A TECHNICAL SURVEY OF POST HARVEST PROCESSING OPERATIONS OF CASSAVA IN EKITI STATE, SOUTH-WEST NIGERIA

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ABSTRACT

Cassava (Manihot esculenta Crantz) is a staple root crop of the tropics. It is a major source of energy in both human and livestock diets. However, cassava is highly perishable and must be converted into stable products soon after it is harvested. This study was therefore conducted to examine the present level of postharvest processing operations of cassava in Ekiti State, South-West Nigeria. The study was carried out using a Participatory Rural Appraisal (PRA) technique. Accordingly, twelve out of the sixteen local government areas of the State were randomly selected for the study. A purposive random sampling approach was used for selecting farmers for participation in the study. Structured questionnaires were administered to 10 cassava processors per LGA to make a total of 120 respondents for the study area. In addition, the method of Focus Group Discussion (FGD) was used to obtain information on the method and level of technologies used for post-harvest processing of cassava in the area. Data were analysed using descriptive statistics. Results show that the products of cassava processing in the study area are garri, fufu, lafun and starch. 58.3% of the cassava processors process between 500 to 2500 kg of fresh cassava tubers per day with 68.3% of the processors employing a combination of traditional and modern methods to perform their processing operations. 71.6% of the respondents use head pans to move cassava tubers from point of purchase to processing facilities. The survey revealed a near absence of mechanized processing of cassava in the study area due to lack of funds by the individual processors to acquire the necessary processing machines. Accordingly, it is recommended that cluster processing facilities should be established which would allow a processor to carry out their unit operations for a fee without necessarily owning the processing equipment.

Keywords: Cassava, postharvest processing, techniques, survey, Ekiti State

INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is one of the most favoured tuber crops of the tropics and a major source of energy in the human and livestock diets. It is highly valued for biofuel and industrial applications. It is an important staple food and cash crop that contributes immensely to food security in the tropics. Cassava grows on a wide range of soils and can yield satisfactorily even on poor acid soils where most other crops fail (Oyekanmi and Okeleye, 2007). The crop originated in Brazil (Allem, 2002), from where its cultivation spread throughout the humid tropics and subtropics. In Nigeria, cassava is mostly grown on small farms and usually intercropped with vegetables, plantation crops, yam, sweet potatoes, melon, maize, beans, and other annual crops (Babatunde, 2011). According to FAO (2017), the world's production estimate for 2016 was 278.75 million tonnes with Nigeria accounting for 57.86 million tonnes, making it the world's largest producer.

Cassava is a high carbohydrate food that produces 250,000 calories/hectare/day compared to 200,000 for maize, 176,600 for rice, 114,000 for sorghum and 110,000 for wheat (Omodamiro *et al*., 2012). Hence, cassava plays a major role in addressing the food security issues in Nigeria. Furthermore, cassava generates income for its producers, processors, transporters and marketers. It also serves as raw material in industries such as bakery, textile, paper, plywood and confectioneries. The use of cassava as a source of ethanol for fuel, energy in animal feed, and starch for industry is on the increase (Taiwo, 2006; Kolawole and Agbetoye, 2007). However, fresh cassava tubers are a highly perishable produce with a moisture content of about 70%. As a result of their high moisture content, cassava tubers are susceptible to rapid deterioration and therefore have a short postharvest shelf life. This situation severely limits their market potentials and their benefits to cassava farmers. The high moisture content of cassava tubers predisposes them to rapid postharvest physiological deterioration (PPD) within 24 to 72 hours of harvest (Simonyan, 2015; Saravanan *et al*., 2016; Zainuddina *et al*., 2018). According to Saravanan *et al*. (2016) the estimated losses of fresh cassava roots due to PPD is nearly one-third of total harvest world-wide. Njoku *et al*. (2014) reviewed documented strategies to delay postharvest physiological deterioration in cassava. They include the use of improved storage techniques, conventional breeding, and genetic engineering to produce target changes in metabolism. Taiwo and Fasoyiro (2015) posited that one of the ways of reducing cassava loss is through processing. The authors suggested that cassava, therefore, must be processed into various forms in order to increase the shelf life of the products, facilitate transportation and marketing, reduce cyanide content and improve palatability. Furthermore, processing helps to reduce food losses and stabilizes seasonal fluctuations in the supply of the crop. .

