

## **Wastes in the Supply Chain of Agro-Industrial Products in the Valley of Lima, Peru**

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### **Abstract**

*This article seeks quantify the loss of competitiveness of the supply chain of products, in agricultural potential products as sweet potato and tomato moreover exports products as mango, tangerine, lucuma and asparagus (which are produced in the valleys of Lima, Peru) results expressed by waste generated. It was evaluated the impact on the market price declines generation by poor performance of the organizations of the chain in relation to methods, processes, infrastructure uses and existing government policies, proving a loss of value products mentioned between 6,4 % and 14,9 % value.*

**Keywords:** efficient supply chain, agro-industrial, wastes

### **Introduction**

It has been estimated that between 25 % and 50 % of food produced and sold is wasted along the supply chain (Green and Johnston, 2004; Nellman et al., 2009). Waste means any substance or object which the holder discards or intends, or is required discards (Waste Framework Directive, WFD, 1975), that is mean the loss of value too. When a housewife goes to market and buy a kilogram of fruits or vegetables, some part from its weight that was paid includes any “substance”, which will not be used by the housewife because she believes that is worthless, so it is consider a waste. Nonetheless that “substance” is bought to the same price like whose part which causes direct benefit, for instance in the case bananas, no banana’s peel are consumed, nevertheless all consumers should dispose tons of banana’s peels to take its precious food. But not all wastes are found directly, some are generated on the way to the consumer, for instance transport is often intense and sometimes stressful for goods, reaching to lose their value from a “first quality” product state, at the point of departure to a state of product “second” or even “third” quality (some consumers could considered a disposable product) at the final destination, the beating and mistreatment transport in the route from the supplier to market reduce the quality of products, in characteristics such as freshness, safety and integrity.

Supply chain consist in carry raw materials and parts for processing to finished product from the supplier at the client end, generating in this consumption and use of materials flow; wastes, which are not always taken into account in the supply chain flow management. «A supply chain as a whole ranges from basic commodities (what is in the ground, sea or air) to selling the final product to the end-customer to recycling the used product. Material flows from a basic commodity (such as bauxite mine as a source of aluminum ore) to the finished product (such as a can of cola). The can is recycled after use. The analogy to the flow of water in a river is often used to describe organizations near the source as upstream, and those near the end-customer as downstream. We refer to each firm in the supply chain as a partner, because that is what they are. There is a collective as well as an individual role to play in the conversion of basic commodity into finished product» (Harrison and van Hoek, 2008).

### **Methodology**

The first goal of this research was to find the list of products to be studied.

At beginning the information was sought in database available in the public libraries as the Ministry of Agriculture of Peru, which annually carries statistics for each agricultural product as; production levels, daily prices of major products, yields per hectare harvested for each product, and so on (MINAG, 2007; SUNAD, 2008).

With this information and having been considered four variables to take in count as; domestic national production levels, export levels, Lima's valleys production (that is mean Lima, Huaral, Cañete, Mala and Lurin) and harvestable potential land that these have in the future, was chosen the next products:

- + Products of higher agricultural potential; Sweet Potato and tomato.
- + Main export products; Mango, Tangerine, Lucuma and Asparagus.

The next step was to meet people engaged in the trade of these products in the main wholesale food market in Lima, for example: the God's City Market, the Unicachi Market, Magdalena Market among others. Who companies represented by 80 % agricultural share market (CEPES, 2007).

Main questions were:

1. What is the daily amount that you sell for that product? (bags, boxes, kilograms).
2. Where the purchases are from?.
3. How your products are shipped from your supplier to your destination? (indicating types of transport and packaging).
4. How much is the average percentage of wastes that you have from your provider to their final destination?

