Constraints and Sustainable Solutions for Adoption of TC Banana Technology and Marketing

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Abstract

Proponents of biotechnology assert that this technology offers enormous opportunities to poor farmers and low-income consumers in developing countries. However, this study has revealed that very little can be accomplished in solving the problems of the rural poor in Africa unless a holistic approach is used to address the problems that they face in maintaining sustainable food production, security, and poverty reduction. The study was conducted to establish the constraints that limited the farmers in Kenya from adopting tissue culture (TC) banana technology. The solutions to these constraints were also examined. The study was done by use of structured research and was carried out in 12 districts of Central and Eastern Kenya where one hundred and seventy farmers were interviewed. In addition seventy-two traders and transporters in 36 markets in the region were also interviewed. The results of the study revealed that the TC banana technology has a great potential to the farming community in Kenya and has enormous provision for extended local market. However, the constraints identified by the stakeholders need to be addressed adequately before the potential is realized.

INTRODUCTION

Over 200,000 small, land holders growing about 70,000ha (equivalent to 2% of total cultivated land) undertake banana production in Kenya. The crop is of paramount importance in food security and income generation. About 1,000,000 t is produced with an estimated value of over US $80 million, equivalent to 50% of domestic horticulture production. Household consumption accounts for about 24 % of total production (Maed, 1997).

The banana trade, mostly dominated by women, is a major rural income generating activity. For instance, in some of the major banana growing areas (Kisii and Central Kenya) banana earns farmers over one billion shillings (US $ 12.5m) per year. At the family level, a small-scale farmer can earn Ksh 1600 (US$20) weekly by selling 5-10 banana bunches. The banana trade is also a major source of revenue to local councils. An on-going study estimates weekly revenue earnings of over 0.5 million shillings (US $ 6,250) for over 50,000 banana bunches traded in Central/Eastern Kenya. (Muthee et al., 2001).

Banana production in Kenya has undergone three phases of development. The predominant East African highland bananas (AAA) have possibly been cultivated for over a thousand years, and are common in all farming systems. In the early part of the last century, due to increased travel, additional cultivars were introduced with their local names denoting places of origin in the region. The second phase came between the 1950's and 1970's with introduction of improved cultivars i.e. Cavendish cultivars and new agricultural technologies e.g. fertilizers, spacing, pruning etc. In the late 1990's the last phase occurred with the introduction of tissue cultured bananas. Tissue culture (TC)

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technology stemmed out of a need to control diseases and pests that had spread through the conventional practice of planting suckers in all banana growing regions in Kenya and which has resulted in declined yields. The technology was also needed to multiply quickly and en masse adequate planting material of indigenous and exotic banana clones for the farming community. Prior to TC technology the country experienced a shortfall of banana planting material due to frequent droughts, disease, pests, limited suckers per stool, high transportation costs and other environmental pressures. It has also been shown through experiments that TC bananas are high yielding and produce better quality bunches than those produced through the conventional suckers.

Attempts to introduce TC technology to the small-scale farmers in Kenya showed that various other issues needed to be addressed for successful adoption of TC technology. This paper reports on results of a study that sought to look into constraints and possible sustainable solutions for the adoption of TC banana technology.

The goal of the study was to improve productivity and income generating capability of bananas through introduction of TC bananas and addressing various production and marketing constraints. The objectives for the study were:

- Identify constraints that prevent farmers from adopting TC technology;
- Apportion constraints to various solution systems to take action;
- Search for practical and sustainable solutions for constraints.

METHODOLOGY

The survey collected primary data using a structured research survey approach. Individual interviewing was done for the whole survey. Two questionnaires were used. The first was the farmers' questionnaire, which included all aspects of costs of production, home consumption, on farm sales and constraints that limit production. The survey covered districts in Central and Eastern Kenya and 170 farmers were interviewed. The second was the market questionnaire, which was divided into three parts. The first part covered the general characteristics of the markets and was answered with the help of the marketing officers. The second part covered all aspects of local banana trading. At each market a resident trader was interviewed. The last part covered aspects of transporting bananas to other markets. A transporter/ external trader was interviewed at each market. The market survey covered 36 markets in Central and Eastern Kenya. Various computer programs were used to analyze the data.

