ECONOMIC ANALYSIS OF IMPROVED BANANA CULTIVARS PRODUCTION IN TANZANIA. A CASE STUDY OF RUNGWE, MVOMERO AND MKURANGA DISTRICTS

BY

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A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN AGRICULTURAL ECONOMICS OF SOKOINE UNIVERSITY OF AGRICULTURE. MOROGORO, TANZANIA.

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ABSTRACT

A study was carried out to assess the profitability of improved banana cultivars in Rungwe, Mvomero and Mkuranga districts. Specifically, the study aimed at comparing benefits of improved versus non improved banana cultivars production, determining the contribution of banana enterprise to total household income, assessing the factors that influence banana household income, assessing the changes in gender roles in improved banana farming system and suggesting the system of distributing new cultivars and clean planting materials to farmers. Data for the study were collected from a sample of 120 farmers; purposive sampling method was used to select the study villages. Cost Benefit and Regression analyses were employed in this study. Study results showed that, NPV was positive and higher on improved cultivar in comparison to non improved cultivars by Tsh 4 429 504 , CB ratio was greater than one though higher in improved cultivars by 3.3 , and IRR was greater than the opportunity cost of capital in both cultivars 16% per acre at 12% discount factor. Regression results in the three districts showed that age, education, gender, farm size, household size and number of extension visits per household were positively related to banana income, while, marital status was inversely related. However, there were no significant differences in contribution of banana income among the three districts. Gender role and decision making results indicate that no changes in these roles were observed among the three districts. To improve distribution of clean planting materials, it is suggested that, contact farmers should provide these cultivars to other farmers and establishment of more demonstration plots as sources of planting materials. Based on profitability of banana technologies, the study recommends the adoption of improved banana technology and the replication of this innovation to other areas with similar characteristics, as an approach towards poverty reduction.

DECLARATION

I, **AGNESS ALEX NDUNGURU**, do hereby declare to neither the Senate of Sokoine University of Agriculture that this dissertation is my own original work and has neither been submitted nor currently being submitted for a higher degree award in any other University.

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The above declaration is confirmed

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(Supervisor)

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DEDICATION

This dissertation is dedicated to the Almighty God who gives me strength and lights up my path, to my late father Alex Marianus Ndunguru and to mother Rosemary Joel Sinzobakwila, who brought me up and gave the value of education.

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LIST OF ABBREVIATIONS

%	=	Percentage
ANOVA	=	Analysis of Variance
ARI	=	Agriculture Research Institute
B/C	=	Benefit/Cost Ratio
CBA	=	Cost Benefit Analysis
EFGs	=	Extension Farmer Groups
FAO	=	Food and Agriculture Organization
FC	=	Fixed Costs
Fig	=	Figure
RGs	=	Farmer Research Groups (FRGs)
FSR	=	Farming Systems Research
GDP	=	Gross Domestic Profit
INIBAP	=	International Network for the Improvement of Banana and Plantain
IPGRI	=	International Plant Genetic Resources Institute
IRR	=	Internal Rate of Return
KCDP	=	Kagera Community Development Project
Km2	=	Kilo Metre Square
MAFS	=	Ministry of Agriculture, Food Security
MVP	=	Marginal Value Product
NBS	=	National Bureau of Statistics
NGO's	=	Non Governmental Organizations
NPV	=	Net Present Value.

OLS	=	Ordinary Least Square
PANTIL	=	Programme for Agriculture and Natural resources Transformation for Improved Livelihood
RA	=	Regression Analysis
SA	=	Sensitivity nalysis
SNAL	=	Sokoine National agriculture library
SQ KM	=	Square Kilo Metres
SUA	=	Sokoine University of Agriculture
TARP II	=	Tanzania Agricultural Research Project, Phase Two
TC	=	Tissue Culture
Tshs	=	Tanzania shillings
URT	=	United Republic of Tanzania
VC	=	Variable Costs
VPO	=	Vice President Office

CHAPTER ONE

INTRODUCTION

1.1 Background

Banana is the fourth most important staple crop in the world, and is critical for food security in many tropical countries (Smale *et al*., 2005). World banana production amounts to some 55 million tons per year, concentrated mostly in Africa, Asia, Caribbean, and Latin America (Yakob, 2003). Several million people depend on the banana trade for their livelihood.

Tanzania is one of the dominant banana producing countries in the world. It ranks second after Uganda in Africa and 7th among the major world producers of banana with an annual production of about 3.6 million metric tons (FAO, 1998; INIBAP, 2002). URT (2003) reported that banana has greater potential commercially through export to other regions and towns, particularly in Dar es Salaam where demand for banana is very high for food consumption. In this regard, banana plays an important role in food security and income generation and thus contributes greatly to the livelihood of smallholder farmers in Tanzania (MOAC, 2001).

Since the crop is harvested throughout the year, it ensures food and income security particularly at the household level. In the past 10 to 15 years, its contribution to household income has been increasing significantly whilst contributions of traditional cash crops such as coffee and tea grown in the same farming systems has been decreasing (Nkuba *et al*., 2002).

In Tanzania, banana production is predominant in the Eastern zone (Mkuranga and Morogoro districts), Northern zone (Moshi rural and Arusha districts), Southern Highlands (Rungwe and Ileje districts), and Lake Zone (Kagera Region) (Anon, 2002; Nkuba and Mgenzi, 2003).

Regardless of the important contribution of banana sub-sector in the livelihood of smallholder farmers, it is faced with various constraints which limit efficiency of the sector in terms of production and marketing (Nkuba and Mgenzi, 2003; Nabbumba and bahiigora, 2004). Among the important constraints is low yield and poor quality of bananas produced in banana growing areas (Nkuba and Mgenzi, 2003; Mbogoh *et al*., 2003). This is partly attributed to poor production practices and dominance of local varieties which are normally susceptible to major pests and diseases (Picq *et al.*, 1998; Mbogoh *et al*., 2003; Nkuba and Mgenzi, 2003)

In an effort to overcome the above constraints and hence improve banana productivity in the country, a project titled "*In-vitro*" micro propagation for mass production of clean planting materials of desirable banana cultivars" was initiated and implemented under the Tanzania Agriculture Research Programme Phase II - Sokoine University of Agriculture (TARP II SUA) from July 2001 to December 2004. The project aimed at the application of the *in-vitro* micro propagation techniques to facilitate higher rates of multiplication and production of clean (i.e., pest and disease free) propagules and introduction of new cultivars with desirable qualities. Thereafter, a follow-up project titled "Improvement of banana multiplication and cultural practices in the Eastern and Southern zones of Tanzania" which is implemented under PANTIL at SUA, was initiated and implemented. The project aimed at increasing the production of banana by farmers to reinforce their food security and livelihood. Among the other activities done by the projects include *In vitro* micro propagation for clean planting materials of desirable banana cultivars, introduction and evaluation of new banana cultivars to targeted farmers in the Eastern and Southern Highland zones of Tanzania.

Several achievements have been recorded with regard to the above two projects including the dissemination of improved cultural practice techniques and cultivars and evaluation of suitability and performance of introduced cultivars (Maerere *et al*., 2006). Scaling in and out of the introduced innovation to other farmers belonging to the same or different agro-ecological zones in the country has been regarded as the key forward strategy to cope up with the ever increasing requirement for qualitative and quantitative banana products and hence, increased food security and income.

In Tanzania bananas are mostly produced at the smallholder level, under permanent farming system where they are often grown in a mixture of cultivars intercropped with other annual and perennial crops. They are also produced in intensively managed home gardens where they benefit from regular applications of manure and household refuse. These production systems have now been unable to meet the demand of rapidly growing population in the major banana growing regions. Pest and diseases have also increased considerably leading to fast deterioration of gardens (KCDP, 2002).Furthermore, banana cultivars grown are limited to endemic landraces dominated by the AAA East African highland bananas, the plantains (AAB) and the desert AAA genome bananas. All these genome groups are known to be susceptible to the pests and diseases prevalent in the East African region (IPGRI, I998).

1.2 Problem statement and justification

Banana has been regarded as an important component of the food system of the Sub-Saharan Africa and Tanzania in particular (Nkuba and Mgenzi, 2003). Together with tropical roots and tuber crops such as cassava, yams and sweet potatoes, they form a major share of starch staple; therefore contribute to significant calories in consumption (Kalyebara, 2003). Yet compared with other cereals, there has been less research investment, less improvement at farm level productivity hence less potential to compete in a liberalized world market economy, and to participate in the rapidly developing urban markets (IPGRI, 1998).

In the last three decades, banana production has been faced by increasing infestations by pests and diseases, and declining soil fertility (Baijukya and Steenhijsen, 1999; Bosch *et el*., 1996). The major banana pests are banana weevils (*Cosmopolites sordidus*), and banana nematodes (such as *Radophilus similis, Helicotylenchus multicinctus* and *pratylenchus goodeyi*). Banana diseases are fusarium wilt known as panama (*fusarium oxysporum*), Black and Yellow sigatoka caused by *mycosphaerella fijiensis* and *mycosphaerella muscola*, respectively. Declining soil fertility due to leaching from heavy rainfall, and poor crop management practices also account for the current performance of banana and its contribution to household food security, which resulted into food insecurity and low income to households depending on the crop for their livelihood. Furthermore, the banana industry is currently facing the problem of inadequate planting materials which are free from disease and insect pest (Nkuba and Mgenzi, 2003). Currently, most farmers use traditional cultural practices in banana production which transmit most of the banana pests and diseases through banana suckers, which are sought and procured suckers (planting material) by farmers from one farm to another. The spread of pests and diseases through this practice can reduce banana yields by up to 90% (Mbogoh *et al*., 2003).

Nevertheless, limited research (i.e. TARP II SUA and PANTIL) has been carried out for the purpose of reducing some of these problems through "*in-vitro*" micro propagation techniques and improved cultural practices although some outstanding results have been recorded so far (Maerere *et al.*, 2006). To achieve significant impact of introduced technologies to other banana farmers elsewhere and hence improve banana production nationwide, this study was carried out to asses the economic worth of the introduction of improved banana cultivars which influence the adoption and use of these cultivars. However, there is no documented information on the economic analysis of these banana cultivars that have been introduced in the Eastern and Southern Zones of Tanzania.

Research findings are a useful feed back to the research community on cultivar benefit, and contribution of the crop itself to agricultural income, planners and policy makers, and banana project. Moreover, lessons learnt can be used to improve management and decision making process with respect to priority setting implementation and management of research activities as well as technology transfer. They may be useful for accountability purposes and to establish the credibility of the public sector research and to justify increased allocation of research resources.

1.3 Objectives

1.3.1 General objective

The main objective of the study was to undertake an economic analysis of improved banana cultivars production by smallholder farmers in Rungwe, Mvomero and Mkuranga districts.

1.3.2 Specific objectives

i. To compare benefits of improved versus non improved banana cultivars production.
ii. To determine the contribution of the banana enterprise to total household income.
iii. To asses the factors that influences banana household income.
iv. To asses the changes in gender roles in improved banana farming system.
v. To suggest the system of distributing new cultivars and clean planting materials to farmers.

1.3.3 Hypothesis

i. There is difference in terms of benefits between improved and non improved banana cultivars production.
ii. Socio- economomic factors relate significantly to household banana income.

1.3.4 Research questions

i. Do men and women have different roles in improved and non-improved banana production?
ii. What is the contribution of banana to household income?

1.5 Organization of the dissertation

This dissertation is organized into five chapters. Chapter one has an introductory part discussing the background information, problem statement and justification, objectives of the study, research questions and hypotheses. Chapter two is a review of relevant literature. Chapter three describes the theory and methodological framework. Chapter four is about the results and their discussion. And chapter five presents findings of the study, summarizes the concluding remarks and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Overview

Agriculture is by far the most important sector in Tanzania in terms of employment, contribution to Gross Domestic product (GDP) and foreign-exchange earnings. In 2004, the agricultural sector contributed 46% of GDP, accounted for about 51% of foreign exchange earnings and 75% of the total employment (URT, 2004).

Agriculture in Tanzania is rain-fed and an activity that is done by small scale farmers. Its growth rate has decreased from 6.5% in 2001 to 6.1% in 2002 due to various reasons including lack of adequate rainfall, falling world market prices, decline in production due to loss in soil fertility, pests and diseases infestations (URT, 2003). This implies that investment in agriculture is likely to lead to yield improvement in farm food production and income security for the majority of rural population.

At present, there is continuous need for investment in the improvement of crops and livestock as a contribution to poverty reduction efforts (MAFS, 2001). However, like in the other developing agricultural economies, where millions of dollars are spent on developing programmes each year, very little is known about the actual benefits of the programme to the poor (Backer, 2002). This situation poses challenging questions such as whether the programmed projects were effective, efficient, and achieved the intended goals. Doss (2003) observed that in the development of the agricultural sector, the increasing challenge for agricultural researchers and extensionist is how and when new technologies used by farmers benefit their livelihoods. There is, therefore, a need to investigate the worthiness of these projects on the livelihood of the poor.

2.2 Economic importance of banana

Banana is mainly produced by smallholder farmers on an average field size ranging from 0.5 to 1.7 ha per household (Mbwana *et al.*, 1998). Bananas are largely grown for food consumption, with surpluses sold in urban areas and some village centres of the rural areas. In Tanzania banana is the staple food crop of an estimated 20-30% of the total population (Nkuba, 2007). Despite the persistence of biophysical and economic constraints, the role of banana as a cash crop compared to other subsistence crops, has gained importance in recent years.

Since the banana plant produces fruit throughout the year, it contributes significantly to food and income security of households in banana growing areas. In the heavily banana-based farming systems such as Mbeya, Kagera and Kilimanjaro regions, about 70% to 95% of the households grow bananas for food and/or cash. In these areas, banana ranks first as the major staple food and first, second or third as a cash crop (Nkuba *et el.*, 2003). In other areas, households maintain only a few banana plants mainly for dessert and roasting. At the national level, banana ranks third in volume of production among food crops in Tanzania (NBS, 2001).

Tanzania cultivates about 350 000 ha of banana and produces 2.6 million metric tones per year (MOAC, 2001). Nkuba *et al*. (2003) reported that for the past ten years the area under banana fluctuate from 350 000 ha to 250 000 ha and its production ranged from 2 000 000 metric tones to 200 000 metric tones per annum. On average, expansion of banana production and increase in productivity of banana is limited by declining soil fertility, increased incidences of insect pests and diseases and poor marketing system.

Table 1: Banana production in each Region of Tanzania 2001 (estimated)

Region	**Tons (‘000)**	**Productivity T/Ha**	**Area (‘000) Ha**	**Rank**
Kilimanjaro	1 383.8	10.5	131.6	1
Kagera	1 150.0	8.3	137.7	2
Mbeya	434.6	9.6	45.2	3
Kigoma	258.3	8.3	31.2	4
Arusha	232.5	10.1	23.0	5
Tanga	113.5	8.7	13.0	6
Mwanza	69.1	7.3	9.4	7
Morogoro	26.1	8.7	3.0	8
Rukwa	18.4	9.2	2.0	9
Mtwara	17.0	7.7	2.2	10
Tabora	13.5	8.4	1.6	11
Ruvuma	9.2	9.2	1.0	12
Coast/DSM	7.0	8.7	0.8	13
Lindi	6.6	8.2	0.8	14
Iringa	1.8	12.0	0.2	15
Mara	1.7	12.0	0.1	16
Dodoma	1.6	8.0	0.2	17
Singida	0.8	8.0	0.1	18
Shinyanga	0.5	4.3	0.1	19
Total			**403.2**	**-**

Source: NBS, 2003

2.4 Gender roles in banana production system

Gender roles, which in this study means the activities performed by men and women and which are socially determined.This provides information and suggestion in banana production systems in terms of the relationship between men and women, Banana production and other enterprises activities. Generally, information on gender roles pinpoints different priorities and preferences of men and women and how introduced projects can work with both men and women in order to realize the intended goal of the project to be undertaken. Msuya (1998) reported that in Tanzania it is difficult for extension agents to hold meetings or address female farmers freely. In most rural societies, the social status of women is inferior to that of men. Due to this, they become a disadvantaged group, especially when it comes to the introduction of new technologies (Shayo, 1990). In most cases, development of technology may be gender neutral. However, its introduction in the society often ends up becoming gender biased.