Processing operations for cassava include peeling, grating, fermentation, pressing, toasting, cooking and milling. A variety of technologies are available for these operations which include peeling machines, chipping machines, grating machines, hammer mills, hydraulic press, dryers and pelletizers. It is important therefore to evaluate the status of cassava processing in order to maximize the economic potentials that cassava processing offers. This would enable rural communities whose livelihoods depend on agricultural economy to benefit from the present traditional food market and new emerging markets. Ekiti State, Nigeria is largely an agrarian State with huge potentials to contribute to the nation's agricultural economy and food security. The objective of this study, therefore, was to assess the status of mechanization of cassava processing in Ekiti State with a view to establishing gaps in post-harvest processing operations of cassava in the State for which technological interventions are imperative.

MATERIALS AND METHODS

Study area

The study area for the purpose of this investigation is Ekiti State. The State is situated in the South-Western part of Nigeria and lies entirely within the tropics. It is located between longitudes 04°51′ and 05°47′ East and latitudes 07° 17′ and 08° 06′ North. It lies south of Kwara and Kogi States, east of Osun State and bounded by Ondo State in the east and in the south. The State has a land area of 6,353 km²and a population of about 2,398,957. There are sixteen Local Government Council Areas in the State. The map of Ekiti State, the study area, is shown in Figure 1.

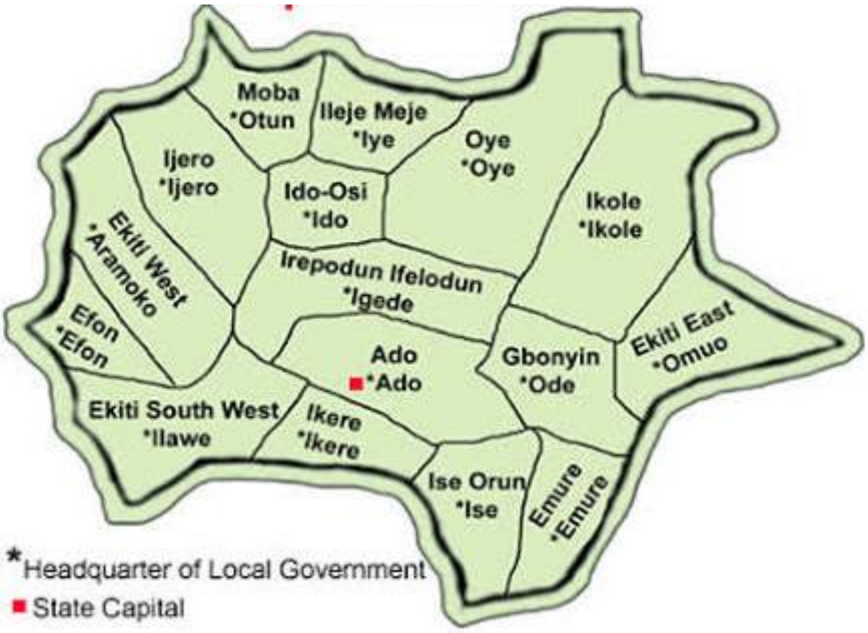

Figure 1: Map of Ekiti State, the study area

Methodology and Data Collection

Locations of the cassava processing facilities in Ekiti State were obtained from the Local Government Councils. The population under study was considered homogeneous. The study was carried out using a Participatory Rural Appraisal (PRA) technique involving cassava processors in the State. Accordingly, four local government areas (LGAs) were randomly selected from each of the three senatorial districts in the State. This gave a total of 12 LGAs used for the study out of the 16 LGAs in the State. The LGAs are Ado, Ekiti West, Ido/Osi, Ekiti South West, Ikole, Ekiti East, Efon, Ijero, Ilejemeje, Moba, Emure and Ikere. In each of the LGAs, ten cassava processors were purposively and randomly selected for the study, giving a total of 120 respondents. Structured questionnaires were administered to the 120 respondents. The information sort using the questionnaire covered type of ownership of processing facilities, gender of owner, marital status, educational qualification, length of experience in cassava processing, location of processing facility, sources of cassava tubers, cassava products, processing space, disposal of cassava peels, disposal of waste water, transport of cassava tubers, quantity of cassava processed per day, source of water used for cassava processing, types of technology used for cassava processing, and problems associated with cassava processing. Data collected from the respondents were analysed using descriptive statistics. In addition to the use of questionnaires, the method of Focus Group Discussion (FGD) involving cassava processors was used to obtain information on the method and level of technologies used for post-harvest processing of cassava in the area.

