OVERVIEW PAPER

Strategies to Improve the Adoption of Postharvest Handling and Agro-Processing Technologies in Africa

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ABSTRACT

Some marked increases in crop production were recorded in recent years because of the adoption of improved varieties and growing techniques, however, the pay-off after harvest is still insignificant. This is because of costly losses, high labor requirements, inappropriate facilities and poor product quality resulting in poor harvesting and handling systems. Little work on value addition is done and processing is limited to traditional products. Information on improved techniques is not known to many stakeholders. Improving the postharvest system stimulates crop production, facilitates processing and marketing of produce, creates opportunities for developing agro-processing enterprises for the production of value-added products to enhance their competitiveness in the market. Developing the agro-processing enterprise involves multiple partners from development institutions, the agricultural and industrial sectors. However, these sectors are still weakly linked as seen in the gap of information and technology flow among farmers, processors, technology designers, machine suppliers and other service providers.

INTRODUCTION

Sasakawa Africa Association (SAA) contributes to food security in Africa through improved productivity and enhanced processing capacity of smallholder farmers. SAA is working with various stakeholders in reducing the postharvest losses, developing agro-processing enterprise by promoting the use of appropriate tools and equipment, developing a network of service providers that links to smallholder farmers, and strengthening the human resource base. The smallholder farmers have important role in increasing food security in Africa. Their access to appropriate technologies is crucial. SAA's strategies to 'take these technologies to the farmers' are proving effective.

Challenges and Opportunities for Postharvest and Agro-processing Extension in Africa

Despite the introduction of yield-increasing technologies in sub-Saharan Africa during the last 3 decades or so, subsistence agriculture generally prevails, and processing at family level dominates. A majority of the farmers cultivate small fragmented farms, which discourages investments on machinery. Manual labor input, usually by farm family members, is required but inadequate. To compensate for this shortage, there is growing need to introduce labor- and drudgery-saving technologies.

Providing appropriate tools and equipment for production and post-production (postharvest) systems can result in better appreciation and sustained adoption of the yield-increasing technologies. Improving the postharvest system will stimulate crop production because it facilitates processing and marketing of the produce. It also creates opportunities for developing agro-processing enterprises for the production of value-added products to enhance their competitiveness in the market.

However, starting and developing agro-processing enterprise in Africa is constrained by uncertainty that exists over access to finance, information and reliable markets. The current agricultural market is fragmented resulting from lack of information, insufficient supply of products demanded by the consumers, and lack of value-adding technologies which requires the attention and intervention of the postharvest sector.

Developing the agro-processing enterprise involves multiple partners from development institutions, the agricultural and industrial sectors. These sectors are still weakly linked as seen by the gap of information and technology flow among farmers, processors, technology designers and manufacturers. Government policies that support this linkage are not well understood, if existing.

Scaling out is yet another challenge after the establishment of the agro-processing enterprise. This will require a market-based solution involving more public and private sectors sharing roles to connect the fragmented market for agricultural products.

Status and Role of Postharvest Handling in Value Addition

In the crop production and consumption continuum (Figure 1), most of value addition activities take place within the post-production (postharvest) sector of the value chain. Post-production consists of various unit operations from harvesting and all subsequent operations carried out until the crop is ready for consumption or for sale.

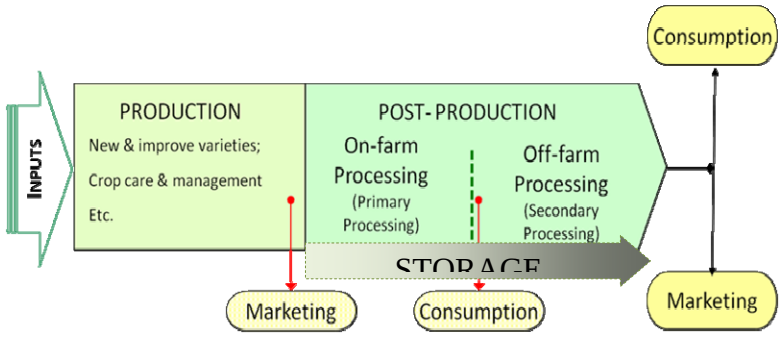

Figure 1 - The crop production to consumption continuum: Post-production sector involves processes that add value to the product before they are consumed or sold

Agro-processing involves a combination of processes to convert the agricultural products into a form that is consumable, storable and marketable. Storage could occur at any point of the chain.

Crop postharvest handling is still done using traditional methods which requires high labor input and result in significant quantitative and qualitative losses. Farm storage structures do not provide sufficient protection to stored crops. This contributes a huge amount of losses due to deterioration resulting from un-controlled atmospheric storage conditions (temperature and humidity) and due to direct consumption by rodents, and the biological activities of insects, pests and microorganisms.

