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System Approach for Evaluating Locally Grown Produce Issues

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Abstract

The potential advantages of locally grown produce are mainly related to the coexistence of production and consumption in the same area. These advantages are: reduced transportation, freshness, better taste, easy traceability, transparency, food safety, environmental sustainability and community development. Despite these positive aspects, the money spent for locally grown produce represents only a small percentage of the total money spent for fresh produce purchases. On the other hand, interest is growing for furnishing produce to local produce schools, hospitals and public institutions. The supply chains of locally grown produce are classified into direct marketing distributions (farmers’ markets, CSAs, roadside stands, on-farm stores) and indirect marketing distributions (restaurants, foodservices, supermarkets). Each supply chain is characterized by different factors, including the expectations of customers which, coincidentally, drive logistics and postharvest handling activities. The supply chains and the logistics of locally grown produce are described, with the analysis of potential benefits and barriers to expansion, using the system approach technique.

Keywords: System approach, locally grown, supply-chain, fruits and vegetables, logistics, simulation.

1. Definition of local produce

There is no single clear definition of “local food”, and there are very few definitions presently in use which refer to the marketing or sale of goods (DEFRA, 2003). Wikipedia describes local food (also regional food or food patriotism) or the local food movement as a "collaborative effort to build more locally based, self-reliant food economies – one in which sustainable food production, processing, distribution and consumption is integrated to enhance the economic, environmental and social health of a particular place" (Wikipedia, 2008). Local food also includes locally grown produce [LGP] (Hinrichs, 2000). In other words, locally grown produce is found in territories where production and consumption coexist.

The definition of "local" is flexible. A farm may see this as the area reachable within a day’s driving because this is where the product can be efficiently moved. Some see "local" as a very small area such as a city and its surroundings, others suggest a bioregion, while others refer to the borders of a nation or state (DEFRA, 2003). Some farmers’ markets have a rule that its vendors must farm within an 80 km (50 miles) radius (Grimsbo Jewett et al., 2007). Locally grown produce falls into the category of Environmentally Identified Products (EIPs). EIPs are types of food which have been obtained in such a way in that their growth, processing, or distribution have a smaller environmental impact than conventionally–grown, processed, and distributed food. Local food supply chains with fewer intermediaries between the producer and the end consumer are widely described as a way to promote more sustainable consumption systems (Sirieix et al., 2007).
To assess the potential advantages, disadvantages and the logistic issues related to LGP, the authors used the system approach, which is a process that refers to the study of the system as a whole, rather than examination of individual operations of its components. The logistics of FFV produce is certainly a discipline where simulations can make important contributions to the organization of the processes, as well as ways in which targeted interventions may be implemented in order to obtain efficiency throughout the entire supply chain (Busato, 2008).

2. The perception of quality attributes for locally grown produce

The quality of LGP is made up of many attributes, both intrinsic and extrinsic. The intrinsic feature of a product includes its key external attributes such as colour, shape, size and lack of defects. In addition, internal attributes include texture, sweetness, acidity, aroma, flavour, shelf–life, food safety and nutritional value. The extrinsic factors refer to the production and distribution systems and include the use of chemicals, the sustainability of production and distribution in relation to energy utilization (Hewett, 2006). Among these there is also the local aspect. A study carried out in Yorkshire on produce from local orchards discovered that the term “local” supplanted “organic” in the mind of the consumer, meaning that local was more valuable than organic (Borrie and Potter, 2005).

An investigation into the distribution of locally grown produce in one supermarket chain in Northern Italy showed that 40% of the consumers chose local produce due to its known origin, 30% linked this attribute to higher quality, 13% to convenient price, and 14% to produce safety. For 3% of the consumers freshness and local economic impact were reasons for buying local produce, while 78% of the consumers were willing to pay more for the local produce if it was advertised (Piccarolo, 2006).

Consumer awareness of local FFV is different if they are purchasing produce, compared to if they are eating it in foodservices. The money spent for locally grown produce in direct marketing distributions represents only a small percentage of the total spending in other distribution channels (CTIFL, 2007c). However, interest is growing in the supplying of local produce to foodservice. Serving “sustainable” food at schools, hospitals and public institutions has become quite popular (Strohbehn and Gregoire, 2003; Cottingham, 2007).

