



Traceability: Formulation and Implementation of an Economic Efficient System in the Fruit and Vegetable Industry

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JEL Classification: Q18

Traceability is a “record keeping system designed to track the flow of product or product attributes through the production process or supply chain” (Golan et al., 2004; Fonsah, 2005a). The globalization of world trade, the North American Free Trade Agreement (NAFTA), food safety in the fresh produce industry, and political and commercial realities have put the traceability regulation on the radar screen. Canada, which is now the number one trading partner of fruit and vegetables from the United States, has become an advocate of traceability, which means that the United States fruit and vegetable industry has no choice but to comply if they must export fresh produce to Canada (PMA, 2005; GS1, 2006; Fonsah, 2003a,b; Huang, 2004).

This study is aimed at developing economic efficient strategies of formulating and implementing traceability regulations in the fruit and vegetable industry. It utilizes techniques adopted by some multinational fresh fruit and vegetable corporations the world over. The specific objectives are (1) to provide fruit and vegetable producers with a practical standard operation procedure (SOP) on how to set up traceability systems, and (2) to provide producers with an alternative on how to economically and efficiently collect and handle traceability records.

How Can Traceability be Formulated in a Farm Firm?

The formulation phase of an integrated traceability process in a farm firm is a function of the following factors: (a) the food safety and quality management system, (b) identification of risk and opportunities involved in the operation, (c) identifying strengths and weaknesses of the organization, (d) aspiration and values of the stakeholders/

owner of the organization, and (e) recognition of the non-economic factors to society. Management plays a vital role in both the formulation and implementation phases of traceability regulations adoption in a farm firm. A well-formulated strategy can still fail if not well managed. On the other hand, good governance can transform an inferior formulated strategy to success (Fonsah, 2003b).

Is the Implementation of Traceability Possible in a Horticultural Farm Firm?

Anecdotal experience shows that an effective implementation of an inferior strategic formulation can provide successful result. On the other hand, the ineffective implementation of even a superior or well-orchestrated strategic formulation can lead to failure (Fonsah, 2003b). That simply means that, although the formulation of a traceability program is important, the implementation is of utmost importance. The best place to start is with the organizational structure and relationship (see Figure 1).

Although the participation of each department on the organizational chart in Figure 1 is crucial, the most important person to implement and follow up the traceability adoption in a farm firm is the operation manager (OM), since he/she is expected to be adept with all the operations in the project. Figure 1 can be adjusted to reflect the structure of any small-, medium- or large-sized horticultural farm producing fruit and/or vegetables. A large farm in this study is defined as greater than 5,000 acres, while a medium-sized farm is from 1,001–5,000 acres. A small farm in this study is defined as less than 1,000 acres.

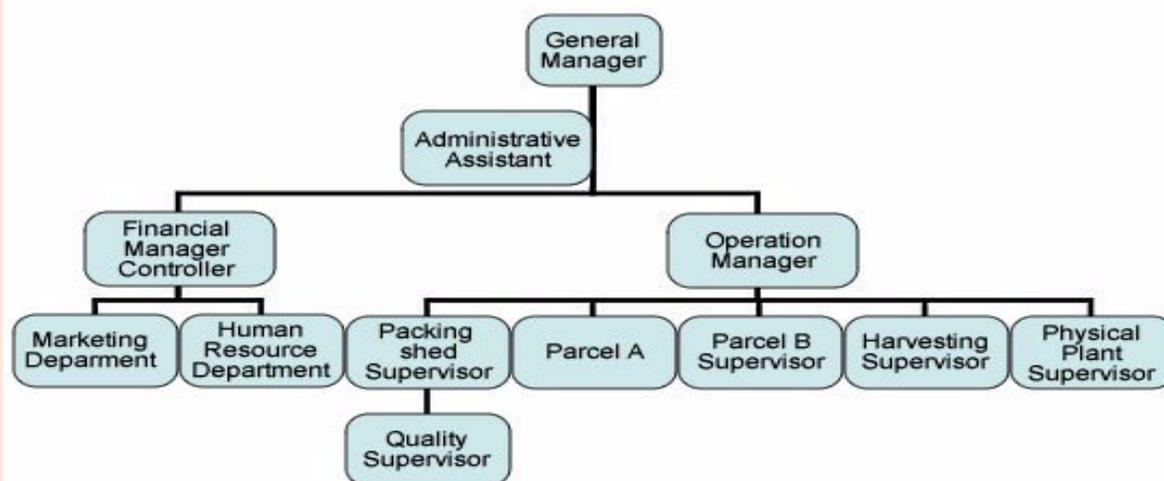


Figure 1. Organizational chart for implementing traceability in a large- and/or medium-sized farm operation.