Analysis of Data

Data were analysed using descriptive statistics namely frequencies and percentages.

RESULTS AND DISCUSSION

Demographic distribution of cassava processors

The demographic distribution of cassava processors on the basis of marital status is shown in Figure 2. The Figure shows that married persons accounted for 32% of all the processors while single persons accounted for only 13.6%. The Figure also shows that 54.4% of the processors were widows and widowers. Cassava processors often depend on family members to provide the needed labour for their processing activities. Perhaps this explains why persons with families constitute 86.40% of the cassava processing community

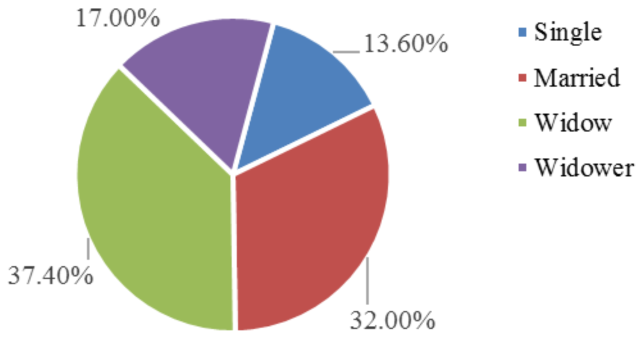

Figure 2: Distribution of cassava processors by marital status

Types of ownership of cassava processing facilities

Figure 3 is a graphical presentation of the types of ownership of cassava processing facilities in the study area. The Figure shows that majority of cassava processors (51.7%) prefer to operate their businesses on the basis of sole ownerships. 25.5% of the cassava processors operate it as a family business while joint ownership only accounts for 20.8%. Many reasons are responsible for the low level of joint ownership of cassava processing ventures. Firstly, partnering with another business owner can be a complex matter (Vaidya, 2012). It takes time and effort to build the right relationship. Secondly, where there is an imbalance in the levels of expertise, investment or assets brought into the venture by the different partners, trust and commitment could be compromised. Meanwhile, trust and commitment between partners leads to better performance in the sense that joint venture participation, amongst other benefits, enables and enhances learning from the partners and facilitates expansion into a new market.

The distribution of cassava processors by gender is presented in Figure 4. The Figure shows that 61.3% of the processors were females, indicating that cassava processing in Ekiti State is a female dominated activity. This finding corroborates with that of Karunwi and Ezumah (2008) who observed that cassava processors were women dominant and that garri was the major end product in the humid forest ecological zone of Nigeria. A similar pattern was also reported by Oyegbami *et al*. (2010) who observed that 68.9% of the cassava processors in Oyo, Ogun and Ondo States were females, and concluded that women play a key role in family farm sector. This trend reveals that the men folk in South-West Nigeria generally tend to believe that certain economic activities should be left to the women folk, especially when performed at the cottage level. Cassava processing is one of such activities. This explains why cassava processing is a female dominated venture in that part of the country.

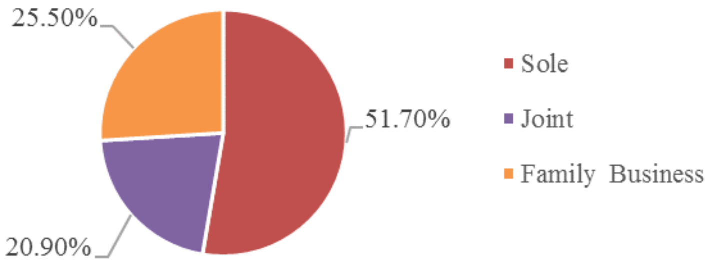

Figure 3: Graphical presentation of Type of Ownerships

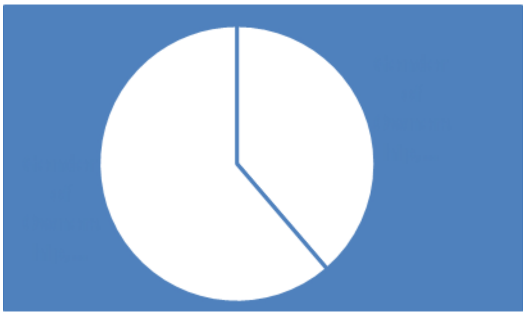

Figure 4: Distribution of ownership of cassava processing businesses by gender

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Types and levels of education of cassava processors

