Analysis of the Postharvest Knowledge system in Ghana

Case study of cassava

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One of the challenges faced by African countries in achieving food security is high postharvest losses. It has been estimated that the value of postharvest losses in sub-Saharan Africa is about US$48 billion a year. In Ghana, for example, postharvest losses for maize, cassava and yam are estimated to be 35%, 35% and 24%, respectively. Although for a crop like cassava, a survey carried by Rickard *et al.* (1992) in Ghana indicated lower levels of physical postharvest loss and estimated losses unlikely to exceed 5%. Rickard *et al.* indicated that the higher figures focus on physical postharvest losses, which represent a direct financial loss to the producer, trader, processor or consumer. Nevertheless, the figures usually do not indicate at which stage of the chain the losses occurred or variations in production centres. In addition, available data often do not differentiate between postharvest deterioration of fresh cassava and loss of processed products. It is necessary to access the postharvest system in Ghana to ascertain what the extent of postharvest loss is, what the underlying causes for these losses are, and whether there is available information used for informing policy and practice. In this study commissioned by CTA, cassava was tracked from the farmer to the market to assist in the following:

- Document the existing methods of processing along the supply or value chain and determine the main areas where postharvest losses occur and estimate the losses;
- Assess the status of postharvest knowledge - handling, processing and packaging facilities, and capability for engineering and equipment design;
- Compare the existing practices to the current state of the art/knowledge of postharvest handling based on literature and document the differences;
- Identify the centre(s) of knowledge/excellence in teaching and research on postharvest and the major areas of focus;
- Assess the human, infrastructural and institutional capacity and readiness to generate, disseminate and use postharvest knowledge across the value chain;
- Determine what additional data is needed to guide policy and strategic interventions to improve the postharvest knowledge system based on findings.

The study was conducted in a gari processing centre in Manchie, a town located in the Greater Accra Region of Ghana. This group was set up in 1992 through the National Board of Small Scale Industries in Ghana. The current membership of the group is 32.
Gari processors in Manchie were selected for this study because it was easy to track the cassava since the cassava is produced in the community and sold to processors. Focus group discussions were employed in interviewing the gari processors and the farmers.

The postharvest handling system for cassava is very simple (Figure 1). After harvesting, the root is cleaned and packed into jute sacks or pans and transported to the local market for sale or for secondary processing. The total postharvest handling system for the cassava through to secondary processing (gari as an end product) has also been mapped out in Figure2.