3. Distribution channels for LGP

The local produce supply chain handles highly perishable produce, with short shelf–life characterized by seasonal production and local appreciation. Some of this produce includes a geographic indication (Pirog and Paskiet, 2004). A detailed view of the many available distribution channels for distributing the locally grown FFVs is presented in Jett and Hendrickson (2006). Farmers’ markets are defined as fixed locations where several farmers gather to sell their own products at recurring times (Jett and Hendrickson, 2006). Farmers’ markets are often located in the middle of cities and towns and they are open seasonally, while others are open on weekends or daily, especially those located in big cities. Markets are classified by different factors, such as their location or structure (open air markets, market halls, and market districts) or defined by what is sold at the market through terms such as “grower only”, “green”, or “organic”. Farmers’ markets have rules and regulations concerning how the items are sold and who can sell them (Phillips, 2007).

Other possible forms are also the on–farm store or the roadside stand. In the first case the store is located at the farm, and people must travel there to buy the product. Often the farm offers other services in order to attract people, especially on weekends, such as attractions for kids and
so forth. Sometimes farms organize U–pick events, where customers may harvest fruit and vegetables themselves.

CSAs are community farms where consumers interested in healthy, safe food join in an economic partnership with cultivators seeking stable markets (Jett and Hendrickson, 2006). Consumers pay a membership fee based on the size of their share. CSAs may either charge an advance fee for the entire season or cultivators may collect a nominal membership fee with weekly or monthly invoices for the supplied goods. One share is usually designed to provide the weekly vegetable needs for a family of four. In return, members receive a supply of fruit and vegetables on a weekly basis during the growing season.

Foodservice is a growing sector in the distribution of LGP. Many universities have started their own projects. Cornell University, NY, USA, for example, pioneered the project to bring local produce to the cafeterias and has a web site with resources and pointers to other resources for promoting local food and sustainability (http://farmtoschool.cce.cornell.edu). To promote the consumption of fresh LGP among students, some pilot projects in Italy involve the distribution of such food in vending machines in schools. The sales price was lower or equal to the previously offered snacks. The vending machines were replenished daily with single–packaged, local fruits and were connected to the supplier via the GSM network in order to avoid a lack of produce. Some pilot projects in London hospitals aimed at increasing the amount of local or organic food served in hospitals to ten percent of the routine catering provision, and therefore, improve health in the hospital community by providing fresher food for patients, staff and visitors. Local farms and food businesses were also supported through this technique. (Cairncross, 2004).

Restaurants will play an important role in the promotion of LGP. Today’s food consumption trends pressure many chefs to source local, high–quality products (Jett and Hendrickson, 2006). The most likely market targets are independently owned and operated restaurants that change menus frequently (Strohbehn and Gregoire, 2003). Many are high–end restaurants that depend on high-quality ingredients. Such restaurants use a limited amount of a single product and need multiple deliveries throughout the week (Nakamoto, 2003). Less pricey, high-volume restaurants could also be potential buyers of local produce, in particular highly perishable FFVs that do not withstand long shipping distances (Grimsbo Jewett et al., 2007). Farmers should consider the following positive aspects of foodservice marketing: higher prices, larger sales volume than retail sales, lower marketing costs and time requirements and a buyer for unique and highly perishable products (Jett and Hendrickson, 2006).

Locally grown produce can also be sold at supermarkets when they cannot be purchased through traditional wholesale channels (Jett and Hendrickson, 2006). Geographic indication of origin, or very well known locally grown produce are accepted by supermarkets and do not compete with the same kind of produce from outside the region (Piccarolo, 2006). By selling to a supermarket, farmers can market large quantities of produce. In some cases, direct marketing to supermarkets eliminates the need for a broker and allows the farmer to label his produce. In other cases, the supermarket is responsible for choosing a label for the product (Piccarolo, 2006). Cooperative forms could help farmers to deal with the supermarket. In some cases, a cooperative of local producers could deal exclusively with the paperwork and information management, e.g., orders, delivery schedules, and payments (Piccarolo, 2006). A greater involvement of cooperatives encompasses the distribution of the product, as well as all the aspects related to post-harvest treatments. A cooperative may even deal with the planning of planting and production.
4. Potential advantages for LGP