The introduction of new techniques into rural sector is not a one day activity. Traditional methods root and form an integral part of agriculture, which binds the community together. Gender role information, in most studies including this one, is the valuable information in Banana farming as a farming system with diversity of product mix which creates many opportunities for all members of the family to be gainfully employed in the farming activities.

2.5 Constraints faced by banana farmers

The major banana production constraints faced by farmers in Tanzania include increased pressure of pests and diseases, declining soil fertility and poor agronomic practices (Bosch *et al*., 1996; Ndile *et al.*, 1999). The major pests of banana found in Tanzania are banana weevils (*Cosmopolites sordidus)* and banana nematodes (different species). Banana diseases are fusarium wilt (*fusaium oxysporum cv cubence*), and Black sigatoka (caused by *mycosphaerella fijiensis)*. In various combinations the different pests and diseases can cause losses ranging from 30-100 % of banana yields (IPGRI, 1998).

Regardless of the banana farming system, local banana cultivars demonstrate tolerance to fusarium wilt but none tolerates banana weevils and nematodes. Banana–based farming systems receive high levels of rainfall, which contribute to leaching of soil nutrients (Baijukya and Steenhijsen, 1999). Large amount of soil nutrients are removed through the harvested fruit bunches, especially if bunches are sold and taken away. Lack of nutrient replenishment in turn leads to declining banana productivity. Producer's prices are too low to justify the use of chemical fertilizers in banana production. The situation is exacerbated by inadequate extension and research services, poor farm input distribution systems, high prices of inputs, and lack of credit for either farmers or traders (Bosch *et al.,* 1996; Ndile *et al*., 1999; Nyirenda, 2001).

Many producers and traders have no information about prevailing prices in markets within and outside the country (Nkuba *et al.,* 2002; Lotter *et al.,* 2003). Banana bunches are bulky in nature and perishable. Farmers often have little alternative but to sell bananas at "throw away" prices. Banana traders have no insurance coverage, therefore the risk is undertaken solely by the business and traders are obliged to charge high marketing margins in order to offset risks associated with the processing of banana into products with longer shelf life products such as dried bananas, banana flour, banana biscuits and bread which is not well developed in the country. That is why only a stalemated of 5% of all banana production is processed (Mbwana *et al*., 1997).

2.6 Banana projects in combating banana constraints

The extension aimed at improving the banana production goes back to the colonial era. The colonial government attempted to eradicate banana weevils but farmers \ resisted the order of uprooting all bananas infested by weevils, partly because of misunderstanding the whole concept (Kabwote, 1974; Nkuba, 2007). Towards the end of the 1960s, an insecticide (dieldrin) was recommended for the control of banana weevils. The insecticide was given free of charge and more than 60% of the farmers applied it (Rald and Rald ,1975). After application, the insecticide was not promising due to falling of banana plants than before and farmers complained that the insecticide killed their banana plants (Ndile *et al.,* 1999). The same problems were also reported by FSR (1990) in Kagera region.

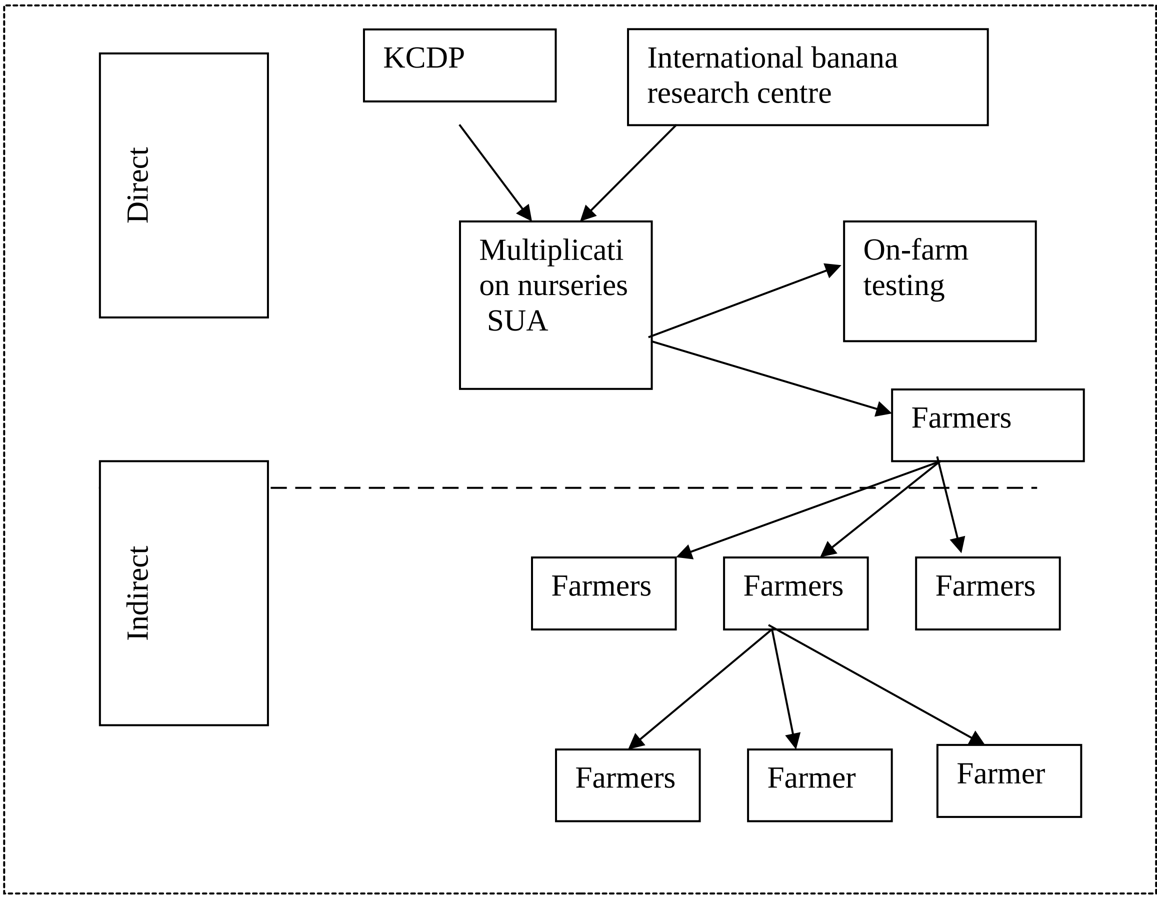
In 1990s, ARI Uyole in the Southern highland zone conducted dieldirin trials to combat the insecticide together with cultural practice of insect trap (Nsemwa, 1991). Most farmers have since been reluctant to apply chemicals in their banana grooves and the farmers reacted negatively to most of the chemicals in banana crop. The introduction of new banana cultivars into the three districts in the Eastern and Southern highlands zones of Tanzania was therefore considered to be a new remedy to the problem.

2.6.1 Introduction of new banana cultivars and planting material disseminations in the Eastern and Southern highlands zones of Tanzania

Since farmers reacted negatively to artificial chemicals on their banana fields, there was a need to look for an alternative such as planting materials that are tolerant to the existing biotic constraints. Between 2001 to 2004 the already mentioned projects aimed at increasing the production of banana by farmers to reinforce their food security and livelihood. Among the other activities done by these projects includes: *In vitro* micro propagation for clean planting of desirable banana cultivars, introduction and evaluation of new banana cultivars to targeted farmers in the Eastern and Southern Highland zones of Tanzania. A total of 26 local cultivars and 5 new cultivars imported from the international banana research centre were collected and established at SUA.

Concurrent to the disseminations activities, the project facilitated the on-farm testing of these cultivars. Over 11 000 plants were regenerated *in vitro*, acclimatized and disseminated to project 6 villages target formers': Kyimo, Bujela (Rungwe district), Tangeni, kwelikwiji (Mvomero district), Mwarusembe and Mkenge (Mkuranga district) and other demanding farmers and institutions. The number of plants disseminated was achieved through direct (nursery to farmers) and indirect (farmer to farmer) diffusion. Distribution of planting materials was mainly free of charge by the projects (Maerere *et al.*, 2006).

Fig 1 depicts the dissemination routes of superior banana varieties and actors involved from the international banana centres to farmers in the Eastern and Southern highlands zones of Tanzania. The dashed line demarcates the direct and indirect disseminations of superior bananas. In direct disseminations, farmers obtained new planting materials from multiplication nurseries, trials or demonstrations. Indirect dissemination refers to farmer to farmer transfer of planting materials.



Key: KCDP – Kagera Community Development Project

Figure 1: **Dissemination routes of new banana varieties in Eastern and southern highlands zones of Tanzania**

2.7 Banana establishment and operating costs

Production costs are normally classified into fixed costs (FC) and variable costs (VC), depending on whether they are incurred only once during the establishment of a project (hence establishment costs) or whether they recur even after the project is established (hence operating costs) (Mbogoh *et al.*, 2003; Hella, 2007). In this study, the costs of land preparation, digging of holes, planting materials and planting labour are classified as fixed costs (FC) since they are incurred only once during the establishment of the TC-banana crop, while the costs of the various types of inputs, including the labour for their application, weeding, deleafing and desuckering are classified as variable costs (VC) since they recur even after the crop is established.

2.8 Review of the previous studies in improved banana technonologies

The study by Mbogoh *et al.* (2003), on social-economic was primarily designed to evaluate the economic worth of the tissue culture (TC) banana project in Kenya. By tracing the operations for ten years, two studies were undertaken in subsequent years i.e., 2001 and 2002. In the evaluation of economic worth of the TC- banana project in Kenya, determination of discounted benefit-cost ratios was considered to be a sufficient analytical approach. The primary data was generated through the survey using structured questionnaires of a stratified random sample of 72 banana producers in the Maragua/Muranga region of Central Kenya, which is the main TC-banana project area in Kenya.

The former study by Mbogoh (2001) shows that the production of both TC and non-TC bananas is economically worthwhile. The benefit-cost ratios for TC and non-TC bananas production were found to be about 2.8 and 3.2 at 20% rate of interest and 2.5 and 3.0 at 30% rate of interest, respectively. The study also showed that the TC banana production has a much higher stream of benefits, with a net present worth which is about 3.4 times greater than that of the non-TC bananas. These findings by Mbogoh (2001). Indicated that TC banana production is considerably more financially remunerative as an enterprise than non-TC banana production.

The followed baseline socio-economic study on economic worth by Mbogoh *et al.* (2003), supported this conclusion, based on the results of profitability analysis. The study currently estimated the benefit – cost ratio of TC-banana production at 20% rate of interest to be about 4.8, a figure that generally reflects improved banana yields since the Mbogoh (2001) study. The analysis of profitability indices shows that the annual rate of return to capital invested in TC-banana production improves drastically as the banana establishment costs are recovered towards the end of year 1 of the TC-banana crop establishment and thereafter. Apart from the income generation perspective, bananas also provide food for household consumption.

Evidently, these two studies discussed above revealed that TC banana production is relatively more capital intensive than non-TC banana production. Comparisons of inputs, yields and returns show that non-TC banana production is basically a low input, low-output type of activity for small-scale farmers, and this makes it conceptually less demanding on their efforts. On the other hand, TC banana production is basically a high-input, high output type of activity. Hence, the production of TC-bananas is relatively more profitable than that of non-TC bananas, and the production of TC-bananas in the project area can be said to be making significant and positive contribution to the livelihoods of the involved rural households. The studies above concluded that small-scale farmers should be encouraged to switch from non-TC banana production to the production of the TC bananas. However, they would have to be educated and encouraged to adopt better management practices because the production of TC bananas requires higher husbandry standards. The higher financial returns per unit area of land associated with the TC-banana production should make the small-scale farmers appreciate the need for the proposed switch (Mbogoh *et al*., 2003).

From the above evidence the researcher found that there was a strong need to study the economics of these cultivars in Tanzania using the case study of Rungwe, Mvomero and Mkuranga districts and see to what extent these cultivars can improve and contribute to sustainable livelihood of the farmers in the country. In this study, the data was collected in situations where there were no clear cuts between farmers with improved cultivars and non-improved cultivars. The reason was that farmers in this study planted these cultivars by mixing them with non-improved cultivars. Furthermore, this study used NPV criteria for decision and later this was supplemented by CBR and IRR criteria. Sensitivity analysis was also undertaken to see what might happen to NPV results after being subjected to various changes.

CHAPTER THREE

METHODOLOGY

3.1 Location of the study areas

The study was conducted in four villages namely, Kyimo and Bujela in Rungwe district, Mbeya region, Tangeni in Mvomero district, Morogoro region and Mwarusembe in Mkuranga district, Coast region. These areas were involved in the PANTIL project entitled Improvement of banana multiplication and cultural practices in the Eastern and Southern Highlands Zones of Tanzania and potential areas in banana production.

3.1.1 Descriptions of the study districts

(i) Rungwe district

Rungwe district was selected as a representative of the Southern Highland regions (i.e., Mbeya, Rukwa, Ruvuma and Iringa) which are important agricultural regions of Tanzania. The district has some important cash and food crops, such as coffee, tea, pyrethrum, cocoa as cash crops and maize, paddy and banana as food and cash crops. Rungwe district covers an area of 2 211 sq. km of which 1 658.25 sq. km (1658 25ha) is suitable for agriculture, 231.06 sq km (22106 ha) is dry land and the remaining 55.27 sq km is not suitable for agriculture because it is water logged, forest and mountainous. The estimated population of Rungwe district is around 307 270 (URT, 2004). This implies that, on average each person in the district occupies about (0.53) of land suitable for agriculture, which is very small for agriculture production as compared to the average holding of about 1.26 ha within the small holder farming system in the country (VPO, 2004). This is explained by the high population density with a very high population to land ratio in the district (Mlambiti, 1999).

(ii) Mvomero district

Mvomero district is one of the six districts of Morogoro region. The other districts are Morogoro urban, Morogoro rural, Kilosa, Kilombero and Ulanga. Mvomero district has 17 wards and a population of 260 252 inhabitants of whom 731 256 are, males and 129 269 are females (URT, 2002). The per capital income of the people of Mvomero district in 2001 was estimated to be about 65 196 (Tsh 1 825 001). The main economic activity is agriculture; done by more than 85% of the population in the district. Food and cash crops include banana, maize, beans, cassava, sorghum, paddy, fruits, cardamom, coffee, cotton, sunflower and sugarcane. The majority of farmers depend on subsistence crop production. Livestock keeping is also carried out consisting of cattle, goats, sheep, donkeys and poultry. About 80% of the livestock include cattle, goats, sheep, donkeys and poultry kept by small and medium scale keepers who migrate searching for pastures and water.