Main qualitative answers to this questionnaire:

- a) The quantities of each product to market is significantly different in each place, for example in the God's City Market sales levels are higher than in the Magdalena and Unicachi markets.
- b) Customer buy in the markets mentioned considering that they are specialized by products, for example, fruits are purchased at the Wholesale Market No. 2 (called Fruit Market too), while vegetables are in the Wholesale Market No. 1 (called The Stop too, "La Parada" in Spanish). It should be noted that small capital markets also purchase their products at The Stop and Fruit Market, but in the God's City Market was said us that they distribute to small markets at South of Lima's Districts.
- c) Transportation from the supply markets to wholesale market in Lima is done in several ways, for instance own transport of traders, however normally are performed on pickup trucks, transport services fees are 0,52 to 1,31 \$ per bag, depending on the distance where the food market are. Other transportation are the station wagon vans who charge fees are similar to pickup trucks. Moreover, these products are used different packaging for each product, for instance tomato, tangerine, mango and lucuma are move in wooden crates, which are used over and over again, while asparagus and sweet potatoes are transported in sacks.
- d) In the case of waste, we asked assistants or dockers of traders, those who were responsible for loading and unloading of the products, their answers let us get data about wastes reported in the Fig.1 to Fig. 6. Traders on this subject were not collaborative to deliver the required information.

After analyzing the answers we go to places where retailers do their daily shopping that mean wholesale Market No. 1 and No. 2.

In the wholesale Market No. 1 is traded tomato, sweet potato and asparagus, but it is important noting that the asparagus that is delivered to Lima has not export quality. Also it is reviewed literature updated for each product, where we found currently prices, percentage of wastes, place of origin, transportation and all information necessary for completion of this project. For the potato and tomato was known that came from the valleys of Huaral, Cañete and Bad, but these were mostly the asparagus grown in the valley of Cañete (HCSR, 2008; CCSR, 2008).

At Fruit Market were contacted top traders of mango, tangerine and lucuma, many are intermediaries, who buying fruit in the valleys of Huaral and Cañete, while others are farmers from the valley of Lurin and Huaral, who trade their products in the Fruit Market. Also it were asked about the prices that merchants have to pay for products to carry till the companies (normally in Lima) which supply package to export those products including asparagus. These information about gathering at wholesale market was contrasted with Centrum (Business School Catholic University of Peru) thesis related (Ayulo and Grau, 2006; Espinosa et al., 2007; Reyes, 2006; Leon et al., 2005), also was consulted the main Peruvian farmers and producers associations such as Peruvian Association of Mango Exporters, APEM (<http://www.camcopiura.org.pe/apem/>), Pro-Citrus ([www.procitrus.org](http://www.procitrus.org)), Pro-Lucuma (<http://www.prolucuma.com/>) and Pro-Mango ([www.promango.org](http://www.promango.org)), whose researches publishing reports about the logistics costs and percentage of wastes generated for each supply chain stage.

In the case of lucuma, we obtained historical wastes levels from processor companies, who made lucuma’s flour during its packaging process. Visiting the valley of Cañete information we sought about products’ costs; tomatoes, sweet potatoes and asparagus. With these data we found costs at different stages in logistics chain calculating shipment values of products to reach the port to export and wholesale Lima’s markets. Many collectors and dealers told us that a particular configuration for products packed in wooden-boxes caused a greater amount of wastage, due to the custom to fill them above the top, exceeding its capacity, the wastes increase to almost 25 %, route Huaral to Lima, a similar case was found in the valleys of Mala and Cañete, to tomato transport, the wooden-boxes was just to fill up at the stop line, to which has significantly reduced the wastes. It should be noted that the wastes presented are based on average price and these are considered waste in the final supply chain stage (HCSR, 2008; CCSR, 2008).

We also obtained prices by unit for each product, services for each stages that has in the supply chain, for example the production process Lucuma’s flour is valued at 1036,3 \$ per ton, which includes harvesting, transportation and processing packaging, but does not include the raw material.