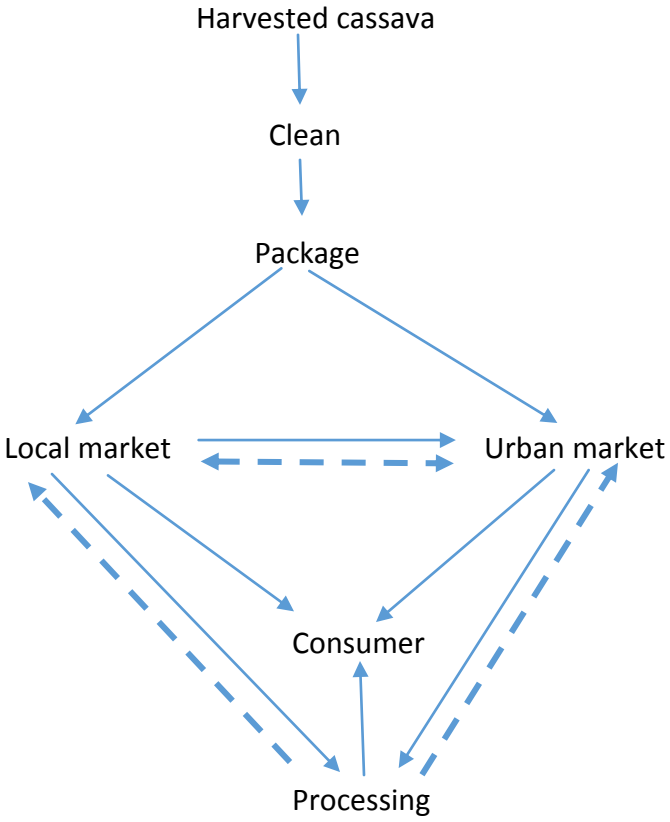

Figure 1: Postharvest handling of cassava

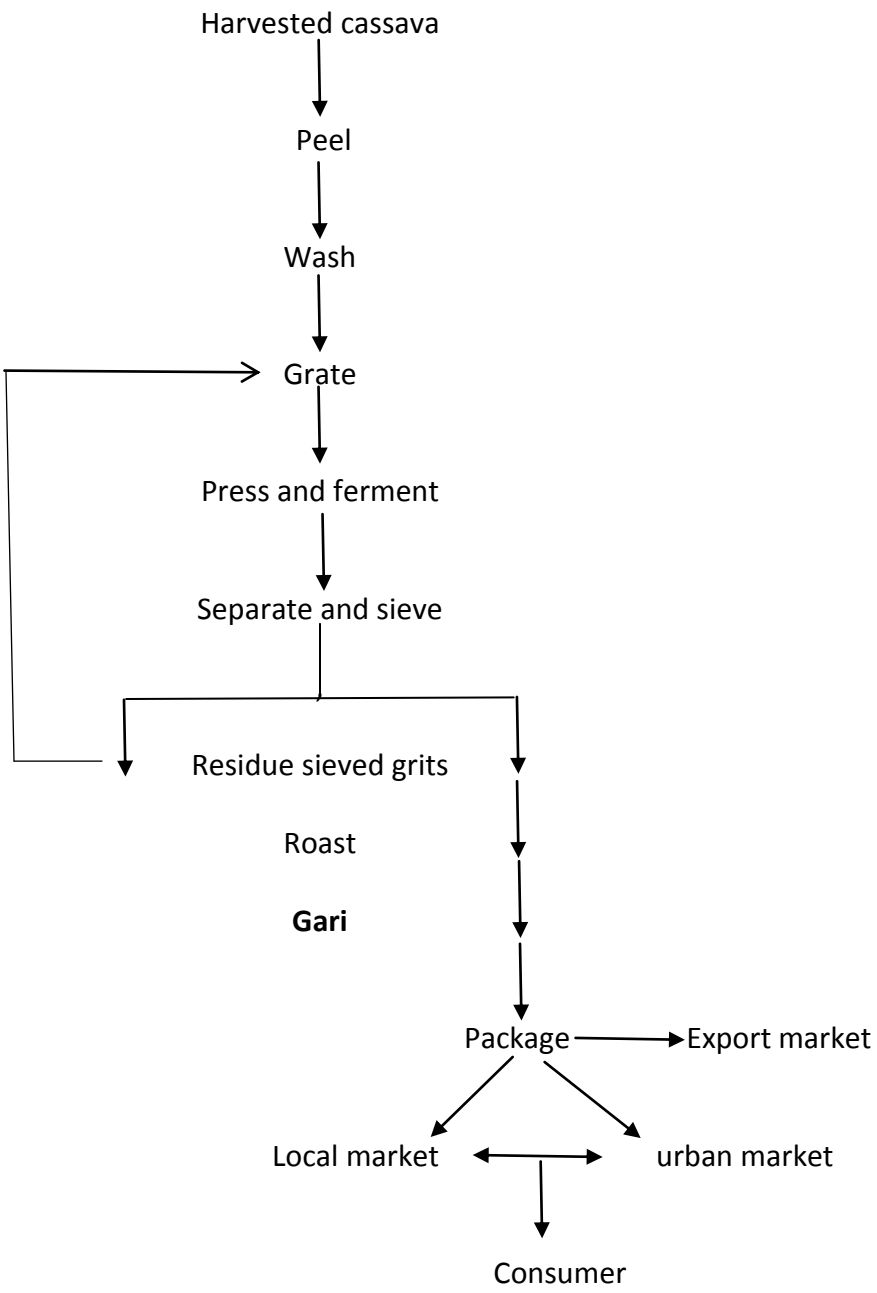

Figure 2: Flow chart for gari processing

Interactions with the gari processors and cassava farmers indicated that the basic knowledge on postharvest handling of cassava is known by the farmers and processors and was employed in varying forms. The whole value chain for cassava from harvesting through to the finished product (gari) was observed and information that would answer the objectives above was sought. Regarding postharvest losses, the farmers and processors indicated that the losses incurred by them were very minimal and a value could not be put on it. If losses did occur, it was a result of lack of market, which meant the gari would have to be sold at a lower price, or if there was a general decrease in the price of the gari or an increase in the price of cassava. The processors also indicated that the cassava is sold by the farmers by demarcating a section of the cultivated plot to the processors. Therefore, if the farmers use low yielding cassava, the gari processors will obtain less gari for the plot and vice versa. To increase profit, the processors ensure that the best varieties are used for the processing of gari. Varieties that are best suited for gari processing are 'Bankyehemaa' (meaning cassava queen), 'Tech' or 'Benin' (originally from the country Benin). According to the processors, these varieties were among others that were introduced by extension workers many years ago and, through trial and error, they have identified these as the best suited cassava for gari processing because of the starch content and its ability to retain starch.

The farmers, on the other hand, indicated that losses incurred are due to rot or pests whilst the root is still in the ground.

A detailed description of each step of the value chain is described below.

Harvesting

Farmers in Manchie cultivate cassava all year round and the cassava is usually intercropped with maize. According to the farmers and gari processors in Manchie, the cassava roots begin to deteriorate within a day or two after harvesting therefore processing has to be done immediately. Although cassava is such a perishable commodity, there are no effective methods available for prolonging the shelf life of the roots after harvesting so the only method currently used is to delay harvesting. Cassava harvesting in Manchie is carried out manually by pulling the root out of the ground where the soil is wet/soft or by the aid of a machete when the soil is very dry. Harvesting is done early in the morning by the processors and used in the same day or harvested in the evening and used the next morning to ensure that the cassava does not deteriorate. The processors call deterioration 'kaka' which, they said, refers to the black spots observed on peeled cassava as it begins to deteriorate that resemble the black spots observed on nails when they are infected.