Table 1 shows the types and levels of educational attainment of persons engaged in cassava processing in the study area. From the Table, respondents that possess the primary school level of education constitute the largest group (40.3%) amongst cassava processors in the study area. Cassava processors who have acquired a secondary education was only 14.5% while those with a post-secondary education is only a paltry 1.61% of all the cassava processors. Processing of cassava is considered to be a vocation that requires little or no skill, and thus performed at artisanal level. Consequently, persons in the study area who possess a post-secondary education tend to relegate cassava processing to unskilled workforce while they in turn search elsewhere for white-collar jobs. In all, 69% of the processors claimed to possess one form of education or the other.

Level of experience of cassava processors

Surprisingly, as few as 10% of the processors admit they have up to 16 years of experience in cassava processing, while only 18.7% had between 11 and 15 years of experience (Figure 5). Most of the respondents (35.8 %) claimed they have been engaged in cassava processing for 6 to 10 years whereas 31.7 % of the processing community has less than five years of experience. In spite of the years of experience of the cassava processors, they tend not to innovate nor adopt modern processing techniques as they continue to carry out their processing operations using traditional methods. The failure of the processors to adopt new technologies may be traceable to their level of education and lack of awareness of such technologies.

Table 1. Type and level of education

Type/Level of education	Number of respondents	Percent
Islamic education	3	4.84
Primary education	25	40.32
Secondary education	9	14.52
Adult education	5	8.06
Post-secondary education	1	1.61
No formal education	19	30.65
Total	62	100.00

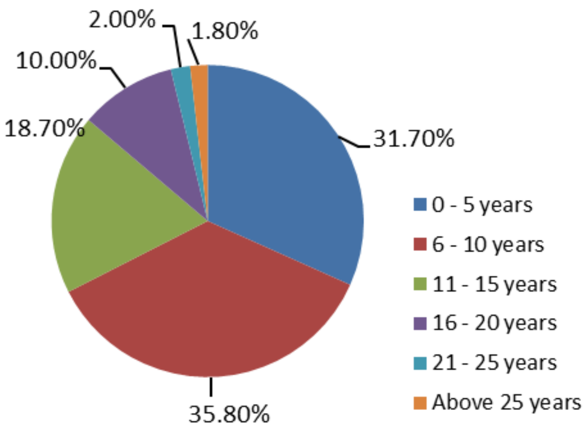

Figure 5: Distribution of respondents on the basis of experience in cassava processing.

Location of cassava processing facilities

The majority (90%) of respondents carry out their processing activities in make shift sheds constructed within the perimeter of their residential areas. On-farm processing is done by as little as 9.17% of the processors while processing at industrial level is done by less than 1% of the respondents (Figure 6). Many factors could be responsible for the near absence of industrial processing of cassava in the study area. Some of the factors that limit industrialization of cassava processing includes small size of the processing facilities, difficulties in gaining access to farm land, lack of funds to purchase large quantities of raw materials, dilapidated access roads to market for their products, lack of access to sources of water and processing machinery as many of them cannot afford to acquire the necessary machines. All of these factors underscore the need for cassava processors in Ekiti State to form partnerships and strategic alliances.

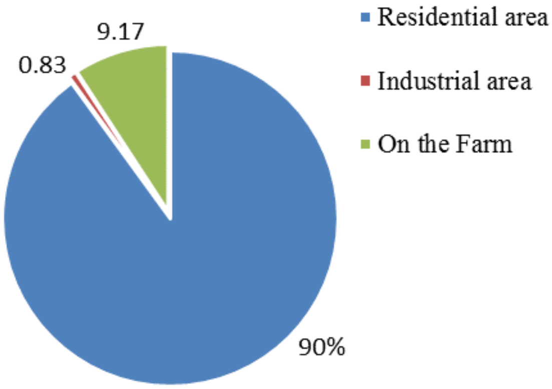

Figure 6: Graph showing the type of location where cassava processing facilities are situated

Sources of cassava tubers used by processors

Table 2 shows the sources of cassava tubers processed in the study area. The Table reveals that 82.5% of the respondents purchased the cassava tubers they process from the open market whereas only 17.5% obtain their raw cassava tubers directly from the farm. Cassava tubers are highly perishable and deteriorate rapidly within two days after harvest. The duration of time between harvest and arrival at market is varied and indeterminate. This implies that freshness of cassava tubers that enter the processing facility cannot be guaranteed as some tubers indeed decay or become fibrous before processing commences. This leads to both quantitative and qualitative losses of the cassava tubers as well as a deleterious effect on the quality of the final product.