Agro-processing is done at the household level for home consumption. There is also limited knowledge on potential agro-enterprise to make the job attractive to the processors. Therefore, the objectives of value-addition programs should address to improve the postharvest handling and storage of, and to add value to, farmers' produce by establishing small-scale, appropriate and sustainable agro-processing business enterprise using simple, inexpensive technologies.

The SAA Postharvest and Agro-processing (PHAP) Extension Program

The Sasakawa Africa Association (SAA) has been supporting programs aimed at combating malnutrition and poverty in Africa through programs that enhance production and increase income. One of the development areas identified by SAA is transforming agriculture into a profitable venture.

SAA's approach is to improve the techniques the smallholder farmers use to produce foods and then help them organize to get credit, acquire inputs and market their harvest more profitably. Adopting a value chain approach to development, SAA now looks at ways that will improve postharvest handling and processing of the farmers' crops in order to realize the gains brought about by improved production techniques.

The SAA PHAP is working to develop postharvest and agro-processing enterprise through the establishment of support systems (appropriate techniques, demonstrations, trainings, quality control, and market linkage) that builds the capacity of technology-users to add

value to their crops. The introduction of improved and appropriate technologies builds up the capacity of technology-users, brings about improved value of the products and in general, improvement of the food system.

PHAP Program Strategies

SAA applies a market-oriented approach to technology dissemination in its four focus countries: Ethiopia, Mali, Nigeria and Uganda. The PHAP programs emphasizes on improving postharvest and storage management, developing agro-processing enterprises and enhance marketing capacity, particularly for smallholder farmers, and women, in the rural areas.

SAA PHAP program is a collaborative effort among different stakeholders engaged in improving postharvest handling, storage and processing of agricultural produce. It works with the Extension Directorate of the Ministry of Agriculture, with non-governmental organizations and other development agencies, with importers and local manufacturers of machines and spare parts, and with farmers and agro-processors' groups.

SAA and agency collaborators/partners promote technologies through demonstrations, and developing linkages with appropriate sectors so that technologies and markets are accessible to end-users.

1. Developing the Program Based on Value Chain Analysis

In order to pursue earlier development works in postharvest research and extension, and to help the target-users optimize their benefits from these technological innovations, it is necessary to conduct a re-assessment of the system requirements and available resources so that a properly-targeted development and extension program could be designed and implemented. This can facilitate the adoption of the technologies, and can also identify potential markets. Following a value chain approach, many of the missing links has to be identified and integrated. SAA's role is to sensitized these linkages and find ways to make them work for the farmers.

A sample project design for development of agro-processing enterprise in the grain post-production value chain is shown in the Value Chain Analysis Matrix (VCAM) in Table 1. Each process in the value chain is analyzed according to constraints and market potential. Possible interventions which focus on enhancing market access and potential partners are identified. The VCAM uses the farmers' own experience and knowledge, and those of the development agents', to understand market potential.

Table 1. A sample VCAM project design for development of agro-processing enterprise in grain post-production sector

Process Flow of Grain	Market Potential	Service Provider	Constraints	Possible Intervention	Institutional Development Project	Intervention Provider
HARVEST	Provide mechanical harvesting service	Harvesting machine owners	In-field transport & road system; Lack of technology	Improve the design of in-field cart & harvester	Technology adaptation; Training of local manufacturers on new technologies	R & D Centers; Educational Institutions; SG2000
ON –FARM DRYING	Use of tarpaulin	Tarpaulin supplier	Lack of awareness	Demonstrate use of tarpaulin	Training users; Optimize sun-drying technique	Agricultural Research Institutes (ARI); SG2000
THRESHING & SHELLING	Mechanical threshing/ shelling service	Threshing machine owners	Repair and maintenance; Spare parts supply	Training in maintenance Linkage to spare parts supplier	Technology adaptation; Training of local manufacturers and operators	ARI; SG2000; Private Sector; Educational Institutions
TRANSPORT	Improved cart sales	Manufacturers	Poor manufacturing skill	Technical training	Training of manufacturers	Private Manufacturing Workshop; ARI
STORAGE	Storage facility (Grain Silo) rental	Grain silo Fabricator; Farmer Cooperative Unions	Access to design of facilities; High storage losses	Improve design of silo or local facilities; Field demonstration	Technology adaptation; Training users on storage management	ARI; R & D Centers; SG2000
MILLING	Mechanical Milling Service	Owners of Mills	Repair and Maintenance; Availability of spare parts	Improve design; Demonstration; Linkage to spare parts suppliers	Technology adaptation; Training of local manufacturers and operators	Private Sectors; ARI; R & D Centers; SG2000

2. Identifying and Adapting Appropriate Value-Adding Technologies

To enhance productivity, SAA PHAP program aims to provide appropriate tools and equipment that overcome excessive losses, high labor input and poor product quality. The criteria for selecting the technologies include: the pattern of crop production, the type and nature of food processing and consumption, the availability of resources, technical and economic capability of producers, and marketing opportunities.