What are the Functions of the Operation Manager in Implementing Traceability?

First, records of the day-to-day operations of the farm firm from planting to packaging must be kept in writing. This record keeping process only requires the operation manager to reallocate his/her work schedule to accommodate time for compiling records. A ledger or a notebook is required in the case of a small-sized farm firm or a computer in the case of a large- or medium-sized farm. Some corporate and multinational fresh fruit and vegetable companies around the world have adopted the ledger system because of its cost effectiveness (Fonsah & Chidebelu, 1995). The advantages of the ledger are as follows: (1) All supervisors must read and sign the ledger prior to going to the field; (2) Any unclear or well-defined instruction must be clarified prior to carrying out the operation. The clarification can be done either by radio, telephone, or the fastest means of communication available; (3) When the ledger is full, the beginning and ending date is

labeled on it and filed for future reference; (4) If any field operation is wrongly implemented, it is easy to trace where the communication breakdown occurred; and (5) It is cheaper to use a ledger than a computer, especially in the case of small farmers who in most cases lack computer proficiency and do not even want to be bothered with it. It is recommended that the records be kept for at least five years.

What Techniques Can We Use for Traceability Data Collection/Record keeping?

The rule of thumb is to have a surveyor demarcate the farm into parcels or plots and draw it into a map. A good map should have the following information: (1) parcel numbers; (2) acreage per parcel; (3) all primary and secondary roads; (4) all ponds or rivers; (5) irrigation system main and secondary lines, if applicable; (6) drainage system, if applicable; (7) bridges, if applicable; (8) offices, packing house, physical plant, or any building infrastructure; (9) cableways

network, if applicable; and (10) nursery, if applicable. Mapping is a common practice.

How Do We Obtain Traceability Information from Field Operations Using a Map?

A staff person can be designated to enter these instructions in the ledger for the supervisors to read and implement. These instructions must be written at least one day prior to execution to give the supervisors enough time to read, collect, and arrange for all the logistical needs to successfully carry out the recommended operations. In the case of a large- or medium-sized farm, the physical plant or field operation supervisor or a combination of technical people will be the ones to implement these instructions. For example, the following is some pertinent information to be entered in the ledger during the planting of bell pepper: (1) date; (2) state manual or mechanical planting, plot, or parcel number, (3) planting pattern (for example double or single rolls); (4) crew number and names of

