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Improving Market Systems
for Agriculture in Rwanda

IMSAR LEARNING SERIES

THE COB MODEL

Aggregating maize on the cob – an innovative solution to address aflatoxin contamination and source high quality maize

THE MARKET CONSTRAINTS

Maize is a key crop grown by smallholder farmers in Rwanda with an annual production of around 450,000 metric tonnes (MT), both for subsistence and the market, during three crop seasons per year – Season A (during which 75% of the annual maize volume is produced), Season B (20%), and Season C (5%).

Premium maize agro-processors in Rwanda still resort to importing maize at a cost premium, as their demand is unmet despite the significant local production. This is largely due to poor post-harvest handling and weak aggregation networks amongst smallholder producers, which prevents buyers from accessing the local produce. Specifically, the key constraints are:

- Lack of awareness and knowledge: Rwanda is particularly susceptible to aflatoxin contamination of grains, with its mountainous, tropical climate being especially favourable for aflatoxin fungi growth and accumulation in maize and other crops. Smallholder farmers and maize aggregators are however insufficiently aware of the aflatoxin problem and lack knowledge of good harvest and post-harvest practices to minimize aflatoxin presence and prevent other quality issues;

- Inadequate post-harvest facilities: The existing harvesting and post-harvest handling of maize in Rwanda are performed by farmers with limited or no access to adequate post-harvest technologies to properly dry, thresh, shell, sort, and grade maize, as well as storage facilities. Indeed, smallholders rely on manual post-harvest handling – drying, shelling and cleaning maize by hand, which takes 6-10 weeks and overlaps with the wet season during the season A harvest, significantly increasing the risk of aflatoxin contamination. During this time, producers lose 15-30% of their harvest and face a 90% rejection rate from premium buyers, largely due to aflatoxin;

Rural households spend time and money in the post-harvest process, and ultimately lack access to premium markets due to low-quality and insufficient volume of grain, which results in low prices. Long term, high risks and low rewards discourage investment in inputs and yields needed for farmers to move beyond subsistence. Finally, the high-aflatoxin maize is fed into the local food supply, impacting health and food security for farmers' and their communities.

THE SOLUTION

Kumwe Karvest was a start-up founded in 2018 in Rwanda, which introduced an innovative model to manage the post-harvest process that smallholder farmers are unequipped to handle. The Cob Model (Fig.1) consists in aggregating maize on the cob instead of grain, which is then brought to an industrial facility where it is professionally shelled, cleaned and dried within 24 hrs, leading to top quality maize with minimal rejections from buyers. Maize buyers can either participate in direct aggregation of maize through a team of field agents or contract an aggregator to procure maize on behalf of the buyer. The Cob Model helps avoiding aflatoxin contamination in the maize value chain, bridging the gap between farmers and agro-processors and leading to improved performance across the value chain, as well as nutrition outcomes.

The Cob Model:

Source from farmers maize **on the cob** (vs grain).

Purchasing before quality decoration widens sourcing channels beyond cooperatives and large farmers

Aggregate from farmers **6-10 weeks earlier** than usual.

Purchasing earlier gives a competitive edge against other buyers and a pricing advantage.

Professionally shell, clean and dry maize **within 24 hours.**

The hubs are semi-mobile, deployed to strategic locations close to farmers or buyers.

Deliver top quality maize to buyers with **minimal rejections.**

The just-in-time process ensures maize reaches its dry-state before any quality deterioration.

KUMWE HARVEST

The low-capacity infrastructure available to and utilised by Kumwe Harvest, as well as their capacity to engage with larger number of farmers, during their pilot was limiting sufficient scale of the Cob Model, and ultimately hindering its proof of concept. Therefore, IMSAR support was designed to strengthen and scale-up the Cob Model, by:

- **Increase grain handling capacity,** to increase the metric tonne throughput and capability to handle wet maize and, as a result, increasing the MT purchasable per day from farmers. This included procuring storage equipment (grain dams) and augers (grain conveyors), as well as floor scales for weighing grain.
- **Extended mobilisation,** in order to reach more and smaller farmers and, as a result, source higher quantities of maize:
  - Deploy a combined team of qualified field agents to support and communicate with farmers and cooperatives;
  - Map and mobilise an increasing number of cooperatives, farmer groups and individual farmers;
  - Increase quality controls and testing on the field for Aflatoxin and moisture content to avoid central site rejections;

- Work in all districts across Rwanda, dependent on season; and
- Introduce and improve ICT to streamline mapping and mobilisation as well as ease data recording.

