AGRICULTURAL DIVERSIFICATION: ITS DETERMINANTS AND CONTRIBUTION TO SMALL HOLDER FARMERS' INCOMES IN PEMBA ISLAND

BY

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ABSTRACT

This study attempts to analyse how smallholder farmers allocate their limited available resources optimally in order to maximize their farms' total net returns and to investigate the factors which determine their agricultural diversification process. The survey covered 150 farmers. Field data was complimented with secondary data collected from key organisations. A pre-tested questionnaire was used to interview smallholder farmers. A logistic regression model was used to determine factors that influence agricultural diversification process. The results show that, the socio-economic factors determine the agricultural diversification, where about seventy one percent of the variability was explained by the included variables. The off- farm income variable has shown high significant level toward diversification. A gross margin analysis was used to examine and compare competitiveness of a set of selected crops having the potentials for diversification. The analyses show that banana has high returns relatively to rest crops. This situation is probable influenced by growth of general demand of agricultural commodities. Therefore, the crops grown by farmers are purely competitive. Furthermore, a linear programming model was used to investigate how farmers allocate their resources in order to maximize farm's total net returns. The results indicate that smallholder farmers' optimal allocation of resources is attained only on banana which maximize net returns to farmers. The maximum net returns per acre are banana 319 953 Tshs, cassava 49 972.00 Tshs, paddy 37 076.00 Tshs, beans 5 368.00 Tshs and sweet potatoes 64 806.00 Tshs. As a result, diversification has been the farmers' major strategy to deal with risks and uncertainties related to weather and marketing system. Therefore, the general conclusion from this study is that, diversification is an inevitable strategic action for smallholder farmers in order to reduce those risks associated to the mono-cropping system, whilst increasing food security and ultimately improving people’s standard of living.

DECLARATION

I, Hamad Masoud Ali, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my original work and has neither been submitted nor being concurrently submitted for a degree award in any other Institution.

_____ _____

Hamad Masoud Ali Date

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The above declaration is confirmed

_____ _____

Professor A.E. Temu, Date

(Supervisor)

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DEDICATION

This work is dedicated to my father, the late Masoud Bin Ali and my mother, the late Sharrifa Bint Saleh who laid down the foundation of my education due to their appropriate care and socialization processes.

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LIST OF ABBREVIATIONS AND SYMBOLS

CN	-	Condition -Number
CP-URT	-	Concept Paper - United Republic of Tanzania
CDI	-	Crop diversification index
GOZ	-	Government of Zanzibar
GDP	-	Gross Domestic Product
Km	-	Kilometers
LPWYE	-	Linear programming WYE
NBS	-	National Bureau of Statistics
NGO	-	Non Governmental Organizations
OLS	-	Ordinary Least Square
RADO	-	Regional Agricultural Development Officer
SACCOS	-	Savings and Credit Co-operative Society
SNAL	-	Sokoine National Agricultural Library
SPSS	-	Statistical Package for Social Science
ZPRP	-	Zanzibar Poverty Reduction Programme
ZEM	-	Zanzibar Economic Magazine
MVP	-	Marginal Value Product

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

The agricultural sector as in other developing countries is the back bone of Zanzibar's economy. The sector contributes about 41% of the Gross Domestic Product and 70 % of export earning. Also, the sector employs more than 85% of the Zanzibar population (GOZ, 2004).

The agricultural sector in Zanzibar is dominated mainly by smallholder farmers who have little access to inputs use and extension services. However, there are a few progressive farmers who have access to essential inputs and extension knowledge. This is because of their aggressiveness in seeking advice from agricultural experts as well as their ability in paying the extension services (GOZ, 2004).

The share of clove industry to the overall economy in Zanzibar is variable due to the fluctuation on the quantity produced and world market price. Concerning to this situation farmers experience economic hardship (GOZ, 2004). Cloves and clove products are the predominant activities in the agricultural sector in Zanzibar and they do contribute about 70% of earnings and employs more than 60% of the labour force. Apart from clove products other cash crops include copra, sea weed, spices, fish products and some vegetables.

Zanzibar is constrained with land availability for sustainable agricultural development (Mkenda, 2001). A big proportional of the available land is already owned and planted

with clove trees. This reduces the opportunity to practice fallowing cultivation. Smallholder farmers are forced to utilize the same land which in turn gets exhausted leading to low productivity.

Additionally, the growth and development of the sector is constrained by a number of other obstacles. These include semi skilled labour force and low usage of capital inputs. The underdeveloped irrigation, limited capital, limited access to financial services, and poor rural infrastructure, also explain the failure. Furthermore, pests and disease out break on crops and animals, erosion of natural resource base and degradation of soil contribute to this problem (URT, 2005). As a result, the level of domestic production remains very low. This is evidenced by the high level of importation of almost 80% of basic requirements (GOZ, 2004).

In 1980s, the government of Zanzibar liberalized its economy. Numerous social and economic adjustment programmes and policies were undertaken. The goal was partly to seek for alternative sources of incomes for the people. These programmes include: trade liberalization; alternative cash crops improvement programmes; liberalization of the tourism sector and establishment of free economic zones. However, despite various strategic measures initiated by the government of Zanzibar to diversity its economy, there is no any sector which has shown good prospects to outweigh clove industry (GOZ, 2004).

1.2 Farmers' Limitations to Increasing Productivity

Farmers' productivity has been low due to several factors. These include huge post harvest losses, more than 35% of the food produce; lack of strong organizations to offer essential services to smallholder producers. Other obstacles are the introduction of trade

liberalization and removal of input subsidies to farmers, at a time when private sector was not in a position to work properly. Apart from that, an underdeveloped cooperatives movement including unclear policy has actually constrained private sector development and agricultural growth.

1.3 Problem Statement and Justification

Agricultural sector plays a major role to smallholder farmers, whereby in the previous four decades people in the Island have had reasonable income from the sales of clove due to its better price in the world market. As a result the majority of people had managed to meet the expenses of their socio- economics obligations including buying of capital assets (GOZ, 2004).

Despite its economics benefits, the income from clove industry have been declining dramatically, hence affecting the life of the rural people. In this regard; the Government of Zanzibar in collaboration with development agencies, introduced various strategic measures as alternative options for farmers to diversify their income sources. Thus, based on that situation, the majority of farmers have been diversifying their crops and shifting to off farm activities.

However, it is not clear whether the measures have had significant contributions to farmers' income as well as reducing food insecurity. It is reported that, about 50% of the people living in the rural areas in Zanzibar are below poverty line (Mkenda, 2001). Therefore, despite the strategies for diversification taken by farmers, there is minimal information pertaining agricultural diversification determinants and the relative competitiveness across the crops grown by farmers. Also, the farm's optimal net returns from allocated resources

are not documented. Thus, there is a doubt about effects and impact of crops diversification in Pemba among stakeholders and policy makers. Thus, this study attempts to explore these issues and document accordingly.

1.4 Objectives of the Study

1.4.1General objective

The general objective of the study is to assess factors influencing and the effect of agricultural diversification on smallholder's income.

1.4.2Specific objectives

(i). To identify the determinants of agricultural diversification among smallholder farmers.

(ii). To examine and compare competitiveness of a set of selected crops having the potentials for diversification.

(iii). To determine how farmers allocate resources for optimal farm's net returns

1.4.3 Hypotheses

(i). Socio-economic factors have no significant effect on the agricultural diversification among smallholder farmers.

(ii). There is no difference in returns among major crops grown by farmers.

(iii). Farmers do not allocate their resources for optimal net farm returns.

Table 1: Links between the studies problems, objectives, hypothesis and analytical tools used

No.	Problem	Objective	Hypothesis	Methods of testing
1	The factors influence diversification are unknown	To identify the determinants of agricultural diversification among smallholder farmers	Socio-economic factors have no significant effect on the agricultural diversification among smallholder farmers	Logistic regression model
2	The relative competitiveness between crops grown by farmers are not well documented	To examine and compare competitiveness for selected crops having the potentials for diversification	There is no difference in returns among major crops grown by farmers	The gross margin analysis
3	The farmers' plan for optimal solution for maximize farm's net returns are not known	To determine how farmers allocate resources for optimal farm's net returns.	Farmers do not allocate their resources for optimal net farm's returns	Linear programming technique

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Definitions and Concepts

2.1.1 Poverty

Poverty refers to the position of an individual or a household in relation to a poverty line whose real value is normally fixed overtime. According to the World Bank (1993) an individual is said to be absolutely poor when he/she cannot attain what is considered to be the minimum requirements of life. The minimum standard of living comprises basic needs such as shelter, clothing, food and nutrition, health care, safe drinking water, education and freedom. In addition, income is also used as an indicator of measuring poverty. Kisusu (2003) reports that relative poverty focuses on the economic well being of the poor in relation to the total population in a specific location. Much literature describes poverty as a situation that emanates from lack of necessary capabilities and entitlement to satisfy human basic needs. Poverty however, can always exist in a society where some of its members fail to attain a certain level of well being considered by the society as reasonable minimum standard of living (Bagachwa, 1994).

In Zanzibar, poverty reduction has been a long running focus of the government policies. In 1999, the long term development strategies the vision 2020 document set out long term targets on poverty eradication and human development as well as on good governance and stability. Therefore, in relation to the above concepts, this study considers the poverty as the condition whereby people is unable to meet his/her daily basic requirements; due to low productivity on mono-cropping farming. Thus, farmers should engage on agricultural diversification action.

2.1.2 Agricultural diversification

Diversification refers to the allocation of resources to a variety of enterprises, the outcomes of which are not closely related; Reardon *et al.* (1992). The opposite of diversification is specialization, whereby firms concentrate their resources on a small number of enterprises (Reardon *et al.,* 1992). Agricultural diversification is a process of accompanying economic growth characterized by a gradual shift from subsistence food crops to a diversified market oriented production system, triggered by improved rural infrastructure, rapid technological change in agricultural production, particularly staple food production and diversified demand in food (Rosegrant and Hazell, 1999). But to this study, agricultural diversification is taken as an action taken by farmers to grow various crops aiming at increasing farm's revenues. The Reardon's definition is important and inevitable to farmer, because it guarantees the farmers earning of income since the crops are negatively correlated with the risk factors. This is also crucial to farmers for the food security matters since varieties of crops are from within his/her production.

