DOI: http://dx.doi.org/10.1590/1678-992X-2015-0439

SCIENTIA AGRICOLA

ISSN 1678-992X

Local food: benefits and failings due to modern agriculture

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Edited by: Luís Guilherme de Lima Ferreira Guido

Received November 12, 2015
Accepted January 03, 2017

ABSTRACT: This paper aims to examine the issue raised by the consumption of locally produced food in all its various aspects, and in particular, addresses how this practice contributes to local and global sustainability. It analyzes the different definitions of local food, the strategies used, the implications of the distance traveled in the transportation of food to the consumer's table – food miles, the relationships between local food consumption and sustainability, farming practices that reduce carbon emissions, contribution of urban agriculture to local food, local trading of food produced by rural farmers, as well as a number of relationships between the consumption of local food and human nutrition and health, local food protection and the ability to support local food production for humanitarian actions in disaster situations. The promotion of "local food" is a complex problem covering environmental issues, the economy and health. Transportation is not the only factor that determines how efficient it is to consume local food. Often, the technologies used for agricultural production are those most responsible for the degree of sustainability in the production and supply of food to the population. Local production does not always mean lower emissions of greenhouse gases. In general, the consumption of local foods, produced in ways adapted to the local environment using technologies with an ecological basis, is something beneficial and salutary for the environment, economy and society in general.
Keywords: food consumption, food miles, greenhouse gases, sustainability

Introduction

"Local Food" means that the food was grown in close physical proximity to the consumer. Around the world there is a growing movement to consume locally produced food known as "Local Food". Although this movement has concentrated somewhat on North America and Europe, other global regions are now becoming involved, specifically Brazil. There are, however, many questions about these policies or popular movements that value the use of local foods, though common sense suggests this attitude has been considered beneficial. This review aims to examine the issues arising out of the consumption of local food in its various aspects, and especially emphasizes to what extent this practice contributes to local and global sustainability.

This review is subdivided into several core topics following the introduction: (a) local food – definitions; (b) history and strategies used to increase local food consumption; (c) food miles; (d) local food and sustainability; (e) urban agriculture; (f) farmers and local food commerce; (g) local food quality; (h) protection of local food; (i) local food and humanitarian aid and (j) conclusions.

Local food - definitions

The term "Local Food" has multiple and sometimes conflicting definitions. In most cases it means that the food was grown in close physical proximity to the consumer (e.g., a few miles from the point of sale, was produced in the same city, or in the same state) (Martinez et al., 2010). It can also mean food sold in an alternative food market (Smithers et al., 2008). Furthermore, it could also refer to the food that has the unique characteristics of a particular place, or carries a certain local cultural value or significance (Sonnino, 2007).

Regardless of the range of meanings, the concept has undeniable power. The growth in world consumption of locally produced food has resulted in significant increases in the amount of sales of food produced by local farmers. This new paradigm has also stimulated new (or re-emerging) marketing strategies (Brown and Miller, 2008). Associations for the Support of Peasant Agriculture (Association de Maintien de l'Agriculture Paysanne – AMAPs) have been spreading through France since 2000. These trust-based partnerships between urban consumers and farmers are similar to Community Supported Agriculture (CSA) organizations that developed in North America in the 1990s (Lagane, 2015). Baskets of food delivered weekly by organizations of farmers are locally promoted and local markets are more highly valued, establishing links between farmers and consumers. However, currently even in large supermarkets one can find shelves with local food on offer.

Due to the subjectivity of the term, some governments have decided to standardize the meaning of "local food" (Table 1). According to the definition adopted by the US Congress in 2008 in the "Food, Conservation, and Energy Act", a product can be considered a "local or regionally produced agricultural food product" if (a) the total distance traveled is less than 400 miles from the source (approximately 644 km) or (b) the product is produced in the same state in which it is marketed (Martinez et al., 2010). However, in Canada, the Canadian Food Inspection Agency recognizes the term "local" as food produced in the province or territory in which it is sold, or also food sold just across provincial borders, within 31 miles (50 km) from the province or territory

Table 1 – Countries and distances to be considered local food.

Country	Distance	Reference
USA	644 km or products produced within the same state in which it is marketed.	Martinez et al. (2010)
Canada	Food sold within approximately 50 km of the provincial borders.	Canadian Food Inspection Agency (2014)
France	150 km.	Conseil de Développement du Pays d'Ancenis (2015)

of origin (CFIA, 2014). It is important to consider that, for example, the province of Ontario in Canada is more than 1,000 km (621.4 miles) long between its furthest limits. Thus, food produced at the most distant border, up to 1,000 km away from its destination is still considered local food. However, Lim and Hu (2015) found that most Canadian consumers did not show a preference for food bearing a generic "local" label over similar beef products labeled as produced within 160 km. This supports the notion that most Canadian consumers would accept food produced within 160 km as local food. Further, they found consumers preferred the generic local label over the 320 km local food label. This suggests that most consumers deemed the 320 km radius limit beyond the definition of local. They also observed that most consumers preferred home-province beef to beef labeled local, suggesting that it might be beneficial for producers to market products as home-province products rather than local products.