(iii) Mkuranga district

Mkuranga district is one of the six districts that form the Coast region. It was established in 1995, when the eastern part and coastal area of Kisarawe district was cut off to form the district of Mkuranga. It is a relatively small district covering 2 432 square kilometres, which is about a quarter of the size of Bagamoyo and about the size of Zanzibar Islands. The district has about 90 kilometres of coastline, extending from Temeke to Rufiji districts. Like much of coastal Tanzania, the district is endowed with coral reefs, mangrove forests, and coastal fisheries. Remote unpopulated islands host endangered species such as the red colobus monkey and attractive birds. In Mkuranga, there are seven coastal villages: Shungubweni, Mpafu, Kerekese, Kisiju, Pwani, Mdimni, Magawa, and Kifumangao and several near-shore islands, hosting the Boza, Kuruti, Kwale, and Koma villages (VPO, 2004). Most of these villages are remote and inaccessible, despite their relative proximity to Dar es Salaam.

Agriculture is the principal economic activity, with over 90% of the households engaged in farming (URT, 2005). The most common food crops are cassava, rice beans and bananas. Major cash crops are cashew nuts, coconuts, pineapples, oranges and bananas. These have been chosen because banana is cultivated by virtually more than 50% of the farmers in the Coast region.

3.2 Research design

Non experimental design was employed whereby a cross sectional research design was used. This design was adopted because it is a one- time affair and is designed to obtain snapshot of a representative group of households at a given moment in time. The design has greater degree of accuracy and precision in social science studies, and it also allows for descriptive analysis as well as determination of the relationships between variables (Deaton, 1997; Bailey, 1998).

3.3 Sampling techniques

The study population was smallholder farmers growing banana in the study areas. The sample involved contact and non contact farmers in project areas. Purposive sampling method was used to select the study villages. Four contact villages (i.e. two from Rungwe, one from Mkuranga and Mvomero districts) initially involved in the projects were included. In each village, an equal number of banana farmers i.e. 15 contact farmers using improved banana technologies and 15 non contact farmers using non-improved banana technologies ware selected. Finally, the contact and non contact farmers were randomly selected.

3.4 Data collection

The study used both primary and secondary data. Primary data were collected from farmers using structured questionnaire while secondary data were collected from different sources.

3.4.1 Pre-testing of Interview schedule

The questionnaire was tested using 10 respondents purposively selected to involve both contact farmers and non contact farmers from Mvomero district and the necessary changes were made on the questionnaire following the results from the pre-testing exercise. This included restructuring and omission of some irrelevant questions.

3.4.2 Primary data collection

A structured questionnaire was designed to capture both quantitative and qualitative data. This consisted of both closed and open-ended questions. The questionnaires were formulated in English and translated into Swahili to facilitate easy communication during data collection. Information such as social-economic data, investment and operational costs, crop outputs and outlets as well as crop marketing and profitability, contribution of banana to household income, gender role in banana production, distribution mechanism of clean planting materials, and general information in banana production systems was accessed through the questionnaire. The units of study were households; therefore appointment was done through village extension officers to respondents' residential areas for interviewing.

3.4.3 Secondary data collection

Additional information was sought from relevant documents/reports and other documentary materials. These were mainly from different institutions such as; Sokoine National Agriculture Library (SNAL) in Morogoro, District offices visited,SUA horticultural unit and internet. Information from these sources was used to supplement information obtained from the field.

3.5 Data processing and analysis

3.5.1 Analytical tools

Both descriptive and quantitative analyses were employed in this study based on the objectives stated. Statistical Package for Social Science (SPSS 12) computer software was used to analyze and generate descriptive statistics mainly statistical measures of central tendency (means, frequencies, and percentages), measures of dispersion (standard deviation), and cross-tabulation. The quantitative analysis which involved benefit -cost analysis and linear regression were calculated using Microsoft Excel 2003 and SPSS 12 respectively.

3.5. 2 Descriptive analysis

A considerable part of the analysis was based on descriptive statistics to describe the responses, characteristics, and trends of some of the data and information. Descriptive analyses such as means, standard deviations, ranges, cross tabulations and frequency distributions were employed to describe the data. SPSS 12 was used to assess changes in gender roles and contribution of banana enterprise to household income

3.5.3 Cost- Benefit Analysis (CBA)

Cost benefit analysis (CBA) systematically analyses the economic justification of a potential investment decision. It involves identifying, measuring and placing monetary value on costs and benefits of a particular project proposal and then comparing these costs and benefits as an aid for decision making (Gittinger, 2001).

CBA is also concerned with identification, quantification and valuation of information about benefits and costs in order to determine the worth of an enterprise. Once costs and benefits have been identified, if they are to be compared, they must be valued. Since the only practical way to compare differing goods and services directly is to give each a monetary value, proper prices for the costs and benefits had to be found in the analysis.

CBA has a great potential as a tool for analysing agricultural project/practices. Its advantages include its wide acceptability, use of a common unit of currency (money) and it has the potential to quantify and compare a broad range of factors, inputs and outputs.

CBA however, has its shortcomings. These include the use of monetary unit as a measure of all costs and benefits. CBA has difficulties in accommodating social and environmental tangibles and its assumption that a favourable income distribution exists does not always hold (Senkondo, 1992).

The CBA discount measures such as Benefit Cost Ratio (BCR), Net Present Value (NPV) and Internal Rate of Return (NRR) are principal measures of project worth. However, important items for consideration in this analysis involved, discount rate, identification of costs and benefits and valuation of benefits and costs.

3.5.4 Cost and Benefits of banana production

In project analysis, the objectives of the analysis provide the standard against which costs and benefits are defined. Simply put, a cost is anything that reduces an objective, and a benefit is anything that contributes to an objective. In banana production, the costs were classified into fixed costs and variable costs, depending on whether they are incurred only once during the establishment of a project (hence establishment costs) or whether they recur even after the project is established (hence operating costs). In this study, the costs of land preparation, digging of holes, planting material and planting labour were classified as fixed costs (FC) since they are incurred only once during the establishment of the banana crop, while the costs of the various types of inputs, including the labour for their application, weeding, deleafing and desuckering were classified as variable costs (VC) since they recur even after the crop is established. A benefit is the production obtained from the first as banana can produce bunches in the first year of establishment and up into the other subsequent years. The produced bunches were valued according the prevailing market prices to get the current money value per production.

3.5.5 CBA in banana production systems

Preparation of CBA for evaluation of improved banana production involved five stages

i. Identifying and measuring costs and benefits
ii. Placing monetary values on costs and benefits
iii. Discounting costs over the life span of banana production
iv. Presentation of the results of the analysis and
v. Making the conclusion using data obtained

The study used the NPV criterion for comparing the two banana production systems, The B/C and IRR criteria were used to supplement the main NPV in improved banana cultivar production versus non improved banana production systems. The different systems were therefore taken to be mutually exclusive alternatives. The preferred discounted measure of the project worth for choosing among mutually exclusive options was the NPV criterion. It is argued that when there are several mutually exclusive alternatives, determining NPV of each enables one to choose directly the best among them (Gittinger, 2001).

Net-Present Value (NPV) refers to a discounted cash flow measure of a project worth which is the current. It is a present worth of cash flow stream. In economic analysis, it is a present worth of the incremental income generated by the investment. The formal selection criterion for the NPV is to accept all projects with zero or greater NPV when discounted at the opportunity cost of capital. This is described below**:**

$$NPV = \sum_{i=0}^{n} \frac{B_i - C_i}{(1+r)_i} \quad or \quad \sum_{i=0}^{n} \frac{INB_i}{(1+r)^i} \quad or$$

$$\sum_{i=0}^{n} \frac{B_i}{(1+r)^i} - \sum_{i=0}^{n} \frac{C_i}{(1+r)^i}$$

Where:

NPV = Net Present Value

INB = incremental net benefit

r = discount rate

n = number of years

I = number of years

B = benefits

C = costs

One advantage of NPV over other discounted measures is that it makes no difference at all as to what point in the computation process, the netting–out of benefits and costs takes place regardless of whether it is done in the middle or end of the project life. However, since NPV is an absolute and not a relative measure it imposes a serious drawback because no ranking of acceptable alternative project or management level is possible using this criterion. A small highly attractive project may have a smaller NPV than a large marginally acceptable project. Another limitation is that this measure cannot be applied unless there is a relatively satisfactory estimate of the opportunity costs of capital.

Benefit –Cost ratio (B/C), according to Hella (2007) is the ratio of project benefit to project cost. The ratio is one of the most popular criteria used in project appraisal and evaluation especially for economic analysis. Benefits and costs are counted at the time they are earned or spent and the cash flow is extended over a period of several years. Usually the number of years is assumed to be the useful life of the useful economic life of the proposed project. Since the project life extends over several years, the cash flow must be discounted to compensate for the time value of money. The decision rule in the benefit-cost analysis is to accept all projects with benefit-cost ratios greater than one when discounted at the selected opportunity costs of capital. Described below**:**

Benefit/Cost (B/C) Ratio = $\frac{\sum Discounted\ Benefits}{\sum Discounted\ Costs}$

$$B/C = \frac{\sum_{i=0}^{n} \frac{B_i}{(1+r)^i}}{\sum_{i-0}^{n} \frac{C_i}{(1+r)^i}}$$

Where:

B/C = Benefit cost ratio

INB = incremental net benefit

r = discount rate,

I = number of years,

B = benefits,

C = costs,

IRR is another frequently used measure of project worth. It does not require the use of a discount rate for its calculation because the IRR is the discount rate that makes the net present worth of the incremental cash flow equal to zero (Gittinger, 2001; Backer, 2002). A satisfactory return should be at least as high as the estimated discount rate. Described below:

IRR is where: $$IRR = \sum_{i=0}^{n} \frac{INB_i}{(1+r)^i} = 0$$

Where:

IRR = Internal rate of return

INB = Incremental benefits in year t

r = discount rate

n = planning horizon or life of project

Thus, the project with IRR greater than the cost of capital is worth.

Sensitivity analysis (SA) is also another important tool in decision making and in developing recommendations for decision makers, better communication, increased understanding or quantification of systems, and model development. In this study, the focus of the SA was on the first three uses. Since the parameter values and assumptions of any economic analysis/model are subject to change or error, SA was done to investigate these potential changes and errors and their impact, i.e. the difference they make to the conclusions drawn from the economic analysis when there is uncertainty about their future values. SA gives information that is important in developing flexible recommendations which depend on circumstances. It is also important in identifying sensitive or important variables. Secondly, SA gives information for increased understanding or quantification of the system by estimating the relationship between input and output variables, and lastly, how much worse off the decision makers would be if they ignored the changed circumstances and stayed with the original or some other strategy (Pannell, 1997). However, Franzel *et al.,* (2001) reported that the method has one measure shortcoming since it fails to account for the probabilities of future outcomes of concerned analysis.

In the case of this study the key question concerned three strategies: opportunity cost of capital of 12% was raised up to 25%, total costs were increase to about 30% and prices of banana produce was reduced by 10%, and changes of NPV and net benefit for each strategy from the base analysis were calculated.

Sensitivity analysis was used by FAO (1992), Gittinger (2001) and Senkondo *et al*. (2000) to assess the effect of changes in key parameters such as input-output coefficients, discount rates, or prices of inputs and outputs (Franzel *et al.,* 2001) and to come up with other values of NPV which were used to decide on investment proposed.

3.5.6 Choosing the discount rate

The discount rate for economic analysis is the interest rate or the opportunity cost of capital. In this study, the CBA was required to compare two banana cultivar production systems. Since costs and benefits of banana have different features and occur for a long time, it is essential to convert the future costs and benefits into parent value, by discounting. Usually it is difficult to estimate an exact discount rate, however, both Powers (1981) and Baum and Tolbert (1985) suggest using real discount rate of 10% to 12% for public investment projects. Gittinger (2001) suggested a common choice to be 12% and World Bank proposed 10% to 12% as an opportunity cost of capital for Tanzania. Therefore, the discounting rate used in this study was 12%. However, since many farmers have relationships with local commercial banks, a lending discount rate of 20% was also used as an opportunity cost of capital for this study. A discount rate of 25% was also used to determine what might happen to NPVs .

3.5.7 Pricing costs and benefits of banana production

The main assumption in undertaking CBA is that prices reflect value or can be estimated in that manner. Economic theory states that commodities have to be priced at their marginal value product (MVP), that is, where the MVP of the commodity equals its price (Senkondo, 1992). Alternatively, commodities are to be valued where the price of every goods and services is exactly equal to the value that the last unit utilized contributes to production. Another method is the use of opportunity costs in valuing goods and services. Theoretically, pricing should be at the point where MVP, opportunity cost and price are equal. At this point no more transfer of resources could results in greater output or satisfaction. However, this occurs where real perfect marketing are operating, that is, where there are many buyers and sellers with knowledge about market and there is no government intervention in the markets. In the real world, markets are not perfect and never in equilibrium (Gittinger, 2001). However, market price is the best approximation of the true value of goods and services that is fairly widely bought and sold (Gittinger, 2001).

In this study, economic analysis was undertaken using prices that reflect real resource use or consumption satisfaction. Therefore market prices were determined at the point of the first sale, what is known as the market farm gate prices. In the study areas, farmers sold their banana in fields therefore no transportation cost was experienced. However, since agricultural product prices are subject to seasonal fluctuations, market price will therefore vary with time of the season. Gittinger (2001) reported that the best point to obtain farm gate prices is at the peak of harvesting season. In this study, the banana crop was harvested throughout the year and selling the crop took place at any time, this implied that banana price was mostly affected by the peak and harvest of other competing crops.

3.5.8 Pricing of non traded goods

For non traded goods such as labour and land, economic analysis requires that they be valued at their marginal value product if they are intermediate goods or services, or according to the willingness to pay criterion if they are final goods or services (Gittinger, 2001).

In the study areas the principle main sources of labour were family members, complimented with little hired labour. The average wage rate per day was Tshs 1500 for all the surveyed districts.

3.5.9 Handling inflation

Inflation is an increase in the general price level of an economy. It has been reported by Hella (2007) that in the past few years, virtually every country has experienced inflation, and the only realistic assessment is that this will continue. Therefore, no project analyst can escape deciding how to deal with inflation in his analysis. The approach that is most often taken is to work the project analysis in constant prices rather than current prices (Gittinger, 2001). In using constant prices it is assumed that current price level (or some future price level-say, for the time of project analysis) will continue to apply. The main assumption in using constant prices is that inflation will affect the prices of all costs and benefits equally except for the specified costs and benefits that varied in comparison with the other so that relative prices of these specified costs and benefits change (Gittinger, 2001). Furthermore, using constant prices allow the analyst to avoid making risky estimates of future inflation rates and to simplify the analytical procedure (Gittinger, 2001). In this study, the 2007 constant prices were adopted.

3.6 Regression analysis

A good and reliable business decision is always founded on a clear knowledge of how a change in one variable can affect all the other variables that are in one way or another associated to it. The Regression Analysis (RA) is a statistical tool which analyzes the relationship between quantitative variables. The objective here is to determine how the predicted or dependent variable Y (the variable to be estimated) reacts to the variations of the predictor or independent variables (Gujarat, 2003).

The first step should be to determine whether there is any relationship between the independent and dependent variables, and if there is any, how important it is. The covariance, the coefficient of correlation and the coefficient of determination can determine this relationship and its level of importance (Gujarat, 2003). But these alone do not help make accurate predictions on how variations of the independent variables impact upon the dependent variables. The objective of RA is to build a mathematical model that will help make accurate predictions about the impact of variable variations. It is obvious that in most cases there is more than one independent variable that can cause the variations of a dependent variable.