According to Averre (1967), two types of deterioration are known to occur in cassava – primary and secondary deterioration. Primary deterioration consists of physiological changes characterised by an internal root discolouration called vascular streaking or vascular discolouration. This discolouration is displayed as blue-black or brownish occlusions and chemical deposits. The time to onset, rate of progression, intensity, pattern and distribution of the discolouration varies between cultivars and roots of the same plant.

Transportation of the cassava from the farm to the processing area is through the use of head pans. The women usually carry the cassava from the farm using head pans and will travel the journey on foot from the farm to the processing centre as many times as is necessary.

Peeling

Peeling of the cassava is mainly done at the traditional level using sharp knives. In household peeling of cassava, the peels are removed from the edible parts by opening up the peel and carefully removing it to leave the edible part intact. However, it was observed that the women slice the peels from the whole roots which took off some of the edible white parts. The processors indicated that slicing the peels off was a faster method and although they tend to lose some of the edible parts, the amount lost is minimal in terms of time conserved for other processes.

Washing

Washing of the cassava is usually done by vigorously cleaning the peeled roots in bowls of water to remove dirt and soil. Clean jute sacks were used to scrub the cassava. Water is scarce in the community and therefore poor practices were observed in terms of dirty water used to wash the peeled cassava roots.

Grating

Traditional grating of cassava is carried out by rubbing the root on the rough surface of a perforated galvanised metal sheet fixed to a wooden board support. This method of grating is very labour intensive and time consuming. To reduce time and labour, medium-scale motorised cassava graters have been introduced. The processors in Manchie utilise a semi-motorised drum grater. The grater, provided by the Food Research Institute, an institute under the Council for Scientific and Industrial Research in Ghana, is powered by electricity but there is the need for manpower to move the grater. Processors are able to grate about 500 kg of fresh cassava in around an hour compared to almost a whole day of grating using the traditional method.

