# ADOPTION OF IMPROVED TECHNOLOGIES IN COCONUT PRODUCTION BY SMALLHOLDER FARMERS IN WEST DISTRICT, ZANZIBAR

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A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF RURAL DEVELOPMENT OF SOKOINE UNIVERSITY OF AGRICULTURE. MOROGORO, TANZANIA.

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## ABSTRACT

Despite the initiative being made by the government and other stakeholders to promote improved technologies in coconut production among the smallholder farmers in West District in Zanzibar, its yield remains very low. This study intended to assess the adoption of improved coconut production among smallholder farmers in West District. Specifically, the study objectives were to: assess farmers' attitude towards improved technologies; assess level of coconut yield before and after the year 2000 of adoption technologies, identify the challenges of using adopted technologies, determine the impact of adoption of improved technologies on the level of coconut production and determine factors influencing coconut production among smallholder farmers. A total of 100 respondents were involved in this study. Data were analyzed using the Statistical Package for Social Science (SPSS) version 16. The findings indicate that smallholder farmers had negative attitude towards improved technologies for coconut production. The mean yield of coconut was 41.08 and 17.74 nuts /palm/year before and after adoption of improved technologies respectively. This indicates that there is a decrease in production inspite of the adoption of the new technologies. The major challenges for using adopted technologies among the smallholder farmers were unaffordable of fertilizer, low replacement spacing, scarcity of land and difficult to control coreid bug. Factors such as income from the coconuts; farm size and education significantly ($p < 0.05$) influenced the adoption of improved technologies on coconut production. The study, therefore, concludes that adoption of improved technologies had reduced coconut production. The study recommends that the Government under the Ministry of Agriculture should support training; dissemination improved technologies, extension officers and smallholder farmers. The farmers should also be motivated in coconut production through reducing problems hindering production such as pest control and fertilizer uses.

**DECLARATION**

I, NEEMA ABDULLA KHALFAN, do hereby declare to the Senate of Sokoine University of Agriculture that this is my own original work done within the period of registration and that it has neither been submitted nor being concurrently submitted in any other institution.

________________________ ________________________

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(MARD Candidate)

The above declaration is confirmed

________________________ ________________________

Dr. C. I. Nombo Date

(Supervisor)

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## DEDICATION

This dissertation is dedicated to the Almighty God, my parents, my beloved mum together with the late Mr. Abdulla Khalfan and Mwarab Khalfan who laid foundation of my education.

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## LIST OF ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| ARIM | Agriculture Research Institute Mikocheni |
| CAADP | Comprehensive African Agricultural Development Programme |
| CBFS | Coconut Based Farming System |
| CGIAR | Consortium of International Agricultural Research Centers |
| CRP | Coconut Research Project |
| CSA | Central Statistical Authority |
| EAT | East African Tall |
| FAO | Food Agricultural Organization |
| FGD | Focus Group Discussion |
| GDP | Gross Domestic Product |
| GR | Green Revolution |
| HYV | High Yield Varieties |
| IDRC | International Development Research Centre |
| ILO | International Labour Organization |
| IPM | Integrated Pest Management |
| KATI | Kizimbani Agriculture Training Institute |
| MARI | Mikocheni Agriculture Research Institute |
| NAP | National Agricultural Policy |
| NBS | National Bureau of Statistics |
| NCDP | National Coconut Development Programme |
| OCGS | Office of Chief Government Statisticians |
| QPM | Quality Protein Maize |
| RGoZ | Revolutionary Government of Zanzibar |
| SNAL | Sokoine National Agricultural Library |

| | |
|---|---|
| SPSS | Statistical Package for Social Science |
| SSA | Sub Saharan Africa |
| SUA | Sokoine University of Agriculture |
| TAM | Technology Acceptance Model |
| URT | United Republic of Tanzania |
| VIF | Variance Inflation Factor |
| WD | West District |
| ZASP | Zanzibar Agriculture Sector Policy |
| ZCRP | Zanzibar Coconut Research Project |

# CHAPTER ONE

## 1.0 INTRODUCTION

### 1.1 Background Information

Coconut (*Cocos nucifera*) is one of the most important crops grown in more than 93 countries in the world in an area of 12.19 million ha, with an annual production of 61 165 million nuts equivalent to 13.59 million tons of copra. More than 11 million farmers, mostly smallholders with low income, grow the palm in 90 countries (FAO, 2009). Indonesia is the largest coconut producing country, with an area of 3.8 million ha and annual production of 3.77 million tons of copra, followed by the Philippines with an area of 3.3 million ha and annual production of 2.49 million tons of copra. India, with 1.9 million ha and annual production of 2.74 million tons of copra, occupies the third place. However, the global increase in coconut production is mainly associated with increase in area under cultivation over the years (Adkins *et al.,* 2006).