When building a regression model, if more than one independent variables are being considered, this is called a multiple regression analysis, but if only one independent variable is being considered, the analysis is a simple linear regression.

The regression model used in this study is shown below

$Y = \alpha + \beta x_i + \mu$

Where:

Y	=	Dependent variable
Xi	=	Independent variables
α	=	constant term,
μ	=	error term
β	=	degree to which independent variables influence the dependent variable at a given level.

In this study, linear regression analysis was used in assessing the factors which affect the value of banana income and planting materials demand. The basic assumption made in this analysis was linearity among dependent and independent variables.

While it is not always true that linearity exists, this assumption was made to make the computational of the functional form easy. It is relatively easy to compute the regression coefficients using the ordinary least square technique (OLS). The main emphasis on regression is its ability to allow prediction, explanation or both. Based on the objective of the analysis, the main aim is to find out how the selected variables can affect banana income and planting materials demand. Thus, the aim of this analysis was explanation rather than prediction. A linear multiple regression model of the form:

$$Y_i = \alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots\ldots \beta_7 X_7 + \mu$$

Where:

Y_i = House hold banana income (i = 1, 2 and 3 districts)

X_1 = Age of the respondents in years

X2 = Number of years in school (education)

X3 = Gender of the respondents (dummy 1= male, 0 = female)

X4 = Marital status of the respondents

X5 = Household size of the respondents

X6 = Number of extension visits per household

X7 = Farm size

β_1, β_2, β_3, β_4, β_5 and β_6 = coefficients of variables (βs indicate the degree to which different factors affect banana income).

α = constant term

μ = error term

This was estimated for Rungwe, Mvomero and Mkuranga separate data based on the assumption that the error terms are randomly and independently distributed. Therefore, the model was used to obtain estimators using ordinary least squares.

The explanatory power of the model was based on the value of the coefficient of determination (R^2). High values of R^2 indicate a large proportion of the observed variation in the dependent variables explained by the included independent variables.

Important problems normally encountered in linear regression analysis are multicollinearity, heteroskedasticity and autocorrelation. The last problem is common for time series data and because this is study was cross-sectional, then the first two problems are considered.

Multicollinearity arises due to correlation among independent variables (Gujarat, 2003). When independent variables are highly correlated, it is not possible to determine the separate effect of any predictor variable on dependent variable. The most typical case encountered in practice is some imperfect, possibly due to the strong association among predictors. In this study multicollinearity was tested by running a VIF test.

Another econometric problem common in linear regression is associated with inconstant error term variance that is heteroskedasticity (Deaton, 1997). Heteroskedasticity problem means that the assumption of constant error term variance (homoskedasticity) is violated. Heteroskedasticity affects the standard errors estimated using OLS method where most of the variance becomes large leading to small t-ratios, where most of the parameter estimates become insignificant unnecessarily (Maddala, 1992). A simple test using scatter plots was used to observe whether the data were normal distributed with constant variance existing or not.

3.6.1 Variables for banana income

a) Dependent variable:

Household banana income was the dependent variable. This is the value of all income generated from banana by the farmer in the 2006/2007 cropping season at the household level. Banana yield in bunches and its respective price was presented as banana income. Monetary unit was used to estimate physical unit of banana production. Household banana income was calculated from banana income generated by farmers in the 2006/07 season. The aim was to determine factors which have influence on banana household income. This study was mainly interested in the value of total banana production (considering both the value that was marketed and consumed). Consumption was valued at the market prices.

b) Independent variables:

The following independent variables were assumed to influence the value of banana income:

X_1 = Age of the respondents in years

X2 = Number of years in school (education)

X3 = Gender of the respondents (dummy 1= male, 0 = female)

X4 = Marital status of the respondents

X5 = Household size of the respondents

X6 = Number of extension visits per household

X7 = Farm size

Coefficient for age was expected to have positive sign, because age indicates maturity of a person, therefore older age implies higher thinking capacity and experience in banana production and hence increase in banana income.

Education coefficient was expected to have positive sign because through formal education one gets more knowledge and skills that enhance the ability to effectively manage resources and obtain higher returns.

Gender of the respondent was expected to have positive sign as male gender is associated with stronger financial and ownerships of resources such as land. The capacity to own resources also is associated with crop production activities including banana production. Thus the coefficient was expected to be positive in favour of male.

The household size also affects banana income. Larger households are assumed to own large banana farm sizes since they have enough labour. This is because labour is one of the inputs to banana income increase. Therefore its coefficient is expected to be positive.

Number of extension visits per household affects banana income because, farmers can improve their banana quality and quantity through skills and knowledge from extension worker. Therefore, coefficient for this variable was expected to be positive.

Banana farm size was expected also to affect banana income. This is because large banana farm size is associated with higher banana yield which increases banana income. Thus the coefficient for banana farm size was expected to be positive.

3.6.2 Variables for banana planting materials demand

a) Dependent variable:

Quantity of banana planting materials demanded was the dependent variable. This is the quantity of banana planting materials demanded by the farmer in the 2007/08 cropping season at household level. The aim was to determine factors which have influence on banana planting materials demanded.

b) Independent variables:

The following independent variables were assumed to affect the banana planting materials demand and were included in the regression model.

X_1 = Age of the respondents in years

X_2 = Number of years in school (education)

X_3 = Gender of the respondents (dummy 1= male, 0 = female)

X_4 = Marital status of the respondents

X_5 = Household size of the respondents

X_6 = Number of extension visits per household

X_7 = Farm size (acre)

X_8 = Price per improved banana cultivar planting material (Tsh)

X_9 = Price per non- improved banana cultivar planting material (Tsh)

X_{10} = Time from planting to harvesting (months)

X_{11} = Banana income (Tsh)

Coefficient for age was expected to have positive or negative sign. Because there is an argument that as an individual grows older; he/she might find it too risky to be involved in activities that are uncertain such as planting improved banana cultivars. But also he/she may be able to take risk due to experience and security. On the other hand, young aged in most cases might deny taking innovations including improved banana cultivars due to lack of experience and socio-economic circumstances (Yazdan and Gunjal, 1998). Yet they can easily take on risky decisions due to their aggressiveness and motivation to accomplish their life goals earlier. Hence both signs positive or negative were expected.

Education coefficient was expected to have positive sign because education is associated with great understanding of new information and benefits of new technology. Therefore educated banana farmers were expected to have more demand of improved banana planting than those with less or no education.

Gender of the respondent was expected to have positive sign as male gender is associated with stronger financial and ownerships of resources such as land. The capacity to own resources also is associated with better crop production management including use of improved banana production skills. This is coupled with using improved banana cultivars which improve banana production. Therefore, the coefficient expected to be positive in favour of male.

The household size also affects demand of banana planting materials income. Larger households are assumed to own large banana farm sizes since they have enough labour. This is because labour is one of the inputs to increase banana production which is associated with demand of banana planting materials. Therefore its coefficient is expected to be positive.

Number of extension visits per household affects banana planting materials income because; farmers can improve their banana quality and quantity through skills and knowledge from extension worker. These skills and knowledge could be using of improved banana planting materials in farmers' field which will be associated with increase demand of improved banana planting materials. Therefore, coefficient for this variable was expected to be positive. Banana farm size also was expected to affect demand of banana planting materials. This is because farmers with large farm size are expected to demand more banana planting materials because they have enough space to expand banana production. The coefficient for banana farm size was expected to be positive.

Price per improved and non-improved banana cultivars planting materials were expected to affect demand of banana planting materials negativery.because increase in the price is associated with decrease in demand of banana planting materials.

A coefficient for Time from planting to harvesting was expected to be positive or negative sign. Banana planting materials with shorter time from planting to harvesting are likely to increase demand of banana planting materials, than those with longer time.

A coefficient for Banana income was expected to affect demand of banana planting materials positively. This is due to reason that, increase in banana income is likely to increase demand of banana planting materials.

3.7 Limitation of the study

The study had the following limitations, which must be taken into account when interpreting the results:

a) Responses of the interviews and the questionnaire were based on respondent‘s memory since most farmers keep no written records of their activities. farmers also had problems of memory recall and some could not estimate some of the research parameters like farm size, age, output harvested per area, amount sold, consumed and convention of local measurements like bags, *tenga* or *fungu* to metric measures (kilogram or tons). In some cases, the researcher had to rely on their rough estimates.

b) Finally, some respondents were not willing to give information because they had never received feedback from studies that were previously conducted. Their argument was “we benefit nothing in answering questions”.

Inspite of the above limitations, the researcher is confident that the data collected is reliable and has adequately addressed the objectives of the study as elaborated in the next chapter.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Overview

This chapter presents the empirical findings of this study. The findings are presented in a way that they allow a logical flow of ideas as governed by the study's objectives and hypotheses. The chapter begins with description of farmers' social economic characteristics, followed by a comparison of the benefits of improved banana cultivar versus non- improved cultivar production, contribution of banana crop to household income, gender roles in banana production system and suggestions on distribution of clean planting materials.

4.1.1 Age of respondents

Table 2 shows that the most active age of the respondents considered was between 19 to 60 years old. Generally results indicate that more than 60% of the interviewed farmers in Rungwe, Mvomero and Mkuranga districts were in the adult category of ages between 36 and 60 years. Variation was significant at 5% to imply differences in age distribution among the districts. The observed age distribution among respondents implies that banana production has absorbed a large number of the economically active population who form the potential labour in agriculture production.

4.1.2 Gender of respondents

Gender characteristic of the respondent are shown in Table 2. The overall Results on gender revealed that, men dominated banana production business and the variation was significant to indicate differences in gender distribution among the districts. Experience has shown that in most patriarchal African societies, male tend to show-up mostly in events happening outside the households than female. Due to these factors, women are often not available during promotion and training on new technologies. There is also a tendency for men to control finance (though not the case of female-headed households) in most rural households thus men have higher purchasing power compared to women. This situation also prevails in banana farmers as majority of males are the ones who own banana fields and show- up during interview sessions in all the study districts.

4.1.3 Marital status of respondents

In this study respondents were also asked to state their marital status. The overall results show that, majority of respondents in Rungwe, Mvomero and Mkuranga districts were married (Table 2) The larger percentage of married respondents among the banana farmers indicates higher proportions of increase in household size and stable families. A stable family can concentrate on production than an unstable one, this may influence banana production as the crop is perennial which needs stable and settled family to take care of it. However, F-test was not significantly different, implying that the marital status distribution was almost the same in all the surveyed districts.

Table 2: Socio – economic characteristics of sampled banana farmers

Variable measured	Rungwe (n= 60)	Mvomero (n = 30)	Mkuranga (n = 30)	Overall % (n= 120)	F-test
Age of respondents					
19 -35 years	36,7 (22)	6.7 (2)	26.7(8)	26.7(32)	
36-60 years	55.0(33)	83.3(25)	63.3(20)	64.2(77)	
> 60 years	8.3 (5)	10.0(3)	10.0(3)	9.2 (11)	4.628*
Gender of respondent					
Male	53.3(32)	70.0(21)	80.0(24)	64.2(77)	
female	14.7(28)	30.0(9)	20.0(6)	35.8(43)	3.502*
Marital status					
Married	90.0(54)	90.0(27)	90 .0(27)	90.0(108)	
Single	3.3(2)	3.3(1)	6.7(2)	4.2(5)	
Widowed	5.0(3)	3.3(11)	3.3(1)	4.2(5)	
Divorced	1.7(1)	3.3(1)	0.0(0)	1.7(2)	0.112
Education level					
None primary	18.6(11)	10.0(3)	46.7(14)	23.5(28)	
Primary	78.0(46)	86.7(26)	46.7(14)	72.3(86)	
Secondary	3.4(2)	3.3(1)	6.7(2)	4.2(5)	4.043*
Land acquisition					
Inherited	66.7(40)	76.7(23)	33.3(10)	60.8(73)	
Bought	13.3(8)	13.3(4)	60.0(18)	25.0(30)	
Hired	1.7(1)	6.7(2)	6.7(2)	4.2(5)	
Offered by village authority	5.0(3)	0.0(0)	0.0(0)	2.5(3)	
Inherited and bought	8.3(5)	0.0(0)	0.0(0)	3.3(4)	
Inherited and hired	5.0(3)	3.3(1)	0(0)	4.2(5)	1.366

Note: Figures in parentheses are numbers of observations. Note: * Significant at 5%, N= Number of respondents

4.1.4 Education level

Results in Table 2 show that majority of the sampled banana farmers had primary education and hence they can read and write. However, the study revealed that 46.7 % of farmers in Mkuranga district have no formal education accounting for the higher percent among the respondents who did not attain any formal education. The reason could be the dominance and influence of Islamic culture in this district as compared to other surveyed districts. F –test was significant at 5%, indicating variations in education among the districts.

Education is one of the long-term strategies that may be used to improve agriculture in the developing counties like Tanzania. Saito (1994) and Akyoo (2004) reported that education in agriculture contributes 50% of the variation in total agriculture output. Likewise, Mwikila (1992) and Mathania (2007) reported education being a factor of growth and productivity. Roughly, the results indicate that sampled banana farmers are knowledgeable. Farmers with this level of education have the potential of adopting modern innovations given conducive environment (Moock, 1976; Saito, 1994) implying better adoption of banana innovations.

4.1.5 Mode of land acquisition for banana farmers

Results in Table 2 showed that majority of respondents in this study acquired land through inheritance. Only a few respondents were observed to hire or offered land by the village authority. Traditionally, land obtained though inheritance in the study areas was reported by respondents in Rungwe and Mvomero districts. Land acquired through this process was divided amongst the sons. Married daughters cultivate farms of their husbands. It was reported by Rwambali (1990) and Urio (2005) that land shortage has not been experienced in Tanzania except for densely populated areas. In many cases, therefore, land shortage may not be the major cause of low production, instead the size/fertility and presence of pests could be the main cause. . However, F-test was not significantly different, implying that the mode of land acquisitions was almost the same in all the surveyed districts.

4.1.6 Household size

The overall mean household size among the three districts was 6.13 people (Table 3). Mkuranga district had a higher household size (7.43) compared to the observed overall mean in all surveyed districts. The higher mean number of people per household in Mkuranga was probably due to polygamy in the district. According to the 2000/01 Tanzania household budget survey, the average household size of the Tanzania mainland is about 5 people (NBS, 2003).

The study results revealed that the study areas had relatively high household sizes compared to the mean household size of mainland Tanzania. However, it is expected that average household size decreases with level of development although slowly and in most cases, better households tend to be smaller (NBS, 2002). Family size was used to determine the available labour for farm work and extent of production, and it also determines the consumption level in a family.

Table 3: Mean household size in the sampled districts

	Districts			
Variables	**Rungwe** (n= 60) Mean	**Mvomero** (n = 30) Mean	**Mkuranga** (n = 30) Mean	**Overall** (n=120) mean
Household size	5.55(1.6)	5.97(2.34)	7.43 (3.12)	6.13(2.36)
Number of male	2.64(1.1)	2.9(1.72)	2.98(2.08)	2.98(1.63)
Number of female	3.02(1.2)	2.79(1.69)	3.15(1,83)	3.15(1.53)

Note: Figures in parentheses are Standard Deviations
n= Number of respondents

4.1.7 Source of labour

On average, each household from this study had around 6 individuals who could permanently provide labour for household production activities. The overall results in

Table 4 show that for the majority of respondents the main source of labour is family members/combination of family and hired labour in the entire surveyed district. It was observed in the study areas that banana labour requirement by farm activities are not seasonal like any other annual crops since banana farms require labour almost throughout the year. Therefore using family labour minimizes competition of immediate activities with hired labour.