Consumers are increasingly concerned about the freshness, safety and nutritional attributes of the fruits and vegetables they purchase, as well the environmental and social implications of the production, packaging and distribution systems used in processing the fresh produce (Hewett, 2006). The potential advantages of local fresh fruits and vegetables [FFV] are mainly related to the coexistence of production and consumption in the same area. Using the system approach it is possible to evaluate the different groups of aspects.

Regarding logistics, it is necessary to focus on ways for improving the quality of fruit and vegetables when eaten rather than simply increasing shelf-life (Prussia and Mosqueta, 2006). By the lowering the lead time between production and consumption, local production offers an alternative to extending the shelf–life of produce. This is even more important for perishable produce (Busato and Berruto, 2006). Often storage is not required because production and consumption occur at the same time. Also, the information flow is easy to manage since the supply chain is much shorter and the expenses in this area are low.

Regarding quality, the shorter transportation and storage times allow farmers to provide high-quality local FFV because products can be harvested more mature while the current shelf–life levels may be maintained. The authors made a simulation model in order to evaluate traditional and short supply chains for locally grown peaches, taking into account their shelf–life and firmness (Berruto et al., 2003). The proposed model embeds both discrete–events, mainly devoted to the description of logistics and external condition changes, as well as continuous-time behavior. The model demonstrates that local produce (nectarines) could be transported for short distances without the support of a distribution center, allowing a shelf-life extension of 22 hours resulting in more uniform firmness of the produce at the sales point (Figure 1), and with only 32% of produce below quality standards (B scenario) to be sold at the store, compared to 65% of the product that follow the traditional supply–chain (A scenario).

![Figure 1. Fruit firmness at the store for nectarines distributed through a distribution center (A scenario) and directly delivered to the store (B scenario).](image)

Small local producers generally provide a broad range and variety of local FFV compared to large scale producers. Small local producers also benefit consumers who may have access to a greater volume and variety of fresh fruits and vegetables, and therefore can appreciate the periodicity of the production.
Global sourcing produce means longer transportation and handling times, which give pathogenic microorganisms additional time to proliferate and reach levels which can cause illnesses (Gorny and Zagory, 2004). Produce that is harvested, delivered and/or purchased on the same day has far fewer food safety or contamination risks. The reduced time between the harvesting and sale of produce reduces the risk of microbial and fungi growth while it expands the shelf-life at retail outlets for the consumer (Berruto et al., 2003).

Less use of packaging avoids the introduction of plastic substances into food, and the reduced diesel fuel emissions by limiting long hauling can help reduce asthma attacks.

It is easier to trace the source of a problem in LGP when customers are dealing one-on-one with a farmer. Under these circumstances, any problem can be quickly identified and resolved (Dargan, 2006). The traceability procedures are much more complex when the supplier buys produce from great distances and accumulates products from many farmers (McGarry, 2007).

Most produce travels long distances before being eaten. In addition to the cost, transporting food has a direct and detrimental impact on the environment and an indirect impact on human health. Generally, the environmental impact of LGP is less than that made through global sourcing. A study (Leopold Center, 2005) defines the concept of “food miles” and indicates that the transportation of the local foods would save 79–94% of the CO₂ emissions as compared to non–locally sourced foods. On the other hand, the “food miles” aspect is an important factor, but not the only relevant issue concerning food production and its environmental impact. To make fair assessments and comparisons, all factors and resources used throughout the life cycle of the product have to be taken into account: production, processing, transport, retail and consumption (Sonesson, 2005; Bhaskaran et al., 2006). Despite the reduction in energy consumption, preliminary findings suggest that consumers may be more interested in the concept if it is related to how food miles may affect product freshness, quality, and taste, rather than the amount of energy consumed (Pirog, 2004). The “local” and “km zero” attribute can be used as a communication cue towards consumers (Smith et al., 2005).