In France, for example, a so-called 'short circuit' is 150 km. According to an official definition, established in 2009 by the Ministry of Agriculture, a short circuit is a form of agricultural marketing that is done either by direct sales from producers to consumers or through indirect sales provided that there is only one intermediary between the operator and the consumer (Conseil de Développement du Pays d'Ancenis, 2015). On the other hand, Brazil, another huge country, has no legislation that defines what local food is. This should be discussed, given its continental size.

In addition to the geographical issues that the term "local" can address, the movement of local food is a "collaborative effort to build a more local based economy, self-sufficient in food. Sustainable food production, processing, distribution and consumption are integrated to improve the economy, environment and society of a particular place" (Feenstra, 2002). Thus, the concept of local food is part of a broader concept of local purchasing and local economy; a preference for buying locally produced goods and services, instead of those produced by business institutions located far from where people are buying. Local food is not just a geographical concept, related only to the distance between producers and consumers, but is also defined in terms of food supply chain characteristics and their social impact (Martinez et al., 2010).

Local food systems also draw inspiration from how food is produced, how it affects health, the economy and the environment. Thus, in some ways, a local food system also incorporates the concepts of "food security" and "food economy". Food systems can be divided into three basic components: biological, economic-political and socio-cultural. The biological component refers to the food production process or how food is produced. The economic and political components refer to the institutional moderation of different groups of interest and control of the food system. The socio-cultural component refers to personal relationships, community values and cultural relationships that affect people in the use of food (Tansey and Worsley, 2008).

What "local" actually means has long been debated in the alternative food networks literature, with the consensus that the term is contested and defies definition. The concept of local food is contextualized and refracted through the people and places in which food is produced and consumed. There is huge complexity involved in understanding, and making sense of local food networks and their relationship with conventional food systems (O'Neill, 2014).

History and strategies used to increase local food consumption

In the United States, those who prefer to eat locally grown food sometimes are called "locavores" or "localvores" (Roosevelt, 2006). These terms were first used around 2005 in San Francisco, California, when a group of "foodies" (i.e., a person who loves food and is very interested in different types of food) launched the website Locavores.com, after being inspired by the book "*Coming Home to Eat*" authored by the environmentalist Gary Paul Nabhan (Tansey and Worsley, 2008). In 2009, the U.S. state of North Carolina launched the campaign "10 % of North Carolina", which aimed to stimulate local economic development by creating jobs and promoting the demand for state products. More than 4,600 people and 543 companies, including 76 restaurants, signed up to support the campaign through the website: http://www.nc10percent.com. They pledged to spend 10 % of their food budget on local food provisions. As a result of the campaign, more than 14 million dollars were spent on locally-grown products (Hampton, 2011).

In Europe, the UK government has for some time encouraged consumers to buy more locally produced food. It is expected that the veneration enjoyed by local food will generate economic, environmental and social benefits in local areas, leading to patterns of more sustainable consumption and production. Furthermore, consumers, in general, approve of the idea of supporting local farmers and their own national economy (Chambers et al., 2007).

Local food advocates ranging from individual consumers to government agencies rally around the idea of knowing who grew their food and how it can be used as a means of enacting social change and improving the

environment. The United States Department of Agriculture (USDA) has codified this sentiment by assigning a diverse set of the agency's initiatives from greenhouse cost-shares to grants for novice farmers to an umbrella program named "Know Your Farmer, Know Your Food" (USDA, 2011; Nost, 2014).

In many ways, local consumption aims to reverse the negative effects of globalization on local economies and communities. Globalization is understood as "the ever-increasing integration of national economies into the global economy through trade and investment rules and privatization, aided by technological advances. Local consumption is a process that reverses the trend of globalization, to discriminate in favor of local" (Hines, 2000). Today, an American popular movement seeks to protect local economies and go against the juggernaut of globalization even as government policies continue to support large food producing companies in the food exporting sector. For example, many efforts of the U.S. Dept. of Commerce are to "support U.S. companies in selling their goods and services abroad" and "aggressively investigating unfair trade practices affecting U.S. exports or imports into the U.S. market" (United States Department of Commerce, 2013), rather than figuring out ways to support local markets. Nonetheless, governments should develop strategies to strengthen the local food market and trade as they do for foodstuff that is exported.

Research approaches that estimate the economic benefits of local food production could inform government strategies and policies that favor local producers. For example, in one case study Loke et al. (2015) estimated that the price of milk in Hawaii, USA would increase by 17 % if the product was locally produced, and by 25 % if it were both local and organic. This information undoubtedly encourages local and organic production from a local producer's perspective, where increases in market price lead to increases in profit. However, this information does not necessarily encourage local and organic consumption as price is a barrier to many consumer groups.