Table 4: Percentage distributions of respondents by source of labour

Source of labour	Districts			
	Rungwe (n= 60)	**Mvomero** (n = 30)	**Mkuranga** (n = 30)	**Overall** (n=120)
family labour	59.0(36)	39.3(10)	45.2(14)	50.0(60)
hired labour	1.6(1)	7.1(2)	16.1(5)	6.7 (8)
both family and hired	39.3(61)	57.1(16)	38.7(12)	43.3(52)

Note: Figures in parentheses are Standard Deviations
n= Number of respondents

4.1.8 Extension services

The results in this study revealed that there were substantial extension services in all the three districts (Table 5). More than 80 % of the respondents reported that there is high extension services delivery in study areas with regard to banana production activities. Very few respondents did not benefit from extension services particularly on banana production. Farmers in the surveyed district reported to benefit more from technical help with regard to banana production than other crops due to presence of banana projects in their districts. Thus, results obtained in Table 6 prove that there is substantial extension service delivery in the study areas concerning banana production.

Table 5: Distribution of respondents by contacts with village extension workers

	Districts			
Responses on contact	**Rungwe** (n= 60)	**Mvomero** (n = 30)	**Mkuranga** (n = 30)	**Overall** (n=120)
Yes	86.7(52)	82.1(23)	87.1(27)	85.7(102)
No	13.3(8)	17.9(4)	12.9(3)	14.3 (17)

Note: Figures in parentheses are numbers of observations N= Number of respondents

4.1.9 Area under banana cultivation

The results in Fig. 2 and Table 6 showed that, generally between 2003/04 and 2006/07 banana acreage in all surveyed districts experienced an increasing trend. The results summarized indicate a positive increase from year to year with a linear increase of the banana area cultivated as shown in Fig. 2. The reason could be its increasing demand as a source of food and cash crop in the study areas. Secondly, banana crop is fairly well distributed in the study areas with tropical and sub tropical climatic condition which allows a wide range of its production. Furthermore, the banana crop is social economically important to both poor farmears and traders who prefer growing banana in the area as it can serve as source of food and income generation throughout the year. In Mkuranga district the mean area was observed to be lower than other study districts, this was attributed to by long drought season experienced in the district compared to others, however, in this area farmers reported that the banana crop was about to be abandoned, but was revived as a result of the introduction of the banana project.

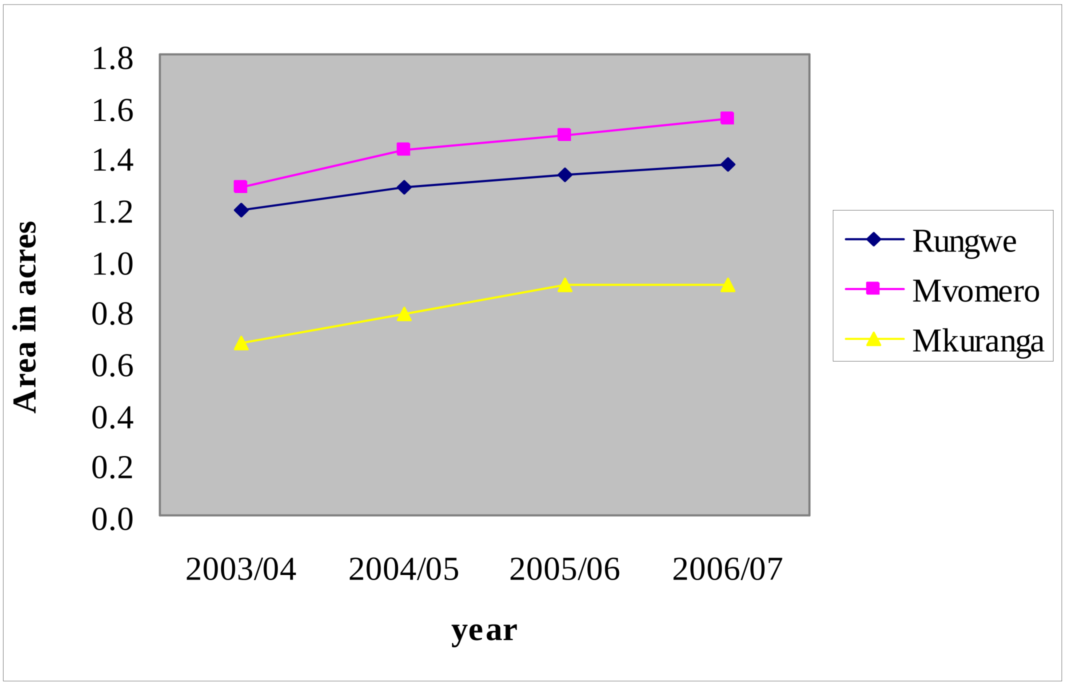


Figure 2: Trend of banana acres cultivated in the study areas

Table 6: Average acres under banana cultivation

Year	Districts			
	Rungwe (n= 60) Mean	**Mvomero** (n = 30) Mean	**Mkuranga** (n = 30) Mean	**Overall** (n=120) Mean
2003/2004	1.19(0.82)	1.28(1.31)	0.67(0.88)	1.08(1.00)
2004/2005	1.2(0.89)	1.43(1.44)	0.79(0.97)	1.19 (1.09)
2005/2006	1.3(0.93)	1.48(1.43)	0.90(0.99)	1.26(1.10)
2006/2007	1.3(0.96)	1.55(1.55)	0.90(0.88)	1.29(1.14)

Note: Figure in parenthesis are Standard Deviation N= Number of respondents

4.1.10 Banana cropping systems

Table 7 presents the results on cropping systems observed in the three districts. In Rungwe district mixed cropping systems was reported by more than 50% of the respondents, followed by intercropping. In Mvomero and Mkuranga sole cropping systems was more dominant, followed by intercropping, while mixed cropping system was reported by few respondents.

In Rungwe district the mixed cropping system was due to land scarcity, high population density and productivity of the arable land which allows mixing of different crops, banana spacing in this area was widely practiced to meet farmers' objectives compared to the other study districts.

Table 7: Percentage distributions of farmers' by banana cropping systems

Cropping systems	Districts **Rungwe** (n= 60)	**Mvomero** (n = 30)	**Mkuranga** (n = 30)	**Overall** (n=120)
Sole	6.7(4)	53.3(16)	46.7(14)	28.3(34)
intercropping	43.3(26)	26.7(8)	33.3(10)	36.7(44)
Mixed cropping	50.0 (30)	16.7(5)	20.0(6)	34.2(41)

Note: Figure in parenthesis are number of observation
N= Number of respondents

4.1.11 Use of manure in banana production

Table 8 presents a summary of manure use. More than 80% of the respondents used manure in their fields. For those who did not use manure the reason was due to unavailability and higher prices, which they could not afford. Those who used manure kept livestock and had ability of buying manure from other sources. However, researchers recommend manure fertilizers over inorganic fertilizers in the banana fields (skinner, 2004) which might be the reason for the higher percentages observed.

Table 8: Percentage distributions of respondents by the use of manure

Use of manure	Districts **Rungwe** (n= 60)	**Mvomero** (n = 30)	**Mkuranga** (n = 30)	**Overall** (n=120)
Yes	96.6(57)	63.3(19)	90.0(27)	86,6(103)
No	3.4(2)	36.7(11)	10.0(3)	13.4(16)

Note: Figure in parenthesis are number of observation
N= Number of respondents

4.1.12 Use of irrigation in banana production

Table 9 shows the responses on irrigation use in banana production by district. The overall results indicate that more than 80% of respondents are not using irrigation. While use of irrigation was reported by few respondents in the study areas, the highest percentage of respondents in irrigation use was observed in Mvomero district compared to other districts. Mkuranga results show that more than 80% of interviewed farmers did not use irrigation in their banana crop although the district experience more dry periods than other district surveyed. Generally, the results in irrigation use for this district could be attributed to by higher investment costs and shortage of irrigation facilities.

Table 9: Percentage distributions of respondents by irrigation use

	Districts			
Irrigation of bananas	**Rungwe** (n= 60)	**Mvomero** (n = 30)	**Mkuranga** (n = 30)	**Overall** (n=120)
Irrigate bananas	25.4(15)	43.3(13)	13.3(4)	26.9(32)
Do not irrigate	76.6(44)	56.7(17)	86.7(26)	73.1(87)

Note: Figure in parenthesis are number of observation
N= Number of respondents

4.1.13 Availability of banana planting materials

The study revealed that availability of banana planting materials in the study areas is adequate. Table 10 shows that more than 80 % of the respondents are able to obtain these planting materials. However, this was only for local banana cultivars due to higher density of banana plant numbers maintained per stool by farmers and the ability of this crop to regenerate vegetatively. For improved cultivars, the planting materials are scarce because very few farmers have this type compared to the local banana cultivars in the study areas. Furthermore, banana Planting materials (suckers) are the most important input when considering the two banana production systems. Availability of these banana planting materials ensures persistence of banana crop in prospect. This implies that the proper strategy to increase improved banana planting materials must be in place so that farmers can secure them easily.

Table 10: Percentage distribution of respondents' by availability of planting materials

	Districts			
Availability of planting materials	**Rungwe** (n= 60)	**Mvomero** (n = 30)	**Mkuranga** (n = 30)	**Overall** (n=120)
Available	88.1(52)	83.3(25)	72.4(21)	83.1(98)
Not available	11.9(7)	16.7(5)	27.6(8)	16.9(20)

Note: Figures in parentheses are numbers of observations
N= Number of respondents

4.1.14 Sources of improved banana planting materials

Table 11 shows the different sources of banana planting materials in the three surveyed districts. Majority of the respondents acquired planting materials from previous fields including demonstration plots of improved banana cultivars in 2006/07 season. Few farmers reported other sources of banana planting materials such as extension officers, banana PANTIL project and relatives/neighbours. Farthermore,Mkuranga results show that main sources of planting materials by farmers was from relatives/neighbours.

Some farmers who planted improved cultivars in the study areas utilized materials from the established demonstration plots established by PANTIL projects and from other pioneer farmers who acquired the materials from the project. This is farmer to farmer mode of disseminating planting materials. However, farmers in the study areas complained about the limited sources of these planting materials which hinder the spread of improved banana cultivars.

Table 11: Percentage distribution of respondents' by sources of improved banana planting materials

Sources	Districts			
	Rungwe (n= 60)	**Mvomero** (n = 30)	**Mkuranga** (n = 30)	**Overall** (n=12)
From previous season	74.1(43)	66.7(20)	40.7(11)	64.3(74)
Extension officer	10.3(6)	3.3(1)	0.0 (0)	6.1(7)
Banana PANTIL project	3.4(2)	10.0(3)	14.8(4)	7.8(9)
Friend/relatives/neighbouring	12.1(7)	20.0(6)	44.4(12)	21.7(25)

Note: Figure in parenthesis are number of observation
N= Number of respondents

4.1.15 Credit accessibility in the study areas

Table 12 summarizes various information with regard to credit accessibility in surveyed districts. The summary includes responses on access to credit facility, borrowing money, sources of credit and reason for not borrowing. Respondents' access to sources of credit revealed that more than 90% in Mkuranga were unable to access credit from any source. With regard to borrowing money, Rungwe was the leading district by percentages. Generally, source of credit among the three districts was SACCOS, this was due to the fact that SACCOS have been established in most of the rural areas in recent years bringing the service near to farmers. However, majority reported that credit facilities were not available and higher risk as reasons for not borrowing.

Table 12: Percentage distribution of respondents' by credit information

Variables	Rungwe (n= 60)	Mvomero (n = 30)	Mkuranga (n = 30)	Overall (n=120)
Access to credits facility				
Have access	53.4(31)	26.7(8)	6.7(2)	34.7(41)
Do not have access	46.6(27)	73.3(22)	93.3(28)	65.3(77)
Did you borrow money				
Borrowed	82.0(50)	53.6(15)	38.7(12)	64.2(77)
Did not barrow	18.0(10)	46.4(13)	61.3(19)	35.8(43)
Source of credit				
NBC	0(0)	11.1(1)	0(0)	2.4(1)
Cooperatives	19.4(6)	22.2(2)	0(0)	19.0(8)
SACCOS	80.6(25)	55.6(5)	50.0(1)	73.8(31)
Individual	0(0)	11.1(1)	50.0(1)	4.8(2)
Reason for not borrowing				
Not available	63.0(17)	37.5(6)	82.8(24)	65.3(47)
Not interested	3.7(1)	6.3(1)	3.4(1)	4.2(3)
High risk/afraid	33.3(27)	56.3(9)	13.8(4)	30.6(22)

Note: Figure in parenthesis are number of observation
n= Number of respondents

4.2 Cost- Benefit Analysis of improved and non-improved banana cultivars production

CBA was undertaken for the selected two banana cultivar production systems, that is, farmers with and without the project in Rungwe, Mvomero and Mkuranga districts. The basic assumption in undertaking CBA is that farmers aim at maximizing net benefits from the banana production. On the basis of this assumption, farmers will prefer a banana production system that has higher net present value as a criterion for decision making.

4.2.1 Working assumptions

The following assumptions were adopted;

i. Banana is harvested between 11 and 15 months after planting, little is known about its economic life. Interviewed farmers of Rungwe mentioned that banana can last up to infinity, while in Mvomero and Mkuranga the banana life span was mentioned to be more than 10 years under good management. Based on above and for simplicity the assumed useful life span is 10 years.

ii. Price used was valued at market prices of the 2007 constant prices. Bananas produce in the study districts were sold at different prices reflecting the type of cultivar sold, size and respective district. To simplify the calculation, all the prices were averaged to come up with one figure using farm gate prices of Tsh 3 600 and 2 000 for improved and non improved cultivars, respectively.

iii. Banana production was estimated per one acre because most farmers were used to this unit of land.

iv. Discount rate used was 12%, 20% and 25% as described in the methodology chapter.

v. Banana production costs were classified as investment and operation costs which occur in year 1 and 2 on wards. This study estimated an average investment cost for improved banana cultivar of Tshs 725 096 and 63 001.67 as operating costs from year 2 onwards. For non improved cultivar, average costs were estimated at Tshs 533 409.7 and 46 793.33 for investment and operating costs, respectively. These were average costs reported by farmers in the study areas with an assumption that improved banana cultivars differ from non-improved banana cultivars in costs of seeds (Suckers), manure, des-suckering and irrigation use.

vi. Banana yields were estimated as an average of 516.3 bunches per acre per annum for improved cultivars and 450 bunches per acre per annum for non improved cultivars. The estimated yield in this study were lower than that reported from SUA horticulture research unit of about 600 to 750 bunches per acre per annum in average for improved banana cultivars.

4.2.3 Results of Costs Benefit Analysis

The results of CBA in respect to the two banana cultivar production systems are shown in Table 13. The results from this analysis showed that after discounting all benefits and costs at 12 %, all the cultivars earned positive Net Present Value, which means that in all scenarios the costs can be recovered. Cost Benefit ratio was above one for both cultivars which ensure that investing in all cultivars all costs will be recovered at the end of assumed economic life. However, the rate of return observed was above the opportunity cost of capital estimated which was 12%.

From these results on decision criterion selected, the cost benefit analysis indicates that all cultivars are worth undertaking. However, the criterion was to select the higher value for the calculated discounting measures which is higher in improved banana cultivars at the chosen discount rate for the period of 10 years.

