Food and Agriculture Organization of the United Nations

©FAO

Food loss analysis: causes and solutions

Chili supply chain in Banyuwangi, East Java, Indonesia

Indonesians have a strong preference for spicy food, particularly red chili (*Capsicum annum L.*), which is abundantly grown in the country. According to the Central Bureau of Statistics, national chili production in 2020 reached 2.77 million tonnes, with a consumption rate of 2.14 kg per capita. The largest chili producer is the province of East Java, accounting for 784 050 thousand tonnes or 28.28 percent of national production. The study on the chili supply chain focused on Banyuwangi Regency in East Java where the distribution of chili production is divided as follows: 70 percent for the wholesale and markets, and 30 percent for the food-processing industry.

The chili supply chain

The FAO food loss analysis case study methodology was employed to analyze critical loss points (CLPs) from August 2022 to October 2022. Direct observations were made at the farmer level, for small and large collectors, and for wholesale market traders. Losses were tracked quantitatively and estimated qualitatively along the chain.

Farmers predominantly cultivate small chilies (cayenne pepper) on average-sized plots of 0.25 hectares.

Large-scale farmers cultivate big chilies on plots exceeding 3 hectares. Farmers typically harvest chilies 65 days after planting and sell them to small collectors or intermediaries. Sorting, initial grading and packaging take place at rural collection sites. Subsequently, collectors either send the products to large traders or sell them in the market through delivery services. Losses occur throughout the post-harvest handling process.

Critical loss points

The field-harvest losses occurring during picking are less than 1 percent. Farmers typically transport the harvested chilies to collectors or traders using motorbikes, resulting in transportation losses of less than 1 percent, except for large chilies which reached 2.48 percent. Sorting and repackaging by large collectors lead to weight losses of up to 2 percent for small chilies and 8.67 percent for large chilies. During regional transportation by delivery services or wholesalers to the destination markets, there is an additional weight loss of approximately 3 percent. Moreover, there is a decrease in quality of 16.4 percent due to physical damages. Figure 1 illustrates the percentage of loss that was assessed for small chilies, while Figure 2 represents big chilies, both showing relatively low losses under normal post-harvest conditions.

FIGURE 1. Small chili supply chain and its loss points

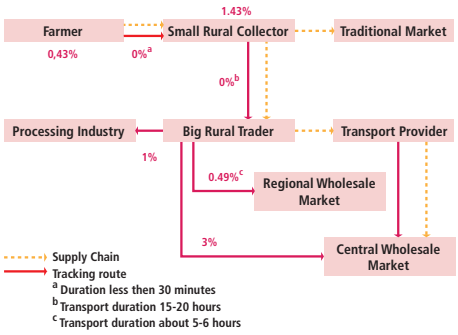
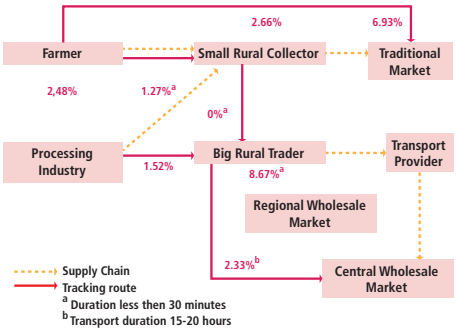


FIGURE 2. Big chili supply chain and its loss points



Bottlenecks of post-harvest losses

The key challenges faced by big traders and chili delivery services in post-harvest handling along the supply chain include selecting appropriate and cost-effective shipping packaging, ensuring swift processing and efficient loading and shipping. Gaps in these aspects of the supply chains result in a significant decline in the quality and selling value of the product. While using used cardboard packaging for big chilies is more affordable, the guarantee against damage is relatively low. Upon unloading at the destination market, the packaging is often damaged, impacting the condition of the products inside. Delays in handling and delivery can lead to high levels of product deterioration, rapid spoilage, and loss of freshness. The costs for cold storage investments and operations were estimated to be USD 93 460 per year (Table 1), affecting the profitability of the intervention that can be achieved at USD 314 830 per year.

By addressing the above-mentioned critical intervention points profitability can add up to USD 408 290 per year. Additionally, non-standard handling conditions, such as hot process rooms, and lack of temporary or cold storage cause quality losses.