Tanzania is the largest coconut producer in Africa. However, production is low when compared to major coconut growing countries in the world due to lack of adequate resources to invest in technologies that would improve production. The area under coconut production in the country is estimated to be about 265 000 ha with an estimated population of 25 million palms that produce 875 million nuts annually, equivalent to about 58 000 metric tonnes of oil, making it the single most important oil crop in the country (MARI, 2012). In monetary terms, the value of the current coconut production from the sales of fresh nuts at farm gate price is ranging between 500 and 800Tsh. which is estimated to be about Tsh. 218 billion annually. However, local consumption of fresh nuts without entering the formal market channels has therefore, reduced the amount of income accrued from coconut production (MARI, 2012).

Coconut is an important oil crop that supports the livelihoods of about 12 million people living in coastal belt of Tanzania (Mtwara, Lindi, Kibaha, Mafia, Bagamoyo and Dar es Salaam) and Zanzibar islands, which is estimated at 26.6% of the population in the country (NBS, 2012). Apart from its bearing supports to livelihoods as the major source of income for the coastal belt, coconuts are preferred due to its adaptability and ability to provide acceptable yields under marginal farming condition (MARI, 2012). It is against this background that the government of Zanzibar has developed special attention on the crop and agricultural sector at large with the main targets of promoting investment, production and productivity as well as ensuring food security thus, improving the livelihoods of coconut farming communities (URT, 2002).

Between 1980 and 2000 the National Coconut Development Programme (NCDP) and Mikocheni Agricultural Research Institute (MARI) introduced improved agricultural technology packages within the coconut based farming systems. The introduced technologies were coconut seed varieties, integrated pest management, agronomic practices and the processing technologies (MARI, 2000). These technologies were aimed at improving the household income of small scale farmers through increasing crop productivity leading to higher income at household level (Masumbuko, 2005).

In a surprising note, coconut production has been decreasing despite the assorted improved technologies. For instance, the level of coconut production before the year 2000 were high, about the mean average of 10 900 coconuts per farmer when compared to 1564 mean average per farmer after the year 2000. Revolutionary Government of Zanzibar (RGoZ) and other stakeholders have directed the efforts to address problems facing the coconut subsector for the purpose of increasing its productivity and benefiting the small scale farmers while at the same time boosting its contribution to the national economy. According to NBS and OCGS (2008), coconut palms production in Zanzibar Islands is estimated to be 31.2 t/ha on an area of 4403.08 ha. This production is low compared to other coconut producing countries in the world, the Ministry of Agriculture need to enhance the use of improved technologies. This study is therefore intending to assess the adoption of improved technologies had reduced coconut production in Zanzibar to provide the answer as to why there is low production despite the farmers adopted improved technologies.

### 1.2 Problem Statement

Coconut is an important smallholder crop in the West District of Zanzibar that serves as a source of income earnings to the majority. However, on average the overall yields are extremely low when compared to the production in the major coconut producers in the world. In an effort to raise the yields, the Government of the United Republic of Tanzania (URT) introduced the National Coconut Development Programme (NCDP) in 1979/80 with the major goal of improving the productivity of the coconut through a number of research and development activities. Despite the adoption of improved technologies, coconut farmers are experiencing lower yields as they are not capable of yielding maximum outputs of 40-60 nuts per palm/year, particularly in the West District of Zanzibar (URT, 2000). For example, documented data shows that coconut farmers are getting yields in the range of 25-30 nuts per palm/year (ZCRP, 2004). It is important to understand as to why there are low yields despite assorted coconut improved technologies.

Therefore, this study intended to assess the adoption of improved technologies in coconut production among smallholder farmers in West District, Zanzibar.