Table 2: Sources of cassava tubers

Source of cassava tubers	Number of respondents	Percent
Farm harvest	21	17.5
Market purchase	99	82.5
Total	120	100

The major types of products derived from cassava processing in the study area are shown in Table 3. From the Table, it can be seen that cassava tubers are generally converted into four major products namely garri, fufu, lafun and starch. Garri accounts for 41.75% of the products of cassava followed by fufu (35.05%) and starch (13.40%), respectively.

Table 3: Derived products of the cassava processing

Type of product	Number of respondents	Percent
Garri	81	41.75
Fufu	68	35.05
Lafun	19	9.80
Starch	26	13.40
Total	194	100.00

It was observed that lafun is least considered as an end product of cassava processing as only 9.80% of the cassava tubers is processed into lafun. The reason for this observation is that lafun commands the least patronage from the dwellers of the area because it is not a traditional food of the people of the area. On the other hand, garri and fufu are the products of preference to consumers and hence a better source of income for the processors.

As observed earlier, cassava processing is rarely industrialized in the study area. Therefore, little space is utilized and most of the cassava processors (68.3%) operate on land areas that are less than 66.89m^2. 30% of processors operate in spaces that range from 66.89m^2- 133.78m^2, while only 1.7% of the processors occupy as much as 200.67-334.45m^2 of land area. The little space used by cassava processors is attributable to the inability of the processors to afford land or equipment. The little capital on investment in turn limits their ability to industrialize cassava processing. Hence cassava post-harvest is characterized by manual or semi-mechanized processing operations.

Sources of water for cassava processing

Table 4 shows the sources of water commonly used at the cassava processing facilities. These are boreholes, reservoirs, wells and open water bodies such as streams and rivers. Majority (70%) of the cassava processors use dug wells as source of water while 12.5% of them use water from streams. Only 17.5% of the processors use water from reservoirs and boreholes. This indicates that most of the processors depend on water sources that do not guarantee adequate hygiene and could be a source of water borne diseases.

Table 4. Sources of water used for cassava processing

Source of water	Number of respondents	Percent
Well	84	70.00
Reservoir	11	9.20
Borehole	10	8.30
Stream	15	12.50
Total	120	100.00

From the study it was gathered that less than 6% of the respondents claim they have capacity to process between 2000-5000 kg of tubers daily. The majority (58.3%) of cassava processors can only handle from 500-2500 kg of tubers per day. As many as 43% of the processors admit they cannot handle up to500 kg of tubers per day. With less than 6% of the processors having the capacity to handle below five metric tonnes of cassava daily, it can be concluded that industrialization of cassava processing in the study area is still at its lowest ebb. Up to 94% of the processors depend entirely on traditional methods of processing or on quasi mechanized processing methods utilizing very basic machines to perform only the most laborious tasks. All other unit operations are performed manually.

A significant proportion of cassava processors in Ekiti State (31.70%) still use the traditional method of processing. However, a majority (68.3%) of them use a combination of traditional and modern technologies for the processing of cassava. In some operations, modern methods are applied such as the use of mechanical graters for wet milling, and screw or hydraulic presser for cassava pulp dewatering. All other unit operations such as peeling of cassava tubers, washing of tubers, pulverization of cassava pulp and toasting of the pulverized pulp are performed using the traditional manual techniques. Almost all the processors depend entirely on traditional methods of processing with a lesser proportion using quasi-mechanized processing methods. This category of processors depends on very basic machines such as graters to perform only the most laborious tasks.