Table 13: Results of Benefit Costs analysis calculation in Tshs per acre

Measure of project worth	Improved banana cultivars		Non –improved banana cultivars	
	12%	20%	12%	20%
NPV	8 162 749.0	5 678 826.0	3 733 246.0	2 562 388.0
BCR	8.6	7.0	5.3	4.3
IRR	16.7%		16.7%	

Source: calculated from appendix 2 and 5

4.2.4 Sensitivity analysis

The CBA does not consider risks and uncertainties. NPV, BCR and IRR are subject to change with changes in opportunity cost of capital, market prices for input and outputs. For these reasons, systematically the NPV results were subjected to various tests. Observations were made of what would happen to the earning capacity of the two cultivars, if opportunity cost of capital is raised up to 25%, increase of total costs to about 30% and when prices of banana produce is reduced by 10%. The results in Table 14 showed that, when opportunity cost of capital was raised, NPVs for both cultivars fell by more than 30% for improved and non improved cultivars. For other suggested changes, the resultant NPVs result showed insensitive to neither reduced prices of output or increase in costs of inputs, since resultant NPVs remained positive when all suggested changes were made to imply stable profit earnings in banana production.

Table 14: Results of sensitivity analysis calculation in Tshs per acre

Sensitive variable measured	Improved cultivar			Non- improved cultivar		
	Original NPV 12%	Resulted NPV 12%	Change NPV %	Original NPV 12%	Resulted NPV 12%	Change NPV %
Increase DF-25%	8 162 749	4 635 573	30.4	3 733 246	2 071 908	44.5
Increase costs by 30%	8 162 749	7 878 567	3.5	3 733 246	3 523 553	5.6
Reduced price/output by 10%	8 162 749	7 251 747	11.2	3 733 246	3 290 024	11.8

Source: calculated from appendix 3, 4, 6 and 7

4.3 Proportion of contribution by banana crop to total household income

Fig. 3a, shows the proportional contribution of banana crop in percentages to total household income in Rungwe district. The summarized percentages in Rungwe district indicate banana contribution was the second in contribution to household income despite the fact that, the district is a banana dominant farming system compared to other surveyed districts. The cause for this might be price offered for banana bunches at peak harvest was low while for maize crop was high to indicate more contribution in the household income. Other minor crops had the least contribution to household income in 2006/07 season. In the district, it was noted that most of the crops cultivated had dual functions of being both food and cash crops excluding traditional cash crops shown in the pie chart. These were for cash earnings only. However, compared to these two traditional crops, banana was contributing more to regular household income. Furthermore, banana crop is harvested throughout the year and perennial in nature with less variable cost compared to other food crops. Also, it allows mixing of other small crops in between like vegetables and legumes which is responsible for household day today life. The benefit observed in this farming system summarises that banana contribution is very important to household income regardless of its position in a pie chart below.

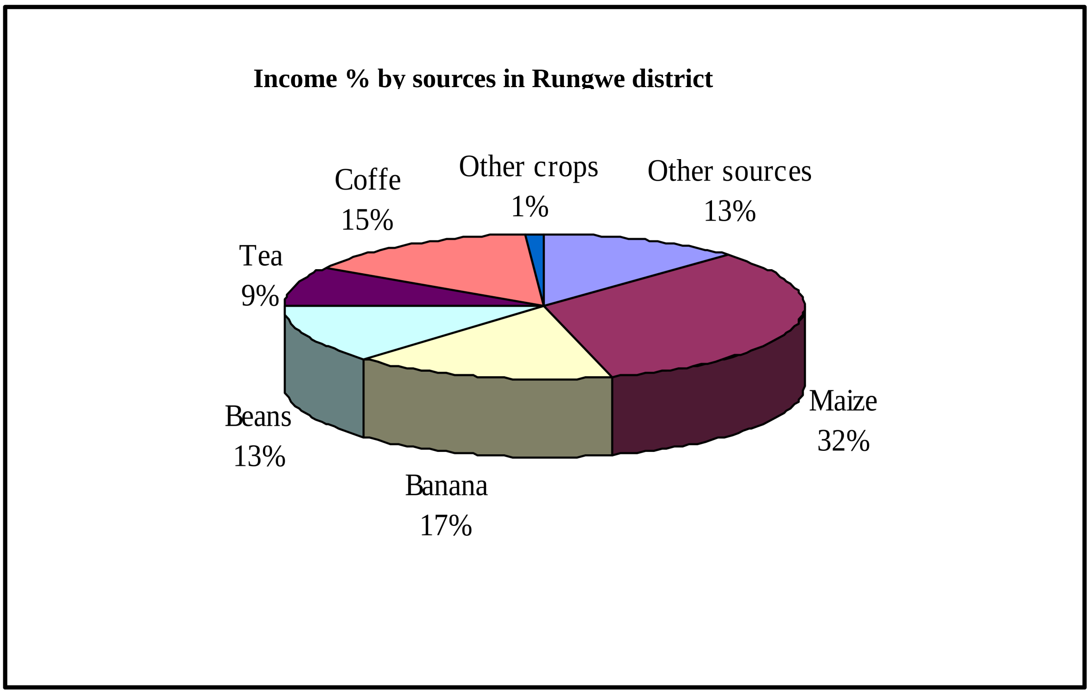


Figure 3a: Proportions of income from different crops and other sources of income in Rungwe district 2006/07 season

Mvomero district in Fig. 3b, the results differ from those shown in figure 4a, banana contributes more than 30% to household income. The contribution of other crops and other sources of income in this district were less important however, to make banana more prominent in contribution as shown in pie chart. The reason for this could be due to the potentiality of the area in the production of this crop and its proximity to the Dar -e s salaam market where the consumption of banana as a dessert and plantain are higher for the produce (URT, 2003).

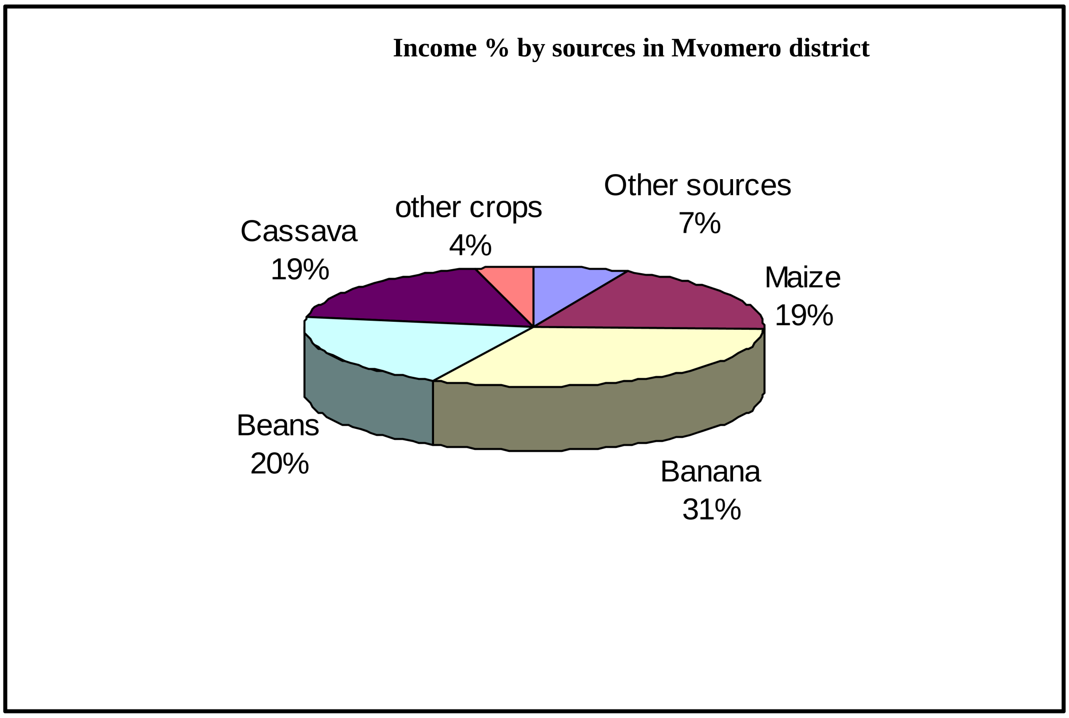


Figure 3b: Proportions of income from different crops and other sources of income in Mvomero district 2006/07 season

The study also reveals that in Mkuranga district, banana crop scored the second position in the pie chart by percentages in contribution to household income (Fig. 3c). The least observed percentage was for the other crops as in the findings from the other districts. The higher contribution by cassava in Mkuranga was due to the fact that the crop is more drought resistant compared to banana unless it is subjected to irrigation which adds to the variable costs of banana production in the area leading to an involuntary fall in benefits that could be realised. Furthermore, Mbogoh *et al.* (2003) pointed out that banana crop is very responsive to moisture stress which might explain the position of banana contribution to household income when compared to cassava in the district.

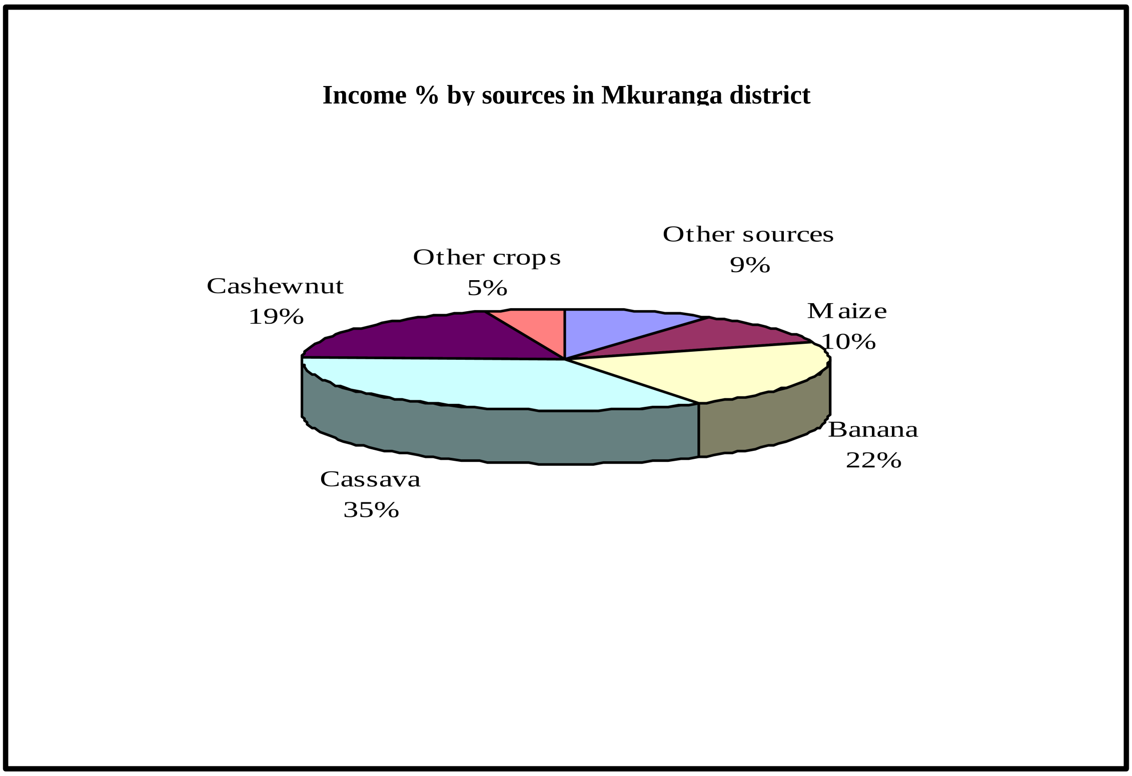


Figure 3c: Proportions of income from different crops and other sources in Mkuranga district 2006/07 season

Based on the findings presented in figures above, one –way ANOVA was carried out in order to establish whether contribution of banana income was significantly different among the three districts. Summary of the results are presented in Table 15. The F-value obtained indicates statistically, no significant difference was observed in mean banana income contribution among the three districts. The contributions were the same in all the surveyed districts.

Table 15: Comparison of mean contribution of banana income among the three districts

Item	District	Mean	STD	Min	Max	F- value
Banana income	Rungwe	189 568.3	403424.605	15 000.00	2 400 000	0.615 NS
	Mvomero	235 220.0	257301.399	15 600.00	720 000	
	Mkuranga	141 103.3	257301.399	5 000.00	1350 000	

NS = Not Significant

4.4 Factors affecting banana income

Results in Tables 16, 17 and 18 showed that with the exception of marital status for three districts, gender and age for Mvomero and Mkuranga respectively, all the other independent variables had positive relations with the banana income. This implies that an increase of those independent variables will result in an increase in banana income, holding other factors constant. However, number of extension visits per household was positive and highly significant for all surveyed districts, other positive and significant variables were education and age for Rungwe, education, marital status and farm size for Mkuranga districts (Table 16 and 17). This means as these variables increase banana income increases.

The explanatory power of the estimated regression models for three districts was satisfactory, that is, more than 50% of variations in banana income are explained by the included variables.

The overall F- test for variables included was statistically significant in explaining the variation in banana income, which implies that the estimated models were powerful enough to explain the variations and well estimated.

The VIF test proved there were no serious problems encountered regarding multicollinearity, and also the results for scatter plot indicated that the data were normally distributed.

Table 16: Results of regression analysis for factors that influence banana income in Rungwe district

Variable names	Coefficients	t- ratios	t -significance	Tolerance	VIF
Constant	9.716	17.829	0.000		
Age (X1)	0.234	1.997	0.051 ***	0.598	1.672
Education (X2)	0.275	2.523	0.015 **	0.690	1.449
Gender (dummy) (X3)	0.001	0.004	0.997	0.907	1.103
Marital status (X4)	-0.025	-0.257	0.798	0.854	1.170
Household size (X5)	0.149	1.415	0.163	0.738	1.355
Contact extension (X6)	0.536	4.758	0.000 *	0.644	1.553
Farm size(X7)	0.166	1.594	0.117	0.757	1.321

R-adjusted 51.7% F-value =10.030** * significant 1% level ** significant 5% level
N = 60 Durbin Watson =1.549 *** significant 10% level

Table 17: Results of regression analysis for factors that influence banana income in Mvomero district

Variable names	Coefficients	t- ratios	t -significance	Tolerance	VIF
Constant	8.665	6.707	0.000		
Age (X1)	0.070	0.572	0.573	0.704	1.421
Education (X2)	0.161	1.100	0.283	0.492	2.032
Gender(dummy) (X3)	-0.002	-0.015	0.989	0.565	1.769
Marital status (X4)	-0.077	-0.528	0.602	0.497	2.769
Household size (X5)	0.226	1.452	0.161	0.435	2.012
Contact extension (X6)	0.750	4.020	0.001*	0.304	2.300
Farm size(X7)	0.172	0.968	0.343	0.337	2.970

R-adjusted 69.4% F-value =10.377** * significant 1% level
N = 30 Durbin Watson 1.416 * * significant 5% level

Table 18: Results of regression analysis for factors that influence banana income in Mkuranga district

Variable names	Coefficients	t- ratios	t -significance	Tolerance	VIF
Constant	7.468	9.127	0.000		
Age (X1)	-0.088	-0.768	0.451	0.866	1.155
Education (X2)	0.203	1.795	0.086***	0.885	1.130
Gender(dummy) (X3)	-0.001	-0.009	0.993	0.904	1.107
Marital status (X4)	0.252	2.155	0.042**	0.828	1.208
Household size (X5)	0.021	0.186	0.854	0.868	1.151
Contact extension (X6)	0.508	4.402	0.000*	0.854	1.170
Farm size(X7)	0.614	5.463	0.000*	0.901	1.110

R-adjusted 67.1% F-value =9.435** * significant 1% level ** significant 5% level
N = 30 Durbin Watson = 2.034 *** significant 10% level

4.5 Decision making and gender roles in the sampled districts

Table 19 shows the decisions and gender roles in improved banana production activities. The results indicate that a range of activities were collectively done by all members of the households in Rungwe, Mvomero and Mkuranga districts. In Rungwe district however, site selection and propping activities were male dominated in among the stated roles. However, the joint decisions were more evident in other remaining banana activities.