Pressing and fermenting

To press and ferment the cassava mash, the grated cassava is packed into jute bags and the open ends tied securely with ropes. In the very traditional setting, the loaded bags are packed on wooden racks and heavy stones placed on them to press out the starchy juice. The mash is fermented during the process and this can take a period of about two days. In Manchie, the processors use a semi-modernised process where a screw press (also provided by the Food Research Institute) is used to press out the starchy juice. The pressing and fermentation process usually takes about 1-2 hours. The women indicated that using the press alone did not get the juice out as expected so sticks are put on top of the sacks with the mash before the pressure from the screw press is applied.

Roasting

Roasting is the final unit operation before the final product, gari is obtained. The roasting is carried out over open fires using cast irons pans. During roasting, the sieved pressed mash is

stirred vigorously over the fire until is it dry and crisp. Usually, one processor roasts the grains until dry and crisp gari is obtained. In Manchie, however, it was observed that roasting of the pressed mash is usually done as a team with between three to four processors performing the roasting operation. The first processor will roast till it reaches a particular moisture content and then it is transferred to a second processor until it reaches the last processor who will roast it till it reaches the required moisture content for gari. The processors indicated that the roasting is carried out in this manner to ensure uniformity in the final product. Another reason is that it is less time consuming when roasting is conducted in this manner.

Packaging and pricing

Gari is packaged to suit the market where it will be sold. For the local markets, gari is usually stored in clear, large polyethylene bags and a standard tin measure of about 2.5 kg (locally known as 'olonka') is used for retailing. For the export market, gari weighing about 2.5 kg is measured into clear polyethylene bags and sealed.

An innovation by the women of Manchie is the introduction of soybean gari, which is gari fortified with soybeans. The soybeans are dehulled, milled and added to the pressed mash and roasted together. Prices of the gari range between 3-7 cedis per 2.5 kg (approx. US$1.5 – 3.5). Gari that is retailed in the market using the 'olonka' is 3 cedis. Plain gari sealed for export is 5 cedis and soybean gari is 7 cedis.

Hotspots for postharvest loss

Discussion with the farmers and processors in Manchie revealed that postharvest loss in cassava is very minimal, especially since the cassava is harvested for processing. As indicated above, some cassava varieties can deteriorate within a day of harvesting but, since the harvested cassava in Manchie is used for processing almost immediately, such loss is not recorded. Egyir *et al.* (2008) indicated that the average loss recorded for cassava during harvesting for dry seasons is 2%. This figure is also largely due to physical loss, such as breaking up of the root etc. Since cassava for processing (grating), if used immediately after harvesting, can utilise physically damaged roots, such a loss will not be recorded. The processors indicated that loss for them is usually financial due to a decrease in price or an increase in the prices of some raw materials. To obtain hotspots for cassava loss, discussions should be held with farmers during the wet season and in areas where the cassava is sent to markets.

Centres of excellence for training and research

Postharvest training and research is conducted by various institutions in Ghana. The institutions with their various departments or units have specific areas of focus. For teaching of postharvest courses, the University of Ghana and the Kwame Nkrumah University of Science and Technology (KNUST) are the main universities involved. These two universities have their specific areas of focus. KNUST is more focused on the engineering aspect, whilst the University of Ghana is focused on postharvest physiology, processing, marketing, preservation and

extension. Other universities in Ghana, such as the University of Cape Coast and University for Development Studies, offer general agriculture or agricultural extension and postharvest topics are taught.

Research in postharvest is carried out by various public institutions in Ghana such as institutions or departments under the Ministry of Food and Agriculture, the Ministry of Trade and Industry and the Ministry of Environment, Science and Technology (MEST). The Council for Scientific and Industrial Research (CSIR) of MEST is the lead research institution in Ghana, which has 13 institutes and four are directly involved in postharvest research (Food Research, Crops Research Savannah Agriculture and Industrial Research Institutes). The universities are also involved in postharvest research. Laboratories for postharvest research are located in the various regulatory authorities, including the Ghana Standards Authority (GSA) and the Food and Drugs Authority (FDA), the Food Research and Crop Research Institutes as well as universities. These laboratories have equipment to measure food safety indices (microbiological, chemical residues, etc.) and for physiological analysis among others.