Fig. 1 Wastes in mango supply chain

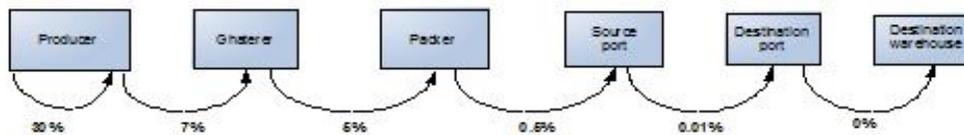


Fig. 2 Wastes in tangerine supply chain

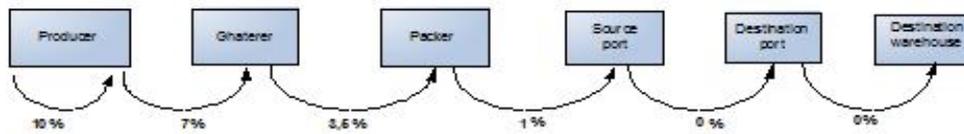


Fig. 3 Wastes in asparagus supply chain

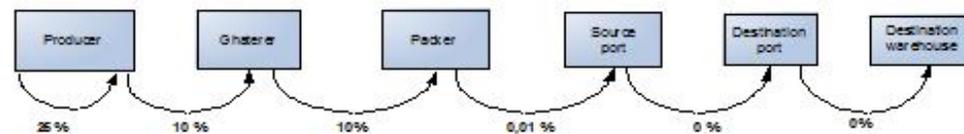


Fig. 4 Wastes in lucuma supply chain

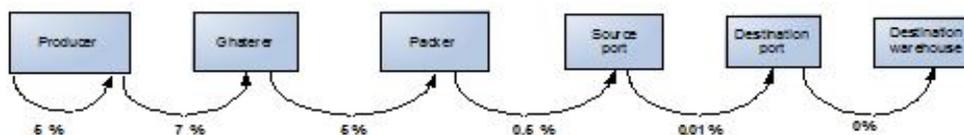


Fig. 5 Wastes in sweet potato supply chain

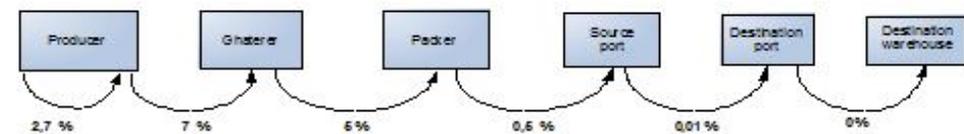


Fig. 6 Wastes in tomato supply chain

**Results**

To achieve the decision model we have different costs in the logistics chain for each product, but each product will have a different configuration in its cost structure, set those items from the original structure in an equivalent model decision.

We performed a model to assess changes in the final price depending on the percentage of wastage, in addition to comparing the previous price and its variation on this, which would have greater visibility on the strategies to follow and improvements in earnings of participants in the logistics chain (Santa Cruz, 2007). After analyzing in detail the decision model, our proposals are aimed at improving post-harvest handling most critical levels, checking that is in the farmer and gatherer where have the highest percentages of wastes are presented, because of bad product handling and poor storage practices.

• **Impact on products costs.**

We present as an example the case of mango (Fig. 7), note the column Costs that the cost of moving each stages in the supply chain including the wastes generated in, if there were not wastes the final price in the port destination to handle the box could be 1,0287 \$/kg (result of S/. 1,126 x 91,36 %), which is below the current price including wastes; 1,1260 \$/kg, a price which takes away opportunities for other countries such as Brazil and South Africa, direct Peruvian Mangoes competitors, whose Prices are 24 % below.

Moreover the proposed model lead evaluate strategies for the elimination of wastes, we can see that link in the supply chain is where greater percentage of wastes are, it can be concluded that the famer is where you could generate the largest waste reduction; 30 %. That mean from 100 % received 30 % is transformed into wastes, however, is on the gatherer work that could impact more significantly on the value of the supply chain, note that the price without affecting wastes becomes 27,97 % of the farm price. On the other hand in a test of the implementation of the control model, we have simulated the following improvements to a reduction in wastes in the farmer of 30 % to 25 % in transport to the packer from 7 % to 5 % and gatherer 5 % to 3 %, they would have a final price of around 1,101 \$/ kg.