Methods of wastewater disposal

The survey further revealed that disposal of wastewater from cassava processing facilities is fraught with a lot of challenges. There are yet no proper methods of wastewater disposal as most (57.5%) of the processors discharge the effluent from their cassava processing facilities directly on the earth surface adjacent to the point of processing. Equally damaging to the environment is the fact that about 31.7% of processors discharged their effluent straight into municipal drains. The discharges invariably find their way into canals and surface water bodies. No treatments whatsoever are carried out on the effluent so as to bring dissolved solids as well as the BOD and COD of the water to acceptable levels. Only a very few processors (10.8%) do discharge their effluents into shallow pits. Even then, the effect of such effluent on groundwater has not been accurately reported for the study area. It is crucially important to know this effect seeing that most homes depend on dug wells for their domestic water supply. Oyegbami *et al*. (2012) described the lack of effective channel for cassava effluent as major constraints in cassava processing. Moreover, the investigators showed that processors are aware of the damage caused by cassava effluent especially to buildings and vegetation.

Methods of cassava peels disposal

The cassava peels that are generated at the processing facilities are disposed of partly by using them to feed livestock, especially goats and pigs. This conversion of waste to flesh to some extent helps to control the environmental menace which would have ensued otherwise. This method of disposal notwithstanding, it was observed that some members of the cassava processing community, in a bid to control the stench that emanates from the piles of cassava peels, burn them within their residential areas. In the process, toxic gases are emitted into the atmosphere causing difficulties in breathing to people in the neighborhood. Figure 7 shows smokes from cassava peels being burnt in a residential area within the study area.

Methods of cassava transportation

Cassava tubers are usually transported from farm to market or factory by means of trucks, cars wheel barrows and head pans. As pointed out earlier, majority (82.5%) of the cassava processors in the study area obtain their raw material from the open market while the rest of them obtain their tubers directly from the farm. The cassava processors disclosed that 53.3% of their tubers were transported to their processing facilities by trucks, while the remaining 46.7% is carried by means of head porterage using pan (33.3%) and sacks (13.4%). Having arrived at the processing facilities, 71.6% of the tubers are moved by means of head pan from one stage to another during the processing operations. The remaining 28.4% of the tubers are moved from one point to the next using bare hands. The study shows that no materials handling technologies of any sort are deployed in cassava processing in the area. This could be attributed to the small scale of operation which does not support the acquisition of processing machinery and materials handling equipment.

Figure 7: Disposal of cassava peels by burning

GENERAL CHALLENGES OF CASSAVA PROCESSING IN THE STUDY AREA

It was gathered from the processors that the major challenges confronting cassava processing in the State are:

a) difficulties encountered in sun drying during the rainy season,
b) seasonal fluctuation in prices of the products of cassava processing,
c) cost of transporting the products to market centers,
d) inaccessibility of rural roads,
e) inadequate supply of power and water,
f) long periods of fermentation during the wet season,
g) lack of information on improved methods of cassava processing and
h) inadequate funds to acquire processing machinery exacerbated by the lack of information on how to access the capital market.

CONCLUSION

From the survey of the postharvest processing operations of cassava in Ekiti State the following conclusions were derived.

a) Four major products are derived from cassava processing in the study area. They are garri, fufu, lafun and starch, amongst which lafun attracts the least attention because it is not a preferred food of the people.
b) Cassava processing in the area is a female dominated venture predominantly performed at artisanal level
c) Only about 10% of the processors possess up to 16 years of experience in cassava processing while nearly one third of the processing community have less than five years of experience.
d) Most of the cassava processors carry out their activities in residential areas on less than 66.89 m^2 floor area where they only process less than 2.5 metric tonnes of tubers per day using traditional methods.
e) A vast majority of cassava processors purchase the tubers they process from the open market, in which case freshness of cassava tubers that enter the processing facility is compromised thereby impacting negatively on the quality of the final product.
f) Sources of water for cassava processing are predominantly dug wells, and to a lesser extent, boreholes.
g) Processing of cassava in the study area is mostly carried out manually.

RECOMMENDATIONS

The near absence of mechanized processing of cassava in Ekiti State could be addressed by establishing cluster processing facilities at the community level across the State. Such community processing centres would allow a processor to carry out their unit operations for a token fee without necessarily owning the processing equipment. This could be achieved through two proven approaches namely (a) an investor establishes a processing plant with the necessary machinery; (b) processors organize themselves into cooperative societies to purchase a set of processing equipment which otherwise could be beyond the financial capacity of individual cooperators. In this second option, an appropriate management system should be put in place to make policies on appropriate pricing of the unit operations and to ensure sustainability of the processing facility.

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