Short supply chains could reduce postharvest losses due to reduced transit times for local produce. Since the environmental impact of produce is often high when travelling toward the consumer, wasting raw material later in the chain is, of course, costly from an environmental viewpoint. Local products with a potentially longer shelf–life could reduce the amount of waste resulting from discarding spoiled produce and packaging (Berruto and Busato, 2006). This reduces the amount of energy and water used per unit of consumed produce, increasing energy and water efficiency.

There are benefits both for farmers and local communities. These are specifically for farmers who produce, handle, process and distribute the LGP, by incorporating tasks that belong to different links in the chain, their share of consumer payments increases and positively effects their income (Gregoire and Strohbehn, 2002). Often, high–quality local produce allow farmers to increase prices. The direct sale of fresh fruits and vegetables to local caterers may provide an important source of income generation for small farms which, occasionally, will not have the need for additional investments in infrastructures and equipment (Tropp and Olowolayemo, 2000).

For local communities, the benefit of strengthening local food systems is often cited (Bryant and Johnston, 1992; Mazereeuw, 2005). The local FFV supply chain could improve the circulation of money within the region and the local economy, thus, helping to break the poverty cycle, while keeping farmers in activity. This is also true for developing countries.
5. Potential barriers to the development of LGP

Lack of availability and information are the most significant barriers to consumption of LGP (Harris et al., 2000). Regarding supermarket chains, the main obstacle appears to be a combination of a lack of supply and not knowing where to obtain local produce (Piccarolo, 2006). The farmers are skeptical of potential profits because the small volume produced, that can be absorbed by local markets, imply higher per–unit costs for the all the activities (production, transportation, distribution) that involve delivering the produce to the consumers. Incentives for harvesting and marketing LGP is, therefore, not great when set against the general objectives of farm businesses. The biggest disincentive is the amount of time, effort and labour needed to harvest, sort and distribute the produce during very busy times on many farms (Borrie and Potter, 2005). The local market relies on small production volumes which yield higher per–unit production costs. For the same reason, handling and logistic costs are also high because the volume being transported is small.

The lack of production coordination between small producers could lead to oversupplies and shortages within a single growing season and generate complains from customers. An overproduction of LGP cannot be sold in time and this leads to significant postharvest losses. Logistic problems for the foodservice industry include the following obstacles involving local FFV purchases: reliability, seasonality, year–round availability, product safety, cost, familiarity of sources as well as an increase in orders received, product processing and payment procedures (Gregoire and Strohbehn, 2002; Strohbehn and Gregoire, 2002b; Strohbehn and Gregoire, 2003).

Associated with a lack of coordination is also the lack of standards among producers, with great variability in quality, size, packaging, ripeness stages, etc. This is a problem for indirect marketing channels (supermarkets, food stores, foodservices).

6. Logistic strategies for LGP

Customer service should be different for each distribution channel, even though the main parameters to take into account are the same for all the channels:

• Quality of the produce. Suitable LGP for short supply chain are products which are difficult to ship over long distances due to their perishability such as berries or products that have strong local or regional appeal but may not have enough widespread appeal to be part of the standard inventory of a large–scale food distribution company. For roadside stands and on–farm stores, in particular, producing a high–quality product is a prerequisite when dealing with a high–end, high-priced product. However this is a niche market, and sometimes over-production can occur.

• Quantity and availability of the produce. Farmers’ markets have no constraints as to the availability of produce, while this is a key factor for restaurants and foodservices. For CSAs this is important since customers need a weekly delivery of the produce. CSAs require excellent management skills, and planning is essential for providing customers with the expected variety and quantity of crops through a 20 to 24 week season. Produce variety and quality is a key issue for CSAs and all other forms of direct marketing. For restaurants and foodservices, season-long quality and availability is a key factor. Members of small farm cooperatives can usually make greater commitments to foodservice in terms of availability, and can usually offer a greater volume of processed farm products than most individual small producers (Tropp and Ololowayemo, 2000). Top quality for restaurants requires supply consistency and means harvesting shortly before the delivery. If the product is unavailable, farmers should consider buying it from a neighbor.
• Traceability of the produce. For farmers’ markets, on-farm stores and roadside stands, despite the fact that the produce should be traceable, the traceability requirements are mandatory, but at much lower levels than with indirect marketing. Supermarkets require food traceability because the commercial activity is responsible for the products sold on the shelves. This has led to the development of private standards of good agricultural practice by some distributors (GlobalGAP, BRC, Nature’ Choice, etc.). For local FFVs, the main problems concern pesticide residues. Organic crops need other types of certification, and, each country also has its own way to deal with the issue and the associated costs.