For cassava, the following institutions, in addition to the above, provide support into cassava research – the Soil Research Institute, also under CSIR, located in Kumasi and the Plant Genetic Resources Centre, Bunso. The table below shows the individual departments or units responsible for postharvest teaching and research.

Institutions responsible for postharvest training and research and major areas of focus

Institution	Department	Major area of focus
University of Ghana	Crop Science (Postharvest Unit)	Physiology, processing and preservation, quality assurance, pathology and pest management
	Agricultural Engineering	Preservation and storage: equipment design
	Agri-economics and Agribusiness	Marketing and managerial aspects of agri-food business and agro-processing
	Food Science	Processing and quality assurance
	Agricultural Extension	Technology dissemination
University of Cape Coast	Agriculture	General postharvest
University for Development Studies	Agricultural Technology	General postharvest
Kwame Nkrumah University of Science and Technology	Agricultural Engineering	Preservation and storage: Equipment design
Ministry of Food and Agriculture	Agricultural Engineering Services Directorate	Equipment design
	Policy Planning Monitoring and Evaluation Directorate	Policy,
	Agricultural Extension	Technology dissemination
Council for Scientific and Industrial Research (CSIR)	Food Research Institute	Food safety, processing,
	Crop Research Institute	Technology development and dissemination
	Savannah Agricultural Research Institute	Technology development and dissemination
Ministry of Trade and Industry	Ghana Atomic Energy Commission	Pest management (Irradiation)
	Ghana Food and Drugs Authority	Regulatory agency
	Ghana Standards Authority	Regulatory agency

Recommendations on specific policy options on key areas needed to strengthen the postharvest knowledge system in Ghana

According to the Food and Agricultural Sector Development Policy (FASEDEP II), the Ghana Government now intends to focus its efforts on greater effectiveness and sustainable equity on impacts. A value chain approach to agricultural development will be adopted with value addition and market access given more attention. Efforts will be intensified to build capacity towards meeting challenges of quality standards in the international market, with a focus on

increasing productivity along the value chain. Attention will also be given to improving standards in local markets and for food safety.

In relation to cassava production and processing, FASDEP II has identified various areas that need attention along the postharvest value chain and have provided specific strategies for the attainment of food security and emergency preparedness.

Some of the specific interventions are as follows:

- Develop improved cassava varieties to meet various demands;
- Create awareness of existing improved varieties and their uses;
- Update protocols for good agricultural practices in cassava production;
- Introduce improved technologies for production and processing of cassava;
- Support farmers to acquire knowledge and skills for adoption of technologies for cassava production and processing;
- Develop and promote utilisation of a variety of products from cassava;
- Improve market access by strengthening linkages among stakeholders in the cassava value chain;
- Collaboration with the private sector to build capacity of individuals and companies to produce and/or assemble appropriate agricultural machinery, tools, and other equipment locally;
- Facilitate the establishment of mechanisation services provision centres, and machinery hire/purchase and lease schemes that also have adequate backup of spare parts for all machinery and equipment;
- Develop human capacity in agricultural machinery management, operation and maintenance within the public and private sectors.

Reviewing the strategies put forward in FASDEP II shows that Ghana is moving in the right direction in order to reduce postharvest losses and also strengthen the postharvest knowledge system. Interaction with the farmers and processors in Manchie also demonstrated that the following areas need more strengthening:

- Processors indicated that they purchase cassava from the farmers by the size of the land which means, if high yielding varieties are cultivated, their gains would also be increased. There is, therefore, the need to educate farmers on using high yield varieties and adopting new and improved technologies.

- Food safety issues were hardly addressed by the processors during the interview. Poor hygienic conditions were observed at the processing area and therefore the processors will need to be given some basic training on food safety and good hygienic practices.

- Under the same heading of food safety, there should be stricter standards in place to monitor gari production for the local and export markets.

- Another observation made was that although the processors seem to have good knowledge about gari processing, most of their knowledge was acquired through trial and error. It would therefore be best if the extension services for this industry were strengthened.

- The gari processors indicated that they have the potential to produce larger quantities of gari but access to the international market was limited and they urgently requested support in this area. A link to these markets would significantly boost gari sales for the Manchie women.

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