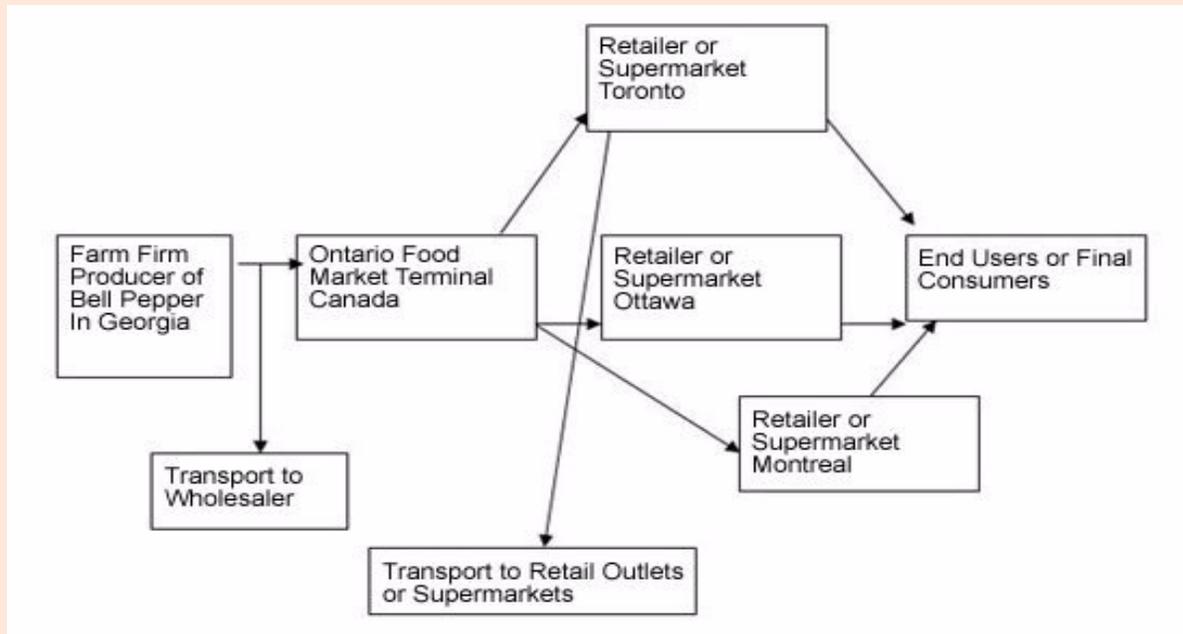


Figure 2. Traceability in a two-level distribution channel for horticultural crops.

crew members; (5) seed number and company from which it is bought; (6) origin of seed and date purchased; and (7) color plot or parcel where the planting operation took place. Enter the same information for all the plots or parcels planted and use different colors for different planting dates. It is suggested here that the same information must be entered for all plots or parcels planted such as weed control, fertilization application, irrigation, insect, pest and disease control, harvesting, handling, and sanitation, respectively.

How Can Packing House Information be Collected for Traceability?

Each packed box must be legibly coded prior to leaving the packing station with a simple stamp code. The coded number should contain the following information: (1) date the box was packed; (2) packer's number – optional; (3) packing station number if the company has

many; (3) packing line number – optional; (4) harvested date; (5) harvested plot number; and (6) harvested crew number and names. If the crop is field packed, the packer will stamp each box immediately after the operation. The stamps are small and self-inked.

Tracking Traceability Back to the Farm with All the Information Gathered

Assuming there is an outbreak of disease on bell pepper shipped to a supermarket in Montreal, how do we trace it back to the farm? In Figure 2, simple steps to follow are presented, assuming the produce goes through a two-level distribution channel: (1) The customers report to the retail chain manager of company ABC supermarket in Montreal, Canada; (2) The manager complains to the wholesaler at the Ontario Food Market Terminal; (3) The wholesaler requests the box number and consignment date from company ABC

manager in Montreal; and (4) The Ontario Food Market Terminal manager sends the number to the horticultural farm firm manager where the pepper was cultivated; (5) On receiving the box packing code, the manager or his associate immediately determines the date on which the box was packed and by which packer; and (6) The manager opens the ledger on the packing date and retrieves the following on packaging, harvesting, fertility application, irrigation, weed, pest and disease control, land preparation, cultivar, and source of the seed that was planted. All of these operations can take less than 30 minutes. Strategic management decisions can then be made in a timely manner to minimize further costs incurred because of the disease outbreak.

Cost of Implementing Traceability

The economic efficient initial cost of formulating and implementing trace-

Table 1. Economic efficient cost of implementing traceability per acre in a farm firm producing bell pepper in Georgia, 2006.

Operations	Medium/Large Firm	Medium/Large Firm	Small Firm	Small Firm
	No Traceability (\$)	With Traceability (\$)	No Traceability (\$)	With Traceability (\$)
1. Field Operations	\$2,725.00	\$2,725.00	\$2,725.00	\$2,725.00
- Includes all pre-harvest variable cost components such as plants, fertility, insecticides, fungicides, nematocides, herbicides, plastic, drip tapes.				
2. Harvesting Operations				
- Picking & hauling	\$1,275.00	\$1,275.00	\$1,275.00	\$1,275.00
3. Packing Shed Operations				
- Container/boxes/crates	\$1,125.00	\$1,125.00	\$1,125.00	\$1,125.00
- Grading and packing	\$1,650.00	\$1,650.00	\$1,650.00	\$1,650.00
- Marketing	\$1,275.00	\$1,275.00	\$1,275.00	\$1,275.00
- Stamps with code number		\$25.98		\$25.98
4. Transportation				
- Temperature recorder (2)	\$128.00	\$128.00	\$128.00	\$128.00
- Mixed cargo	\$27.52	\$27.52	\$27.52	\$27.52
5. Fixed Costs				
- Machinery	\$56.27	\$56.27	\$56.27	\$56.27
- Irrigation	\$220.65	\$220.65	\$220.65	\$220.65
- Land	\$129.53	\$129.53	\$129.53	\$129.53
- Overhead and management	\$408.75	\$408.75	\$408.75	\$408.75
Total Budgeted Cost	\$9,020.72	\$9,046.70	\$9,020.72	\$9,046.70
Total Cost of Traceability	0.00	25.98	0.00	25.98