RESULTS AND DISCUSSION

The results of this study revealed a number of constraints that hinder the adoption of TC technology. Tissue culture bananas require more advanced husbandry practices than the traditional sucker-planted bananas, which in most cases are cultivated under minimum cultural practices. About 20% of the farmers complained of high production costs and about 10% lacked production inputs (Fig.2). In an analysis of 170 TC banana farmers in Central/Eastern Kenya, the number using some additional farm inputs was; manure (96%) fertilizer (30%) chemicals (6%) and watering (11%), (Fig. 1). The high use of manure is due to the fact that farmers in the area use semi and zero-grazing systems of cattle husbandry Inorganic fertilizers and chemicals are available in various agri-supply shops, but only a few can afford to purchase them. TC bananas require a great deal of water, especially after planting. Drought (Fig. 2.) was ranked highest by 40% of 130 farmers and only 11% had irrigation water (Fig. 1). Small holder banana production in Kenya is mainly rainfed making TC banana vulnerable to drought conditions. This creates additional limitation to the adoption of the TC technology. This problem can be addressed in the short run by incorporating water-harvesting technology in TC technology research, which could include roof water harvesting, shallow water holes and in the long term, promoting small- scale irrigation projects.

Traditionally cultivated bananas have been in the field for several decades without replanting and have thus declined in yields (below 10 t/ha) due to aging. Farmers require replacing the aged plants with the more vigorous and higher yielding TC plants. However, a demonstration of superiority of the TC technology over the conventional practice is required. Indeed some of the farmers reported that they were waiting to see the performance of the TC bananas in their neighbors' fields in order to make a decision on whether to adopt the technology or not. The Kenya Agricultural Research Institute (KARI) and Jomo Kenyatta University of Agriculture and Technology (JKUAT) have conducted on station trials of TC bananas for demonstration to farmers. The two institutions have also conducted similar demonstrations in farmers' fields through organized farmers' groups. Through this approach it has been demonstrated in a small scale that TC bananas have better yield performance than the traditional ones (Fig. 3). It is noted that in the major growing area of Kisii, farmers are realizing almost 30% of the TC potential. In the Coast farmers can realize about 70% of the potential. The highest realized potentials are 87% and 80% for Eastern and Central Provinces, respectively. These results show that with the use of TC bananas, yields can increase between 6-8 times per hectare if solutions to the constraints were found. However, more work is needed in this area.

About 25% of the farmers indicated lack of TC banana plants as one of the factors limiting them from adopting the technology (Fig. 2). However, it should be noted that inaccessibility rather than shortage of the TC planting material causes this problem. JKUAT, which is the main producer of TC bananas, has a pilot laboratory with a capacity of one million TC banana seedlings per year. However the laboratory markets only about 50,000 seedlings per year. This is because it is difficult to reach out to the approximately 200,000 small-scale farmers who are scattered throughout the banana-growing region. Moreover these farmers have limited resources and so they cannot afford the plants (each cost about US $ 0.75) and transportation cost to JKUAT to purchase them. To minimize this problem JKUAT has an on going project to establish village nurseries of TC banana, in order to make them more accessible. This project follows the Participatory Rural Appraisal (PRA) approach in which the farmers determine where and who should keep the nursery (Kahangi, 1999). It is hoped that this will not only improve the accessibility of the seedlings but also make them cheaper and therefore more affordable to the farmers.

Forty percent of traders (Fig. 4) and 8% of the farmers (Fig. 2) listed perishability of bananas during postharvest handling as a major constraint for the adoption of the TC technology. Results show that these losses occurred due to poor packaging (25%), poor infrastructure (61%), poor ripening methods (18%), and poor storage (29%) (Fig. 4). Bananas for home consumption and selling in the local market incur minimum losses. With increased marketing, postharvest losses become critical. Large volumes of bananas have to be transported for long distances, and stored for a considerable period of time. High ripening losses also occur as bananas of uneven maturity stages are ripened together. Postharvest diseases also take a large portion. The poorly set ripening environment and structures accentuate the losses, unpredictability, uneven ripeness (poor quality) and are unfriendly to environment. The limited space, which the traditional ripening structures provide, restrict the banana supply to only small volumes. TC technology provides high yields spontaneously resulting in large volumes which the farmers and traders do not have the capacity to handle. A typical marketing situation in Kenya is for farmers to transport banana bunches on ox-carts, wheelbarrows, bicycles, etc to the rural local markets. Traders use these markets as collection centers where the banana bunches are assembled and transported by trucks to large urban markets. Stacking whole bunches, bare or hands in gunny bags on large trucks encourage heavy mechanical damage due to compaction. Farmers and traders argue that the problem of high postharvest losses, packaging and transportation should be addressed if they were to benefit from the new TC banana technology. KARI/Thika is addressing some of these postharvest problems as explained below.