- **Improve payment modalities** to ensure farmers are paid quickly and efficiently:
  - Pay the majority of farmers and cooperatives via bank transfer or mobile payment;
  - Support farmers and cooperatives in access to bank accounts and mobile money;
  - Ensure farmers are paid in 0-5 business days;
  - Provide post-purchase support in the form of a call centre; and
- **Develop use of waste cob:** Conducting a feasibility study around waste cob conversion to usable products to increase and diversify revenue streams for companies adopting the model, and ultimately supporting sustainability, whilst reducing agricultural waste.

Through IMSAR, and other development partners support, Kumwe Harvest reached significant scale and attracted interest in the cob model. The company was acquired by Africa Improved Food in 2020 with the intent to aggressively expand the model both in Rwanda and regionally.

THE BENEFITS OF THE COB MODEL TO MAIZE VALUE CHAIN ACTORS

Smallholder farmers and cooperatives

- Reduction of costs related to post-harvest processing and risk of crop losses during post-harvest, which increase farmers' incomes and their ability to purchase agricultural inputs for the next season;
- Significant reduction in time as farmers are no longer required to work on threshing and drying activities. Instead, farmers can better engage in other farming activities, such as planting and preparing the next agricultural season, other income generating activities as well as having more time for domestic work and child or family care. This is particularly good for women farmers as they often do most of the post-harvest processing and now benefit from a more manageable workload.

Buyers and aggregators:

- Due to increased contract performance from farmers and maize cooperatives, aggregators and buyers can source and/or supply higher volumes of maize from Rwanda and access stable and more remunerative markets;
- Reduced rejection rates to amount to 5-10% given a robust quality control and assurance system.

Other post-harvest handling service providers:

- Organisations with existing warehousing infrastructure can be involved through providing services related to storage whether in silos or warehousing, and can extend their business to provide additional services related to shelling, drying, and maize handling;
- Organisations with transport logistic capacities can be involved through providing services related to maize aggregation and transportation from processing sites to buyers.

KEY REQUIREMENTS OF THE COB MODEL VS THE TRADITIONAL GRAIN MODEL

The Cob Model requires a different set-up and investment compared to buying and selling maize grain, as follows:

- Investment requirements into machinery, infrastructure, pick-up and aggregation system and testing equipment

The Cob Model requires setting up centralised processing facilities close to the origin of maize, including investment in:

- Dryers: The capacity of dryers can vary between 12 MT – 34 MT holding capacity of a cost between $30,000 USD – $80,000 USD depending on the quantities demanded by the buyer;

- Shellers: The capacity of shellers have a holding capacity of 20 MT at a cost of $30,000 USD;
- Warehousing: An aerated warehouse is required for maize to be stored and processed with rental fees varying across the country.

For the Cob Model to be attractive, the aggregator/buyer should develop an effective pick-up and aggregation plan. To achieve quick aggregation, an efficient method is to deploy a field team to manage quality testing and logistics related to pick-up. Note that transportation of maize cob is more costly relative to the conventional grain model due to the space and weight of cobs. To ensure a robust quality control and assurance system, the aggregator/buyer should invest in the following equipment:

- Moisture Content Analysers: $360 USD per kit;
- Aflatoxin testing equipment: $ 200,000 USD;
- Accuscanner: $7,000 USD per machine.

- **Investment in farmers communication and training**

The Cob Model calls for continuous awareness of the key constraints faced by farmers and their preferences and priorities. It therefore requires being aware of the key farmers priorities and aspects that will help determine their adoption of the Cob Model, which include:

- The immediate need for household cash needs. Therefore, buyers should prioritise to pay farmers as quickly as possible;
- Pricing of the maize cob versus the price on the local market, with farmers preferring to sell shelled grain if pricing is not sufficiently attractive;
- Farmers value the maize cob as it is primarily used for cooking fuel. Therefore, the farmer must feel compensated for the loss of the cob;
- Seasonal climatic factors will influence the ability for farmers to meet moisture content requirements. It is important to consider if the season is particularly wet or dryer , as this will influence the capacity of farmers to meet moisture requirements when drying at the farm level.