Another strategy is to put information about the origin of food on the packages. For example, Korean consumers have a positive perception of and preference for domestic rice, particularly when country of origin information is provided (Lee et al., 2014). Many consumers favor the idea, as promoted by retailer advertisements, that farmers produce in harmony with nature and their products can be purchased conveniently in the supermarket next door. Regionalization suggests traceability as it provides an air of knowledge about production methods. For example, one major Austrian discounter offers for its organic line not only a differentiation into "regions of origin" but complete traceability on the internet via the bar code and even CO_2 footprint calculations on the packaging (Schermer, 2015).

The registration of a local food item under Protected Designation of Origin (PDO) or Protected Geographical Indication (PGI) is an interesting regional and cultural based strategy to protect local production. For example, 'Vatikiotiko' is a local onion landrace from Greece with special quality features, such as strong and pungent taste and storability. In their study, Petropoulos et al. (2015) sought to characterize the 'Vatikiotiko' landrace and record its morphological traits and nutritional value in comparison with commercially cultivated genotypes. They found the 'Vatikiotiko' landrace to indeed have unique nutritional value (sugar content, mineral composition and fatty acids profile) in comparison to commercial genotypes, providing an argument to potentially introduce it as PDO or PGI. Another important aspect of this product is its cultural importance for the local region, owing to its survival over the centuries, and its special taste and flavor due to the microclimatic conditions of the region, which lends high quality to this product.

As for the promotion of local food products and services, a study by Mynttinen et al. (2015) recommends a stronger focus on the added-value of "exciting and authentic novel experiences" in the provision of local food products and cuisines exclusive to the local culture. First, this entails the development of the brand around local food products and services with adequate labeling to guarantee the authenticity, identity and nature of the products to the tourist. Second, joint promotional efforts by farmers' groups and the regional tourism association might facilitate local products becoming more easily available in local events. Moreover, fairs and festivals arranged around meals can be used to attract visitors to regions and provide organizers an opportunity to make a wide range of consumption activities. Third, the consumption of locally produced ingredients could be increased through cooperation between the farmers and owners of self-catering cottages: e.g. in terms of "welcome packages" including samples of local foodstuffs. Fourth, gift-wrapped local food products could be sold on the premises of tourist accommodation and in the local supermarkets as souvenirs and presents. Fifth, more intensive inclusion of local ingredients and special menus of authentic local cuisine offered by local cafes and restaurants in line with seasonal availability can be seen as an opportunity to add value for tourists. This was confirmed in a study by Sompong and Rampai (2015).

Food festivals can provide high levels of interaction between customers and producers, and offer an opportunity for traditional culture, livelihoods, and the local food movement to intersect. At their individual stalls, producers offer visitors the opportunity to sample their produce, allowing them to experience the taste and flavors of the food, at the same time as being able to discuss the origin of the food and production processes. Results indicate that engagement and positive emotions at a food festival are good predictors of food buying behavior six months later, highlighting the significance of emotions and engagement in influencing food purchas-

ing choices. Thus, one recommendation on a local scale could be to enact policies that encourage food festivals which involve local producers and foods to influence longer-lasting food buying behavior in positive social and economic ways (Juergensen and Demaree, 2015).

In fact, public policies and marketing are the strategies most commonly deployed to improve local food consumption and are the ones that result in stronger gains.

Food miles

The "food miles" concept, originating in the United Kingdom, has been very prominent in policy, media, and social movements in northern countries. This concept has been used to suggest that the importing of food from distant countries inherently causes more emissions than cultivating and consuming local products (Kemp et al., 2010). One of the reasons why consumers choose to purchase local foods is to reduce the "food miles" of their purchases (Brown et al., 2009), that is, reduce the distance that their food travels from farm to plate, in an effort to decrease the emission of greenhouse gases (GHG). In fact, it is assumed that consuming more local agricultural products results in reduced emissions of GHGs and the imminent impact of climate change, and thus contributes to environmental protection and conservation. However, the calculation is not so simple. Food production causes emissions of greenhouse gases at many stages between soil preparation and harvesting. Even from great distances, food transportation generally represents less than 15 % of the total energy used to produce food products (Brodt et al., 2013; Plawecki et al., 2013). Thus, transportation is only one aspect in the analysis of the pathway from agricultural production to the consumer's table.

Plawecki et al. (2013) compared the GHG emissions in the production of organic lettuce grown in a greenhouse and sold in Michigan, USA, with conventionally grown lettuce in California transported to Michigan in refrigerated trucks for sale. After taking into account the energy consumption associated with diesel burning, fertilizer production, activities involved in agricultural production, transportation and manufacturing inputs such as the vegetation and irrigation materials, the authors concluded that the total GHG emissions for each 1 kg of lettuce produced locally in Michigan was 4 times lower than the lettuce that came from California. In this case, the use of organic farming techniques and local production in Michigan resulted in lower greenhouse gas emissions compared to conventional production in California and the cumulative emissions from transportation.