Men and women have different production objectives that should also be addressed. More enterprising individuals, generally men and groups, require technologies that will address their income-generating objectives, while most women, representing individual or family units, require technologies that will provide more and better food for the family with less labor input.

SAA PHAP program collaborates with research and development institutions, training centers, local manufacturers, and other relevant service providers to identify and adapt these technologies. Collaborations with the International Institute of Tropical Agriculture (IITA) in Nigeria and the Selam David Röscli Technical and Vocational College (SDRTVC) in Ethiopia, resulted in development of simple technologies with the desired features of mobility, ease of operation and maintenance, and can be used for multiple crops. Some of the more popular machines already adopted in Ethiopia are: multi-crop thresher, maize sheller and grain cleaner.

3. Conducting Field Demonstrations

Field demonstration is an important and effective means of technology dissemination. It is conducted to promote awareness on improving the handling and processing of farm produces, and exposes available technological options to potential users, as well as policy makers. This allows sensitization of rural development projects which could solicit support for funding, implementation and adoption.

The demonstrations provide an opportunity for technology designers, suppliers, and extension workers to get direct responses from producers (farmers and agro-processors) on the suitability of the technologies being introduced. The feedback facilitates technology development and enhances the adoptability of the technologies.

4. Establishing Postharvest Learning Platforms

Parallel to demonstration activities, postharvest learning platforms are established to showcase improved technological options and their associated benefits. Unlike field demonstrations, which are done occasionally, the platform is operated continuously under actual conditions to analyze operational efficiency, management and profitability. The platform also serves as a venue for training of extension staff and producers while providing more information on utilization potentials and constraints which can be basis to fine-tune technologies, or develop and adopt technology dissemination strategies.

The platforms are established with the active participation of the farmers and agro-processors and extension workers in selected sites in the SAA countries. Some criteria for site selection are: type and number of crops and the cropping patterns, volumes of production, nature of crop processing and utilization, accessibility to markets, availability of extension services. Additionally, the sites are selected for their potential for commercial activities and market expansion. The expressed willingness of producers is also considered.

5. Capacity-Building

Training is an important component of the PHAP program. Different types of trainings are designed and implemented to enable development partners to carry out the task of bringing the technologies to end-users effectively.

a. Training on improved postharvest handling and storage technologies

This training is intended for extension agents and staff of partner institutions who are responsible for demonstrating the technologies, and training operators and end-users. They are also expected to oversee the sustainability of the technologies from project –base to a processor- or farmer-managed operation.

b. Training on operation and management of technologies

This training is intended for operators, farmers, and agro-processors to enable them optimize the utilization of technologies and the benefits derived therein. Extension workers and technology suppliers trained through the project usually conduct this type of training. Consequently, the extension workers increase their contacts with farmers and agro-processors, which improve their credibility. For the manufacturers, it is part of their product promotion and after-sales services which could expand their business contacts.

c. Training on manufacturing and servicing of the technologies

This training is intended for local manufacturers and their technicians to enable them meet the expected increased demand for improved postharvest handling and agro-processing technologies.

The training is designed to enhance their manufacturing skills to improve the quality of fabricated equipment, to provide after-sales services and to enforce quality control to sustain the functionality of the equipment. Training the manufacturers and coordinating their activities is necessary so that the technologies are supplied with the right quality in the right place at the right time. The after-sales service component makes local manufacturing enterprise more viable and attractive. This eliminates one of the constraints to adoption of imported technologies, i.e. the unavailability of spare parts and services.

d. Training on improved traditional processing and adoption of new products

This training is intended for group/s of agro-processors, particularly women, to enable them appreciate the benefits of their hard labor in the production of family food, and to enable them to improve the quality of their products and process new products demanded in the market. The aim of the training is to teach the processors techniques that reduce time and energy spent when using traditional methods. New products with potential market demand are also being introduced and groups are trained on their processing requirements. The training includes topics on packaging and good product presentation, quality control, hygiene and nutrition.

6. Promoting Private Service Providers

Involving the private sectors and individual entrepreneurs as service providers had proven to be effective. SAA PHAP has reported cases of successes where the technologies were purchased by private individuals to improve their operations, and to provide agro-processing services to other producers. This provides additional source of income to the entrepreneurs.

