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STRATEGIES OF RISK MANAGEMENT FOR CASSAVA PRODUCTION IN MOZAMBIQUE

Mallik A-As-Saqui

Abstract

Mozambique covers an area of 78.3 million hectares, of which 36.1 million are cultivated land and about 10.8 million have high potential for agricultural development. About 80% of the people depend directly on agriculture for their livelihood. Many types of food crops are grown, especially rice, maize, cassava, sweet potatoes, beans, groundnuts, and cowpeas. Cassava, cultivated throughout the country, is consumed raw, cooked, or processed. The leaves are also eaten as a vegetable. Being an important crop, cassava farmers face many production risks, especially lack of access to good cultivars with high production and quality, post-harvest technologies, markets, and processing and utilization techniques. Diseases and pests are also prevalent. Research geared towards the solution of these risks is being carried out at the Instituto Nacional de Investigação Agronômica (INIA) of the Ministry of Agriculture, in collaboration with other organizations. Although the country has suffered 16 years of civil war, attempts are being made to resolve some of the constraints to successful production, utilization, and technology transfer. This paper elaborates on the major risks of cassava production and strategies of risk management in Mozambique.

Introduction

Mozambique has an area of 78.3 million hectares and a population of about 16 million. Except for the zone near the western border, the terrain is a low-lying plateau of moderate altitude, descending through a subplateau zone to the Indian Ocean on the east. The coastal lowlands, with altitudes of less than 200 m, is narrow in the north but wide in the south, and occupies about 40% of the total land area. The main peak in the western highlands reaches 2,436 m. Mozambique is crossed by at least 25 important rivers, which all flow into the Indian Ocean. The country, typically, has a rainy and dry season. The rainy season has monthly averages of 26-29 ^{o}C, with cooler temperatures in the interior uplands. The cooler dry season (June and July) has temperatures averaging 18-20 ^{o}C in the southern coastal region.

Agriculture is the most important economic activity, accounting for 48% of the GDP, employing more than 80% of the labour force (of whom 60% are women), and generating a substantial percentage of the country's export earnings (cashew nuts). Most of the production comes from the family sector, which also produces 93% of the maize marketed locally, 40% of the rice, 99% of the beans, and 27% of the vegetables marketed. The family sector can be defined as being 89% rural, with an average 1.5 ha for primary rainfed production, using few or no inputs, except seeds and labour. Farming is mainly subsistence, but surplus crops are marketed. Risk avoidance is an important strategy in cultivation (MA 1993).

Rainfall, which varies from 200 mm in the driest southern areas to >2,000 mm in the higher regions, is subject to extreme annual fluctuations and erratic distribution. This has led farmers to develop strategies that minimize risks rather than optimize yields. Despite the climatic risks, the country has enormous agricultural potential. The soils are predominantly fertile and land is plentiful (36.1 million hectares of arable land), with only 20%-30% of the estimated cultivable area currently under crops. Ample surface water resources, mostly unexploited, provide possibilities for irrigating as many as 3.3 million hectares. Forests cover 40 million hectares and wildlife is abundant.

Unfortunately, not only has much of the country's agricultural potential been unrealized, but also, in the last decade, the sector’s performance has deteriorated alarmingly. Food production is inadequate and most families are far from self-sufficient. The gap has been met with massive food imports (largely donations), while agricultural exports, which once generated substantial foreign exchange, have been reduced to a fraction of their former levels. This deterioration can be attributed to structural weaknesses inherited from the colonial period (e.g., emphasis on cash crops and large, heavily mechanized, state farms at the expense of the family sector and food crops); natural disasters such as floods, droughts, and cyclones; and war in the countryside.

Cassava, a staple food for about 50% of the population (Barreiros 1991), plays an important role in alleviating hunger. It is cultivated almost exclusively by small farmers who employ traditional production systems that give low but stable yields. Northern Mozambique is considered favourable for cultivation (average yields = 6.5 t/ha), but the southern and central zones are becoming more and more important (average yields = 1.0-1.5 t/ha) in response to famine conditions caused by severe drought in recent years.

About 2 million tons of cassava is produced yearly on about 500,000 ha. Cassava is used primarily for human consumption as fresh food or as flour. About 3.0%-3.5% of production is used to feed animals, mostly poultry. In addition, leaves are eaten throughout the year as a vegetable and are sometimes used for feed.

Peak planting time is October, but planting dates vary widely, ranging from August to January, which may significantly affect yield. Weeding is often insufficient (once or twice) instead of the 3 or 4 times that are considered necessary. Farmers intercrop cassava with beans 3 months after planting cassava. Most small farmers maintain the same planting distance, even on those parts of their land where they cannot intercrop, mainly for lack of seeds. For monocropped cassava, the farmers decrease planting distances to allow earlier canopy closure and reduce weeding. Fertilizers are not usually applied.

Major Production Risks

The most relevant risks of cassava production in Mozambique are as follows:

(1) Risks of farming inherent in the continued civil war, as well as insecurity in farming areas.