Banana packaging and transportation studies at KARI/Thika (Chege, 1996) indicate that only 23% of the banana bunches transported bare on tracks were sellable after 325km. Bananas dehanded and packaged in crates lined with a thin polyethylene sheet transported the same distance and track yielded 70% sellable bananas. In the pilot study sites dehanded and graded bananas are packaged in plastic crates (1kg) with a thin polyethylene sheet with a gross mass of 17kg, thus the unit of sale. KARI/Thika designed a one ton, 6mm plywood prefabricated banana ripening chamber that uses high yielding ethylene climacteric fruits, e.g. purple passion fruits, to effectively initiate banana ripening in schedule (Chege 2001). TC banana farmers in the pilot study sites are using this technology. They have also been trained on other postharvest techniques such as dehanding, delatexing, disinfesting, grading and packaging (Chege 2000). However this technology needs to be extended to other areas. KARI/Thika is also conducting a study on setting a maturity index calendar for various agro-ecological zones in Kenya. County/ Municipal councils should address the problem of storage facilities as nearly all the markets are open-air and do not have permanent stalls (Fig. 4).

Reliability of markets is catalytic in promoting production and consumption. Farmers will not adopt a technology unless there is a market outlet for the output. Thirty percent of the farmers (Fig. 2) complained of unreliable markets and 40% of the traders (Fig. 4) said prices were unreliable coupled with postharvest problems discussed above. Results showed that the banana marketing system in Kenya is rudimentary (comprising 88% open-air market) but has the basis for improvement (Fig. 5). Frequency of marketing days is a measure of reliability. Most markets operate for 2 days (66%). The region had 91 market days per week (Fig. 6). Competition is another measure of reliability. The 36 markets had 3318 banana traders accounting for 14% of all traders. The amount of bananas traded per market day was about 35,000 bunches and 63% were transported to other areas. This indicates a considerable opportunity for banana trade. The proximity to Nairobi markets gives another reliability indicator. Demand for bananas in Nairobi is about 4000 t per week and the Central/Eastern region supplies about 63% of this demand.

At the farm-gate level the farmer realizes a net margin of 37% of the selling price. At the rural market the trader still gets a margin of 28% of the selling price despite increased marketing costs. At the terminal market, mostly in Nairobi, the transporter/ trader realizes a net margin of 20% for green and 40% for ripe bananas. Favorable price relationships are critical to farmers. It was noted that cultivar preference influences prices at the market level giving a price differential of 46% while at farm level it was only 10%. TC bananas were ranked higher by consumers. This preference and price discrimination will play a critical role in adoption.

As discussed above, improvement in postharvest handling practices will lower the marketing costs and raise the net margins for farmers, traders, and transporters. This will encourage the three categories of stakeholders to adopt the TC technology faster.

Provision of good and adequate infrastructure is an essential for marketing and critical for bulk and perishable products like bananas. A good rural feeder network is particularly essential for production and marketing of bananas. The Kenya road network is over 150,000km. Rural access roads and minor road programs were aimed at improving rural roads but most roads are in a pathetic condition and impassable during rain seasons. The problem of poor roads was cited by all categories of stakeholders i.e., farmers (27%) traders (61%), and transporters (70%) (Figs. 2. and 4.). Poor roads increase transport costs and this has a bearing on final net margins. Average transport costs were analyzed at US $ 0.40 per bunch, which is about 39% of total marketing costs. This clearly indicates the need for an improved network. Road infrastructure is a public good and can only be solved on a long-term basis. There is a need for increased funding for rural feeder roads. Furthermore, the trucks used for transporting bananas and other horticultural produce are open, unrefrigerated and therefore unsuitable. This affects the quality of the products and hence the price.