## 1.3 Justification of the Study

Coconut crop continues to serve as an important source of household and national income in Zanzibar. This leads to a need to ensure the sub-sectorial high performance in terms of increasing productivity. The concerted efforts to promote for improved technologies to smallholder farmers were expected to yield promising results by increasing productivity. However, smallholder farmers have been experiencing low yields despite the adoption of these technologies hence; raise the need to assess the adoption of improved coconut production technologies among small holder farmers in West District, Zanzibar

The findings of this study therefore, will be beneficial to the government and other responsible authorities in coconut subsector in Zanzibar to understand some reasons as to why there is low productivity despite assorted interventions. On other hand, the study findings will play a vital role towards reframing strategies to boost coconut productivity as well as motivating smallholder farmers engaging into coconut production.

## 1.3 Objective of the Study

### 1.3.1 Overall objective

The overall objective of the study was to assess the adoption of improved coconut production among smallholder farmers in West District, Zanzibar.

### 1.3.2 Specific objectives

The specific objectives of this study were:

i. to assess farmers' attitudes towards improved technologies for coconut production;
ii. to assess level of coconut yield before and after adoption of the technologies;
iii. to identify challenges of using adopted technologies among the smallholder farmers;
iv. to determine impact of adoption of improved technologies on the level of coconut production; and
v. to determine factors influencing coconut production among smallholder farmers.

### 1.3.3 Research questions

The following were the research questions:

i. what are the farmers' attitudes towards improved technologies for coconut production?
ii. is there statistically significant differences in coconut production prior to and post technology adoption?
iii. are there challenges in using improved coconut production among smallholder farmers? and
iv. what is the impact of improved technologies on of coconut production?

### 1.4.4 Research hypothesis

The study hypothesis was:

**$H_0$:** There is no statistically significant influence of socio-economic characteristic of the respondents on coconut production.

# CHAPTER TWO

## 2.0 LITERATURE REVIEW

## 2.1 Definitions of Key Concepts

### 2.1.1 Adoption

Mitropoulos and Tatum (2000) defined adoption as a process by which an individual or organization identifies and implements a new technology. This process starts from awareness to continued use of the innovation, which results into perfect relationship between intention and behavior of adoption (Gollwitzer, 1999).

Doss (2003), who conducted a study on farm-level technology adoption in Eastern Africa, came with distinction between discrete and continuous technology adopters among typical farmers who use either unimproved or improved inputs. The author defines a farmer as being an adopter if he or she is found to be using any improved materials. With respect to the adoption of improved varieties, discrete adoption refers to a farmer who stops using a local (traditional) variety and adopts an improved variety. In contrast, continuous adoption refers to situations where farmers increasingly planting more land to improved varieties, while continuing to grow some local varieties (Lopes, 2010).

### 2.1.2 Technology

Technology is a body of knowledge used to create tools, develop skills and extract or collect materials. In addition, Technology is the making modification usage and knowledge of tools, machines, crafts, systems, and methods of organization in order to solve a problem, improve a pre-existing solution to a problem, achieve a goal, handle an applied input/output relation or perform a specific function (Liddell *et al.*, 2000).

Technology is also assumed to mean a new, scientifically derived, often complex input supplied to farmers by organizations with deep technical expertise. Neill and Lee (2001) cited by Parvan (2010) point out that majority of existing literature on agricultural technology adoption is focused on Green Revolution (GR) technologies such as irrigation, fertilizer use, and the patterns of high-yield variety (HYV) seeds.

### 2.1.3 Smallholder farmers

Smallholder farmer is a person who participates in the day-to-day activities by providing labour and management of the farm or livestock. In Tanzania, agriculture is characterized by subsistence and smallholder farmers who operate on average of 0.2 to 2.0 hectares with low productivity of about 0.88 tons/ha compare to World average of more than 5 tons/ha. (URT, 2010).

In additional, smallholder farmers are the drivers of many economies in Africa even though their potential is often not brought forward. Smallholder farmers are defined in various ways depending on the context, country and even ecological zone. Often the term ‘smallholder’ is interchangeable used with ‘small-scale’, ‘resource poor’ and sometimes ‘peasant farmer’. In general, terms smallholder only refers to their limited resource endowment relative to other farmers in the sector. Smallholder farmers are also defined as those farmers owning small-based plots of land on which they grow subsistence crops and one or two cash crops relying exclusively on family labour (Aaron, 2012).

According to URT (2000), 51% of the population in Tanzania lives below the international poverty line and 36% is classified as poor and mainly living in the rural areas. Smallholder farmers are in a vicious cycle of low income, low savings, low capital, low productivity and consequently low income. This means smallholder farmers are not able to adopt recommended agricultural technologies due to capital constraints.