ability in a small, medium, or large-farm firm producing bell pepper in Georgia is estimated at \$25.98 per acre, respectively (Table 1). This is the cost which the grower will incur for purchasing a personalized rubber stamp with the packer's code number. Although one stamp is capable of

producing thousands of impressions, this study assumed that at least two packers will be needed to pack 1,500 boxes of bell pepper per acre to be economically efficient, irrespective of whether the fresh produce was packed at the packing shed or in the field. The initial cost will eventually

reduce as only a self-inking replacement pad which cost from \$4-\$7 will be needed after the ink runs out.

The field operation or pre-harvesting variable cost, harvesting, packing, and fixed costs were derived from an enterprise bell pepper budget (Fonsah, Escalante, & Byrd, 2005c). It was assumed that two temperature recorders was needed per container worth \$64, and since 1,500 boxes of pepper can fill 1.64 containers, a total of four recorders worth \$128.00 would be required. However, this is a common practice whether traceability is adopted or not. Further, the cost of polyethylene pallet covers needed for tracing commingled produce in the same container was \$27.52. This is also a common shipping and/or refrigerated container transportation SOP. Different color polyethylene pallet covers can be used for each consignment. One roll that can cover 88 pallets costs \$77.50. The cost of a ledger was not included because any notebook will suffice and it is part of the office stationery.

Is Traceability Possible During Transportation?

During transportation, any kind of recording device that would provide accurate documentation in different time and temperature ranges could be used to track any fluctuation in temperature that would affect the quality of the fresh produce. There are so many inexpensive ones, such as the cox recorder or a disposable strip temperature chart recorder. The price ranges from \$10 to \$450 per unit and it is recommended to have at least two in a container, one at the back and one at the front. This is a standard procedure in the fresh fruit and vegetable business irrespective of whether traceability is implemented

or not. A grower, small, medium, or large, who is yet to adopt this technology, is taking a great risk. There are more sophisticated data logging software that can be installed in the computer to monitor all containers carrying fresh produce to various destinations around the world right in the office. Although these are more expensive, they are better for well-established larger growers and the price becomes cheaper in the long run. In this study, 4 disposable strip temperature chart recorders were utilized for the price of \$32 each, which is equivalent to a 1.64 container of fresh pepper and to 1,500 boxes per acre.

Is Traceability Possible if There are Mixed Produce in the Same Container?

In the case of co-mingling of produce, one of the most economic efficient ways to trace them is by using a different colored pallet strap for each category of produce. Another technique is to use different color covers. Some of the commonly used ones are the polyethylene and insulated pallet covers, respectively.

How Can One Use Rubber Stamp for Traceability?

A rubber stamp is an efficient method to trace who and when the produce was packed, and possibly where, in the case of multiple packing stations. Although any shape of rubber stamp will do, for quality and cosmetic appearance purposes, a round self-inking stamp will suffice. One of these is capable of producing thousands of repetitive impressions without re-inking and better still, the stamp can be re-inked. The stamp is small, light, portable, and convenient to carry. Furthermore, you can customize it and the prices range from

\$12.99 to \$23.99 each. Assuming 1,500 boxes of bell pepper per acre, 2 stamps at \$12.99 each should suffice.

Discussion Notes

In the first section, information on how traceability can be formulated was provided. Secondly, information on the implementation strategy was discussed. Thirdly, the functions of the operation manager in implementing traceability were elaborated. Then the techniques on how to collect traceability data and/or record-keeping were provided. Next, the methods of obtaining traceability information from field operations using a map were vividly discussed. In section six, the strategies utilized to collect packing house traceability information were provided. Section seven provided information on tracking traceability back to the farm in the case of a disease outbreak. The cost of formulating and implementing traceability using our economic efficient model was discussed in section eight. Section nine provided information on how traceability could be adopted during transportation of fresh produce. Section ten discussed the implementation of traceability when fresh produce are co-mingled. Finally, the use of rubber stamps in the adoption of traceability was elaborated.

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