However, local production does not always translate into lower emissions. In a similar analysis which evaluated the energy consumption involved in the production of tomatoes in Sweden and Spain, for consumption in Sweden, it was found that GHG emissions were higher for tomatoes produced locally. That's because only about one-fifth of the energy was required to produce tomatoes in Spain. Swedish production required high use of coal burning to heat greenhouses needed for local production. Thus, transportation is not the only factor that determines how efficient local food really is. It must also be considered whether the methods used in the production process are conventional or organic and whether the siting of that production occurred in a field or greenhouse with temperature control through the use of fossil fuels (Carlsson-Kanyama, 1999). Thus, the inputs in production at the field level, and not just transportation factors, must be given due consideration.

Saunders and Hayes (2007) reviewed several studies that compared energy use and emissions of GHGs, from cultivation to consumption of agricultural products with local and imported origin. In general, where products are air freighted, the transportation component contributes significantly to the total energy and CO_2 emissions in the supply chain. In the case of sea freighted produce the transport contribution is much lower and frequently insignificant compared to the energy and emissions associated with other parts of the supply chain. According to the authors, the shortest distance to local markets is generally offset by the higher transportation efficiency of imported products, which reduces the energy consumption per unit transported.

In accounting for the total energy spent in the production of food, it is important to assess the entire food system from production to the consumer's table and thus enable an evaluation between local or imported food. Saunders and Barber (2008) reported that, due to different production systems, even when transportation was taken into account, dairy products imported from New Zealand used half as much energy as their UK counterparts, and in the case of lamb, a quarter as much energy. The importation of apples from New Zealand is 10 % more efficient than UK apples in terms of energy expenditure as this evaluation showed that products imported from New Zealand to the UK used less energy, from production to the consumer's table than those locally produced in the UK; the lower the power consumption, the lower the emission of greenhouse gases.

GHG emissions from the food supply in the UK, excluding changes in land use, were estimated. According to Garnett (2008), agriculture is responsible for 40 % of total GHG emissions, fertilizer manufacturing contributes 5 %, food processing 12 %, packaging 7 % and transport 12 %. Corroborating these data, Edwards-Jones et al. (2008) concluded that the distance traveled by food is a poor indicator of the environmental impacts of food production.

It is often said that locally produced food consumption can greatly reduce the carbon footprint of agriculture. However, there are many controversies surrounding this statement, which demand more research on the subject. For example, Matos (2009) in evaluating sunflower oil consumption in Portugal, found that the seeds of oilseed produced in Portugal are sent to Spain,

for extraction processing and oil refining. The refined vegetable oil travels back to Portugal where it is packaged and distributed to hypermarkets, and finally to consumers. The GHG emissions analysis shows that to produce and put 1 L of edible vegetable oil on the shelves of national hypermarkets in Portugal, the product's carbon footprint is 2.77 kg CO_2 eq. Production of oilseed contributes the largest fraction of GHG emissions (80 %), followed by the extracting and refining stage (12 %), packaging (6 %), road transport (3 %), and local distribution (1 %). The authors found that the greatest contribution to the carbon footprint comes from nitrous oxide, the result of denitrification processes associated with the use of nitrogen fertilizers. However, Michalsky and Hooda (2015) did a quantitative assessment. They selected five commodities (apples, cherries, strawberries, garlic and peas). Selection of the commodities fulfills a key prerequisite that all of them can be grown under current UK climatic conditions and are commonly bought by UK consumers. A scenario-based approach determined the level of emissions savings that could be achieved by local food production in the UK. The least dramatic change of Scenario-1 (25 % reduction in imports by increasing their local production by the same amount) could save 28.9 kt CO_2 e yr^{-1}, while Scenario-2 (50 % reduction) and Scenario-3 (75 % reduction) could result in savings of 57.8 kt and 86.7 kt, respectively.

New indicators are urgently needed because research shows that spatial localization in general and minimized food miles in particular are not adequate or even required for most of the goals of alternative food systems (Cleveland et al., 2015).

Local food and sustainability

Leff (2009) commented that the slogan "thinking globally and acting locally", so tenaciously promoted by the discourse of sustainable development, has been a ruse to induce in local cultures the unique thought and background knowledge of the economic rationality of a hegemonic world in which "other worlds" don't fit. However, the challenges of sustainability and democracy, of entropy and otherness, open the siege of globalized unique thinking and move it towards local singularities, leading to the construction of an idea capable of amalgamating the power of the real (ecology) and the meaning of the symbolic (culture).

Consuming only locally produced food does not guarantee the ecological sustainability of our agricultural systems. Thus, the place where our food is grown brings no assurances of the methods used to produce the food and the subsequent impact of these methods on the environment and biodiversity (McWilliams, 2010). If local agriculture and food is to be truly beneficial, it is important that local agriculture conserves the biodiversity of the agro-ecosystem. Thus, it is the role of sustainable agriculture to contribute to the conservation of organisms that play important activities such as pollination and pest control (Philpott et al., 2014).