## 2.2 Importance of Coconut Sub-sector and Rationale for Farmers

Coconut is an important oil crop that supports the livelihood of majority of coastal people in Tanzania and the sustainability of their environment. It is referring as to the *Tree of Life* because of the many products that can obtain from one tree crop. However, this has not been the case and poverty continues to loom despite the many products that accrue from the crop (Mwachiro and Gakure, 2011). Despite the enormous potential of the crop, coconut farmers in Tanzania are poor and lack adequate resources to invest in technologies that would improve production (MARI, 2012). To unlock this potential, the Government of the United Republic of Tanzania (URT) initiated the National Coconut Development Programme (NCDP) in 1979/80 with the major goal of improving the productivity of the coconut sub-sector through a number of research and development activities (MARI, 2012).

The NCDP put in place a sound scientific, technical and infrastructure capacity in research for the development of the coconut sub-sector. A number of production and processing technologies were developed, disseminated and also adopted by farmers. However, these research and development activities were not sustainable after the closure of the NCDP because of funding constraints. The tangible achievements in terms of sustainable technologies that were developed were not adequate adopted by target farmers partly because of failure to up-scale and disseminate them widely (MARI, 2012).

## 2.3 Farmers' Attitude towards Improved Technologies for Coconut Production

A study on farmers' attitude towards improved agricultural technologies was carried out to investigate the farmers' attitudes, demographic, economic, socio-cultural and environmental characteristics as well as the contribution to sustained use index of these and some other independent variables. According to Ogunsumi (2011); Ganpat and Bholasingh (1999), two hundred and eight (208) farmers/respondents consisting of 133 adopted and sustained the use of agricultural technologies and 75 that abandoned the use of the already adopted technologies.

Based on the authors, agricultural technologies developed and disseminated should meet farmers' socio-cultural, economic and environmental changing situations, technologies should be cost effective, and flexible for result oriented adoption and adaptation is therefore, recommended. Basis of this study was concluded that improved technologies was achieved well on farmers' attitudes, and related of the study of adoption of improved technologies for coconut production 100 that adopted improved technologies.

Ganpat and Bholasing (2010) explored and described farmers' attitudes toward farming in Trinidad. It examined farmers' overall attitude, determined the attitude component factors, and how these varied based on selected farmer and farm system variables. The prevailing view that "farmers have unfavorable attitudes" had been challenged. Some areas of "unfavorable attitudes" had identified and examined to determine if these were constant for all categorizations of farmers. The results showed that overall; farmers had favorable attitudes toward farming, which varied based on some characteristics of the farmer and the farm system. No differentiation was evident on farmers' attitudes and attitude component factors based on gender, ethnicity and land tenure status. In addition, from the three factors identified, technology belief showed the highest level of differentiation among farmers. On top of that, this study had shown high level of significance among the farmers attitudes toward farming in Trinidad with compared of the study of adoption of improved technologies in coconut production (Ganpat and Bholasingh, 2010).

## 2.4 Challenges Facing Coconut Producers

### 2.4.1 Challenges observed in agricultural biotechnology

Although the country recognizes the tremendous potential that achieved from biotechnology, several challenges need to be addressed before the goals set had achieved. The following are the challenges facing the smallholder farmers which includes the products of research will not create any measurable impact unless they had transferred to end users and/or commercialized. The challenge is to transfer products to users, particularly to small farmers and fishermen. All countries share these same challenges, opportunities, and constraints although at different levels. The above challenges, opportunities and constraints can be addressed by CGIAR Centers at the International level and by national Research and Development centers at country level, with harmonized activities at international, regional and country levels (Reynaldo, 2000).

In addition, Reynaldo (2000) mentioned that, the yields of crops and livestock have been declining, while demands are increasing, because of the rapid increase in population. Conversion of prime agricultural lands into other uses has placed tremendous pressure on the agricultural sector to increase productivity per unit area. Productivity had affected by poor soil fertility, the incidence of pests and diseases, abiotic stresses such as drought caused by El Niño and climatic factors especially typhoons. The challenge is to use biotechnology to increase productivity and yield on the farms using minimal inputs.