(2) Use of low-yielding local cultivars, which are susceptible to pests and diseases.

(3) Lack of planting materials of high-yielding, good-quality cultivars.

(4) Inadequate agronomic practices.

(5) Incidence of diseases, especially African cassava mosaic disease (ACMD) and cassava bacterial blight (CBB), and use of infested and/or infected planting materials.

(6) Prevalence of pests, especially of cassava mealy bug (CMB) and cassava green spider mite (CGM).

(7) Lack of adequate knowledge of production technologies, utilization, and processing.

(8) Lack of market facilities and transport; price fluctuations.

(9) Inadequate extension services for transferring technology to farmers.

(10) Inadequate linkages between research, extension, and training.

(11) Agro-climatic factors such as drought, erratic rainfall, and low-fertility soils have adverse effects on yields and eventually add to the other production risks.

Strategies of Risk Management

The Instituto Nacional de Investigação Agronômica (INIA) of the Mozambican Ministry of Agriculture is working in collaboration with other institutions to overcome some of the major production risks. They are applying the following strategy: introducing, testing, and evaluating cassava cultivars for adaptability to the major production and consumption regions, for tolerance of major pests and diseases, and for good-quality yield.

INIA’s current efforts in cassava improvement are aimed at producing cultivars that:

(1) Are resistant to pests and diseases, particularly ACMD and CBB, and CMB and CGM.

(2) Are high yielding.

(3) Produce good-quality roots with high starch and low fibre contents.

(4) Contain low levels of HCN, particularly those cultivars intended for use as food.

(5) Can produce early but do not deteriorate if not harvested immediately.

(6) Have high protein content.

(7) Have desirable characteristics for mechanical harvesting, that is, short non-spreading roots and minimum foliage.

(8) Are adapted to a wide range of environments.

Other current priorities include:

(1) Following up biological control and integrated measures for cassava pest and disease management.

(2) Developing agricultural practices adapted to different agro-ecological zones.

(3) Developing and maintaining the national germ plasm bank.

(4) Studying post-harvest technologies for preservation, utilization, and industrialization.

(5) Organizing and setting up rapid, efficient systems to produce pest-and-disease-free planting materials (tissue culture methods).

(6) In collaboration and coordination with seed and agricultural services, developing a multiplication system to produce planting materials and distribute to farmers.

(7) Diffusing technology in close collaboration with other institutions.

To achieve the foregoing, INIA launched several strategies through a root crops improvement programme, initiated in 1982 with assistance from the International Institute of Tropical Agriculture (IITA), the Food and Agriculture Organization of the United Nations (FAO), the East and Southern Africa Root Crops Research Network (ESARRN), and the United Nations International Children's Emergency Fund (UNICEF). To date, INIA has developed several high-yielding cultivars adapted to various agro-ecological zones; established a germ plasm bank, a tissue culture laboratory, and a biological control unit for CMB; and developed different agronomic practices for improved production. The programme has also published several articles for extension personnel on adaptation and rapid multiplication of cassava.

Moreover, work continues on developing cassava production systems for the ultimate benefit of farmers.

Diseases and Pests

At present, the most important risks faced by smallholders are pests and diseases. These are discussed, together with strategies to be followed for managing these risks for improved production.

African cassava mosaic disease (ACMD)

This disease is the most important viral disease attacking cassava. Prevalent throughout the cassava-producing areas of Mozambique, ACMD causes yield losses ranging from 20% to 80%. Several control measures have been suggested; by far the most promising is the use of resistant cultivars. In Mozambique, cv. TMS 30001 has been found to be resistant, and work continues to produce other resistant cultivars. One mechanism of resistance is that after infection, the virus remains restricted to the basal portion of the stem (Singh 1973).

A second control measure is to select planting materials from apparently healthy plants. If the cutting initially used for planting is healthy, then the resulting plant will be free of the disease. Even if the plant is later infected with ACMD through transmission by whitefly, it will not become as sick as when the disease is present in the 'mother' cutting. Even in healthy plants, the basal part of the stem is more likely to contain the virus; thus, cuttings from the middle of stems should be used.

The ACMV can be inactivated by growing infested cuttings at temperatures of 35-39 ^{o}C for 4-6 weeks. New shoot growth is devoid of disease symptoms (Chant 1959). A temperature of 39 ^{o}C gave a higher percentage of healthy plants than lower temperatures. Although this method may be effective for controlling the disease in small plots, its practicality in the field is yet to be tried.

Whitefly populations can be kept low by occasionally spraying with insecticides, such as Sevin (carbaryl), during the first 6 months after planting. After 6 months, infections are unlikely to become serious by harvest time.