SAA PHAP is adopting this strategy to accelerate the adoption and scaling-up of improved postharvest and storage technologies in the four SAA focus countries. SAA identifies and sensitizes enterprising individuals who had been motivated by field demonstrations and by experiences in the postharvest learning platforms. They are trained on agro-business management, the operational and maintenance requirements of selected technologies, linked to agro-machinery and spare parts dealers, and machine shops to assist in their machine maintenance requirements.

The success of this strategy will depend very much on the type of technologies and the market opportunities that could be created by the improved process.

7. Supporting the Establishment of Agro-processing Enterprise for Women

In Africa and other developing countries, crop postharvest and food processing activities, in addition to household chores, are jobs reserved for women. This is to a large extent dictated by social and cultural norms.

The process is still traditional requiring high labor input. PHAP program aims to empower women by facilitating their access to technologies that save time of the processors,

improve the quality of their products and increase their income.

The empowerment of women producers through access to important information, training and technologies has enhanced their confidence. Women have wealth of relevant knowledge and understanding of the process and therefore can influence technology adaptation and adoption. Funding to establish and sustain their enterprises however is still a challenge.

Adoption of Improved Postharvest and Agro-processing Technologies

The postharvest and agro-processing technologies being disseminated are simple, compact, easy to operate and maintain, applicable for different crops and addresses the diverse nature of African crop and food processing systems.

Current agro-processing enterprises emanating from SAA interventions are improving the quality of life of the rural families through increased income, employment, improved food security, empowerment and nutrition.

Milk Processing Enterprise for Women Group

A women group in Semen Belessa, Southern Region of Ethiopia, traditionally processes milk from their cows into local cheese and butter for family consumption. It takes 2-3 hours to process one liter of milk to butter. The group was provided with a milk separator, butter churner and other relevant equipment (Figure 2) in the first quarter of 2012. Training on proper handling, storage and processing of the milk was likewise given to members. The group now processes cheese and butter from 1 liter of milk in less than 30 minutes and the quality for the products had improved because the milk can be processed quickly before any chemical changes occur. The operation is growing into a profitable business enterprise.

Adoption of Multi-Crop Thresher

The multi-crop thresher with a 7-Hp petrol engine power-drive was introduced in Ethiopia to help solve the drudgery of threshing teff, the staple food crop of Ethiopia. The thresher has a capacity of 500 to 600 kg per hour. Because of its compact design, it is easily transported with a donkey cart.

Mr. Ayele from Shashemene, Southern Ethiopia (SNNPR) is the first farmer who invested on the thresher after he witnessed a field demonstration by the SAA-AP project staff in 2002. By the end of 2004, he owns 3 units of the threshers which he operates with 5 hired workers. Providing threshing service has become his family's main source of income. Mr. Ayele is popularly called 'Mr. Thresher' in the area which he takes pride with a big responsibility, i.e. service to his people. Encouraged by his success, his brother also bought two units of the thresher and employed 5 operators.

In 2011, there are over 250 units of threshers in Shashemene area alone. They are owned and operated by private entrepreneurs who transport the thresher in donkey cart to as far as 500 km to reach the smallholder farmers (Figure 3).

Figure 2. Cream separator for cheese production by a women group

Figure 3. The multi-crop thresher transported on donkey cart to reach farmers even in remote areas

Lessons Learned and Recommendations

The successful implementation of any extension program, postharvest technology transfer for instance, will depend on good program design and management. Any technological interventions must involve the participation of the end-users from project design.

We note from our postharvest technology transfer work that:

- Implementation strategies that are proving effective include: on-farm technology demonstrations, establishment of postharvest learning platform, involving the private sector, and facilitating the development of women agro processing enterprises
- The most desired features of on-farm postharvest technologies are: easy to operate and maintain, and light weight allowing for mobility in rugged roads
- Intensive training for various
- technology-user groups create awareness and develops skills required to operate and manage the technologies
- Encourage Private Service Providers (PSP) who could provide producers/processors access to use of technologies allowing for more efficient operation.

The implementation of the postharvest program using the strategies discussed is resulting in increasing number of users (adopters) of technologies. Feedbacks from users are encouraging; however the rate of diffusion of technologies is still very slow. Several issues of design, social science, and technology transfer require increased attention for development and extension. A number of interventions are still needed and more challenges are to be dealt with, such as: sourcing appropriate technologies, new product development, linkages to market, access to credit, and issues of quality control. How can adoption be sustained?

It important to note that postharvest research and extension require the coordinated efforts of the different value chain actors including producers, service suppliers, marketers, policy-makers, others. Government policies must be in place to allow small to medium scale value-adding industries to pursue their businesses while at the same time provide affordable value-added products to rural and urban populace.

The adoption of improved postharvest and agro-processing technologies will move the market providing sufficiently good quality products and increasing income of rural producers.

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