• Processing, Packaging and labeling. For farmers’ markets marketing locally grown produce is quite easy because it is only necessary to wash off the produce and clean and sanitize the package. Generally, packaging is not required (Suslow, 1997a). Catering to the clients’ specific preferences in terms of products and packaging has been instrumental for some successful cooperatives supplying to foodservices. This is not related to the quality of the product itself, but concerns regulations, traceability and the delicate handling of produce. Product packaging and labeling pertain to compliance with government (state and national) food safety regulations and easy ordering for managers. The ability to tailor the product packaging to meet the specific needs of individual schools can exert a considerable influence on the foodservice director’s decision to use or retain the services of a local vendor (Tropp and Olowolayemo, 2000).

To successfully produce and sell LGP, farmers have to implement some logistic strategies:

• Increase variety of produce. Providing variety of produce allows for an increase in sales. This is a key issue for whoever is interested in selling LGP. Produce growers have a considerable amount of success by marketing specialty fruits and vegetables with strong regional appeal to local institutions or supermarkets.

• Location of the stand and of the produce. This aspect is not important for deliveries to supermarkets. Some timely deliveries to restaurants and foodservices require relatively short distance from producers. For on–farm stand and roadside stands, the optimal location, however depends on the customer base, on whether they buy produce on daily or weekly basis or whether they can only visit the farm occasionally. The location of the farmers’ market is crucial. In this case, the compliance with the concept of customer proximity, e.g., the distance between place of residence and the place of purchase, is important. An area reachable by car, bike or walk within two to 15 min is considered nearby. The availability of parking for loading and unloading produce is also important in order to avoid long distance transportation of the produce, both for farmers and customers. The location of a roadside stand and on–farm store can greatly influence its profitability. Roadside stands and on–farm stores are most successful in high traffic volume areas (Jett and Hendrickson, 2006). A visible location is usually a prerequisite for a successful farm or roadside stand.

• Production Planning. Thorough and careful planning should facilitate the scheduling of planting, production, harvesting and postharvest treatment, and the delivery of the right product at the right time and to the right place. To facilitate work with foodservices, it is important to plan planting in order to offer the quantity of the products necessary during the growing season (Strohbehn, 2002; Grimsbo Jewett et al., 2007). This involves planting a bit more than required to deal with shortages within the season. Overproduction in other periods has to be sold through alternative distribution channels, such as farmers’ markets (Nakamoto, 2003).

• Differentiate the distribution channels. In order to avoid a shortage of produce in presence of a delivery contract with a foodservice or a restaurant, selling produce to more than one
channel could help. In this case, the surplus in one channel could be sold through alternative distribution channels, such as farmers’ markets (Nakamoto, 2003).