Before the major economic reforms, which were implemented in response to poor economic performance in Tanzania, smallholder farmers remain poor due to low producer prices, poor inputs availability and poor market structure among others. However, after the implementation of major economic reforms the smallholder farmers are still in vicious cycle due to high input prices caused by removal of subsidy, low crop prices less than the cost of production caused by liberalization of prices and markets and lack of reliable rural financial services caused by liberalization and structuring of the financial sector (URT, 2000).

### 2.4.2 Poor adoption of agricultural technologies

Reasons for poor adoption of recommended agricultural technologies are many and vary from one place to another. Factors such as poor rural infrastructure, inadequate supporting services, producers limited capital and access to financial services, weak and appropriate legal framework, land tenure and taxation policy and low priority accorded to agriculture public resources allocation and disbursements mentioned by URT (2000) all lead to poor adoption of recommended agricultural technologies and especially the low use of agricultural inputs. However of all the reasons for poor adoption of agricultural technologies producers' limited capital and access to financial services is probably the major reason facing smallholders. It was noted that most of the smallholder farmers are poor (Mwasaga, 2001).

### 2.4.3 Coconut Production Constraints

According to MARI (2012), the main constraint of the coconut sub-sector is low production that is attributed to two main factors, namely low productivity, and low expansion and rehabilitation of the area under coconuts. Key factors for low productivity include poor coconut husbandry practices, effect of drought stress, poor soil fertility, incidence and severity of pest and plant diseases that estimated to kill more than eight million palms. Other factors are aging of coconut trees and planting of low yielding coconut varieties.

### 2.4.4 Other challenges

The lessons and experiences from Zanzibar in reducing hunger and poverty, most of developing countries still a major challenge; as a result, agriculture will remain the important economic activity in these countries for years to come (Haggblade and Hazell, 2010). This is because 75 percent of the farmers in the world are poor; they live in rural areas and the sector of agricultural employs 40 percent of the workers in developing country and contribute over 20 percent to their GDP (ILO, 2004). It is concluded that adoption of improved agricultural technologies face some of constraints to this depressing condition which relays to low capacity among farmers that contribute to low yield production.

## 2.5 The Impact of Improved Technologies in Coconut Production

Improved technologies in coconut production have been observed to increase nut yields elsewhere. The increased yield through utilization of improved technologies, in turn increases income among coconut farmers (URT, 2000). For example, a major problem facing the Philippines coconut industry was high incidence of poverty among coconut farm families. However, after introduction of some technologies, the level of poverty started declining through improved coconut yield (Aragon, 2000).

On the other hand, high prices of improved technologies hinder the poor farmers to afford the technologies. This has, in some instances, made the poor farmers continue having low coconut production. In addition, Rodriguez *et al*. (2007) found that the low income of coconut farm can be attributed to one or a combination of the following factors: low coconut yields, low prices of farm produce, a limited market, and underutilization of coconut land and high cost of farm inputs.

## 2.6 Coconut Production and its Related Factors at Household Level

A typical coconut farmer can hardly live within his/her income from coconut. Even if he/she has the opportunity to replace his/her palms with high yielding. It has long been established that planting crops in between palms of coconut is desirable. It promotes intensification of cultural management, not only of the intercrops but also of the coconut which results in improvement of the coconut yield and increased farm income from incremental yield of coconut and those of inter/mixed crops. In some circumstances, integrating coconut farming with livestock raising is profitable (Batugal, 1999).

In coconut production, there are many factors influencing it. Among others they include level of education of the farmers, importance of the coconut, which is mainly for income and food. Other factors are observed to be coconut acting as assets when the household faces problems. According to Surhato (2000), despite its declining viability, the coconut producing countries continue to produce it in view of the importance of the coconut as a social crop. These countries have realized the potentials coconuts hold in economic development and poverty alleviation particularly, among the rural population. For most of these countries, coconut is still the backbone of their economy and it could be the base on which their rural economies are based. Meanwhile, continued research and development activities in the producing countries, have contributed largely to the improvement in the income of the coconut farmers. Land ownership, wealth status of the households, availability of extension services and seedlings as well as labour are important in coconut production. From this basis, in this study coconut production looked at these important factors as reviewed from the various authors.

## 2.7 Factors Influencing Adoption of New Innovations/ Technologies

There are several factors influencing adoption of innovation/technology. Some factors are related to the technology characteristics, others to the characteristics of potential adopters, some are related to the social systems under which the technologies are going to be adopted (household socio economic characteristics) and some are related to the complex systems outside technology and adopters (policy and legal frameworks) (Arts *et al.,* 2011).