2.2.3 Levels of diversification

Diversification can occur at the micro, regional and macro levels. At the micro level, the individual households diversify in order to strengthen their sources of farm and non-farm income. They involve both horizontal diversification towards new agricultural commodities and vertical diversification into non-farm activities, such as marketing, storage and processing. At the regional level, regions pursue agricultural activities in which they have comparative advantages (Taylor, 1994). In relation to this study, diversification is based on the micro level which looks on the individual smallholder farmers who pursues diversification in order to increase income sources.

2.2 The role of Agricultural Diversification

Fleming and Hardken (1994), in their study, reported that, smallholder farmers have been most successful in increasing productivity when diversifying their activities through an adaptable growth strategy entailing a combination of new cash cropping activities with established subsistence food activities rather than a major transformation of input usage. Fleming and Hardaken (1994) in their study observed that the main path to improve smallholder-farming systems is through improved technological management practices and field husbandry methods that are simple. When a smallholding is diversified into cash crops production, the farmer has the opportunities to select those activities that complement each other, given the seasonal nature of their labour demands. This would enable them to utilize family labour resources fully throughout the year (Fleming and Hardaken, 1994).

2.3 The Determinants and the Effects of Diversification

The determinants and effects of diversification were not conclusively predicted in the previous empirical literature (Reardon *et al.*, 1992). Studies in different locations and economies have found that the consequences and causes of diversification vary (Ellis, 1998). Diversification can impact and be impacted by poverty, income distribution, the environmental and infrastructure. For example, on the one hand diversification may have a negative impact on income distribution if the wealthier households are more capable of diversifying their economy (Hart, 1994); on the other hand, it can also serve as insurance for the rural poor (Evan and Ngau, 1991). For example, Pattanayak and Sills (2001) found out that households facing more variable crop production or poor harvest would depend on non -timber forest products as economic buffers. Despite this variation, there is some consensus in favour of policies supporting diversification by rural households because of

its potentiality in enhancing their welfare and because it may allow more efficient use of both human and natural resources (Ellis, 1998).

The impacts of diversification on the environment have been found to be mixed and case specific (Ellis, 1998). Diversification may reduce the demand for cleared land by raising the opportunity cost of household labour, or the demand for forested land by providing financial support for the intensification of agricultural production (Piction, 1997). For example, studies have found out that off-farm labour is negatively related to deforestation in the Amazon (Gody *et al.*, 1997), Piction (1997).

2.4 The status of Diversification in Tanzania

Amani (2005), in his study noted that, although Tanzania's Government has been advocating diversification of agriculture into non-farm activities as a key solution to address problems of low productivity in the agricultural sector. This effort has not been successful because most of these income generating activities are small in scale and have often been taken as coping strategies. The demand for a diverse range of food products will continue to grow rapidly in Africa's large metropolitan areas (Amani, 2005). An urbanized population tends to consume more fish and meat, vegetable and animal oil and fats, fresh fruits and vegetables, as well as the prepared food, thus, providing African farmers with new important opportunities for diversifying agricultural product into high value products for domestic and regional markets. Trade of this type already accounts for 42 percent of the total value of agricultural products traded across borders in the African region (Amani, 2005).

Senkondo (2000) in his study analysing the risk behavior of smallholder farmers noted that diversification is not a new phenomena in Tanzania. Many farmers maintain either mixed farms (i.e. diversified agricultural enterprises) or pursue a relay farming system.

2.5 The status of Agricultural Diversification in Pemba

Accordingly to Zanzibar's agricultural development reports, including the (GOZ, 2004), agricultural diversification is undertaken by many farmers in Pemba. They either practice intercropping or relay crop systems. Together with that, there is a high potential for agricultural diversification in Pemba. This is contributed by the higher growing potential of domestic market. Further, the potential of island favour the growth of different crops. These include high value crops such as fruit, vegetable and spices. However, all these have not yet been grown profitably on the limited land (GOZ, 2004).

Akyo, e*t al.* (2007), during ‘analysis of spice industries in Tanzania’, noted that the farming system of island with the exception of cinnamon, spices are mostly intercropped with other crops. These include banana, citrus, and varieties of tree crops. Other crops grown under intercropping are clove, chilies, cinnamon, cardamom and turmeric. Also black pepper, ginger and vanilla are grown. All these crops are grown under situation of intensive intercropping. Thus, all the above arguments confirm that people in Pemba undertaken crops diversification.

2.6 A Review of Empirical Studies on Diversification

Proper analysis is the key to rightful decision making in any endeavor. An analytical method is a function of previous methodologies and procedures for which improvement can be made to enhance new finding and strengthen reliability of old ones. This review of

analytical tools focuses on the first and second objectives of the study namely to identify the determinants of agricultural diversification among smallholder fanners and to determine the fanners' optimal farm's net returns respectively.

2.6.1 The analytical tools for factors determine agricultural diversification

The study by Alia *et al.* (2003), on the determinants of crop diversification, through the application of the regression model found out that the results obtained have several implications for policy makers, farmers and other stakeholders. Ordinary least square (OLS) model is yields unbiased coefficient of estimates for regression with which the dependent is censored tries to answer the question such as (i) what factors determines the level or the magnitude of sales. The Ordinary Least Squares (OLS) model is applicable when all households participate in the particular activity. But in reality not all smallholders participate. Some households may not prefer to participate in a particular activity in favour of another, while others may be excluded by the conditions of the activity. Therefore, we can hypothesize that at least some households are prevented from agricultural diversification. Thus we reject the model because if fail to capture the binary variable.

In another study, conducted by Goetz (1995) used the Tobit model in analyzing and modeling the effect of transaction costs on an economic activity. Unlike the OLS method, the Tobit model yields unbiased coefficient estimates for regression with which the dependent is censored. Further, author used selectivity model to improve Tobit model in case where the decision of individual to carry out any activity is influenced by the non random and unobservable factors including willingness in bearing risks. If the process that switches an individual to certain state is not a random one, but it is rather influenced by the

switching mechanism not only to less efficient but also to biased parameters estimates in the question related to the decision. This model was not used in this study.

Finally, Kilima *et al.* (1999) adopted a cross tabulation analytical technique to find out if there was any association between respondents' marital status and membership in the cooperation. This analytical tool is advantage when looking the association between variable. This is not usefully to our study hence rejected.

Moreover, Kisusu (2003) when determining the factors that make of farmers to adopt or not to adopt new technologies employed the logistic model. This is usefully since it consider the probability variable of the dependent variable. Therefore we adopt it.

Thus, based on these previous studies, both tobit and probit models are reviewed positively for analyzing, but deliberately this study adopts the logistic model in analyzing the factors enhancing the smallholder farmers to diversify crops activities. This is because of its simplicity and also our empirical model comprises with the binary /dummy variables hence employing any other model would create a problem.

2.6.2 The analytical tools for determination the optimal farm's net returns

Radhakrishnan *et al.* (1975) used linear programming model to find out optimum cropping pattern in the pre and post development situations. The constraints used in the model included farmland, farm labour, capital and water. They revealed that in the predevelopment conditions farmers were attaining optimality, therefore no income increase was possible even if the linear programming model readjusted were adopted under the post-development situation, and farmers did not attain optimality.

Another study conducted by Chaudhy (1976) used the linear programming model for analyzing the increasing income on the bullock operated farms of l2acres each. The author concluded that the given resources and constraints in all the farms included in the samples were operating near the optimal level, therefore the adoption of linear programming solution would only increase the provision of additional funds which would increase farm production.

Bajwa (1978) study used the linear programming model for developing optimal farm plans for small fanners in Lelhya tehsil of the Punjab. The constraints used included land, capital and water supplies. Te optimal cropping pattern solution increased income by 2.2% as compared to the existing solution.

In their study Nadda *et al.* (1978) study applied the linear programming technique in studying the performance of hill fanning in the Himchal Pradesh, India. The sample farms came from the low hills, mid hills and high hills. The model suggested that by growing fewer crops income would increase as compared to crop diversification followed under the existing situation. They suggested that the provision of capital would further improve the situation, suggested cottage industry for better utilization of farm labour, in situation where labour was in excess.

In another study, Singh (1978) through the utilization of the linear programming tool aiming at studying an income from 251 tractors and bullock operated farms from 6 regions. The fanners were grouped into small, medium, and large farms. The results showed that the HYV paddy replaced the local paddy, while local maize maintained its position against the hybrid maize in region 1and 11. In region 111, too, the HYV paddy turned out to be a

paying crop. The 1V American cotton was completely replaced by Desi cotton Hybrid maize did not find any place in this region. Optimum cropping pattern was found to be more labour intensive and vary demanding in term of fertilizer and capital. Following the linear programming model recommendations, the net income increased more significantly in the less developed areas, as they were operating at sub optimal levels.

Sharif (1979) conducted a study to determine the most profitable cropping patterns and maximum farm income. He applied the linear programming model and found out that in the optimal plan the monsoon cropped area decreased by 12.24% while the winter cropped area increased by 12.0% more than the existing level to yield the maximum farm income. In addition it was noted that the overall cropped area decreased by 2.18% over the existing one. The fallow wheat and fallow sugarcane were turned out to be the most profitable crop rotations.

Thus, based on all those previous studies above, this study adopts the linear programming model in identifying how smallholder farmers allocate their resources optimality in order to maximize farms' total net returns, since is flexible and would give us the answers of which resources are scarce and which are surplus as well as the issue of optimal solution.

2.6 Description of Analytical Techniques Use in Diversification Studies

2.7.1 Logistic model

The binary logistic model using maximum likelihood method was employed to analyse the socio-economic factors that determine small holder farmers to pursue agricultural diversification.

The estimated empirical logistic regression model is specified in equation (6)

$$ln\left(\frac{\rho}{1-\rho}\right) = \beta_0+\beta_1 ldsz + \beta_2 edu + \beta_3 Ocp + \beta_4 frexp + \beta_5 ext + \varepsilon \ldots\ldots\ldots\ldots (6)$$

Where,

$ln\left(\frac{\rho}{1-\rho}\right)$ is the natural logarithms of probability to diversify (p) divided by the likelihood of not diversify (l-p) of the ith observation. β_0 = constant, ldsz = House hold land size (number of acreage), edu= Education level (X2 = 1 if formal X2 = 0 if non formal), Ocp=Primary occupation (X3 =1 if is a farmer X3= 0 otherwise) frexp= Experience in crop production (number of years), Ext=number of visits, and ε = Error term and β_1, β_2 …… to β_6 parameters to be estimated.