The other scenario in gender role and decision making is presented in Table 20 for non improved banana cultivars. The summary of the results showed that substantial amount of decisions are done jointly by both men and women in the households surveyed. Additionally, the decision and gender roles done by females were observed to be less significant in percentage wise compared to those performed by both male and female authority in non-improved banana cultivar production activities for Rungwe, Mvomero and Mkuranga districts.

Table 19: Percentage distributions of respondents by decision making and gender roles in the sampled districts for improved banana cultivars

Activity	Rungwe(n = 30) Authority			Mvomero(n = 15) Authority			Mkuranga(n = 15) Authority		
	Male	Female	Both	Male	Female	Both	Male	Female	Both
Site selection	31.0(18)	0(0)	17.2(10)	13.8(8)	1.7(1)	10.3(8)	12.1(7)	3.4(2)	10.3(7)
Cultivar choice	29.3 (17)	0.0 (0)	28 (11)	15.5 (9)	1.7 (1)	15 (5)	13.8 (8)	3.4 (2)	15 (5)
Planting method	25.9 (15)	3.4 (2)	19.0 (11)	12.1 (7)	3.4 (2)	10.3 (6)	10.3 (6)	5.2 (3)	10.3 (6)
De-suckering	32.8 (19)	1.7 (1)	13.8 (8)	10.3 (6)	3.4 (2)	12.1 (7)	8.6 (5)	6.9 (4)	10.3 (6)
weeding	13.8 (8)	3.4 (2)	31.0 (18)	6.9 (4)	5.2 (3)	13.8 (8)	5.2 (3)	6.9 (4)	13.8 (8)
pruning	28.1 (16)	0 (0)	19.3 (11)	8.8 (5)	3.5 (2)	14.0 (8)	8.8 (5)	5.3 (3)	12.3 (7)
Fertilizer application	13.8 (8)	5.2 (3)	27.6 (16)	8.6 (5)	5.2 (3)	12.1 (7)	8.6 (5)	5.2 (3)	12.1 (7)
propping	32.8 (19)	.0 (0)	15.5 (9)	12.1 (7)	3.4 (2)	10.3 (6)	8.6 (5)	5.2 (3)	12.1 (7)
Harvesting	5.2 (3)	3.4 (2)	39.7 (23)	10.3 (6)	1.7 (1)	13.8(8)	8.6 (5)	6.9 (4)	10.3 (6)

Figure in parenthesis are number of observation

N= Number of respondents

Table 20: Percentage distributions of respondents by decision making and gender roles in the sampled districts for non –improved banana cultivars

Activity	Districts								
	Rungwe(n = 30)			**Mvomero(n = 15)**			**Mkuranga(n = 15)**		
	Authority			Authority			Authority		
	Male	Female	Both	Male	Female	Both	Male	Female	Both
Site selection	31.0(18)	0(0)	17.2(10)	13.8(8)	1.7(1)	10.3(8)	12.1(7)	3.4(2)	10.3(7)
Cultivar choice	29.3 (17)	0.0 (0)	28 (11)	15.5 (9)	1.7 (1)	15 (5)	13.8 (8)	3.4 (2)	15 (5)
Planting method	25.9 (15)	3.4 (2)	19.0 (11)	12.1 (7)	3.4 (2)	10.3 (6)	10.3 (6)	5.2 (3)	10.3 (6)
De-suckering	32.8 (19)	1.7 (1)	13.8 (8)	10.3 (6)	3.4 (2)	12.1 (7)	8.6 (5)	6.9 (4)	10.3 (6)
weeding	13.8 (8)	3.4 (2)	31.0 (18)	6.9 (4)	5.2 (3)	13.8 (8)	5.2 (3)	6.9 (4)	13.8 (8)
pruning	28.1 (16)	0 (0)	19.3 (11)	8.8 (5)	3.5 (2)	14.0 (8)	8.8 (5)	5.3 (3)	12.3 (7)
Fertilizer application	13.8 (8)	5.2 (3)	27.6 (16)	8.6 (5)	5.2 (3)	12.1 (7)	8.6 (5)	5.2 (3)	12.1 (7)
propping	32.8 (19)	.0 (0)	15.5 (9)	12.1 (7)	3.4 (2)	10.3 (6)	8.6 (5)	5.2 (3)	12.1 (7)
Harvesting	5.2 (3)	3.4 (2)	39.7 (23)	10.3 (6)	1.7 (1)	13.8(8)	8.6 (5)	6.9 (4)	10.3 (6)

Figure in parenthesis are number of observation

N= Number of respondents

4.6 Factor affecting Demand of planting materials

The estimated planting material demand equation shows that the explanatory power of the planting materials demand factors was unsatisfactory. Only about 23.9% of the variations in banana planting materials demand are explained by included variables. However, Maddala (1991) and Garson (2007) urges that low R^2 value obtained may not mean that the model is not good.

The F- test was statistically significant (Table 21) implying that it is unlikely to find out that the factors included in the model do not explain the variations obtained in banana planting materials demand by farmers. The coefficients of banana income were positive and significant at 1%, this implies that as the level of banana income increases banana planting materials demand increases as banana income is pivotal in planting materials demand. However, age, marital status, number of extension visits per household, farm size, time from planting to harvesting ware also positive but not statistically significant, indicating a straight relationship between these variables and planting materials demand. Gender, education, household size, price per improved cultivar, price per non-improved cultivar shows negative coefficients and statistically not significant to indicate inverse relationship among these variable and banana planting materials demand.

Table 21: Regression results: demand for planting materials

Variable names	Coef.	t- ratios	sig	Tolerance	VIF
Age (X_1)	0.141	1.568	0.120	0.794	1.260
Education (X_2)	-0.053	-0.563	0.575	0.716	1.396
Gender dummy(X_3)	-0.004	-0.043	0.966	0.832	1.202
Marital status (X_4)	0.093	1.097	0.275	0.883	1.132
Household size (X_5)	-0.093	-1.080	0.283	0.865	1.056
Contact extension (X_6)	0.126	1.528	0.129	0.947	1.143
Farm size(X_7)	0.186	2.179	0.031	0.809	1.236
Price/improved cultivar(Tsh) (X_8)	-0.086	-1.025	0.308	0.809	1.232
Price/non-improved cultivar(Tsh) (X_9)	-0 053	0.549	0.589	0.821	1.218
Time from planting- harvest(month) (X_{10})	0.141	1.633	0.105	0.910	1.099
Banana income(Tsh) (X_{11})	0.439	4.938	0.000*	0.863	1.158
Constant	421.48	3.843	0.000		

R-adjusted 23.9% F-value 4.731* * significant 1% level ** significant 5% level
N = 120 Durbin Watson 1.855 *** significant 10% level

4.7 Means of disseminating improved banana cultivars

A number of suggestions were put forward by the sampled farmers on means of disseminating improved banana cultivars. The overall results in Table 22 revealed that distribution of clean banana planting materials by district should concurrently move together with establishment of more demonstration plots and from farmers who acquired those materials from banana projects in the study districts surveyed. Farmers responded to this question in the study areas believing that those pioneer farmers have those materials and they can provide easily to fellow farmers who will need them in future.

In Mkuranga district, the study observed considerable suggestions on village leaders to make efforts in providing multiplication plots apart from suggestions reported above. It was pointed out by Lowenberg-De Boer (1999) that improved seed has little value unless it is in the hands of growers. Traditionally banana farmers were used to exchange banana suckers free of charge for local cultivars. This was also expected for improved banana cultivars. The introduced cultivars in the study areas targeted few farmers who were involved in the project. The dissemination efforts in the study districts were achieved through direct (nursery to farmers) and indirect (farmer to farmer) diffusion. Distribution of planting materials was mainly free of charge by the mentioned projects whereby, through direct diffusion, farmers obtain new planting materials from multiplication trials, or demonstration plots and indirect dissemination through farmer to farmer. However, for the sustainability of the banana project in future, the system of distributing clean planting materials has to be in place so that improved banana cultivars spread in the entire region of Tanzania.

Table 22: Percentage distribution of respondents' by suggestion on means of disseminating improved banana cultivars

Suggestions	Districts			
	Rungwe (n= 60)	Mvomero (n = 30)	Mkuranga (n = 30)	Overall (n=120)
Project establish more demonstration plot	33.0(37)	39.3(24)	39.7(31)	36.7(92)
Farmers acquired from PANTIL provide to other farmers	44.6(50)	42.6(26)	9.0(7)	33.1(83)
Village leader provide plot for sucker multiplication	0.0(0)	0.0(0)	32.1(25)	10.4(26)
More group formed for hosting demonstration plot	0.0(0)	1.6(1)	2.6(2)	10.0(25)
Farmers involved in the project provide sucker to other farmer in future	0.0(0)	0.0(0)	3.8(3)	1.2(3)
Project to establish multiplication centres in the project areas	12.5(14)	0.0(0)	6. 4(5)	19(7.6)
SUA continue to multiply and sell to farmers	9.8(11)	16.4(10)	6.4(5)	12(3)

Figure in parenthesis are number of observation   N= Number of respondents

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Overview

The general objective of this study was to undertake an economic analysis of improved banana production in Rungwe, Mvomero and Mkuranga districts in the Eastern and Southern highlands Zones of Tanzania. The study aimed at comparing benefits of improved versus non-improved banana production, determining the contribution of banana enterprise to total household income, assessing the changes of gender role in improved banana faming system and studying the system of distributing new cultivars and clean planting materials to farmers.

The improvement of banana multiplication and cultural practices in the Eastern and Southern highlands Zones of Tanzania were initiated and implemented under PANTIL project. In the two zones the districts addressed were Rungwe, Mvomero and Mkuranga. These were selected to host the demonstration trials pertaining to banana cultivars. However, this was a follow-up project after TARP II SUA which was implemented from July, 2001 to December , 2004.

Against such a back ground, this study intended to objectively determine the benefits of the introduced cultivars by the mentioned project in the three districts. The costs incurred and benefits obtained by farmers in both scenarios, of with and without situation, were calculated. Economic analysis was conducted to determine the cultivar worthiness. The economic analysis of the improved banana cultivars were directed towards determining empirically whether the investments on the cultivars contribute significantly to the economy of the targeted farmers.

The study also attempted to determine the contribution of banana on household income. It also studied the changes in gender roles as a result of introducing these banana cultivars and distribution mechanisms of the improved banana cultivars.

5.2 Conclusions

5.2.1 Benefits of improved banana cultivar versus non- improved banana cultivar production

The measures used to evaluate improved banana production were NPV, CB ratio and IRR. The NPV was positive but higher on improved cultivar, CB ratio was greater than one though higher in improved cultivars, and IRR was greater than the opportunity cost of capital in both cultivars. Sensitivity results also indicated stable earning capacity of two banana cultivars as NPVs were positive after being subjected to various changes. However, improved banana cultivars production had higher values for criteria selected, therefore, the hypothesis set was accepted.

5.2.2 Contribution of banana enterprise to total household income

To determine the contribution of banana to total household income, pie charts were used to summarise the proportional contribution in each study district, in all districts significant contribution of banana crop was prominent. F- values in banana income contribution among the three districts showed no significant differences.

5.2.3 Factors affecting banana income

Among the factors which affect banana income, the number of extension visits per household, education, age, marital status, and farm size were found to be significant in explaining the variations in the observed banana income. Therefore, hypothesis set was accepted as Increase in utilization of these variables is likely to result into higher banana income in the surveyed districts.

5.2.4 Changes in gender roles

In assessing changes in gender roles as a result of the introduction of the banana improved cultivars in the study areas, descriptive statistics was performed. No pronounced changes in the gender roles and decision making by all members of the family were observed. Therefore, banana innovations can address any member of the family in all the three districts despite the fact that, there were more male respondents in the sample surveyed.

5.2.5 Means of disseminating improved banana cultivars

To improve distribution of clean planting materials, descriptive statistics was also performed. Important suggestions were, farmers formerly involved in the banana project should provide these cultivars to other farmers and the project should establish more demonstration plots as sources of these planting materials.

Farmers' ideas were to have these materials at their locality and acquire them easily when they are needed. Mkuranga farmers suggested that, apart from establishment of more demonstration plots, village leaders should provide the plots for multiplication of planting materials.

The study further discovered that farmers in the study areas need more demonstration plots which are more public for the purpose of obtaining materials in future. The more scores in this response by all the three districts was to discourage farmer to farmer transfer of materials as at present the system is not efficient. Furthermore, farmers who acquired the materials hesitated to provide to others, this was due to selfishness and the few plants available to some pioneer farmers involved in the project. The improved cultivars in these areas are still fewer in quantity which does not allow selling of cultivars to other farmers. This is because most farmers planted new cultivars, their having them in small numbers, which can only sustain their own field demand, and those from the demonstration plots are few to meet the targeted population demand. among the factors affecting demand of these planting materials banana income were positive and significant while age, marital status, number of extension visits per household, farm size, time from planting to harvesting ware also positive but not statistically significant

5.3 Recommendations

Several recommendations can be drawn on the basis of the foregoing discussion:

- Banana production is profitable both to farmers and the country's economy as a whole. The study recommends farmers to use introduced cultivars together with appropriate banana recommendation agronomic packages, so that banana crop enterprises can be used as one of the strategy towards poverty reduction by smallholder farmers.

- Since farmers can grow banana as a food crop locally for household self consumption, it is recommended to encourage farmers in stabilizing and expanding their banana crop production.
- Banana technologies have proved viable in the three districts at household level, and then should be replicated to other areas with similar characteristics, as one of the approaches towards poverty reduction if market and price conditions are fairly operating.
- Furthermore, the study recommends dissemination mechanisms for a crop such as banana, a similar mix of tools is necessary. Product markets as well as farmer exchange or marketing of planting materials must be characterized and the costs of transacting in these markets documented, while the social position and nature of social relationships that guide these transactions must be understood.
- Encourage farmer participation in agriculture production groups such as farmer research groups (FRGs), extension farmer groups (EFGs), non-governmental organization production groups and different meetings to enhance contact with extension worker. The meetings are likely to have advantage of becoming aware of new banana innovation concurrent to establishment of demonstration plots for multiplication of clean banana planting materials.

5.4 Areas for future research

In order to enrich the findings of this study, further work is necessary to address the following aspects:

i. Banana marketing study to investigate attributes considered by farmers versus attributes considered by processors, traders and consumers. Formation of marketing groups or associations can strengthen the empowerment of farmers to access markets and bargaining.

ii. Study on assessing the constraint to adoption and economic impact of new banana cultivars on livelihood of farmers in two zones is necessary.

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APPENDICES

Appendix 1: Economic analysis of improved banana cultivars production; questionnaire

Name of Enumerator……………………………………..