Production level (thousands tonnes)	Mango					
	Cost	Price real acumulate	Percentage waste	Price without waste	New percentages	New price
320.7						
	0.150		30.00%	13.32%	25.00%	
		0.150				0.150
Price farms		0.195				0.188
	0.072		7.00%	6.39%	5.00%	
		0.267				0.260
Price collector		0.286				0.272
	0.315		5.00%	27.97%	3.00%	
		0.601				0.587
Price Packager		0.631				0.605
Storage	0.000		0.00%	0.00%	0.00%	
Transport fees	0.040		0.50%	3.55%	0.50%	
Others expenses	0.030		0.00%	2.66%	0.00%	
		0.701				0.675
FOB		0.704				0.678
Shipping fees	0.210		0.01%	18.65%	0.01%	
		0.914				0.888
CFR		0.914				0.889
Insurance wholesales	0.002		0.00%	0.18%	0.00%	
End port expenses	0.090		0.00%	7.99%	0.00%	
Selling comission	0.120		0.00%	10.65%	0.00%	
		1.126				1.101
CIF		1.126		91.36%	91.36%	1.101

Fig.7 Mango analysis

**Discussion**

The proposed annex presents improvements through four strategies to reduce cost due to wastages generation in the supply chain:

- + Training.
- + Quality.
- + Infrastructure
- + Sectorial policies.

- **Training.**

In the case of management of storage products in the farmer and gatherer, it must conduct a preliminary study which analyzed the optimum levels of temperature, humidity, bacterial load, maximum storage periods for each of the products, all of which should be directed to the appropriate operational management products that enable significant reduction of wastage and spoilage, this should be done considering the location, because the storage control conditions differ in Matucana, Huaral or Mala valleys. For handling the products during transport, it must train on the proper use of resources and techniques in handling, transfer, hauling, transport, packaging and control of equipment.

It recommends strengthening the customer-supplier relations, through mutual understanding of the experiences that might be useful to all participants of the process in a management framework that seeks to increase the profitability and competitiveness of the logistics chain. In addition it must improve the business management skills of farmers, producers, intermediaries and carriers, teaching the importance about their capital management and evaluation of investment in infrastructure and improvements.

- **Quality.**

Some of the export products do not correspond to the type which are required on overseas markets, the current crop are mostly native types meanwhile varieties of higher demand for exports, such as Kent and Atkyns. It must certify crops, as farmers have no certainty that variety is being grown in many cases, this causes to be brought to the gatherer who rejects certain percentage of production. Crops improvements must focus on their capacity to resist pests and extend their storage-life.

- **Improve Infrastructure.**

Improving the storage into the cold chain, that will be achieved with environments controlled using cold warehouses, trucks and handling equipment refrigerated, and adequate monitoring to verify proper operation. These must be compulsory to products whose intermediaries, gatherers and logistics operators are part of international trade, while for products with agricultural potential should ensure the preservation of products for long periods in major wholesale markets in different cities.

- **Improve Sectoral Policies.**

It should encourage the union of producers associations promoting business competitiveness and management its activities, supporting to those are involved in the growing of demands of both domestic and foreign products, these associations will also be able to obtain technical and financial assistance, which would boost agricultural industries. Many producers lacking the necessary information about which products are in increasing demand, and not take advantage of these opportunities, some farmers have devoted many years to only one type of products, although some producers are reluctant to change, the main barriers are adequate disclosure of current business, training in agriculture science and skills to use new technologies to access information through Internet, updated bilingual information (local dialects).

Researchers interested in continuing our research could focus on applying the model referred to other suppliers valleys agrobusiness and food marketing. Defined for this regional supply chains, working conditions, productivity and results of regional wastes of each market.

### **Conclusion**

There is loss of competitiveness due to the generation of wastes in the supply chain of products catering to commercial and industrial sectors of food, are the order of:

- + Mango without waste .- The price would be 91,367 % of the total price.
- + Tarangine without waste.- The price would be 88,68 % of the total price.
- + Asparagus without waste.- The price would be 93,31 % of the total price.
- + Lucuma without waste.- The price would be 85,15 % of the total price.
- + Sweet potato without waste.- The price would be 93,6 % of the total price.
- + Tomato without waste.- The price would be 98,78 % of the total price

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