The model has advantages when 'errors of the linear regression are normally distributed, one practical advantage is that the computer is already available and data need not be replicated to apply maximum likelihood estimation. Further is that the difference on the logistic scale are interpreted regardless of whether the data are sampled prospectively or retrospectively. To identify the factors which account for agricultural diversification among smallholder farmers, a logistic model was used because of the fact that the dependent variable was binary, that is it explains whether the smallholder farmers "the clove farmer" diversify or not. The choice of the model was based on the assumption that the disturbance (error) component of the response follows a binomial distribution and the logistic distribution of the error term (Liao, 1994). Logistic can be used to determine the

attributes of those who undergo diversification. The results generated through logistic regression can also be used to predict the future of the agricultural diversification

2.7.2 Analytical tools in determining the use resources for optimal farm returns

The Linear programming model

This tool has been used to examine the farmer optimal resources allocation for profit maximization. The objective function of the LP models may be expressed by the following equation.

Maximize $Z = \sum C_i X_i$ ..... (1)

Subject to the following constraints

1. $HmXi \leq B_{11}$ ..... (2)

2. $WiXi \leq B_{12}$ …..... (3)

3. $LiXi \leq B_{13}$ ..... (4)

4. H', W_i and $L_i \geq 0$ ..... (5)

Where

Z=the value of the profit maximized

Xi=Activities i (i=l, 2 ..... .n)

X=Crops

Ci=the net contribution to each farm activity i

Bj=The quantity available of resources j (j= 1,2 ..... m)

1. Hm =Average man-day farm house hold worked in crop i

   B_{11}=Man-day available for work.

2. Wi= Average working capital required per crop i.

   B_{I2} =Available working capital.

3. Li=Amount of land available for crop i.

B_{13}=Total land available for crop production

Equation (1) is the objective function to be maximized, equation (2) is the man-day constraint, Equation (3) specifies the land constraint and equation (4) specifies that all activities (Xi) can only take non negative values.

- **Selection of LP model as an appropriate technique**

One of the specific objectives of this study was to find out the potential effect of possible resource reorganization on smallholder farmer income (i.e. net return). Thus, the analytical techniques chosen to accomplish this objective must satisfy the following criteria; (i) it should be capable of estimating which of the farmer resources most are limiting. These estimates need to be made with a consistent logical framework that allows inclusion of all relevant production activities. This will help the planner that either suggests the programmes to increase the availability of constraining resources or that use resources more efficiently. (ii) It should be capable of generating solutions for all relevant cropping and resource set combination. (iii) The techniques should be flexible enough to capture all essential aspects of small farm production in the island. (iv). It must be capable of handling spatial interactions between the crop activities. Because of its additive and linearity assumptions the LP does portray the spatial interactive within the activities and because of its flexibility it allows the farmers to consider the effects of various resource use on the plan such as iteration between cassava and banana. Its simplicity in both the application and costs outweighs the advantage of other tools.

- **Advantages of the LP model**

The major advantage of the LP model as the farm planning or farm policy tools of analysis is that it allows the farm manager or the policy maker to consider a wide range of alternatives quickly and at a comparatively low cost.

The limitations of LP model

1. The simplified LP model may not adequately represent the very complex situation in the peasant farm household.
2. The data collection procedures by survey often minimize the opportunities of a researcher to obtain accurate production coefficients.
3. The survey data may be inaccurate due to the measurement problems or data may be unrepresentative due to variations between farms or between years.
4. All programming activities are treated as being equally risky.
5. LP ignores the effect of law of diminishing return.

In LP analysis, the activities which involve the decreasing costs cannot be treated adequately with the present programming methods (Bartlell *et al*., 1978). Efforts to overcome these problems may lead to concentration on data collection techniques at the expense of gaining an understanding of the farming system and making improvements in the models.

- **Data requirement for LP model**

For the LP exercise 4 types of data were required (1) the identification of the activities to be included in the model (2) the production of the coefficient data (3) the product and input price data (4) the identification and specification of relevant constraints such as subsistence require the land to be available, the availability of capital and demand for labour. This included (1) the labour which was involved in different fanning operations in the

production cycles of each crop (2) the cash spent for hiring labour, transport and purchasing of other input not produced by the family (3) the family produced or free inputs like cow dung, seeds, etc, which could cost the farmer some cash to obtain and any other expenses in agricultural production.

The time spent was recorded by hours of crop production so that it could be converted to the man days for the LP exercise. The farmer was asked to give information on five crops that seem to be the most common crops in the Island which have some contribution to the family income. The major items the farmers were required to provide for crops grown were (1) The average farm operation, the type of labour used; that is whether family labour or hired labour; and the total times spent in terms of hour of the operation per day (2) The produce specified what type, the amount sold and the revenue received. The farmers were also asked to report the variable inputs like manure, fertilizers, pesticides, seeds for specific crops and the acreages.

2.7.3 Gross margin analysis

The gross margin analysis was employed to test the hypothesis which stated that Diversification of crops has no significant effect to smallholder farmer's income. From each crop, the gross margin was calculated based on the following formula.

$GM_i = \Sigma TR_i - \Sigma TVC_i$

Where:

GM_i = Gross margin of i^{th} crop in (Tsh/ha)

TR_i = Sum of total revenue from sales of ith crop in (Tsh/ha)

TVC_i = Sum of total variable costs spent on production of i^{th} crop in (Tsh/ha).

The gross margin technique was selected since the study did not consider the fixed cost as most farmers do not consider it. Most often the new technologies in smallholder agriculture are aimed at increasing the farm production due to the fact that the increased income is one of the immediate objectives of the overall enterprise of the farmers (Johnson, 2003). It was found useful to compare the gross margin of the selected crops so as to establish the relative economic profitability of farm crop production.

The producers tend to allocate more resources to crops giving the higher returns per unit of each resource utilized (Hazell, 2004). Thus, high returns will warrant future production of a more competitive crop, as transferable resources are switched from the low paying crop to high paying crops (Hazell, 2004).

To define the concept of gross margin, we first have to distinguish between the variable and fixed costs. The variable costs are those cost that increase or decrease as the output changes (Cramer *at al.*, 2001). The common examples of variable costs in crop production include the seeds, fertilizers, and pesticides. The most important fixed costs in agricultural production are ownership of land, family labour, farm buildings and farm machinery and implements. The gross margin of farm activity is the difference between the gross income and the variable costs incurred (Makeham and Malcolm, 1986). The gross margin analysis is thereby a simple, but in many cases, a sufficient powerful tool for economic analysis of the introduced technologies (Makeham and Malcolm, 1986).

- **Advantages and limitations of gross margin technique**

According to Ferris and Malcolm (2000), the gross margin analysis has the following limitations;

- The gross margin is not a profit figure. The fixed costs have to be covered by the gross margin before arriving at a profit figure.

- The gross margin can vary widely from one year to the next. This is due to the differences in market prices, weather conditions and efficiency. The gross margin can also differ considerably from farm to farm. This can result from the differences in performance levels or differences in the overall system of production or method of recording.

- The comparison of the average gross margins can be useful, but it should be done over a number of years. However, GM gives the starting point in the assessment of the farm.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Overview of the Study

This chapter presents the methodology used to obtain data for this study. It also outlines the statistical procedures which were employed in analyzing the data. The chapter comprises the description of the study area, research design, population, sample size, formulation and administration of research questionnaire, pre-testing of the instrument and data analysis. Also describe the sampling unit.

3.2 The Study Area

3.2.1 Administrative structure

The study was conducted in Pemba Island which is the sister island to Unguja to make Zanzibar. Zanzibar is divided into 5 regions; 3 regions in Unguja and 2 regions in Pemba. Further, Zanzibar has 10 districts; 6 districts in Unguja and 4 districts in Pemba. Each district is divided further in to small constituents known as Shehias. Based on the 2002 census, the estimated population of Zanzibar is one million people. Fifty one percent are female and forty nine percent are males. The population growth is 3% per annum and the average population density is 337 persons per sq km. About six five percent of the population lives in the rural areas. Out of these percentages more than 70% either directly or indirectly depend on agricultural activities for their livelihood. Therefore there are large number of people who would be used for diversifying crops.

3.2.2 Topography and climate

Zanzibar is 2643 square kilometers (Unguja 1658 sq km and Pemba 985 sq km). The island receives two rainfalls a year the long and the short rains. The long rains start in March and end of May; and the short rains start on August and end in December. Thus, it implies that there is opportunities for farmers to practice crops diversification particularly relay cropping.

3.2.3 The main occupations of the people

A main occupation of the people in Zanzibar is agriculture; about 132 000 ha of Zanzibar land (Unguja 64 000ha and Pemba 68 000ha) is under cultivation, although the average size of the land holding per family is less than 1.5 ha. Apart from farming and fishing activities, which employ high percentage of people, other activities such as cattle rearing trading and government employees are available too.

3.3 Data Collection

Primary data used in the study were collected from farmers, by administering structural questionnaire with both open and closed questions indicated in appendix 1. Variables such as age, education level, farm size, yields and price sold, inputs and costs incurred (varieties, fertilizers, labor and agrochemical) were captured by the questionnaires. Open ended questions were used to get different comments and opinions of the respondents. The secondary data obtained from documents and study reports reviewed from difference sources including Sokoine National Agricultural Library (SNAL) were supplemented.

3.3.1 Sampling design, sampling size, sampling frame and sampling unit

A purposive sampling was used to select Wete and Chake Chake districts from North and South regions respectively. The selection has considered that, these districts are leading in agricultural activities as the environments of the area are more conducive for farming. These districts are small towns that having markets centers and ports. Therefore, there is a high interaction of people from different ethnic groups. This all stimulates the production and marketability of different crops, and hence stimulate agricultural diversification.

Purposive sampling has been used to select the five Shehias from each district based on their potentiality in growing many crop enterprises. From each Shehia, fifteen respondents were randomly selected for the interview, making a total sample size of 150 farmers. The "population" was the total households with farmers engaged in agricultural activities, while the "sampling unit" was the household head. The Shehias registers were used as the sampling frame. The sample sizes for farmers interviewed are presented in Table 2 below.

Table 2: Respondents distribution

District	Number of respondents	Shehia	Number of respondents
Wete	75	M/mdogo	15
		Kambini	15
		Kisiwani	15
		Chwale	15
		Ole	15
Chake Chake	75	Pujini	15
		Wawi	15
		Vitongoji	15
		Wara	15
		Uwandani	15
Total	**150**	**10**	**150**

3.3.2 Data Analysis techniques

Both the descriptive and quantitative analyses were employed in this study, based on the objective stated. Descriptive analyses involved the used of means, percentage, ranges and

cross tabulation. The quantitative analyses involved the use of logistic regression, linear programming and gross margins analyses.