The adopters' characteristics and innovation characteristics have been acknowledged to be the leading factors of adoption till recently other studies have shown a significant correlation between characteristics of potential adopters like education, income, age, gender, innovations with adoption behavior (Rogers, 2003). Other factors influence the adoption of improved coconut management practices in Batticaloa District. The results showed that farm land extent, age, membership with social organization and participation in organization activities are the most significant factors affecting the adoption of improved coconut management practices (Selvarajah and Geretharan, 2013).

**2.8 Theoretical Context**

There are different types of models that have been used to explain adoption decisions of new technologies. However, no single model can embrace and explain all aspects of adoption and the traditional attitude of smallholder farmers towards technologies (Thangata and Alavalapati, 2003). According to Rogers (2003), adoption occurs when one has decided to make full use of the new technology as the best course of action for addressing a need. Adoption is determined by several factors including socioeconomic, environmental, and mental processes that are governed by a set of intervening variables such as individual needs, knowledge about the technology and individual perceptions about methods used to achieve those needs (Thangata and Alavalapati, 2003). Some of Rogers (2003) generalizations as significant variables that affect adoption, which have also been used in other adoption studies, include educational level, farm size and income.

A study is needed to ascertain why farmers do not increase production of coconut despite the adoption of improved agricultural technologies.

According to Porter and Donthu (2006), two research paradigms have emerged to explain technology adoption and acceptance. One paradigm is system specific, and focuses on how a technology's attributes affect an individual's perception of a technology. This in turn affects the usage of the specific technology. The technology acceptance model (TAM) has come to be one of the most widely used models within this paradigm (King and He, 2006; Porter and Donthu, 2006). Many technologists believe that advantageous innovations will sell themselves, that the obvious benefits of a new idea will be widely realized by potential adopters, and that the innovation will therefore diffuse rapidly. Most innovations, in fact, diffuse at a disappointingly slow rate (Rogers, 2003). The most determining factors are impact of the technologies to be adopted. Mostly, they should be grounds of improving yield, cost-effective, user-friendly, labour saving and market values. On this basis, the study has an impression that the farmers are not using the technologies as required that is why the rate of production keeps on declining.

## 2.9 Empirical Studies of Adoption of Improved Technology in Coconut Production

### 2.9.1 Coconut palm replacement model for Tanzania farming system

One of the factors contributing to low income in coconut production systems is the declining productivity of coconut trees due to senility. About 75% of coconuts in Tanzania are more than 45years old of which a significant number are above 60 years (Mwinjaka *et al.,* 1999). The effect of senile palms in the coconut industry in Tanzania is not different from other countries. The situation is further worsened by the increasing area of coconut getting senile (Suharto, 2000). Bad crop husbandry practices and failure to adhere to optimal replanting strategies leads to a non-optimal production, both in terms of quantity and quality. Other factors identified are unstable prices of coconut products, ineffective or weak support services and poor credit facilities. This, in turn, leads to an un-competitive production system and stagnating output and income for the whole sub-sector (Mwinjaka *et al.,* 1999).

It has been recorded that productivity and net economic returns of a coconut farm declines significantly with age, if trees are not optimally replaced. Mwinjaka *et al.* (1999) observed that unless replanting measures were promptly taken, there would be 2% decline per annum in coconut production due to senility. A coconut farmer normally aims maximizing his total from the farm enterprise over the years. Thus, it necessary for the farmer to determine the optimal replacement time of old coconut palms in order to win both economies of scale and time. In essence, therefore, a replacement of coconut will ensure the long- term viability of the coconut industry (Mwinjaka *et al.,* 2000). Based on this study, some farmers who adopted the improved technologies in West District still had senile palms (old coconut trees) in their farms.

The study conducted by Hoppe (2002) mentioned that, most of the recent empirical studies on new process adoption use probit and logit, linear probability and hazard rate models where the dependent variable is the time of adoption of new technology by individual firms, while those on new product adoption tend to focus on the measurement of early – mover and late – advantages. Recent contributions to each line will be briefly reviewed in turn.