CONCLUSIONS

The constraints identified by farmers, traders, market officials and transporters could be apportioned for their solutions to: public system, research community, private sector and farmers.

The public sector system includes the central and local governments. This system handles overall issues of national policies (agricultural, research, food technology, pricing, and infrastructure). In relation to TC bananas the critical area is funding of research and provision of extension.

Research should be geared at solving the problems that were identified in this study, which include: agronomic practices, irrigation requirements and water sources in banana production, postharvest handling, storage, quality assurance and distribution mechanism of TC banana seedlings.

The private sector consists of traders/transporters, cooperatives, banks, and processors. This sector has to be involved in physical provision of inputs, credit, packaging, storage facilities, transportation, etc. It has also to be involved in provision of information on cultivar preferences, prices and markets.

The farmer is the critical factor in adoption of technology and the fulcrum in weighing technical (research) aspects of the technology against the marketability and profitability of the technology. All aspects of technology transfer revolve around the farmer. On one side the farmers have to obtain information on technology availability, husbandry requirement, costs and information on markets and weigh them against private profitability, risk perceptions, and food security needs.

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Literature Cited

Chege, B.K. 1996. Banana packaging (crates) and transportation for domestic market in Kenya KARI, National Horticultural Research Center. Annual Report.

Chege, B.K. 2000. Farmers training on post harvest of horticultural crops, KARI, National Horticultural Research Center. Annual Report.

Chege, B.K. 2001. Use of Ethylene for commercial banana ripening, KARI, National Horticultural Research Center. Annual Report.

Kahangi, E.M. 1999. Participatory Rural Appraisal Assessment on Banana production constraints and opportunities. A report submitted to the Government of Netherlands through Biotechnology Trust Africa.

Ministry of Agriculture and rural development 1997, crop - Division annual Report

Muthee A.M. 2002. Draft Report on banana Production and Marketing in Central and Eastern Kenya.

Figures

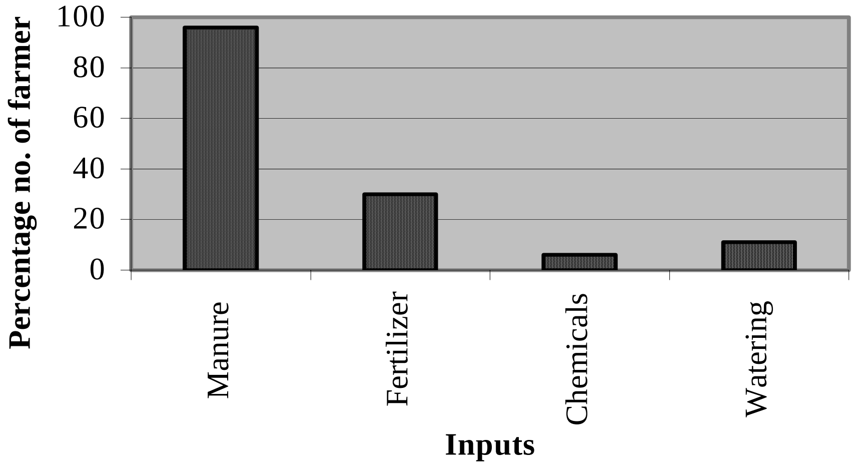

Fig. 1. Percentage of farmers using additional inputs in TC banana cultivation.

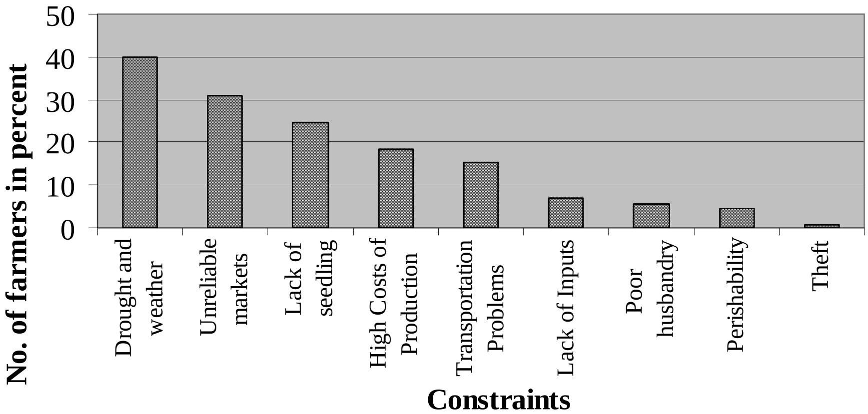

Fig. 2. Constraints limiting production of TC bananas.