3.3.3 Model specification

3.3.3.1 Logistic regression model

The binary logistic model using maximum likelihood method was employed to test hypothesis which started that socio-economic factors have no significant effect on the agricultural diversification among smallholder farmers. The estimated empirical logistic regression model is specified in equation (6).

$$ln\left(\frac{\rho}{1-\rho}\right) = \beta_0+\beta_1 ldsz + \beta_2 edu + \beta_3 Ocp + \beta_4 frexp + \beta_5 ext + \varepsilon \ldots\ldots\ldots\ldots\ldots (6)$$

Where,

$ln\left(\frac{\rho}{1-\rho}\right)$ is the natural logarithms of probability to diversify (p) divided by the likelihood of not diversify (l-p) of the ith observation. β_6= constant, ldsz = House hold land size (number of acreage), edu= Education level (X_2 = 1 if formal X_2 = 0 if non formal), Ocp=Primary occupation (X_3 =1 if is a farmer X_3= 0 otherwise) frexp= Experience in crop production (number of years), Ext=number of visits, and ε = Error term and β_1, β_2 …… to β_6 parameters to be estimated.

Table 3: Specification of variables included in the logistic model

No.	Variable	Measurement	Expected relation

1.	Land size	Acreage	+
2.	Education level	Years in school	+
3.	Experience in crop production	Years in farming	+/-
4.	Extensions services	No of visits	+
5.	Off farm income	Amount in shillings	+

Description

+ Means a variable is expected to be positively related to the probability for diversification.

- Means a variable is expected to negatively related to the probability of diversification.

The logistic regression can be used to determine the likelihood of attributes of those who undergo diversification. The results generated through logistic regression can also be used to predict the future of the agricultural diversification. Thus, based on the above hypothesis, the null hypothesis will be accepted when socio-economic variables have no any effect on the agricultural diversification. While, the rejection of the hypothesis would be made when there is effect hence accepting the alternative hypothesis.

3.3.3.2 Gross margin analysis

The gross margin analysis was employed to test the hypothesis which stated that Diversification of crops has no significant effect to smallholder farmer's income.

From each crop, the gross margin was calculated based on the following formula:

$GM_i = \Sigma TR_i - \Sigma TVC_i$

Where:

GM_i = Gross margin of i^{th} crop in (Tsh/ha)

TR_i = Sum of total revenue from sales of i^{th} crop in (Tsh/ha)

TVC_i = Sum of total variable costs spent on production of i^{th} crop in (Tsh/ha).

Thus, the accepting of the hypothesis would be taken when the incomes between the crops grown by farmers are not differed. Otherwise the rejection of null hypothesis will be done and accepting the alternative hypothesis when the incomes differed.

3.3.3.3 Linear programming model

The linear programming model was used to determine the objective stated that how farmers allocate resources for optimal farm's net returns. Also to test the hypothesis this stated that farmers do not allocate their resources for optimal net farm's returns. The model in the study will be used to analyze five crops namely banana, paddy, cassava, sweet potato and beans. The constraints used were land area, labour (man-days) involved in different farming operations and inputs (such fertilizers, seed and pesticides).

Equation (1) is the objective function to be maximized, equation (2) is the man-day constraint, Equation (3) specifies the land constraint and equation (4) specifies that all activities (X_i) can only take non negative values.

Therefore, the acceptation of the hypothesis would be done when all crops yield enter the optimal solution.

3.4 The validity and reliability of data

Using cross-section data limits observation over time. This makes it difficult for the study to account for changes due to time difference. The data were collected from clove farmers

in Pemba Island who are characterized with the problem of poor records keeping. Thus, their responses depended on their memories in different aspects. This is because some transactions were informal in nature. Therefore such data can hardly be fully reliable. Farmers under this study area were assumed to be homogenous in terms of educational and economical features. Thus, the reliability of the data does some how have the same weaknesses; however the study addressed this problem by using probe questions to farmers to see it reality. In addition, the small sample size may affect the representativeness of the population parameters as well as the fact that the survey data was based on the head of household due to the habit of marring more than one wife, probably there are chances of double counting of males in two different household. However, this problem was addressed by taking one of the household wives as the head of household and ignoring the membership of the husband in that particular house. However, in spite of the above limitations, it is expected that the data collected were reliable and adequate to address the objectives set forth for the study.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Overview

This chapter presents the results and discusses the findings from the study. The chapter is divided into three major sections; the first section presents the descriptive statistics showing the characteristics of the sampled households involved in crop production. This is followed by the empirical results and the discussion from logistic regression, linear programming model and gross margin analysis. Further, the chapter addresses the hypothesis of the three objectives.

4.2 Economic Profiles and Household Variables

Ferris and Malcolm (2000) reported that the household characteristics have important implications on the farming practices. They also give the knowledge of the general behavior and attitude of the people in the study area. Hence, it is important for that matter to describe the socio economic and demographic characteristics of the sampled households. Thus, based on our objectives, the descriptive statistics help to know the distribution of family members (family labour) involved in farming operations. Since agricultural diversification concerns the growing of many crops. Obviously, knowing the descriptive statistics assists the author to know at what extent the family pursuing agricultural diversification, in relation to its available resources.

4.3 Household Variables

4.3.1 Age Distribution

Table 4 below depicts the age distribution of smallholder members. The range of age of the respondents was from 25 years to a maximum of 75 years. About 7% of the respondents were above the age of 60 years, 39% were between 46 and 60 years, 41% were between 36 and 45 years, 9% were between 26 and 35 years; and 4% were between 18 and 25 years category Table 3. The large percentage of the respondents are between 36 and 45 years, which is very close to the age group of been 46 and 60 years. This explains the fact that, there was a little involvement of the young people in farm activities probably due to the fact that most of the young people are at school and in the madrasa period. Further, normally youths also either migrate to urban areas (Zanzibar and Dar es Salaam) or engage in off farm activities. Thus, this reduces the opportunities of the family to under go crops diversification. However, since the large percentage of family members is on the active working age. Probably they participate fully in crops production hence increase the potential of household farmers to engage on crops diversification.

Table 4: Age of heads of household

Age intervals	Frequency	Percentage
Below 25 years	6	4.0
Between 26 and 35years	14	9.0
Between 36 and45 years	62	41.0
Between 46 and 60 years	58	39.0
Above 60 years	10	7.0
Total	**150**	**100.0**

4.3.2 Sex of household heads

The descriptive statistics data indicated in Table 5 shows that, 87% of the household heads are males while only 13% are females. This shows the typical coastal society characterized with Swahili and Islamic culture; where most of the families are males headed even the situation where the male is relatively younger than the female members. The family of this type is generally has features of male domain and /or oppression of women especially on decision making. The decision such as what crop to grow and how to use of produces and revenues are predominantly judged by male. Further, the participation on development activities such as training and adoption of new technologies also become a problem to female members. This reduces the diversification's potential to female if the household is leaded by male. But, since most of household heads are male domain the likelihood for agricultural diversification is high since is one who made decision most exposed to new information. Table 4 is concerned.

Table 5: The sex of the household heads

Sex	Frequency	Percentage
Male	131	87.0
Female	19	13.0
Total	**150**	**100.0**

4.3.3 Marital status of respondents

A Fig. 1 below shows that, about 87% of the respondents were married. This explains that the society is stable. A stable family can be more concentrating on production than an unstable one. This situation implies that there is high possibility of agricultural diversification. This is because the level of participation of family members in decision making process with respecting one another is large. Thus, whenever the new idea is introduced by any family members, the possibilities of acceptance are higher. There fore

household farmers become easy to diversify crops. But this situation should be considered carefully since of the Islamic culture allows males to marry up to 4 wives

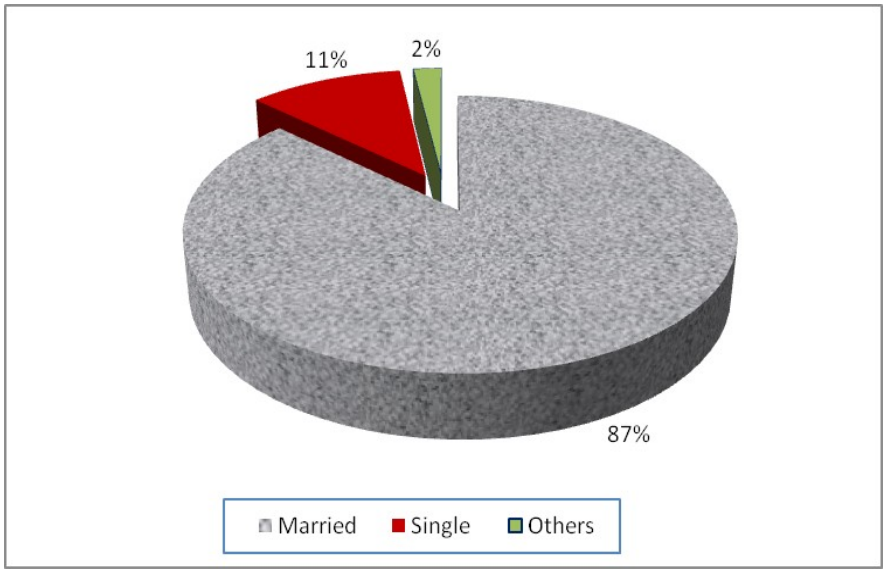

Figure 1: Marital status of respondents

4.3.4 Education level of the householders

Fig. 2 presents the percentages of the sampled smallholder farmers against their education levels. Education is one of the long-term strategies that may be used to improve agriculture in the developing countries like Tanzania. Amani *et al.* (1994), report that education in agriculture contributes 50% of the variation in the total agriculture output. In Pemba island the majority of the respondents have primary education (i.e. 36%), followed by secondary education 20% and then tertiary/university education and above l0%. It is about 34% of members did not attend formal education in other word; they attended non-formal education. A population likes this, which comprises with some skilled members is likely to be influenced with changes. This is contributed by the high potential of the adoption ability

and easier to interpret things. In addition, the educated person has high influence on access to information and exposure. These issues made the people to capture new phenomena easily and therefore apply them. Therefore there is high level of farmers to increase their income level since they are optimistic.

