TRIP REPORT

Title: Postharvest Handling of Grain and Vegetables in a East Timor Watershed

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Rice and Maize Postharvest Handling

In the Baucau region, both crops are hand harvested during the dry season. Rice is threshed in the field. Small petrol motor driven portable machines are used by some. Other growers use hand-threshing over a pole, by tramping or occasionally using animals. The rice is accumulated in traditional palm woven baskets (1.5 m diameter, 0.75 m tall), or in former cement canvas bags ($1m^3$). The grain is then moved in smaller baskets or used bags, for final drying by spreading on a concrete slab or

on a woven palm mat. Rain during harvest is apparently not a major problem for rice and hence it can be dried in the open without the need for a shelter. In a semi-commercial operation, maize, which is harvested before rice, a large covered, drying crib has been constructed. Fires are sometimes lit in the crib if there is insufficient cross ventilation to ensure drying of the shucked maize. Small growers will string the cobs together and hang them from roof rafters or construct simple racks. For both rice and maize, experience is used to judge moisture content and suitability for storage.

Maize after drying (2 to 4 weeks) at the semi-commercial operation is mechanically shelled and stored in 220 L steel drums that are sealed tightly. On the small operations, it is shucked and shelled as needed. In the markets, three to five shucked cobs are sold for consumption. The cobs offered for sale in the Baucau markets were very variable in size and grain color (mainly white and yellow). Storage in sealed 220 L container in the shade has the clear advantage that the air-seal only needs to be broken on a single container as needed, maintaining the seal on all other drums. If a large single silo was used, maintaining a air-tight seal would be difficult and insecticides would probably be required to minimize losses.

Rice is stored without milling. Seed grain was seen stored in 220 L sealed drums and in palm woven baskets. FAO has sponsored seed grain storage bins that provide protection against rats. The FAO designed bins are not airtight and care is necessary against introducing weevils. The reported price is $7 per bin, whereas the 220 L steel (former oil drums) are $25 each.

Rats are reported as a common problem. Protection is taken against rats in some cases. In the semi-commercial operation, rat poison is used and found to be effective. In small subsistence situations, sometimes rat guards are placed around the rack supports to prevent rats climbing to the suspended cobs.

The rice/ maize weevil (*Sitophilus* spp) was found in spilled maize grains on a mechanical sheller. The sealed drums, especially for maize, were reported to be very successful in preventing losses to rats and preventing weevil infestations from building up in the stored grain. The drums also offer the advantage of allowing the airseal to be broken on a limited quantity of grain as the maize is needed. Unmilled rice stored heaped on concrete floors or in basket is eaten by the rats. Weevils

were not reported as a significant problem on unmilled rice. Indonesian literature does report high losses from weevil and other grain insects in milled and polished rice. A grain moth was reported by the semi-commercial operator, though the species was not clear from the description. The moth could be the Angoumois grain moth (*Sitatroga cerealella*) reported in Indonesia and more common in drier areas.

Postharvest maize loss as high as 60% have been reported for East Timor (Catholic Relief Service Report, 2003). The cause of this loss was not reported but was probably due to rats and weevils. No published figures are available as to loss and the MAFF officers asked were not able to estimate average losses. The absence of reliable data as to actual losses and the cause(s) makes the determination of economic threshold levels for intervention problematic. Recommendations can be made to minimize and prevent unnecessary losses. No grain insecticide was apparently being used, cost being an issue.

One rice farmer who was interviewed needed to harvest 1.2 tonnes of rice to feed eleven adults and children and have planting seeds for the next season. Excess rice is sold, if he does not meet his 1.2 tonne target he will need to buy rice for the year. Decisions are made at the dollar level. It costs $1.50 per three months to send one child to school, currently only two are attending. The family also eats sweet potato, casava and bananas, along with vegetables and beans.

Milled and polished rice was of minimal quality. The lower quality of the local rice, though perhaps having better flavor, was due in part to possible grain shattering during threshing, milling, and polishing. Mechanical threshing should be carried out at 20 to 25% moisture content and hand threshing at less than 20%, if drier grain cracking and breakage is a frequent problem The out-turn from polishing had both whole grains and pieces. The imported rice is cheaper, cleaner, and only whole grain is marketed with broken grains being


sieved out and diverted to other uses. Local rice is sold having both whole and broken grains and insufficient polishing creating an overall lower appearance quality. There are "unique" local varieties with red and black grains that if available in consistent quantity and quality may have potential for export.

Preliminary Recommendations.