For many consumers, the term "local" conjures up images of environmentally friendly, small farms and local properties. However, it is worth considering that these images are not implicit in standard definitions. If local farms are using industrial farming methods that include widespread use of agrochemicals this practice will have negative impacts on biodiversity (Kimbrell, 2002). Furthermore, the indiscriminate use of pesticides can also have strong negative impacts on the local community and on local agricultural workers. A representative example of this would be the strawberries produced in Watsonville, California, which is only 20 miles (32.1 km) from Santa Cruz, CA. Conventional strawberry production requires a large amount of soil fumigants including methyl bromide, which destroys ozone in the stratosphere. Conventional strawberry production impairs biodiversity, destroys soil microbiota, and causes pesticide drift to loom over neighboring towns and schools (Reeves et al., 2002). These strawberries may be considered local food, if consumed in Santa Cruz, but are they produced in a sustainable way? Do the production methods used ensure the protection of biodiversity and maintain the health of rural workers? These questions suggest that a beyond "local" perspective and approach is needed in order to combine both sustainable agriculture and local economic benefits. If we consume a local product that degrades the local environment, we are actually condemning the place where we live for a purpose that is not desired.

One alternative is the consumption of local and organic food Badgley et al. (2006) estimate that organic methods could produce enough food on a global per capita basis to sustain the current human population, and potentially an even larger population, without increasing the area under cultivation. The authors also evaluated the amount of nitrogen that can be fixed by leguminous cover crops used as fertilizer. The results indicate that organic agriculture has the potential to substantially contribute to the global food supply and reduce the environmental impacts of conventional agriculture. However, certification of organic food is rooted in social, legal and bureaucratic institutions that often accentuate traditional economic inequalities between companies and countries. Onerous and expensive organic certification requirements create significant barriers to entry of poor farmers in the southern countries in this niche market. Furthermore, certification promotes the concentration of production in the hands of large corporate producers. Large corporate retailers also benefit from organic certification, as it facilitates their control over suppliers (Raynolds, 2004).

Agriculture can be a major consumer of fossil fuels during production and input application phases but the amount of carbon emitted varies greatly depending on the methods of production, food processing and marketing processes (Edwards-Jones et al., 2008).

Grain crop systems based on soil tillage result in high emissions of CO_2, combined with huge soil losses.

In Brazil, the no-till system is widely used in order to combat soil erosion by water. In addition, this soil management technique leads to the accumulation of soil carbon stocks and provides high crop yields for many years (Machado, 2005). Nunes et al. (2011) evaluated the effect of soil management systems based on tillage, cover crops and P fertilization on C and N stocks in physical fractions of the soil organic matter and microbial biomass in an Oxisol soil in Brazil after 11 years of soybean-maize rotation (*Glycine max-Zea mays*). Phosphorus fertilization led to accumulation of organic C and N in the soil, regardless of tillage and cover crop systems. Higher stocks of organic C and N and higher microbial biomass were found under no-till compared with conventional tillage. The conversion rate of C added to the soil by crops in organic C was 4, 8 and 14 % for conventional tillage and no-till systems with pearl millet (*Pennisetum glaucum*) and velvet bean (*Mucuna aterrima*), respectively. Also in an Oxisol soil, Corazza et al. (1999) found that soils under no-till management sequestered 21.4 Mg ha^{-1} of CO_2 and emitted 8.3 Mg ha^{-1} of CO_2 resulting in net carbon accumulation in the soil. Similarly, the use of more ecological cropping systems instead of the traditional fallow/maize systems was an efficient tool for storing soil organic matter and increasing the sequestration of agricultural carbon and, therefore, mitigate the greenhouse effect. Amado et al. (2001) found that rotation of maize and velvet bean, grown for eight years resulted in the sequestration of 15.5 Mg ha^{-1} of CO_2, while the fallow and maize rotation resulted in net emissions of 4.32 Mg ha^{-1} of CO_2.

Another way to ensure quality of food is through participatory certification, where the organization's own farmers and consumers make it possible to perform the certification of products (Radomsky, 2009). This is an effective way to encourage local organic production with quality and independence. In the United States, local food organizations are doing an excellent job in promoting the movement of consumption of locally produced food. However, it is interesting that such organizations also work to support sustainable food production techniques in order to protect both the local and global ecosystems. Agricultural ecological production methods based on intercropping, crop rotation, biological pest control, trap cropping, and other methods ensure greater protection of biodiversity (Altieri, 1999; Harvey et al., 2008) and may reduce carbon emissions (Lin et al., 2012) while protecting the local and global environments.

It is important to consider that there is great variation in the forms or the technologies involved in food production between from farm to farm, especially the amount of carbon emitted or sequestered.

