine) or to improve the physical appearance of the product (lead chromate in turmeric).
At the farm level, a range of factors can lead to food being unsafe, such as naturally occurring toxins in the food itself, contaminated water, unsafe use of pesticides, and veterinary drug residues [22]. Unhygienic handling and poor storage conditions can also cause unsafe food.

4.4 Environmental impacts and sustainability concerns

Important debates are currently underway on how best to balance a city’s reliance on longer supply chains with the need to reduce energy consumption and the adverse environmental impact of food miles [12]. Evidence is emerging that with the right improvements in transport and logistics technology, long supply chains can lower transport costs and emissions per ton. However, at a local level, investments in new roads and road maintenance and the regular updating and maintenance of vehicles will also reduce the cost of transport and GHG emissions.

Nevertheless, with the increasing incidence of product recalls and food safety scandals, consumers trust in self-regulatory systems and the business ethics employed by many of the large food companies is rapidly diminishing. Consumers around the world have begun to embrace food products that support local food producers. While there are many motivating factors behind the trend, it is believed that the demand for local food is largely being driven by anti-globalisation sentiments. Locally sourced foods are perceived to offer consumers fresher produce, clear provenance, and the ability to support the local economy and the livelihoods of smallholder farmers.

Food packaging is also high on the agenda. While there is the desire to use more packaging as a means of protecting the product from damage and extending shelf-life - and thus reducing food waste - there is an urgent need to reduce the use of plastics. Plastic is an enormous problem in the fresh produce industry, for not only is plastic an affordable and effective method of packaging fresh fruit and vegetables, but considerable technological advances have been made in active and intelligent packaging which moderate the exchange of gases to prolong shelf-life, but also communicate with consumers to minimise early disposal and excessive purchasing [23].

Other environmental concerns include groundwater pollution and the pesticide risks associated with the intensification of agricultural production [6]. In the horticulture sector, the loss of habitat and pollution from agrochemicals is affecting pollinators and the natural enemies of pests, reducing the value of important ecosystem services [24]. Eutrophication, arising primarily from the excessive application of nitrogen fertilisers, is negatively impacting fresh water quality.

With urbanisation comes increasing conflict over both land and water. Given that over 70 percent of the world’s freshwater is currently devoted to agricultural production, conflict over water from residential and industrial users and the environment itself will negatively impact the global food system [2]. Increasing productivity will also depend on healthy soil, but close to one quarter of all agricultural land is already degraded.

4.5 Food waste

Approximately one third of the food produced for human consumption is either lost or wasted [22]. Not only does this result in the wastage of vast amounts of natural and human resources, but the 1.3 billion tonnes of food waste, in the process of decomposition, makes a significant and unnecessary contribution to GHG emissions.

In the transitional economies, most of the food losses and waste are attributed to financial, managerial and technical limitations in harvesting techniques, the lack of suitable storage and cooling facilities, poor infrastructure, poor packaging and weak marketing systems [22]. However, in the industrialised countries, most of the food is wasted at the consumer stage, which implies that a significant proportion of the food discarded is still fit for human consumption. Regrettably, much of the food is wasted because it fails to meet the high aesthetic quality standards established by many of the major food retailers, whereas at the consumer level, poor purchase planning and expiring ‘best-before-dates’ can result in large amounts of food waste. While some of the reject product is sold to food processors or as animal feed, as it is not always financially viable, considering the lower prices in these sectors, much of waste product is simply dumped as landfill.
With increasing urbanisation, poverty and malnutrition is shifting from the rural sector to an urban environment. Here it is important to understand that food insecurity is more often a question of access to food (purchasing power and prices of food) rather than the availability of food. While improving the efficiency of food supply chains may help to bring down the cost of food to the consumer, it is equally important to investigate strategies to recapture, recycle and redistribute food that would otherwise be discarded. In response to public demand, most retailers now offer misshapen vegetables and blemished fruit as part of their basic range, albeit at a discounted price.

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