The Cob Model also calls for training and awareness raising with farmers, including on aspects as: A:

- Ensuring transparency on the cob to grain conversion rate through conducting trials of cob to grain conversions targeted at farmers, with the aim to demonstrate the outcome of the model's approval of maize on cob containing 77% grain and 23% cob. It should be noted that the conversion can depend on various factors such as the type of maize seeds, etc. Such sessions should include a focus on cost-benefit analysis;
- Training and technical assistance on improved post-harvest handling activities, including management of maize quality by using testing equipment, such as aflatoxin kits and moisture content readers

- **Investment in processing capacity**

While the Cob Model demonstrates great potential in maximising maize volumes and reducing rejection rates, taking on additional responsibilities is also followed by challenges that should be managed. Together with efficient aggregation which also applies to the conventional grain model, managing post-harvest activities can involve operational challenges as stated below:

- While acquiring the appropriate dryers and shellers is critical, it is equally important to identify a team which can ensure successful execution. As farmers rely on buyers to meet their contract commitments, the Cob Model requires accurate forecasting and maintenance of drying and shelling capacity. The processing performance can be challenging if the team and/or service provider experiences many breakdowns and/or does not perform best operational practices at sites.
- One of the key expenses related to post-harvest handling is the cost of drying after shelling. If the maize is sourced at a high moisture content, the cost of drying will also increase. In addition, the time it will take to dry will also increase, thus reducing the capacity. In addition, this cost driver is also influenced by market prices related to fuel and/or electricity costs.

HOW TO INCORPORATE THE COB MODEL INTO OPERATIONS

If the Buyer can meet the investment requirements of the Cob Model, the next phase is to develop the activities related to the entire process from farmgate to the factory gate:

- **Define quality specifications:** The maize buyer defines key criteria and specifications of the maize based on the respective business model. Principally, the acceptable levels of aflatoxins should be determined based on the use of maize, whether for animal feed or human consumption. For maize targeted at human consumption, the general advice is to target Grade 1 maize at a maximum of 7 ppb to meet recommended food safety standards. Other relevant specifications relate to limitations of diseased and pest damaged grain, discoloration, broken kernels, and total defective grain;
- **Implement a quality control and assurance system:** Prior to buying maize, the team of field agents are to visit farmers and coordinate optimal locations for points of aggregation. Developing a pick-up schedule based on the capacity of post-harvest handling is required to avoid logistical challenges and the risk of rejection rates. The processing sites should also be equipped with field agents who manage careful testing of moisture content and aflatoxins. Finally, the maize is required to be tested before dispatch but after drying and shelling to ensure optimal quality of the dry grain of 13.5% moisture content;
- **Set up key processing sites for post-harvest handling:** Identification of processing sites should be determined based on the geographical location of the source of maize. Generally, the East of Rwanda is a good location given the high availability of maize from farmers. After purchasing maize on the cob at the farm gate, the objective is to shell and dry the maize at a facility as soon as possible. The buyer can choose to manage the process of post-harvest activities or outsource shelling, drying, and maize handling.
- **Pricing and Payment:** The buyer's pricing model should account for the increase in maize bags required as cobs are more voluminous than maize grains. The increased quality of maize requires an additional price premium given additional sorting and cleaning activities required by the farmer. Finally, the farmer should feel satisfied on the compensation for the cost of the cob as it is used for cooking fuel;
- **Capacity Building of Service Providers:** If the buyer chooses to partner with service providers on post-harvest handling, a collaborative model is recommended. Specifically, to optimise processing capacity and efficiencies, operational excellence by the service provider is preferred. By strengthening performance of the cob model, the service provider and the buyer will be able to scale up operations and ensure sustainable supply of foods to the Rwandan population.

AFRICA IMPROVED FOODS

Through IMSAR support, Africa Improved Foods, developed a Supplier Development Programme with the aim to to increase professionalisation and operational efficiency of smaller aggregators/processor to adopt the cob model. The process entails:

- Performance assessment of aggregators to identify gaps and opportunities for improvements; areas evaluated include: site infrastructure, drying and shelling operations (including operational efficiency, equipment/infrastructure maintenance, quality of standard operating procedures, operations monitoring and tracking system), and ability to integrate quality control and assurance across operations;
- Development of a road map towards professional excellence in line with AIF requirements;
- Capacity Building – customised training sessions provided by AIF, including on quality, storage, operations and safety;
- Monitoring of uptake of best practices and overall performance improvements.

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