1. Sanitation of storage areas between harvest would help to reduce weevil infestations. The weevil can live for a year and lays eggs throughout it's life. Egg and larvae development stage is about 35 days at ambient temperatures.
2. Procedures need to be developed to reduce weevil infestation associated with the use of the traditional woven baskets and used grain racks. The traditional woven baskets can be used up to five years if not severely damaged by rats. In India and Pakistan, neem seed oil spray is recommended. Few neem trees were found in East Tumor and no extraction is apparently carried out.
3. Raising the baskets holding grain off the ground on a platform would help in controlling rats. The platform would allow barriers to be installed to prevent rats easily reaching the grain. The platform would allow air-circulation and keep the gain moisture content low. Maize stored at 10% or less moisture content and cool temperatures reduces the rate of weevil development

4. Maize cobs suspended from racks, rafters, or trees should have tight long necks to inhibit weevils from entering. Cobs with open necks or partially shucked should be sorted out and used first.

5. For East Timor's rice to compete with imported rice closer attention needs to be paid to quality. The overall poor quality appearance is influenced by mixing of different varieties after harvest, limited size sieving before and after milling and polishing, and milling grain that was too dry and susceptible to shattering. Better grading and awareness of grain moisture content prior to milling and polishing would be useful. NO moisture meter was apparently available. Rice should be at less than 14% moisture content for storage and milled when at about 14%. Grain cracking and breakage due to over-milling is a primary cause of losses in this step.

Vegetable – Cold Chain.

Vegetables are frequently planted after the rice crop is harvested. Some growers at higher elevations are beginning to grow vegetables all year round. Production was traditionally seen as the responsibility of women with the men caring for the rice, maize, and beans. This distribution of responsibility is changing as the cash potential gained from vegetable growing has become more significant.

The range of vegetables is similar to that found in other South-East Asian markets though quality was more variable. Leafy vegetables range from mustard cabbage, white stem cabbage, Chinese cabbage, head cabbage, spinach, sweet potato stems, cassava leaves, papaya leaves, and kang kong. The fruits include tomato, capsicum, chili, beans, cucumber, squash, breadfruit, pumpkins and egg plant. Papaya male flowers were widely available, other legume flowers were also sold. In Baucau, coconut, papaya, young breadfruit, green mango, banana (Pisang Singapore, Pisang Goreng,

Pisang tamanga), and a few pineapple were most commonly seen. Root crops for sale included onions, garlic, sweet potato, taro, carrot, cassava, and potato. Preference is for the dry yellow flesh sweet potato and cassava.

Vegetables are most plentiful during the dry season and in shortest supply in the wet season, especially in the months of December, January, and February. This period of limited supply offers an opportunity for the drier areas with irrigation to focus on supplying quality vegetables when the prices are at their peak. Frequently, the only leafy vegetable available in this period is kang kong. Unfortunately, kang kong does not have a high social status though it has almost twice the protein content of lettuce. A farmer would receive about 50 cents for a cabbage and this would be sold in Dili for $1 to $1.50 during the peak season June, July and August. During December, January and February periods prices at the stalls can apparently reach $3 for cabbage

Postharvest handling and marketing is typical for many Asian countries having little or no cold chain. Vegetables are harvested and consumed normally within 48 hours. Some effort is made to protect the product from heat during this postharvest marketing phase. For leafy vegetables, the outer wrapper leaves may not be removed until the product is made ready for sale at the market. These practices show some understanding of the potential for losses from dehydration and wilting, and mechanical injury. The product is sold as a unit, not weight, and the consumer must judge the amount being sold.

Leafy vegetable are most commonly harvested in the morning and packed into used rice bags. No washing is apparently practices though wetting down of the leafy vegetables did occur at stalls. If no vehicle

is available, the bags are taken to the roads to wait for the local bus. At the roadside, the bags may be covered with a few leaves, often banana, presumably to give some protection from the sun. The bags are placed onto the bus roof or inside the vehicle. On the roof, the bags are tied down with rope. Tomato and fruit were most frequently seen in small (ca 5 kg) woven palm baskets and these were carried inside the bus. The small district buses would converge on the towns such as Baucau along the main east-west national road. If not sold in that town, the product would be loaded onto inter-town buses for the journey from Baucau to Dili for sale arriving by 9 pm. These products would appear in the Dili market the following day.

The grower or a selected representative of a village would take the produce to market to sell at a stall in Dili or Baucau, or directly into the smaller villages. Buyers from Dili with their own transport do visit and purchase directly from farmers with which they have developed a relationship. No formal cooperatives exists. During Indonesian time, cooperatives were mandated for grain (rice) and a Bulog (National Food Logistics Agency of Indonesia) office and warehouse was established in Baucau. This cooperative no longer functions. There were not cooperatives for fruits or vegetables. Informal "cooperatives" do apparently operate at the village level.