Food loss analysis: causes and solutions • Chili supply chain in Banyuwangi, East Java, Indonesia

TABLE 1. Budget calculation for additional cold storage

Item	Value	Unit
Product Quantity (Small Chili)	18 835	tonne/year
Product Value	1 806	USD/tonne
Loss rate	6	%
Anticipated loss reduction	20	%
Cost of intervention	193 548	USD
Depreciation	5	Years
Yearly cost of investment	38 710	USD/Year
Yearly cost of operation	54 750	USD/Year
Total yearly cost of solution	93 460	USD/Year
Client cost per ton product	4.96	USD/tonne
Food loss	1 130	tonne/year
Economic loss	2 041 449	USD/Year
Loss reduction	226.02	tonne/year
Loss reduction savings	408 290	USD/Year
Total Client costs	93 460	USD/Year
Profitability of solution	314 830	USD/Year

Post-harvest losses reduction and prevention

Chili supply-chain instability, with post-harvest losses of up to 50 percent, is primarily caused by external factors, especially transportation conditions to the markets. The long distances between production centres and markets prompt suppliers or transportation services to prioritize speed, resulting in product damage and supply shortages (Figure 3). Excessive production during the main harvest season combined with constant market demand necessitates the provision of cold-storage facilities to address supply surges. To accommodate the surplus supply during the main harvest season in Banyuwangi Regency, three units of cold storage with a capacity of 10 tonnes per week each would be required. A total storage capacity of 500 tonnes is needed based on the annual production from Banyuwangi Regency. The implementation of cold-storage facilities is expected to reduce post-harvest losses by 20 percent. The chili supply chain commonly faces the issue of supply-demand mismatch, leading to unstable prices and inflation. Oversupply during the peak harvest period causes prices to drop below the farm-gate price. The delays and surpluses lead to losses of up to 16 percent, or roughly USD 3 592 467 annually. Post-harvest losses can be reduced by approximately 60 percent through increased value addition and utilization of off-grade products. Investing in agro-industrial processing would allow for the production of value-added chili-based ingredients. Establishing small-medium enterprise agro-industrial processing could also facilitate employment opportunities in rural areas. This line of action would require investing around USD 311 828 per year to develop two industrial units with a capacity of 3 tonnes per day for chili processing into pasta products. Efficient implementation of the chili processing industry during periods of excess production, estimated at 250 tonnes per day, could prevent post-harvest losses amounting to USD 2 155 480 per year (Table 2).

FIGURE 3. Harvesting and transportation of chilies

TABLE 2. Budget calculation for two new processing units

Item	Value	Unit
Product Quantity (Big Chili)	7 667	tonne/year
Product Value	2 903	USD/tonne
Loss rate	16	%
Anticipated loss reduction	60	%
Cost of intervention	645 161	USD
Depreciation	12	Years
Yearly cost of investment	53 763	USD/Year
Yearly cost of operation	258 065	USD/Year
Total yearly cost of solution	311 828	USD/Year
Client cost per ton product	41	USD/tonne
Food loss	1 237	tonne/year
Economic loss	3 592 467	USD/Year
Loss reduction	742	tonne/year
Loss reduction savings	2 155 480	USD/Year
Total Client costs	311 828	USD/Year
Profitability of solution	1 843 652	USD/Year

Recommendations to minimize losses

Chili farmers demonstrate strong competitiveness, a willingness to face crop failure risks, and a quick adoption of production technology, particularly cultivation techniques. However, they encounter challenges each planting season, such as pests and diseases that can lead to crop failure. To mitigate these risks, farmers tend to use excessive amounts of fertilizers and insecticides. Post-harvest losses are as high as 6 percent because of insufficient application of good handling practices (Figure 4).

FIGURE 4. A rural collection centre

In Banyuwangi District, where small chili production reaches 18 835 tonnes annually with a 6 percent loss rate, training in good handling practices and technical assistance services are crucial. For instance, establishing Post Harvest Technical Assistance Facilities (PHTAF) is recommended. This would require about USD 14 510 per year, resulting in a 50 percent chili loss reduction that would save up to USD 1 006 200 per year.

Researchers from universities and agricultural research centres have developed various innovative technologies to minimize post-harvest losses in chili. Modified-atmosphere packaging and controlled-atmosphere storage technologies are effective in reducing food losses. Article 47 of the Food Law in Act No. 18/2012 supports interventions that can enhance food access. Socioeconomic innovations are encouraged. Currently, supply-chain actors implement good handling practices, particularly in packaging and sorting. However, under adverse conditions such as oversupply, transportation disruptions, storage delays, fluctuating market prices and abnormally rainy weather, product losses can reach 50 to 60 percent. Interventions should focus on preventive measures to address bottlenecks caused by external factors and incentivize value addition through processing.

This information sheet summarizes the results of the report Eriyatno, E., Larasati, L., Herianto, A., Fatmaningrum, D., Bucatariu, C. and Galvez-Nogales,E. 2023. Food loss prevention and reduction analysis in Indonesia: a case study on chili, cabbage, and shallot. Jakarta, FAO.