- **Implement customer service.** Customer service requirements are related to the type of customer (consumers at farmer market, member of CSA, local foodservice, etc.).
- **Providing timely service and allowing credit card payments** improve customer service and increases the produce sales for farmer markets, roadside stand and on–farm stores. Other activities like home deliveries could help also to improve customer service and the competitiveness of the firm. For foodservices, customer service involves timely deliveries of the right kind of produce, in the desired quantity and reliable quality.
- **Timely distribution and scheduling of sales activities.** Some activities such as foodservice and restaurants, often must observe strict restrictions when it comes to food delivery schedules. To ensure that the delivered products are high–quality and fresh, a maximum delivery time of 1.5 hours is advised (Schofer *et al.*, 2000). Restaurants have also strict delivery times because they often have limited cold storage. Consequently, prospective local farmers are often only able to obtain contracts with school foodservice providers if they are prepared to adjust their delivery schedules to meet the specific needs of their customer base. Supermarkets do not have very tight deliveries as foodservices do. Some supermarkets, which are located very close to the production point, could also plan two deliveries per day for orders placed the previous day: one in the morning, and one in the afternoon. The second daily delivery allows the supermarket to adjust its stock levels and provide fresh, high–quality produce with a longer shelf-life. This also allows uniform labor utilization on the farm level. For roadside stands and on–farm stores, the logistic problem is the opening hours for customers to buy the produce. Opening hours range from eight to 10 per day. Harvesting can proceed during the opening hours and provide fresh produce to the stand throughout the day. This helps to distribute the daily work among personnel and preserves product freshness, but is not feasible in all weather conditions. For the farmers’ market, it is important to be at the stand during the opening hours. Adjusting to the seasonal flow of customers by providing an adequate number of people working at the farm stand is also important in order to provide timely service to customers (Berruto and Busato, 2009).
- **Group locations, produce and orders.** Without noticeable change in customer service, delivering the product in the same location for many customers (e.g. CSA deliveries) helps to considerably reduce the working times associated with the distribution of produce. Some CSAs cooperate with local food cooperatives, churches, office parking lots, or other similar locations to avoid the delivery to each house. Some members may even be willing to use their home as a drop site for others in their area (Grimsbo Jewett *et al.*, 2007). In some cases, a cooperative of local producers could deal exclusively with the paperwork and information management, e.g., orders, delivery schedules, and payments (Piccarolo, 2006). Grouping orders and produce to reduce the time spent in deliveries permit important time saving. It could, however, also delay the deliveries if not well managed.

### 7. ICT and information sharing

Information exchange provides more knowledge along the supply chain and allows for creation, delivery and share value (Collins, 2006). It is important to streamline and expedite the exchange of information, even for locally grown FFVs, because it is less expensive to invest in the exchange of information sharing rather than in distribution infrastructures (Busato and Berruto, 2006; Prussia and Mosqueta, 2006). Traceability could help to streamline the information flow in both ways along the supply chain (Bollen *et al.*, 2006).

Farmers often do not pay attention to customers, nor provide information about product
availability or shortages, or, if they do so, they do not provide it on time. In the case of local produce sold to final consumers, the customer base is quite large. The use of the Internet and e-mail helps these producers in particular to efficiently handle information, yield good returns on investments, have an excellent potential for promoting their business and expanding marketing opportunities. A way for consumers to provide feedback to the producers could also be of interest. Moreover, wireless communication through SMS is brief, immediate and could provide the consumer base with news about available products and seasonal sales for some fruits and vegetables.

The information needed when concluding a contract with a local restaurant or supermarket pertains to: products available for sale, volumes and forms of sales, availability period, frequency of deliveries and prices. Here, having a cooperative or a system that streamlines the transactions and information flow in both directions could help to reduce the lead times and increase the shelf-life of the produce. The potential of information exchange to increase profits in the supply chain while distributing highly perishable FFVs has been shown using a simulation model (Busato et al., 2007). The model shows that information sharing effectively improves the performance of the supply–chain for fresh fruits and vegetables with profit increases ranging from 9% to 24%. This proves that the sharing of information along the supply chain can be very effective when there are decisional procedures for exploiting the value of the information. Profit optimization in this case also increases the sustainability of the supply chain. In fact, information sharing affects not only the produce sold and profits, but also reduces waste from unsold products.

8. Conclusions

Local supply–chains, though not available for all produce, are of interest for fresh, locally grown produce. The advantages are related to: reduced transportation, freshness, better taste, easy traceability, transparency, food safety, environmental sustainability and community development. Despite these positive aspects, the money spent for locally grown produce represents only a small percentage of the total money spent for fresh produce purchases. On the other hand, interest is growing for the furnishing of produce to local produce schools, hospitals and public institutions.

In order for the sale of LGP to work, it is important for consumers to be willing to buy this type of produce and for the producer to be capable and willing to provide and sell low–quantity, high quality fresh produce to many customers. There are logistic strategies necessary to adopt in order to make this business profitable and sustainable. Among these, the differentiation of distribution channels and information sharing are of significant importance.

References