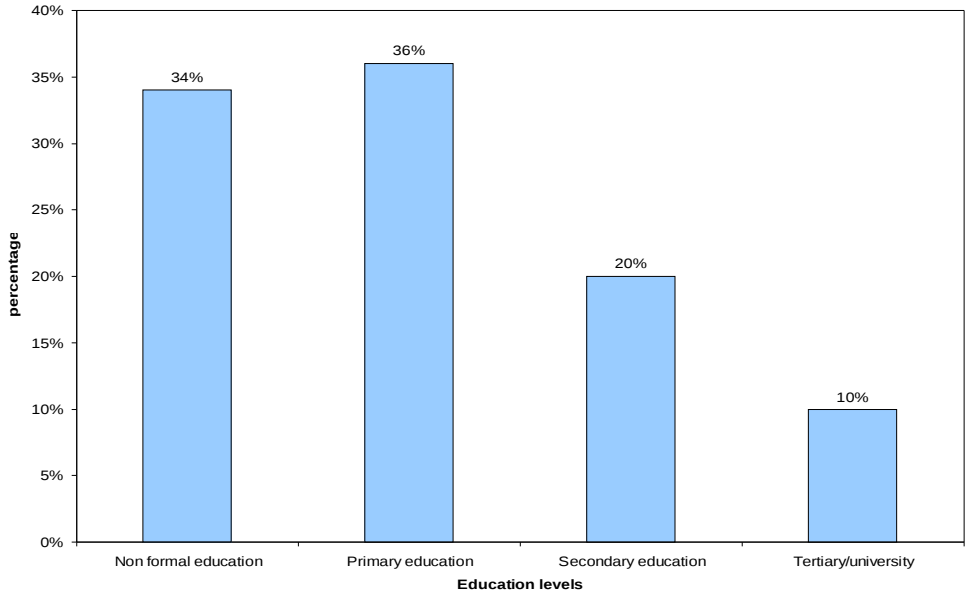

Figure 2: Education level of respondents.

4.3.4 Land acquisition

Table 6 depicts the various way of land acquisition from the sampled farmers. Farmers acquire their land plots through different ways. The survey revealed that 13.33% of the respondents inherited land, 15.21% acquired land through purchasing, 14.10% leased, 23.27% through the government allocated land, 16.86% through borrowed and 17.235% of the respondents got their land though family land. This situation creates a high opportunities for farmers to undergoes agricultural diversification, particularly on the annual crops. However, for family land, borrowed land and sometimes three acres government allocation become difficult for farmers to perform agricultural diversification

especially perennial crops. This is because it becomes a problem when members decide to inherit the land while there are crops on it. Therefore diversification is possible to annual crops.

In additional, in the Island as a whole, one can generally say that there is no enough land for agricultural development purpose. The average land area under cultivation owned by the respondents was 1.6ha. This is in line with the findings from the previous studies presented (Mkenda, 2001). This situation resists the possibilities of farmers to diversify crops accordingly. But, due to the many fragmented small plots owned by farmers, there is a chance to pursue agricultural diversification due to variation between the lands and soil types among plots. However, the extent of diversification is usually very low hence low incomes level is attained.

Table 6: Land acquisition

Mode	Respondents	Minimum	Maximum	Mean	Std deviation	Percentage
Inherited	63.00	0.30	9.50	1.72	1.87	13.33
Bought	38.00	0.30	12.00	1.96	2.53	15.21
Leased	11.00	1.00	3.00	1.82	0.84	14.10
Government Allocated	5.00	3.00	3.00	3.00	0.00	23.27
Borrowed	49.00	0.50	11.00	2.17	2.22	16.86
Family land	88.00	1.00	8.00	2.22	1.34	17.23

4.3.5 Off farm Activities Performed by Household Head

Apart from agriculture, the members of the household perform a diverse range off farm activities as a means to increase a scope of income to the household. Table 7 illustrates different activities conducted by other members of household, whose main occupation is not agriculture. Parallel with those are activities done by farmers during off farming

period. The data shows that 41% of the household members are engaged in business enterprises, 17% are in cattle keeping and 8% are working in the civil services (government employees). Meanwhile, 9% remain as student and 7% are performing automotive works. However, still there are about 9% of females who do food making activities including housewives. Also there are 6% and 3% of respondents who participate in arts works and fishing sector respectively. This situation implies that, to those families with small members engaged on off farm activities the potential to under go diversification is large.

Table 7: The Off farm activities

No.	Activities	Frequency	Percentages
1.	Business enterprises	62	41.0
2.	Cattle keeping	26	17.0
3.	Student	13	9.0
4.	House wife and food making	13	9.0
5.	Government employee	12	8.0
6.	Crafting and Arts works	9	6.0
7.	Automotive works	11	7.0
8.	Fishing and sea wed	4	3.0
	Total	**150**	**100.0**

4.4 Reasons for Diversification

The Table 8 presents the smallholder farmers' opinions on the reasons that made them to diversify. The following are the key reasons mentioned by smallholder farmers.

4.4.1 Environmental problems

About 37% of the respondents mentioned climatic change as the reason for starting diversification. Previously, the farmers enjoyed heavy rains with the prolonged small rainfall. This convenience of season enabled farmers to grow crops almost the whole year in sequential bases. For example, during the preparation of rice farming they manage to

grow legumes up to the harvesting time without interfering with farming activities. Currently, the situation is quite the opposite characterized by unreliable rainfall and sometimes drought. Thus, from this ground the farmers were forced to grow many crops which are somehow tolerant to these disasters.

4.4.2 Food security

About 33 % of the respondents mentioned food security as the reason for smallholder farmers to diversify. Mono cropping is often characterized by more risks related to production and marketing as well which leading to food insecurity. Thus, in order to ameliorate the problem associated by mono cropping, farmers adopted agricultural diversification as a strategy toward become food insecure in area of availability, access, stability and utilization of balance diets.

4.4.3 Traditional practices

The current study noted that 22% of the respondents reported to have diversified their crops as part of their traditional practices. This trend implies that smallholder farmers are performing diversification based on tradition practices, regardless of increasing net returns. But, they oriented practices inherited from their parents probable due to risks associated with the crops or perceived knowledge within that particular society. Thus, concerning to this argument farmers grow some crops while they are sure their ultimate production would become low. For example, society has a negative attitude towards a person who does not grow rice and often the society becomes reluctant to invite such person in harvesting operation (RADO, personal communication, 2007).

4.4.4 Agricultural marketing challenges

Although the major goal of the farmers is to maximize profit, 7 % of the respondents reported that, lack of reliable market information on inputs and outputs prices is among the reasons for them to diversify their crops. Often of the period were operating at loss due to imperfect information pertaining inputs and outputs of agricultural commodities. Therefore, they are forced to diversify their farming activities in order to spread the marketing risks; hence increase the scope of the income sources.

4.4.5 The poor soil fertility and productivity

About 1% of the respondents mentioned poor soil fertility as being among the reasons for crops diversification. Generally, the island is characterized by rough and undulating terrain which fosters the soil erosion process. Apart from that, inappropriate technologies, inadequate husbandry practices, fragmented land parcel and continuous cultivation without fallow periods have resulted into declining of soil fertility. Thus, as a strategic measure to ameliorate the situation farmers supposed to pursue crops diversification.

Table 8: Reasons for diversification

No	Factors	Frequency	Percentages
1.	Environmental problem	38	37.0
2.	Food security	34	33.0
3.	Traditional practices	22	22.0
4.	Marketing problem of agricultural products	7	7.0
5.	Low land fertility and productivity	1	1.0
	Total	**102**	**100.0**

4.5 Farmers Ranking of Crops in the Order of Importance

The study also aimed at finding out how farmers rank of crops according to priority. Farmers were asked to point out the five most important crops in the order of preference. According to respondents' opinions as indicated in Table 9, the most preferred crops are paddy, cassava, banana, sweet potatoes and beans. Paddy was ranked as the most important crop by all the respondents. This, is because, it is the most preferred food crop to most local people.

Cassava is the second important food crop. It is regarded as a food security crop due to its drought resistance and adaptability to diverse types of soil and weather. It is grown by more than 90% of the farmers in Pemba. The yield of cassava in Pemba is very low. This is because of poor farming practices. The varieties used are low yielding and highly susceptible to disease. Further, the poor maturing rate of varieties was also experienced.

Banana was ranked by respondents as the third most preferred crop. Previously the crop was perceived as the food crop but recently, due to the expansion of domestic market, it is as a cash crop. However, the crop competes with rice on land since it performs better in the wet land. Currently, crop is grown in the up land hence suffered very much with drought. The exportation figure indicated in appendix 3 shows that is the leading crop marketed in Zanzibar town.

Sweet potatoes have a very important role in Pemba. Though it is ranked fourth position, sometimes are used as a cash crop. It has a special role as a food security crop to many low income families. This is because of early maturity habit. People use it for break fast and food the yield of sweet potatoes is relatively low due to many reasons. This includes

inadequate availability of planting materials and poor soil fertility. This is due to the continuous intercropping system between sweet potatoes and cassava. Further, the use of low quality varieties which are susceptible to disease and pest has contributed in to low production.

Table 9: Farmer's ranking of crops in the order of important

Crop	Respondents	Percentage	Rank (top 5)
Paddy	150	25.0	1
Cassava	124	20.0	2
Banana	112	18.0	3
Sweet potatoes	59	9.9	4
Legumes	45	7.6	5
Vegetables	32	5.2	6
Cloves	24	4.0	7
Coconuts	19	3.2	8
Maize	18	3.0	9
Mangoes	9	1.5	10
Pineapple	4	0.7	11
Yams	4	0.7	12

4.6 Regression Analysis

4.6.1 The regression model and variables

The regression model used has been based on the binary logistic regression function as explained in detail in Chapter 2. It is expected that the decline in previous yield and price of crops would compel farmers to diversify crops as a strategic measures to compensate for the loss in order to maintain or increase the farm's net return and ultimately the income. Regression analyses were adopted to assess factors that affect farmers to undertaken diversification. Agricultural diversification was thus the dependent variable and the regressors were land area available, education level, and experience in farming, off farm income and extension contacts. The results in Table 10 show that the model has predicted correctly the cases at 71% and statistically significant at $p<0.5$. The results in table show

that four out of five parameters examined have significant influence on agricultural diversification. Both, these factors influenced agricultural diversifications are positively as expected. The final results of parameters estimation are summarized in Table 10.