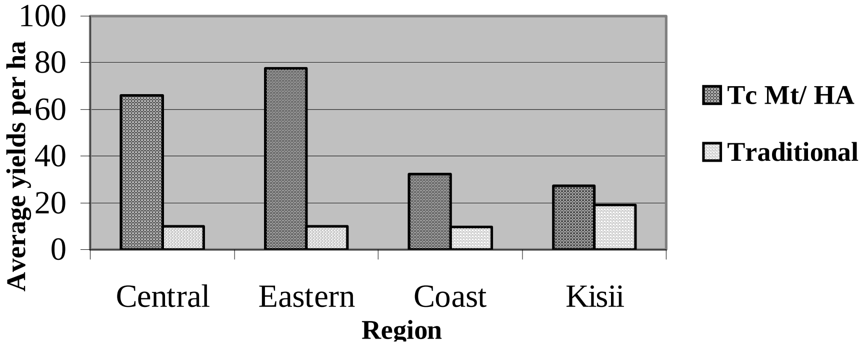

Fig. 3. Yield comparison on TC and traditional bananas.

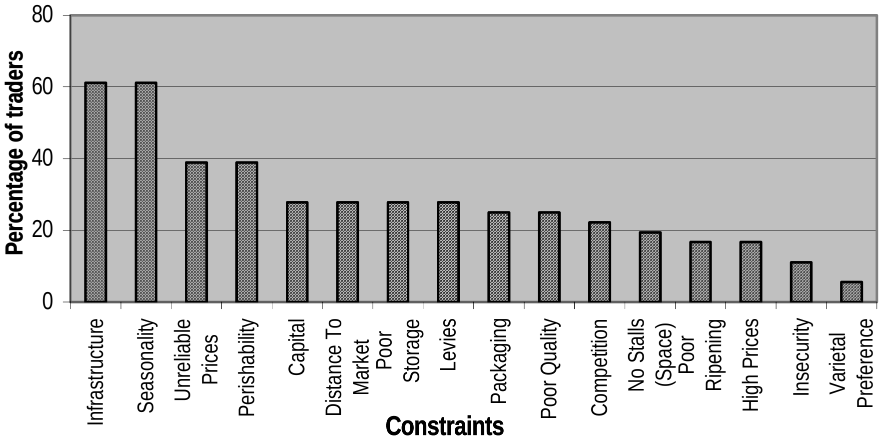

Fig. 4. Constraints faced by traders in banana marketing process.

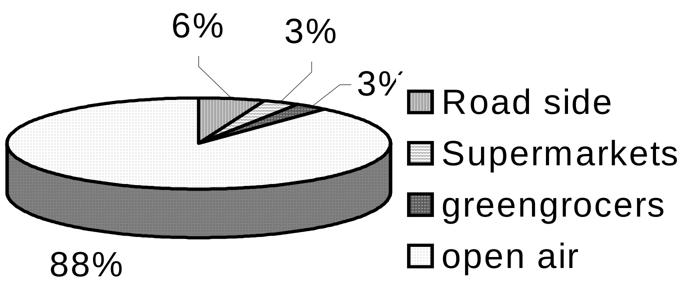

Fig. 5. Banana marketing system in Central and Eastern Kenya.

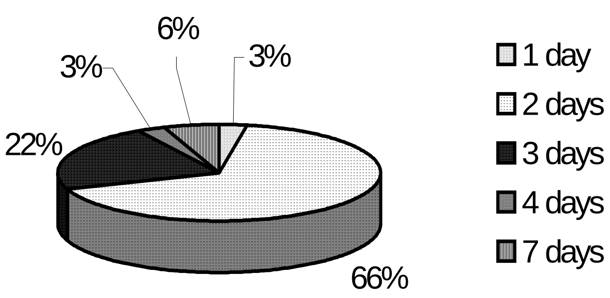

Fig. 6. Frequency of marketing in Central and Eastern Kenya.