Urban agriculture

In recent years urban agriculture has strengthened production in many parts of the world. Here, food is both produced and usually consumed locally in cities and in the suburbs of cities. These urban green spaces, including backyard gardens, have the potential to provide families with a more affordable alternative for improving their diet and for supplementing their income from the sales of surplus food grown. Eichemberg and Amorozo (2013) evaluated the consumption of fruits and vegetables, which are partly supplied by homegardens in Rio Claro, SP, southeastern Brazil. The authors found that spices and teas consumed by the families interviewed were obtained from homegardens, revealing its importance in food consumption and health promotion. However, among 98 species found in homegardens, only 38 % appeared in the diet of the respondents, which indicates an under-utilization of crops in these homegardens. The study concluded that the main role of homegardens is to provide variation in the diet, which contributes to the consumption of different types of products.

Urban agriculture is commonly discussed as a sustainable solution for dealing with gaps in the local food system, and proponents often highlight the many social, environmental, and economic benefits (Cook et al., 2015). The Amazon region in northern Brazil consisting of nine states is currently an area of increasing urban concentration as a result of economic development, and 70 % of its population now live in urban areas. New migrants to cities continue to rely on self-provisioning, especially through growing food in urban homegardens, to meet their food needs. For example, the maintenance of urban homegardens in Santarém, in the state of Pará, helps new urban migrants to survive in a highly developed, highly populated city by providing a part of the food directly through local production (WinklerPrins and Souza, 2005).

The expansion of urban agriculture assists in reducing GHG emissions not only by producing food but also by reducing the amount of food transported from farming areas and thus reduces the food mileage. For example, if Seoul, South Korea, implemented urban agriculture in a 51 km^2 area, it would be possible to reduce CO_2 emissions by 11 million kg annually. This numerical value is the same amount of CO_2 absorbed annually by 20 km^2 of pine forests and 10 km^2 of oak tree forests that are 20 years old (Lee et al., 2015). Thus, urban forms of agriculture have the potential to mitigate climate change impacts especially in highly developed urban areas.

Machado and Machado (2002) commented that public policies aimed at encouraging and implementing urban agriculture can promote the local development of the peripheries of large cities. In addition, by redirecting community goals, through participatory action in all development processes, it is possible to offer healthy life choices for young people and children as well as generate jobs and improve the quality of life of the elderly or the unemployed. The production of good quality nutritional and pesticide-free food, developed at relatively low cost, can contribute not only to improving the quality of life, but also to increasing family income.

Farmers and local food commerce

Many farmers who live in the countryside have difficulty in locally marketing their products. This is due to several factors such as inadequate visual quality standards imposed by the market, lack of community organization, or a lack of consistency in production. Lima Filho et al. (2012) analyzed purchase of fruit and vegetable policies in supermarkets in Campo Grande, in the Brazilian midwest. Interviews were conducted with representatives of small and medium markets and large supermarkets. Large supermarkets most frequently source vegetables and fruits from other states, while small and medium-sized markets source more from local producers. For the supermarket, fruit and vegetables produced locally are fresher and have a lower cost; however, the low dependability of supply and the lack of variety offered by local producers are considered unsatisfactory points. Certainly, better organization of local farmers would help in maintaining the supply of agricultural products with greater regularity and diversity.

A major obstacle to localization is the lack of economic, organizational and physical structures on the appropriate scale for local aggregation and distribution of food. Local food hubs are emerging as an important tool for overcoming this obstacle by pooling food products from a number of smaller farms and delivering them to grocery stores, schools, hospitals and restaurants (Cleveland et al., 2014). Alternative Food Networks (AFNs) have arisen with the potential to re-connect the different participants in local food systems (Cicatiello et al., 2015). Another local agriculture revitalization strategy is the Farmers' Markets (FMs). These markets have emerged and/or grown in northern countries, as an important place of engagement for producers, consumers and producers of local foods. However, FMs are seen as a complex and ambiguous space where the local notions of quality, authenticity and legitimacy find expression in communications and transactions around food (Smithers et al., 2008). A recent empirical analysis involving sellers, buyers and managers in 15 markets in Ontario, Canada sought to understand how participants "read" the market as a breathing space and then build the terms of (their) "engagement" (Cicatiello et al., 2015). The authors found that FM customers wish to support Ontario farmers and agriculture and, therefore, direct their expenditures to FM food. Furthermore, consumers make purchases at FMs with an expectation that they may get other benefits from local consumption. For example, consumers have the ability to not only know the origin of their food by purchasing at a market that only allows food from a specific area, but they also have the opportunity to meet the farmer/producer, learn about how the food was produced, and establish long-lasting relationships between consumers and farmers/producers. These relationships related to food production, trade, and consumption can create a sense of cooperation and community (Cicatiello et al., 2015). However, these values and benefits can vary and be context-dependent, as, although the notion of "local" can be highly valued, its interpretation in meaning and degree of importance varies greatly from consumer group to consumer group.