Cassava bacterial blight **Xanthomonas campestris** *pv.* **manihotis** *(CBB)*

A serious disease, it is not yet a major threat to the Mozambican cassava crop. CBB usually results in heavy crop losses and, where infection is severe, the crop may be lost completely. The earlier in the season the infection occurs, the greater the eventual yield reduction. Several control measures exist for CBB: the first is to plant disease-free cuttings. Sprouts arising from older portions of infected plants are usually free of CBB for the first 2-3 weeks. They can then be excised and rooted to produce healthy plants. This method is used to produce certified CBB-free planting materials from clones that are already infected.

A second control measure is to effectively manage diseased material. If diseased plant residue is burned just before the dry season, then the bacteria will die in the dry soil. Managing diseased material on a regional basis is also important.

The use of resistant cultivars also helps control CBB, as does pruning most of the aboveground portion of infected plants. This latter method only delays the disease; it does not completely control it. Moreover, because pruning results in severe yield reductions, this measure is not usually recommended.

Crop rotation also controls CBB, as the genus *Manihot* is its only host. Given that the pathogen survives in the soil for only a few weeks and in plant residue for a few months, if other non-susceptible crops are grown for one or two seasons before cassava, the disease will have been effectively controlled. Control will be even more certain if plant residue is burnt in conjunction with crop rotation.

Cassava mealy bug (**Phenacoccus manihoti*****) (CMB)***

A major pest that has become a serious production constraint in Mozambique. It has caused yield reductions of 57%-85% (Singh 1980). The CMB is a dry-season pest, proliferating rapidly at temperatures between 27^{o} and 29 ^{o}C. It multiplies parthenogenetically: only one female is needed to cause infestation. In the field, CMB is spread by wind and, over large distances, through the movement of infested planting material.

Both short-term (cultural and chemical) and long-term (biological and resistance-breeding) control measures are being investigated. Some progress has been made, for instance, studies on cultural control have revealed that early planting and mulching can reduce pest damage. Chemical treatment of planting material is desirable, although chemical control is perhaps not recommended for Mozambique, where cassava leaves are eaten as a vegetable.

Parasites and predators of CMB have been found in Mozambique, but are of little help in controlling the pest. Biological control agents have therefore had to be introduced. During the 1987/88 cropping season, a predator (*Epidinocarsis lopezi*) was released by IITA and, so far, seems to be effective.

Biological control is a new approach for controlling CMB in Mozambique. Preliminary work initiated at INIA was directed towards identifying parasites and predators that are available locally and determining their efficiency in checking mealy bug populations. In some areas, the pest was apparently not controlled, probably because the quantity of predators released was too small. Another difficulty is that when CMB infestations are severe, farmers reduce their cassava fields drastically. Most predators released are produced locally and, with inadequate facilities, the predator population always decreases.

Variegated grasshopper (Zonocerus variegatus)

This insect causes considerable damage to the cassava plant by feeding. Infested plants can be completely defoliated, with the consequent loss of photosynthetic capacity. The grasshopper may also feed on the bark of some cultivars, resulting in the possible death of the entire plant. No effective control measure has yet been devised for the grasshopper. Fortunately, the grasshopper seems to prefer certain cultivars to others; identifying or developing cultivars that are unattractive to this pest may therefore be possible.

Cassava green spider mite (Mononychellus tanajoa) (CGM)

The mite is a serious pest that feeds on buds, leaves, and stems near the plant's growing points. The leaves that emerge from infested buds are deformed and have yellowish spots. Damage is more serious during the dry than the rainy season (Nyiira 1973). The mite can be controlled with chemical sprays such as Kelthane (dicofol), chlorobenzilate, or Rogor (dimethoate). These sprays, however, are expensive and not always economically feasible to use. Cultivar TMS 30395, screened at INIA, is moderately resistant to this pest.

Cassava scale (Aonidomytilus albus)

The scale infests mostly stems and cuttings, and is controlled by burning infested residue and planting healthy cuttings (Swaine 1950). When infestation is heavy, an insect predator (*Chilocorus distima*) may be introduced for biological control. Sivagami and Rao (1967) suggest that sprays of 0.1% Metasystox (methyl demeton), 0.05% parathion, or 0.1% malathion can control the scale effectively.

*Termites (*Coptotermes *spp.)*

These are serious pests in certain parts of the country, especially in newly planted fields where they may severely damage or weaken the cuttings, thus resulting in poor stand establishment. Older plants may also be attacked; but the more vigorous the plant, the less prone it is to termite attack. Control involves discovering the home of the termite colony and destroying it. Infested plant residue in the field should also be destroyed.

Advantages of Risk Management

In Mozambique, cropping cassava, using methods risk management, is indeed attractive. Its ease of cultivation, high yield per hectare, and ease of improvement through breeding combine to make cassava potentially a formidable competitor among food crops. Although cassava may not always be preferred to other crops as a food, it will always be patronized for as long as it remains a cheaper source of food calories than most crops. When its production (from planting to harvesting) becomes mechanized and improved cultivars are adopted, its competitive position throughout the country is likely to be enhanced. The type of research now being done on cassava suggests that these innovations will not be long in coming.

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