Table 10: The regression results

Variable	Coefficient	Standardized Error	Wald Beta	Df	Significance
Constant	-11.559	4.631	6.231	1	0.013*
Land area	3.356	1.460	5.281	1	0.022*
Education	3.967	1.852	4.589	1	0.032*
Experience	-0.073	0.69	1.102	1	0.294
Off farm income	3.886	2.342	2.752	1	0.007**
Extension	5.986	2.935	4.158	1	0.041*

-2 log likelihood =317.379 Cox &Snell R Square 0.96

Overall cases predicted correctly 71 %

Note: R- Square = 71%

*Significant at P< 0.1 **Significant at P< 0.01

The first objective of the study was to identify the determinants of agricultural diversification of smallholder farmers. The results show that about 71 % of the dependent variables (probability of farmers to diversify agricultural activities) are attributed by the included variables. The rest percentage is due to the disturbance term. This amount of goodness of fit is reasonable enough for explaining the cause and its effect. The remaining variation (error) would probably be explained by the fact that, there are some keys variables which are either not included in the model or there are one or more variables which are included in the model but having no significant effect. With the exception of

experience in farming variable which is negative, the rest of the variables are positive. This most contributor variable seems to be the off-income.

4.6.2 Effect of land area on crop diversification

According to the Table 10 indicated above. The logistic model results show that, the coefficient of total farm size as an independent variable found to be significant with a positive relationship (P<0.l) to the probability of farmers to diversify crops. The unit increase in land area has been resulted the change of 3.356 increase on the agricultural diversification. This implies that, as land is one of the factors of production. It is surely that those farmers having sufficient land area are likely having good chance of growing different crops. This is because; generally the households' land holding areas are very small.

Thus, probably those farmers with large land area would have high potential to diversify agricultural activities. Therefore, would have a chance to provide year around full time labour (Cheryl *et al.*, 2001). This is because an increase in farm size has been associated with widening of capital resources, which are known to have a direct influence on farm productivity. The relatively wider capital base enables farmers to access inputs with little difficult. It also influences them to carry out other different agronomic practices in timely. Also, they would use hired labour. Hence, farmers have potential to engage in diversification of crops while spread the risk.

4.6.3 Effect of education level on crop diversification

The results from Table 10 above show that education levels are positively and significant related at P < 0.1 to agricultural diversification. The unit change in education level resulted in to 3.967 increase on the level of agricultural diversification. That is smallholder farmers

with high level education have higher likelihood of diversifying agricultural enterprises relatively to those without formal education. This implies that most of the farmers in the Island went school. The reason is the present of free education system, which declared by Zanzibar' government since 1964 revolution. Thus, with the exception of few people in the old generation, the remaining people in the new one are some how educated. Based on those grounds, farmers have greater level of understanding and interpreting things. Therefore, have large potential of adopting new technologies hence diversifying their crops enterprises.

4.6.4 Effect of experiences in cropping farming on crop diversification

The experiences in cropping farming are inversely related to the likelihood of farmers' crops diversification as indicated in Table 10 of the print-out appendix no 3 results. The unit increase in number of year in farming has resulted in to -0.073 decrease in agricultural diversification. This means that, agricultural practices among the old people is more traditional, since most of them have limited technical know how. In addition, agricultural diversification involves a lot of activities do be done. But the older people are not very much active. As results, people tend to practice their traditional oriented crops practices rather than adopting the new high yielding crops. Thus, the chance for agricultural diversification to the elder people is questionable.

4.6.5 Effect of the off farm income on crop diversification

The off farm labour measures the extent of the off farm income earned by a household from when one or more of its members are employed outside the crop farming. The result shows that the likelihood of smallholder farmers to undertake agricultural diversification is highly significant and positive (P<0.l). The results in Table 10 indicated that, a unit change

in shilling to off -farm income has been resulted in 3.886 increases on agricultural diversification. It is likely that small holder farmers with large off farm income have one or more family members working outside the village. Thus, the income earned by them probably would increase income. Hence improve the purchasing power to the families including purchase of farms inputs, hired labour, borrow or purchase land for farming thus crop diversification process.

4.6.7 The effect of extension services contacts on crop diversification

Generally, the degree of extension services contacts measures access to information and expertise are assumed to reduce both cost and risk of diversification. The results in the Table 10 above show that, extension services contacts are highly significant and positively related to the likelihood of farmer's diversification process ($P<0.01$). The change of one unit in number of visits causes the change of 5.986 increases on agricultural diversification. The implication is that, farmers who have more contacts with extension services acquired new knowledge and skills. This situation creates high knowledge and skills to farmers. This situation influences in interpreting and adopting new technologies. Therefore, due to high skill in farming operation, it is likely would increase in provided others necessary condition available. Hence agricultural diversification is influenced by extension contacts (Alia *et al.,* 1975) would be performed. The conclusion is that socio-economical factors have significant effect on agricultural diversification among smallholder farmers. Therefore, we rejecting the null hypotheses and accepting the alternative hypothesis which says socio-economic factors have significant effects on small holder farmers to undergo diversification.

4.7 Gross Margin Model

The gross margin analyses were performed for each crop in order to assess the relative competitiveness of crops grown by the farmers. The gross margin gives the contribution of each crop to the variable costs and profits. Thus, a farmer can use it as a guide in selecting different crops to grow. In this study, the items considered in calculating the gross margin were labour used in different operations, fertilizers and costs for physical inputs like sprays for insecticide.

4.7.1 The gross margin results

Table 11 shows a summary of the gross margin per acre, and return per man-days for the specified crops on smallholder farms based on 2006/07 yields and prices in the Island. The average cost per crop used to calculate the gross margin was obtained by computing the figure for each item for all the households producing the crop.

Table 11: The gross margin for major crops based on 2006/07 yields

Item	Cassava	Paddy	Banana	Sweet potatoes
Variable cost items				
Land preparation mandays@1500	12 562	144 937	42 937.5	12 000
Planting mandays@1500	6 000	8 437.5	50 625	6 000
Weeding and animal scaring mandays@1500	37 500	102 375	102 750	24 000
Fert application mandays@1500	-	-	-	-
Harvesting, mandays@1500	6 000	9 750	6 000	12 000
Fert rate (industrial) kg@500	-	14 121		-
Fert rate (organic) 50 kg@ 1000	7 810	-	8 667	7 500
Insecticides	-	6 600	-	-
Hired labour	17 146	19 978	14 575	10 114
Seed cost	9 577	12 197	23 245	3 112
Variable cost				
Production cost (II)	**96 595**	**310 805.5**	**248 799.5**	**74 726**
Average yield (kg/pc/acre)	454	108.41	763.00	165.26
Average price (Tsh.)	124.38	342.00	228.57	54.66
Gross return (Tsh) (I)	**56 296**	**39 440**	**269 520**	**25 284**
Gross margin (Tsh)	**-40 885**	**-271 365**	**20 721**	**-49 442**
Man-days p.a (family labour)	10.58	84.31	45.9	16.67
Return per man-day	-3864.34	-3,218.65	451.43	-2 965.93
Return per Shs. **(I/II)**	0.58	0.13	1.08	0.34

4.7.2 Variability of the net returns for selected crops

The gross margin analysis shows that, the returns for the crops selected fall into two categories. There are crops with negative returns; these include paddy, cassava and sweet potatoes, while banana is the only crop with positive returns. However, it is a fact that returns per unit is very much affected by the costs of production as well as the price of the end product when other factors are held constant. The banana production gives the highest average returns both per acre and per shilling invested. This is not only due to better market price; but also due to relatively low family labour per operation although weeding operations are done most frequently.

Cassava, sweet potatoes and rice had negative returns, despite that cassava had the highest yields per acre during the same season. This is because cassava is a relatively drought resistant crop compared to other crops. Consideration that, last year some places of Pemba especially the northern region were affected by drought, therefore contributes very much on the low production level to crops. Further, the low market price for cassava could probably be associated with high production of the crop (Theory of demand and supply applies). Meanwhile, sweet potatoes and rice are relatively susceptible to drought and that is, most of the acreages were not harvested since most of the sweet potatoes are grown in the upland and sandy soil (RADO, personal communication, 2007). Thus, conclusion regarding the hypothesis that there is no difference in return among the crops grown by farmers is rejected and accepting the alternative hypothesis that, there is a difference in the net returns among farmers crops.

4.7.3 The linear programming model results

The linear programming model was employed to address the objective stated that; how farmers allocate resources for optimal farm's net returns. It also intended to answers the hypothesis stated that, farmers do not allocate resources for optimal farm's net returns. Therefore, smallholder farmers plan to grow five crops namely banana, cassava, beans, paddy and sweet potatoes known as activities in the model. They planed to allocate their available (land, labour and inputs) as a constraints in order to maximize farm's net returns. Also intended to identify which crop is at optimal. Further, they needed to identify which constraints are limiting and which are abundant.

4.7.4 Optimal plan for agricultural diversification under pure competition

The print- out of the linear programming results depicted in the Appendix 3 shows that; the overall optimal solution found after one interaction. This optimality was found on banana only. The maximum value of net returns attained by small holder farmers was 319 953

Tshs. The plan suggested by LP technique is that in order for the farmers to achieve above amount of net returns, a total of 1.835 acres and the capital inputs of 174 400 Tshs are needed provided other necessary conditions remain constant. This implies that, there is not room for farmers to increase the income from banana unless able to change the model. This is because banana has attained the optimal solution.

Further, since smallholder farmers have other policies (objectives) apart from that of maximizing profit (Mlambiti, 1985). These include food security, subsistence issue and wealth accumulation. Thus, when deciding to produce at least one acre of one crop among those four crops, which are not at optimal situation for example cassava. They must allocate their available resources for the production of one acre of cassava first, then allocating other remaining resources in their production of other crops including banana. But they should be aware that by doing so, they automatically reduce the current maximum value of net returns attained from banana crop. As a result, farmers would receive less the amount. Meanwhile, they made some of resources to remain idle such as labour since the optimal was not there. This would in turn increase the under utilization of resources including under employment. This situation leads to lowering of income level and low abilities of doing savings to farmers which would consequently result into low diversification.

Furthermore, the model suggested that the smallholder farmers were operating at a point near the optimal solution according to their available resources base. The low level of resource endowment by the farmers made them not achieving fully satisfaction of their goal. But this is not so severe limitation to reach their intended goal. To achieve full satisfaction farmers should allocate their present stock resources more efficiently.