Vegetable production was formerly assigned to women, but now also involves men as the cash generating ability becomes more apparent. Groups of women and men in a village sometimes band together to sell their produce in town. A representative will take the produce to town and sell it on behalf of the group often to stall owners who they know. This practice meant that only one has to undertake the one day journey and reduces the transportation expenses.

A number of covered market sites have been built including an impressive

Portuguese facility in Baucau. These are not used and simple stalls are constructed at the roadside. The structures would provide rain protection, but offers little sun protection during morning and afternoon market periods. The provision of shade for both the stall owner and product is a critical step to avoid product heating and quality loss.

In Baucau, no refrigerated cold storage facilities seem to exist. The absence of a reliable electricity, the inherent cost of such facility, the low per unit cost of the product, and almost continuous production and short duration from harvest to consumption would possibly make cold storage uneconomic except for specialized high value products. In Dili, four facilities have cold storage capabilities. Dili Cold Store has storage rooms for chilled and frozen meats and other products. Leader, Lita and Landmark markets have refrigerated freezers and chill containers. These containers are the standard 20' refrigerated shipping containers. Lita has at least five such containers and Leader four.

One of these markets receives three refrigerated containers per week, two of which are frozen and the third chilled. The chilled containers are filled with mixed loads, which could include fruits and vegetables and possibly eggs. The mixed loads do lead to significant problems: wrapped lettuce having significant russet spotting on the petiole and possible odor problems. However, separate containers for the different products is difficult to justify based upon the limited quantities being imported. Consideration could be given to splitting shipments between different weeks (i.e. leafy vegetables being sent each fortnight and fruits the other week). Consolidating orders with other markets is a possibility.

Barges are used to bring in standard-sized 20 foot containers from Darwin and Singapore. The barges have electrical hook up as does Dili docks. A refrigerated container arriving on a Tuesday night will be cleared by customs on Wednesday and in a Dili store on Thursday.

The quality of the imported fruits and vegetables seen in the markets was variable. Part of the difficulty may be due to the long distances from production areas of these temperate products. A second concern would be initial quality being shipped and the difficulty of making a claim.

level.

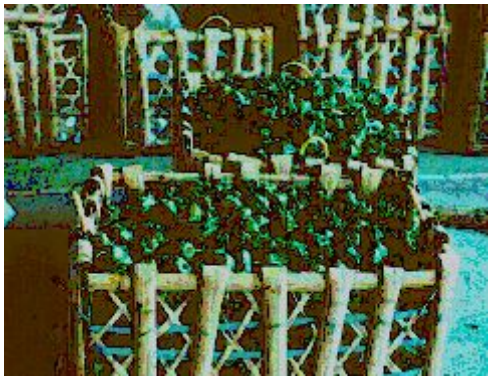
Preliminary Recommendations

1. The rapid marketing, 24 to 48 hours from harvest, has many good points. Leafy vegetable can normally withstand up to 72 to 96 hours at 25 to 30°C if precautions

are taken to limit dehydration and mechanical injury. However, outer wrapper leaves are often removed in this system and product weight is lost. An unseen loss in this system would be in nutritional quality especially of vitamins. Disease is not a major issue for leaf vegetables, but is a problem for fruits (tomatoes, bananas, breadfruit, capsicum) if not handled carefully. The root vegetables (sweet potato, cassava, taro, and potatoes) can be marketed with little loss with this system.

2. Mechanical injury and dehydration are the major causes of losses in this system. Harvesting the product in the morning while turgid and cooler and protecting the harvested product from heat (direct sunlight) are necessary steps to limit dehydration. Wetting down the leafy products by sprinkling with clean water, as seen in the markets, is useful to keep the product cool and turgid. A simple imperative cooler using available natural resources (bamboo and palm fronds) and prevailing wind could provide a cooler storage area.

3. The major difficulty is to minimize mechanical injury (compression, abrasion, injury) in the current system. The use of rice bags to transport leafy vegetable and pliable woven palm baskets for fruits offers limited protection to the product. Though the rice bags were not excessively compressed during packing, the vegetables on the bottom had no protection from the nearly 1 m of product above them or when the bag was dropped during handling. Tomato woven baskets were small and flexible and were only stacked 3 to 4 deep. Natural materials are available to make more rigid containers (bamboo) that can be lined with banana or other leaves to provide a smooth liner. However, this change would involve a significant change in current handling practices and would impose a greater inconvenience in back-handling the empty containers from the market for the reuse. It may be possible to devise a collapsible container using wood and bamboo. Reusable plastic containers would have a high initial expense and potential diversion would prevent widespread application at this stage of market development.



Example of a rigid bamboo basket used elsewhere in SE Asia to market vegetables