Date………………………………

A. General information

A1. Type of farmer; 1=Use improved banana cultivar (   )   2 = Use non – improved banana cultivars (   )

A2. Name of farmer

………………………………………………………………………………

A3. Village…………… (1= Kyimo 2 = Bujela = 3 = Tangeni 4 = Mwalusembe)

A4. District…………… (1 = Rungwe2 = Mvomero 3 = Mkuranga)

A5.Region………………(1= Mbeya 2 = Morogoro 3 = Pwani)

B. Household characteristics

B1. Age of the respondent ……………………

B2. Sex …………… (1= Male, 2= Female)

B3. Marital status ……… (1=married, 2= Single, 3= Windowed, 4= Divorced)

B4. House hold size ………………… No. of males ……………. No of females ………

B5. Age of household members;

NO	AGE GROUP	MALE	FEMALE	TOTAL
I	1 -18			
II	19 -35			
III	36 - 60			
IV	> 60			

B6. Education level of a farmer (indicate by putting tick)

None primary	Primary	Secondary IV / VI	Post secondary Dip/Degree

C. Crop production

C1.How did you acquire the land? 1= Inherited ………………2 = Bought………..

……………..

3 = Hire…………………..4= Offered by village authority

………………………..............

C2. If hired, what is the rate per acre (Tsh)

……………………………………………..............

C3. If bought, what is the price /acre?

…………………………………………………....................

C4.Mention main crops grown last cropping season and rank them in order of importance

Crop	Acres	Rank

C6. What is your source of labour?

1= family labour …………… 2= Hired labour ………….. 3= Both (a) and (b) ………………

C7. If hired, what is the rate/ha?

………………………………………………………………..

C8. Estimate the yield obtained from main crops cultivated in your farms last cropping season?

Crop	No of plot	Plot size	Yield /ha	Sold or not 1=sold, 2=not sold	Price/product sold

C9 Estimate total income from other sources for the last cropping season in your household…………………………………………..

C10. Give the information about the implements used in the farm

Implement	1=yes, 2=no	1= hired, 2= owned	Hired rate	Purchase price
1.Tractor				
2. Ox plough				
3. Hand hoe				

C11. Do you use the following inputs in your crop production?

i) Fertilizer (chemical) ……………. 1= yes 2= no

ii) Pesticides ………………… 1= yes, 2= no

iii) Irrigation……………… 1= yes 2=No

iv) Manure…………………1= yes 2=No

C13. If using (i) and (ii) above how do you get them?

1= buying from private shops ………………….2= cooperative unions ………………

3= Extensions officers …………………………. 4= friends …………………………

5= others specify)

…………………………………………………………………………….

C15. Do you have any access to credits facility............................ 1= Yes 2= no

C16. If yes, what is the source?

1= NBC …………2= CRDB …………………….3=

Cooperatives………..............................

4= Individuals ………………. 5= Saccos …….. 6 = others specify………………

C17. Have you borrowed money in any of the above sources?……….1= Yes 2= no

C18. If yes, what is the source…………..

C19. If no, why? 1= Not available ………………. 2= Not interested …………………

3= High risk/ afraid ………4= others specify ……..……….

C20. Do you have contacts with the villages extension workers?......... 1= yes 2= No

D: Banana production information

D1For how long have you been in banana production?

1= less than a year ………………………. 2= 1-5 years …………………………

3 = 6-10 years ……………………………4= more than 10 years ………………

D2. For how many years have you grown improved banana variety? ………………

D3.What is the acreage for banana crop for the past four years / seasons?

Year	**2003**	**2004**	**2005**	**2006**
Plot				

D4. If for sale where did you sell for the last seasons?

Buyer **Amount sold** **price**

i. Local middlemen ……………………………………………………………

ii. Local markets ……………………………………………………………………

iii. Urban market ……………………………………………………………………

E: Banana yield and income

E1. Indicate costs of materials used in banana production

Materials	Quantity used	Price pre unit	Total cost
Seeds(suckers) / ha			
Fertilizer(manure)			
Herbicides in litres			
Insecticides in kgs /litres			
Spray rental			
Any other specify			

E2**.** Indicate banana productivity for the cropping season 2006/07

Cultivar name	No. of stools in the field	No.of bunches harvested per month or year	Price per bunch

E3.Indicate banana production costs

Establishment cost		
Operation	**Costs/unit**	**Total cost**
Cost of land (Tsh/acre)		
Land preparation (labour)		
Holes preparation (labour)		
Planting (labour)		
Manure application (labour)		
Weeding (labour)		
Fertilizer application haulage		
Operational costs		
Weeding		
Propping		
De-suckering		
Pruning		
Harvesting		
Transport cost		
Yield in bunches/acre		

F: Eestablishment of sustainable system for planting material distribution

F1**.** How long does it take from planting a sucker to harvesting?...................................

F2. How many years do you maintain a sucker until it is uprooted?..............................

F3. How many suckers required/acre……………………………………………….

F4. Which cropping system do you practice in your banana field (1 = sole 2 = Intercropping 3 = mixed cropping)

F5. How many banana planting materials can demand per year………………………

F6**.** What is the current sources of your banana planting materials?...............................

1= from the previous season ……………………. 2= extension officers …………

3= PANTIL Banana project ……………………….. 4=friends/ relatives / neighboring

5=others (specify)…………………………………………………………………

F7. Are planting materials available when needed 1= yes, 2=no (   )

F8. If yes where do you get them?...

F9. If no why? Explain…………………………………………………………….

F10. How much do you pay per improved banana plating materials…………………

F11. How much price per non-improved banana planting materials…………………

F6. Suggest the best way to get planting materials in future

………………………………………………………………………………………

F7. How many years does it take to plant a new banana stool? ....

...

G: Gender role in banana production

G1**:** who has the authority in overall decision making in banana production

Type of decision	**Authority Personal**	**Any clarification**
Site selection		
Choice of cultivar		
Planting method		
De-suckering		
Weeding		
Pruning		
Fertilizer application		

Propping		
De-budding		
Harvesting		
Selling		
Intercropping		

Thank you for your co-operation

Appendix 2: Benefit –cost analysis for improved banana cultivars

Year	COST	BENEFIT	NBT	DF12	DF20	DF25	BNPV 12%	BNPV 20%	BNPV 25%	CNPV 12%	CNPV 20%	CNPV 25%
1	725096	302450.7	-422645	0.893	0.833	0.8	-377422	-352064	-338116	647510.7	604005	580076.8
2	63001.67	1857909	1794908	0.797	0.694	0.64	1430541	1245666	1148741	50212.33	43723.16	40321.07
3	63001.67	1857909	1794908	0.712	0.579	0.512	1277974	1039252	918992.8	44857.19	36477.97	32256.86
4	63001.67	1857909	1794908	0.636	0.482	0.41	1141561	865145.5	735912.2	40069.06	30366.8	25830.68
5	63001.67	1857909	1794908	0.567	0.402	0.328	1017713	721552.9	588729.7	35721.95	25326.67	20664.55
6	63001.67	1857909	1794908	0.507	0.335	0.262	910018.2	601294.1	470265.8	31941.85	21105.56	16506.44
7	63001.67	1857909	1794908	0.452	0.279	0.21	811298.3	500779.3	376930.6	28476.75	17577.47	13230.35
8	63001.67	1857909	1794908	0.404	0.233	0.168	725142.7	418213.5	301544.5	25452.67	14679.39	10584.28
9	63001.67	1857909	1794908	0.361	0.194	0.134	647961.7	348212.1	240517.6	22743.6	12222.32	8442.224
10	63001.67	1857909	1794908	0.322	0.162	0.107	577960.3	290775.1	192055.1	20286.54	10206.27	6741.179
Total							**8162749**	**5678826**	**4635573**	**947272.7**	**815690.6**	**754654.4**
	NPV 12%	**8162749**										
	NPV 20%	**5678826**										
	B/C 12	**8.6**										
	B/C 20%	**7.0**										
	IRR	**16.7**										
	% fall npv	**30.42997**										

Appendix 3: Cost increase by 30%

Year	Costs	benefit	NBT	df 12%	DF20%	NPV 12%	NPV 20%
1	942624.8	302450.7	-640174	0.893	0.833	-571675	-533265
2	81902.17	1857909	1776007	0.797	0.694	1415478	1232549
3	81902.17	1857909	1776007	0.712	0.579	1264517	1028308
4	81902.17	1857909	1776007	0.636	0.482	1129541	856035.5
5	81902.17	1857909	1776007	0.567	0.402	1006996	713954.9
6	81902.17	1857909	1776007	0.507	0.335	900435.7	594962.4
7	81902.17	1857909	1776007	0.452	0.279	802755.3	495506
8	81902.17	1857909	1776007	0.404	0.233	717506.9	413809.7
9	81902.17	1857909	1776007	0.361	0.194	641138.6	344545.4
10	81902.17	1857909	1776007	0.322	0.162	571874.3	287713.2
					Total	**7878567**	**5434119**
	% fall npv	**3.5**					

Appendix 4: Reduced price by 10%

Year	Costs	benefit	NBT	df 12%	DF20%	NPV 12%	NPV 20%
1	725096	272205.6	-452890	0.893	0.833	-404431	-377258
2	63001.67	1672118	1609117	0.797	0.694	1282466	1116727
3	63001.67	1672118	1609117	0.712	0.579	1145691	931678.6
4	63001.67	1672118	1609117	0.636	0.482	1023398	775594.3
5	63001.67	1672118	1609117	0.567	0.402	912369.2	646864.9
6	63001.67	1672118	1609117	0.507	0.335	815822.2	539054.1
7	63001.67	1672118	1609117	0.452	0.279	727320.8	448943.6
8	63001.67	1672118	1609117	0.404	0.233	650083.2	374924.2
9	63001.67	1672118	1609117	0.361	0.194	580891.2	312168.7
10	63001.67	1672118	1609117	0.322	0.162	518135.6	260676.9
					Total	**7251747**	**5029375**
		% fall npv	**11.2**				

Appendix 5: Benefit –cost analysis for non- improved banana cultivars

Year	COST	BEBEFIT	NBT	DF12	DF20	DF25	BNPV 12%	BNPV 20%	BNPV 25%	CNPV 12%CNPV 20	CNPV 20%	CNPV 25%
1	533409.7	168000	-365410	0.893	0.833	0.8	-326311	-304386	-292328	476334.9	444330.3	426727.8
2	46793.33	900000	853206.7	0.797	0.694	0.64	680005.7	592125.4	546052.3	37294.28	32474.57	29947.73
3	46793.33	900000	853206.7	0.712	0.579	0.512	607483.1	494006.7	436841.8	33316.85	27093.34	23958.18
4	46793.33	900000	853206.7	0.636	0.482	0.41	542639.4	411245.6	349814.7	29760.56	22554.39	19185.27
5	46793.33	900000	853206.7	0.567	0.402	0.328	483768.2	342989.1	279851.8	26531.82	18810.92	15348.21
6	46793.33	900000	853206.7	0.507	0.335	0.262	432575.8	285824.2	223540.1	23724.22	15675.77	12259.85
7	46793.33	900000	853206.7	0.452	0.279	0.21	385649.4	238044.7	179173.4	21150.59	13055.34	9826.599
8	46793.33	900000	853206.7	0.404	0.233	0.168	344695.5	198797.2	143338.7	18904.51	10902.85	7861.279
9	46793.33	900000	853206.7	0.361	0.194	0.134	308007.6	165522.1	114329.7	16892.39	9077.906	6270.306
10	46793.33	900000	853206.7	0.322	0.162	0.107	274732.5	138219.5	91293.11	15067.45	7580.519	5006.886
Total							**3733246**	**2562388**	**2071908**	**698977.5**	**601555.9**	**556392.1**
	NPV 12%		**3733246**									
	NPV 20%		**2562388**									
	B/C 12%		**5.3**									
	B/C 20%		**4.3**									
	IRR		**16.7**									
	% fall npv		**44.4**									

Appendix 6: Cost increase by 30%

Year	Costs	benefit	NBT	df 12%	DF20%	NPV 12%	NPV 20%
1	693432.6	168000	-525433	0.893	0.833	-469211	-437685
2	60831.33	900000	839168.7	0.797	0.694	668817.4	582383.1
3	60831.33	900000	839168.7	0.712	0.579	597488.1	485878.7
4	60831.33	900000	839168.7	0.636	0.482	533711.3	404479.3
5	60831.33	900000	839168.7	0.567	0.402	475808.6	337345.8
6	60831.33	900000	839168.7	0.507	0.335	425458.5	281121.5
7	60831.33	900000	839168.7	0.452	0.279	379304.2	234128.1
8	60831.33	900000	839168.7	0.404	0.233	339024.1	195526.3
9	60831.33	900000	839168.7	0.361	0.194	302939.9	162798.7
10	60831.33	900000	839168.7	0.322	0.162	270212.3	135945.3
Total						**3523553**	**2381921**
	% fall npv	**5.6**					

Appendix 7: Reduced price by 10%

Year	Costs	benefit	NBT	df 12%	DF20%	NPV 12%	NPV 20%
1	533409.7	151200	-382210	0.893	0.833	-341313	-318381
2	46793.33	810000	763206.7	0.797	0.694	608275.7	529665.4
3	46793.33	810000	763206.7	0.712	0.579	543403.1	441896.7
4	46793.33	810000	763206.7	0.636	0.482	485399.4	367865.6
5	46793.33	810000	763206.7	0.567	0.402	432738.2	306809.1
6	46793.33	810000	763206.7	0.507	0.335	386945.8	255674.2
7	46793.33	810000	763206.7	0.452	0.279	344969.4	212934.7
8	46793.33	810000	763206.7	0.404	0.233	308335.5	177827.2
9	46793.33	810000	763206.7	0.361	0.194	275517.6	148062.1
10	46793.33	810000	763206.7	0.322	0.162	245752.5	123639.5
Total						**3290024**	**2245994**
	% fall npv	**11.8723**					

Appendix 8: Average benefit and cost of improved banana cultivar production per acre

Output	**Total benefit in Tsh**	
Yield in bunches/acre (year 1)		84 bunches x 3600tsh = 302 450.7
Yield in bunches/acre (year 2)		516.3 bunches x 3600tsh =1 858 680
Operation	**Establishment cost per acre in Tsh**	
Cost of land (Tsh/acre)		339 104.3
Land preparation (labour)		43 200
Holes preparation (labour)		32 950
Planting (labour)		18 916.75
Manure application (labour)		21 341.67
Weeding (labour)		30 088.33
Fertilizer application haulage		24 310
Seed (sukers)		15 2311.7
	Operational costs in Tsh	
Propping		31 816.67
De-suckering		13 705
Pruning		9 115
Harvesting		8 265
Transport cost		-
Grand total		**725 096**

Appendix 9: Average benefit and cost of non-improved banana cultivar production per acre

Output	Total benefit in Tsh		
Yield in bunches/acre (year 1)		75.6 bunches x 2000Tsh =	151 200
Yield in bunches/acre (year 2)		405 bunches x 2000Tsh =	810 000
Operation	**Establishment cost per acre in Tsh**		
Cost of land (Tsh/acre)			289 139.6
Land preparation (labour)			31 233.33
Holes preparation (labour)			31 233.33
Planting (labour)			17 133.33
Manure application (labour)			22 116.67
Weeding (labour)			16 850
Fertilizer application haulage			10 033.33.
Seed (sukers)			62 076.73
	Operational costs in Tsh		
Propping			21 950
De-suckering			10 668.33
Pruning			7 883.333
Harvesting			6 291.667
Transport cost			-
Grand total			**533 409.7**