In conclusion, the key to FM success in the movement lies in the ability and motivation of participants to prioritize social and environmental over just economic goals (Cleveland et al., 2014).

Local food quality

In comparing the nutritional quality of local and non-local foods, one popular assumption is that local food is often more nutritious because items are fresher. Edwards-Jones et al. (2008) considered the nutritional quality of local and non-local food in their review. They purport that if consumers buy products from a farm after a few hours of harvesting, it is expected that their nutritional quality will be high. However, if quality is related to the smallest time interval between harvesting and consumption, then it should be noted that food produced at great distances, as in the case of products grown in Kenya, may also be available for sale in some parts of northern Europe within 24 h after harvest. For this reason, it is not possible to state categorically that fruit and vegetables produced locally will always be of better nutritional quality than products from further afield. Quality depends on how they were grown, and the type of post-harvest process they have undergone. Thus, the authors concluded that the characteristics of cultivation, processing and storage are certainly more important in determining the quality of fruits and vegetables than the distance between producer and consumer.

It is also worth considering the issue of mass public opinion regarding which foods should be eaten. With the advent of fast food chains there was a sharp increase in advertisements displaying certain products as being more tasty and cheaper, and as a result, this generally discouraged people (especially younger generations) from buying fresh produce, some of which was locally produced.

Frequent consumption of "fast food" has strong positive associations with weight gain and insulin resistance, and eating "fast food" increases the risk of obesity and type 2 diabetes (Pereira et al., 2005). On the other hand, Salois (2012) found that the greater the number of smaller local food retail outlets in a location, the lower the rate of obesity and diabetes in that location. The author assumes that this is due to the possibility of encouraging better and healthier food choices. Thus, increasing the availability and affordability of healthy foods are key strategies to improving diet and health (Budd et al., 2015). With respect to obesity, Hamilton et al. (2014) believe that urban agriculture, with local food production, shows particularly significant potential for stifling the obesity epidemic.

In a number of regions, the composition of nutrient data of fruit and vegetables of local food are being formulated by health professionals such as physicians and nutritionists in order to enhance recommendations

for consumption of locally produced food. In several places, many local food products (e.g. pequi [*Caryocar brasiliense*] in Brazil, paterna [*Inga paterno*] in El Salvador, Kulākula [*Syzyginus guineense*] in Angola) are not included in nutrient data compositions of foods in books studied at university. Thus, physicians and nutritionists are unlikely to recommend such products to their patients. Yet, in a number of locations, to know the nutrient composition can be powerful tools for promoting local food systems. For example, the West African food composition tables (FCT) allow users to treat health problems related to diet, and to strengthen local development and encourage biodiversity. In addition, the preparation of these nutrient composition listings contributes to a reduction in poverty in rural and urban areas (Stadlmayr et al., 2013). Samuda (2003) reported that in 1995, the Regional Data Center for food composition activities in the English-speaking Caribbean (CARICOMFOODS) was established. The geographical area represented by CARICOMFOODS covers 18 territories scattered throughout the Caribbean basin. The compositions of 1,000 kinds of local food are described in these tables.

The use of the nutrient content of local foods is very important in the development of local food. Many universities in the South used books published in the North in their nutrition and medicine courses. These academic standards led to an overvaluation of diets that contained food produced in the North at the expense of local food from the South.

Protection of local food

The maintenance of genetic diversity within local food plants and products has also been discussed at length. For example, Mexico is the center of origin and diversity of maize (*Zea mays* L.), with great genetic wealth. Maize comes in different colors, textures and amylopectin and amylose content in their starch (Sandhu et al., 2004). Each type of maize can be used for cooking specific foods and these foods are traditionally used in their places of origin. The preservation of the genetic biodiversity of maize will lead to the preservation of local foods. Moreover, maize in this region is the major local food. Thus, the protection of the genetic integrity of local varieties of maize is of paramount importance. However, with the increase in the use of transgenic maize, the genetic purity of this local food is being threatened. Quist and Chapela (2001) reported the presence of transgenic DNA in native Creole maize populations grown in the remote mountains in Oaxaca, Mexico, which is part of the Mesoamerican center of origin and diversification of culture. The transgenic DNA in Creole maize samples, indicates the occurrence of multiple introgressions probably mediated by pollination. As pollination in maize occurs mainly on the wind, the pollen of transgenic plants can pollinate native plants and contaminate natural DNA with transgenic DNA. Further, Lopez (2011) assessed the existence of a relationship between the presence of transgenes and the appearance of new abnormal phenotypes in maize in five communities in Oaxaca. Leaf tissue was sampled from 500 native corn plants with abnormal phenotypes and 500 native corn plants with normal phenotypes. Transgene presence was observed in at least 18 % of all the plants sampled; the Cry1Ab protein was the most frequently encountered (of the three tested). In addition, there was a significantly higher frequency of recombinant proteins in abnormal phenotypes (117/500) compared with normal phenotypes (62/500)(Lopez, 2011). This gene flow is not the only possible environmental impact. Overall damages to crops, wild relatives, pesticides, and the wider ecosystem are another result. For instance, herbicide resistant organisms stimulate the use of herbicides, antibiotic resistant species create health risks, and genetic engineering in monocrop agriculture promote erosion and the spreading of disease. On the other hand, we must recognize the important role of biodiversity conservation achieved by small farmers in the South. This is critical, as the southern countries contain most of the world's biodiversity both in terms of the variety and species of crops that are used as food (or agrobiodiversity) (Harvey et al., 2008).