However, another option suggested by the model is to increase additional funds which would increase farm production (Chaudhy, 1976). This result implies that, there is lees utilization of capital inputs including fertilizers. Probable is due to the remove of subsidies programme by government in agricultural inputs. This strategy was done to allow private traders engage in industry following free economy policy. But, so far, no private institution engaged fully in the provision of farms inputs; and when happened most of the farmers fail to afford inputs at market price. In addition, banana production and marketing are relatively increasing due to the increase in domestic market demand as a result of multiplier effects of tourism sector. This situation has resulted farmers to consider the crop as a cash crop rather than a food crop. Consequently, according to the LP print-out of the Appendix 3 presented in Table 12. The results showed that there are some crops which are not at optimal solution and their corresponding net returns needed before the crops entered in the optimal solution. The crop and its present net returns are cassava (49 972.00 Tshs), paddy (37 076.00 Tshs), beans (5 368.00 Tshs) and sweet potatoes (64 806.00 Tshs). The planning tool suggest that in order for paddy to be produced at optimal solution the total net return of 176 186.12Tshs is needed. A total of net return 108 915.36Tshs is needed for cassava, this is in parallel with a total net returns of 129 454. 50 Tshs is needed for the production of sweet potatoes. Also, a total of 78 350.63 Tshs are needed for beans.

Thus, in order for those crops to enter the optimal solution, more capital resources are required until they are able to attain the above mentioned the net revenue. This deficit implies that farmers are producing below optimal level which is due to the low level of inputs use. In addition, these crops are mostly used as a food crops by many farmers since they practice subsistence farming. Thus, the levels of yields sold are relatively low in

comparison to total banana production since it depends on surplus available after home consumption.

Table 12: The non optimal activities

No.	Crops	Present net returns (NR)/acre	NR (Tshs) needed before
1.	Cassava	49 972.00	108 915 335
2.	Paddy	37 076.00	176 186 120
3.	S/ potatoes	5 368.00	129 454 596
4.	Beans	64 806.00	78 360 627

Moreover, it is clear that agricultural development is an integral process and that, the policies and activities of government authorities at all levels have profound effect on rate of development and achievements of this sector. These policies and actions are of many kinds. For a smallholder farmer planning should therefore involve the process of deciding what he/she should do with respect to polices and actions affecting agricultural development in a given period of time. In order to make the appropriate decision, the smallholder farmers need to have clear information on the amount and nature of its resources that are land, labour, and capital, and how they relate to attain the intended farmer objectives. Since these resources are often inadequate for the small holder farmers to do all that can be done; farmers have different opportunity costs in their production process. Thus, choice have to be done based on relative priorities of the farmer's policies and goals. Based on our results smallholder farmers have different opportunities costs for producing crops. For example the opportunity cost of farmers to produce banana to paddy is 319 953 Tshs; while the opportunity cost of producing paddy is 37 076 Tshs. The results also, show that opportunities costs of producing sweet potatoes and beans are 5 368.00 Tshs and 64 806.00 Tshs respectively. Thus, the farmers have high opportunity cost of producing banana to other remaining crops. Therefore, as farm's planning technique, the

LP model suggested that farmers should plan to produce banana. This is because the returns they receive will compensate the gain from other crops.

4.7.5 The marginal value product (MVP)

The linear programming results show that the marginal value product (MVP) is 3.65 Tshs. This represents the ratio of the margin value product (VMP) relative to its margin factor cost (MFC). This situation occurred when the inputs are allocated as indicated by the conditions that exist along the expansion path. That is the worth of the increment shilling spent by farmers on inputs to the firm if the inputs are allocated according. Further, the MVP principle assumes that some given fixed amount of funds in total are available for the purchase of inputs; it provides the decision rule with respect to how the available funds should be allocated in the purchase of the inputs.

In the purely competitive environment, the respective margin factor costs are the inputs prices. But according to LP print-out shown in the Appendix 3 results; it implies that for every one shilling increase in buying extra unit of input made by smallholder farmers, there is an increase of 3.56 Tshs from the extra output sold by farmers. Thus, according to this figure, farmers still have a room to inject their additional shilling in buying more inputs for production process until it reaches the situation whereby for each additional shilling spent for purchasing extra unit inputs, it produces unit shilling of the output sold.

However, in order the farmer to produce at the point of global profit maximization; which is a special point along the expansion path when MVP is equal to l. This is probably a point on the expansion path further out than the point when MVP is equal to 3.56 Tshs. This implies that the funds for the purchase of inputs were restricted. Therefore, this

confirms that there is a shortage of using capital inputs for smallholder farmers in the agricultural production activities in the Island. This is probably due to the fact that there is not subsidies policy in agricultural inputs as well as the possibility that farmers are not rational in using inputs. As a result, the availability of inputs becomes a big problem and farmers become variable in use of inputs at the markets price.

4.7.6 Slack constraints

The linear programming results show that there are two variables which remained as slack constraints as indicated in the Appendix 3 of the LP print-out. These are the family labour and land area.

- **The available family labour (man days)**

In the case of the family labour, which is measured in term of man-day, the surplus labour is 73 255 man-days. This means that the smallholder farmers have idle man days which are not utilized fully in the crops production activities. As a result, people are under employment in crops production hence leadings to relaxation during season and off season. Therefore, it is through agricultural diversification where these idle man-days can be fully utilized in production system. However, although diversification has been taken place but it is at low level particularly on the part of intercropping system and relay cropping system. This situation results in to diseconomies of scale and diseconomies of size in the agricultural production system. Therefore, to make a firm under economies of scale there is a need to re adjust the cropping system in order to reallocate the family labour into a fully time employment all year around.

But due the low economic development of the Island this surplus labour would likely remain under utilized; and gradually increased each day due the high population growth in the Island. This was confirmed by the farmers themselves during interviews that their average working period is between l and 2 hours per day with the exception of the rice farming season, particularly during weeding and harvesting operations which are performed for a long time (Personal conversation with farmers, 2008)

- **The available land area**

The total land area is an important factor that determines the level of the production process to smallholder farmers. In this study, the noted supply of the total land area varied from 0 to 38 acres with an average of 4 acres per household. But according to the LP results, there is a surplus land of 4.64 acres. This implies that, since farmers would allocate only 1.8 acres to optimize the net return in banana production, there is an opportunity for them to use the extra land available for production of other crops which also having the potential for diversification.

Therefore, the conclusion concerning the hypotheses that farmers do not allocate resources for optimal farm's net returns is rejected, and accepting the alternative hypotheses says that, farmers allocate resources for optimal farm's net returns. Therefore potential for the agricultural diversification is possible.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATION

The general objective of this study was to assess the effect of agricultural diversification on smallholder's income. It aimed at identify the determinants of agricultural diversification

among smallholder farmers, examine and compare competitiveness for selected crops having the potentials for diversification and to determine how farmers allocate resources for optimal farm's net returns. The following are the conclusions of the study:

5.1 Conclusions

The study was designed to test to three hypotheses. The first null hypothesis says that, socio economic factors have no significant effect on agricultural diversification among small holder farmers. The null hypotheses should be rejected and the alternative hypotheses be accepted which says that the socio-economics factors play a big role to smallholder farmers to do agricultural diversification. The findings show that about 71% of the smallholder farmers' probability to diversify agricultural activities is attributed by the included variables. This implies that, either there are some key variables which missing in the model or some included variables have not significant effect.

The second null hypothesis says that, there is no difference in returns among major crops grown by farmers. This hypothesis should be rejected and accepting the alternative hypothesis which says the returns among major crops grown by farmers is differentiated. Its implication is that banana crop has relatively high returns compared to other crops. There fore the crops are purely competitive ones hence farmers should plan the adoption of agricultural diversification.

The third null hypothesis stated that, farmers do not allocate resources for optimal farm's net return. The null hypothesis should be rejected and accepting the alternative hypothesis that farmers allocate resources for optimal farm's net returns. This implies farmers are rationale on resources allocation for maximizing farms’ profit. However, emphases should be placed on banana production.

Thus, the general conclusion is that smallholder farmers face socio-economics factors, whereby land area, education, off farm income and extension services have a positive relation to their probability for agricultural diversification, while experience was the only factor which is negatively related to the likelihood for agricultural diversification. These factors have large effects on householders for maximizing income.

5.2 Recommendations

- The existing agriculture system is characterized among other factors by the utilization of local low yielding varieties. Therefore it is recommended that, the government should establish the seeds farms unit, accompanied by farmers open days and farmer's field schools. In order to ensure that the improved varieties seeds are available around the farmer's environment.

- The extension service unit is not well operated with the exceptional of those localities with specific projects or programmes such as PADEP. These work very closely with highly skilled and experience personnel, under participatory bases. Thus, it is recommended to the policy makers and to related agricultural development partners that the existing extension service systems be revived by emphasizing the modern extension system which favours the massive communication and participation under farmer's environment.

- The utilization of inputs especially artificial fertilizers are insufficient due to fanners' low purchasing power to small older fanners at market price. Together with cut off of the subsidy programmes by the government without having in place well

established organizations. Therefore, it is recommended that there is need to resume the subsidy programme parallel with the establishment of a well input provision Agency.

- The main objective of any smallholder fanner is to maximize profit. But there are other policies/ objectives such as food security, wealth accumulation and alike. Therefore, it is recommended that apart from profit maximization goal. There is a need for the government to declare the food security policy, for the production of drought tolerant crops such as cassava in order to be self sufficient in food as well as reducing the risks and uncertainty.

- Smallholder farmers are not-optimally allocating resources for their crops enterprises, with the exceptional of banana production. Therefore it is recommended that, farmers should plan their resources at optimally allocation.

- The existing marketing channels are inadequate to absorb all farms' outputs due to unreliable transport to Zanzibar town. Also, individual smallholder farmers are not able to reach the International markets. To deal with this problem, it is recommended that there is need to re-establish co-operative societies and farmers' organizations at different levels. But government should encourage and support them both financially and technically.

- The farmers' organization and clustering are not well developed. As a result farmers' opinions and welfare are not well captured and incorporated during agricultural development planning. Therefore, it is recommended that the

smallholder farmers should establish their own organizations and networking. This would make them to have a strong voice, meet farm' requirements and be easily reached by the external experts hence increase their income.

- It is recognized that the provisions of adequate inputs including quality seeds due to lack of funds. Therefore, it is· recommended that the government should take deliberate action to establish rural bank and support SACCOS at rural areas (community level).

- The results show that the only plan the smallholder farmers should adopt for optimal return is banana. Therefore, it is recommended that farmers should make efforts and set future programs for the production of banana crop for commercial purposes.

- The banana and rice are competing for wet fertile land. Therefore, it is recommended that farmers should use the wet fertile rice's land for the production of banana crops. Since the opportunity cost for rice would be compensated by the opportunity cost of banana if other factors remain constant.

- The smallholder farmers have the surplus land and labour which confirm that the economic sector is not reaching its potentiality. Therefore, it is recommended that smallholder farmers should use these surplus factors of production by diversifying crops enterprises.

- It is also recommended that, policy markers should establish the crops processing industries in order to use labour effectively and most efficiently. This will reduce the • under employment problem. Secondly to address problems related to storage and post harvest wastes of crops, especially perishable ones such as banana.

- The opportunities of growing high value crops suck as vegetable are constrained by the prevailing infestation of pests, diseases, and unreliable rain falls. Therefore, it is recommended that, integrated pests' management (IPM) approach and irrigation system should be established.

- The rice crop should only' be cultivated in irrigation schemes. The ram fed rice production is likely to be at risk and uncertainty due to drought. It is also causes to leave bare land and underemployment. Therefore it is recommended that farmers should plan for irrigation or bunds systems. Whilst, policy makers those should increase the number of irrigation schemes and establishing rain water harvesting programme.

- The small holder farmers have surplus labour in the production process. Thus, the best alternative options could be the introduction of multi-cropping system particularly sequential cropping system installation.

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APPENDICIES

Appendix 1: Farm Household Questionnaire

AGRICULTURAL DIVERSIFICATION: ITS DETERMINANTS AND CONTRIBUTIONS TO SMALLHOLDER FARMERS' INCOME IN PEMBA ISLAND

A: THE HOUSEHOLD DEMOGRAPHIC VARIABLES

1. Questionnaire number----------

2. Name of enumerator----------

3. Date of interview----------

4. Respondent locations.

Region---------- District----------Shehia ----------

Village----------

5 HOUSE HOLD CHARACTERISRICS

Family size----------

Adult (18years and above) ----------

Children under 18 years ----------

Male---------- Female----------

NAME HEAD OF HOUSEHOLD.

Gender 1= Male 2=Female	Age (Yrs)	Marital Status 1= Married 2=Single	Education Level 1=Non-Formal Education 2= Primary Education 3= Secondary Education 4=Tertiary/University	Experience In Crop Production (Yrs)	Other Activities

6. OTHER HOUSEHOLD MEMBERS

	Name	Sex 1= Male 2=Female	Age (Yrs)	Education 1=Non-Formal Education 2= Primary 3= Secondary 4=Tertiary/Univ	Participation In Agric 1=Full Time 2=Part Time 3=No	Other Activities Performed	Relation Hh 1=Wife 2=Child 3=Relative
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							

B: FARM RESOUCES, PRODUCTION AND REVENUES.

This section focused on the seeking the information concerning the level of resources household has for production their productivity and revenue obtained.

7. Give area in acreage allocated for various farm activities in the year 2006/2007

No.	Crop	Area (acreage)
1.	Paddy	
2.	Banana	
3.	Cassava	
4.	Maize	
5.	Vegetable	
6.	Coconuts	
7.	Clove	

8.	Legume	
9.	Yams	
10.	Spices	
11.	Others (specify)	

8. **Land ownership aspect**

(a) Total land area owned (acres) _____ (leased, user right)

(b) Total number of plot owned. _____

©Type of ownership: (Indicate acreage in the appropriate space)

Leased	Inherited	Borrowed	Government allocated (3 acres)	Family plot	Bought

9. How many dairy cows do you have currently? ----no

10. What number of heads do you have?

Indicate the detail of your livestock composition

	Type of livestock	**No of head**	**Types of breeds**
1.	Dairy		
2.	Multi purpose cattle		
3.	Dairy goats		
4.	Multi purpose goats		
5.	Layers		
6.	Broilers		
7.	Local chicken/ducks		

11. Can you please rank your crops according to relative importance? 1 for most important .....and 5 for the least important

No.	**Crop**	**Farmer's rank**
1.	Paddy	
2.	Banana	
3.	Cassava	
4.	S/potatoes	
5.	Clove	
6.	Mangoes	
7.	Legume	
8.	Vegetable	

9.	Coconuts	
10.	Maize	
11.	Pine apple	
12.	Yams	
13.	Citrus	
14.	Others (specify)	

12. Based on 2006/07 harvests, please help in filling the Table.

Crops/kg	Banana	Rice	Beans	Maize	Cassava	S.ppt
Amount harvested						
Amount sold						
Amount consumed						

13. Why do you diversify your crops instead of concentrating on the most profitable crop? …….

C: HUSBANDRY PRACTICES AND THE ASSOCIATED COST OF PRODUCTION

This section intends to generate information on crop production, husbandry practices, cost involved, income generated and the problems associated with it.

14. When are these husbandry practices undertaken in your production practices?

Crops	Land prep	Nursery	Planting	Weeding 1	Weeding 2	Fertilizer application	Harvesting	Store/ Pack
Banana								
Clove								
Rice								
Coconut								
Beans								
Cassava								
S/potatoes								
Maize								
Vegetables								

15. How the labour utilized in crop production and what is are the association costs in different crops.

Paddy

Operation /labour	**Labour involved**		
Land prep	Family	Hired labour	
planting		Man-days	Price rate/Tshs/person
Weeding			
Fertilizer application			

Insecticide application			
Harvesting storage			

Banana

Operation /labour	**Labour involved**		
Land prep	Family	Hired labour	
planting		Man-days	Price rate/Tshs/person
Weeding			
Fertilizer application			
Insecticide application			
Harvesting storage			

Cassava

Operation /labour	**Labour involved**		
Land prep	Family	Hired labour	
planting		Man-days	Price rate/Tshs/person
Weeding			
Fertilizer application			
Insecticide application			
Harvesting storage			

Legumes

Operation /labour	**Labour involved**		
Land prep	Family	Hired labour	
Planting		Man-days	Price rate/Tshs/person
Weeding			
Fertilizer application			
Insecticide application			
Harvesting storage			

Sweet potatoes

Operation /labour	**Labour involved**

Land prep	Family	Hired labour	
planting		Man-days	Price rate/Tshs/person
Weeding			
Fertilizer application			
Insecticide application			
Harvesting storage			

15. Variable costs

Crops	Seed			Fertilizer		Pesticide		Herbicide		
	Type	Amount	Cost (Tshs)	Type	Cost (Tshs	Amount	Cost (Tshs	Type	Amount	Cost (Tshs)
Maize										
Clove										
Rice										
Banana										
Sweet potatoes										
Cassava										

16. Production cost in dairy enterprises

Item	**Quantity**	**Unit cost**	**Total cost**
Purchase			
Housing			
Feeds			
Medical			
Labour			
Transportation			

17. Indicate relative estimated annual earned income from the activities performed by household members

Type of activities	**Estimated income**	**Farmer's own rank**
Income from the sale of crops products		
Income from the sale of livestock products		
Casual employment		
Business enterprises		
Permanent employment		

Crafting and art		
Fishing and sea weed		
Firewood and charcoal sale		
Remittances		
Others (specify)		

18. Use and source of inputs

Type	Do you use? 1=yes 2=No	Source of inputs 1=Government 2=Private trader 3=own farm 4=others (specify	Estimated annual expenditure on inputs (Tshs)
Industrial fertilizers			
Organic fertilizers			
Herbicides/seeds/planting material			
Chick/ breeding stock			
Veterinary medicines			
Animal feeds/concentrates			
Mechanization			
Farm implements			

D: MARKETING INFORMATION

19. Where do you sell your crops after harvesting?

Crop	Farm (1)	Village (2)	Nearby market (3)	Cooperative (4)
Paddy				
Maize				
Clove				
Cassava				
Banana				
S/potatoes				
Coconuts				
Legumes				
Groundnuts				
Vegetables				

20. What is the average milk/cow …….lts.

E: FARM ORGANIZATION AND INSTITUTIONAL SUPPORT

21. Is there any farmer's organization in your districts / shehia (1) Yes; (2) No
22. Are you a member of any organization above? (1) Yes; (2) No
23. Are you access to extension services (1) Yes; (2) No
24. If yes, how frequencies are you visited (1) once a week; (2) twice a week; (3) once a month; (4) once a year; (5) Others specify.

Thank you very much for your cooperation

Appendix 2: Exported crops from Pemba January - December 2007

Type of crop	Amount	Destination	Tax revenue
Banana (bunches)	88,670	Zanzibar town	1,872,500.00
Cassava (50 bags)	1,401	Zanzibar town	735,000.00
Sugar cane (20 pcs)	49	Zanzibar town	25,000.00
Green tobacco	13.5	Zanzibar town	25,000.00
Groundnuts (50kg)	3	Zanzibar town	1,500.00
Mangoes (100kgs)	933	Zanzibar town	277,000.00
Coconuts (No)	12,700	Zanzibar town	33,000.00
Water melon (50kg)	3	Zanzibar town	1,500.00
Cocoyam (50kg)	4	Zanzibar town	2,000.00
Total			**2,972,500.00**

Source – Ministry of Agriculture Livestock and Natural Resources, Zanzibar

Appendix 3: Linear programming package

Appendix 3: Linear programming package

Wye College Micro-Linear Programming Package Version 4.0 May 1985
****
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Evolution of the optimal plan for: Diversification of Agricultural Activities
****

Iteration number	Incoming variable	Outgoing variable	Pivot value	Net Revenue
1	Banana	Capital	%48934.00	0.00

Optimum solution found after 1 Iterations - -

Maximum value of Net Revenue = 319953.112 - -

Plan :
****

		Level	Lower limit	N.R. range for which each activity level stays constar (with the incoming variable) Present N.R.	Upper limit
*Banana	Acre	1.835	144251.125(Beans)	174400.000	OPEN

Activities not in optimal plan
****

		Present N.R.	N.R. needed before entry
Cassava	Acre	49972.000	108915.355
Rice	Acre	37076.000	176189.120
S-Potato	Acre	5368.000	129454.596
Beans	Acre	64806.000	78350.627

Binding constraints
****

		M.V.P. $/unit	Lower limit	Resource supply range over which the M.V.P. is cons (with the outgoing variable) Present Level	Upper limit
Capital	Tshs	3.564	0.000(Banana)	89774.000	227053.766(Land)

Slack constraints
****

		Lower limit	Surplus	Upper limit	Surplus
Labour	Mday			345.125	283.960
Land	Acre			4.000	2.835