Local food and humanitarian aid

Another important issue to be addressed is the development of local food in disaster situations. Humanitarian aid work, in times of major disasters, demonstrates the mutual aid capacity that nations have when facing dire situations. Much aid food is donated, and shipped from far-away locations to disaster zones. Yet, in these situations the development of local food can be a lever for the resumption of development. Harou et al. (2013) conducted case studies of food assistance programs in disasters in Burkina Faso, in North Africa and Guatemala, Central America. The authors concluded that there could be a 63 % reduction in costs if the food were to be purchased locally or nearby. Thus, given the size of the program, the same funds could potentially provide another three months of daily rations for approximately 20,000 people. The authors comment that, furthermore, given the capacity of planning in advance and the feasibility of providing local food where possible, priority would be given to acquiring food from local small agriculturalists. Lentz et al. (2013) generated estimates of timeliness and cost-effectiveness, comparing three forms of aid in cases of national disaster. They are: US transoceanic food aid shipments, local or regional food purchases funded by the US, and cash aid. The study was conducted in nine countries over the same period. The authors concluded that the local purchasing of food or distribution of cash or vouchers would result in time savings of about 14 weeks and an average economic gain of 62 %. If only the grains were to be bought locally there would be, on average, a savings of 50 %.

Local purchase of food, in addition to offering economic savings,would stimulate the resumption of local development.

Conclusions

The promotion of "local food" is a complex issue which incorporates the realms of environment, economy and health on both the local and the greater national and international scales. Governments should have strategies in place to promote and strengthen the local food trade as much as they have historically for the export market. Transportation is only one aspect of an assessment of the life cycle from agricultural production to consumption and local production does not always equate to lower GHG emissions or to sustainable food production. Thus, whether the methods used for agricultural production are conventional or organic, and whether production occurred in a field or, for example, in a greenhouse with temperature control through the use of fossil fuels are factors that must be considered when evaluating local food efficiency and sustainability. Consuming only locally produced food does not guarantee the ecological sustainability of our agricultural systems.

Urban agriculture has the potential to provide families with a low-cost alternative for diet improvement and to supplement their income from sales of surplus food grown. It also provides families the ability to grow foods that are culturally relevant. In addition, purchasing local foods at Farmers' Markets gives consumers the ability to discover where their food comes from and who is producing it, and with that knowledge, a certain assurance about the production methods on-farm.

The use and understanding of the nutrient composition of local foods is very important in the development of local food. Many universities in the southern countries have used books produced in the North in their nutrition and medicine courses. These academic standards have led to an overvaluation of diets that contain food produced in the North at the expense of local food from the South. Thus, there is a need to integrate local knowledge into the evaluating process of nutritional benefits and locale-based values of local food.

Protecting the maintenance of the genetic purity of local food has also been much discussed. We must recognize the important role played in the conservation achieved by small farmers in the South, because it contains most of the biodiversity of the world both in variety and species that are used for food.

Another important issue to be addressed is the development of local food in disaster situations. Given the capacity of planning in advance and the feasibility of providing local food where possible, priority would be given to acquire food from local small agriculturalists. In addition to these aspects, the local purchase of food would result in the resumption of local development.

In conclusion, we need more data that can provide information on the environmental, economical and health impacts resulting from the consumption of locally produced food compared to those produced far from the place of consumption. Research on this topic has been and remains limited (Edwards-Jones et al., 2008). However, in general, the consumption of local foods, produced in ways adapted to the local environment and the use of technologies with ecological conditions, is certainly one positive factor in promoting improvements to the health of the environment, the economy and society in general.

Acknowledgements

We would like to thank CAPES – the agency for the Coordination for the Improvement of Higher Level Personnel for funding the sabbatical of Fábio Cunha Coelho and Enilce Maria Coelho in UCSC – University of California Santa Cruz making this study possible. We would like to extend our thanks to Professor Stacy Philpott, CASFS - Center for Agroecology & Sustainable Food Systems, the Ant Labs group of UCSC. I also thank the Lab. of Phytotechnology, especially Professor Sílvio de Jesus Freitas, of the State University of North Fluminense Darcy Ribeiro (UENF), for their support in this work and a special thanks to my son André Fialho Coelho for the English review.

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