Comprehensive Africa Agricultural Development Programme (CAADP) encourages and supports, among others, investment in agricultural research, technology dissemination and adoption to increase agricultural productivity and economic growth in the continent. Empirical studies using micro-level data indicate that agricultural intensification through dissemination and adoption of better agricultural technologies can reduce poverty and food insecurity in SSA (Shiferaw *et al.,* 2012; Kijima *et al*., 2008).

### 2.9.2 Study of low production and productivity

According to Negash (2007), similar studies of low production and productivity, which are mainly associated with poor adoption of improved technologies and poor marketing system, were among the major problems. Adoption of improved technologies is one of the most promising ways to reduce food insecurity in Ethiopia. The result of the study indicated that majority of farmers in the study area preferred local variety over improved because of local market and consumption demand.

Other studies (Asfaw *et al.,* 2012; Abebaw and Haile, 2013; Asfaw *et al.,* 2012) evaluated the potential impact of adoption of improved legume technologies on rural household welfare measured by consumption expenditure in rural Ethiopia and Tanzania. The analysis reveals that adoption of improved agricultural technologies has a significant positive impact consumption expenditure (in per adult equivalent terms) in rural Ethiopia and Tanzania. This confirms the potential role of technology adoption in improving rural household welfare as higher consumption expenditure from improved technologies translated into lower poverty, higher food security and greater ability to withstand risk. Abebaw and Haile (2013) investigated the impact of cooperatives on adoption of agricultural technologies. The results suggest that cooperatives can play an important role in accelerating the adoption of agricultural technologies by smallholder farmers in Ethiopia.

In Ethiopia, population pressure in rural areas has contributed to the decreasing size of farms and cultivation of impoverished soils on slope and marginal lands that are generally highly susceptible to soil erosion and other degrading forces. In the 1999/ 2000 production year, about 69 percent of the households owned farms of less than or equal to one hectare in size whereas only 0.5 percent of the agricultural households possessed a farm size of greater than 5 hectares (CSA, 2002). According to Urgessa (2014), Ethiopian agriculture is virtually small scale, subsistence-oriented and crucially dependent on rainfall. More precisely, more than 95 percent of the country's agricultural output is generated by subsistence farmers who use traditional tools and farming practices.

### 2.9.3 Low productivity on coconut production

Coconut mite damage and crop diversification were guided by the premise that when farmers are faced with natural challenges such as recurrent pest attacks, which have impact on production, they will adapt in different ways depending on their interpretation of the problem. If the problem persists, then farmers may completely change their farming systems. In response to a rapid decline in cash income from crop production, farmers may alter the types of crops grown, relative crop area or variety portfolio. The result further indicated that the damaged nuts cause a loss of more than 30% of the cash income from coconut. Intercropping coconut with cassava, maize, cashew nut, sorghum and pineapples were the alternatives used by farmers to cope with declining coconut production caused by coconut mite by Oleke *et al.* (2012).

Based on this study tallies, 70% of the farmers in Zanzibar depend on agricultural activities directly or indirectly. In additional few respondents (coconut adopters) have contributed to the decreasing size of farms. A hundred percent (100%) of the respondents owned farms of less than or equal to one hectare in size only 0.5% of the coconut household possessed a farm size of greater than 5 hectares ((NBS and OCGS, 2008).

### 2.9.4 Previous research on adoption of improved agricultural technologies in smallholder farmers

Among the few review of previous studies (Kisusu, 2003; Joseph, 2008; Chuma, 2009; Mohammed, 2009; Kilave, 2010; Mwanga, 2010; Gregory, 2010; Mwanga, 2002) done in Tanzania hinged on the adoption of improved agricultural technologies in small scale farmers. Such few studies have not provided sufficient evidence to identify with improved agricultural technologies contributions to the performance of agricultural based improved agricultural technologies in the country.

Kisusu (2003) assessed adoption and impact of improved dairy and irrigated rice production on poverty alleviation in Dodoma, Tanzania. The empirical results and other reflections indicated that improved rice production, average annual per capita income and purchasing power parity increased by 20% and 25% respectively after the project. Similarly, Chuma (2009) investigated factors affecting the rate adoption by small scale farmers of the agricultural technologies and their interactions on maize production in Mvomero District. Their empirical findings suggested that more research was needed to identify farmer’s current practices on maize production and marketing to develop further new technologies which are relevant to the farmers’ needs and environment.

Kilave (2010) investigated on social influence and it was responsible for continued use of agricultural technologies. Further, the author found out that socio economic characteristics of household influenced adoption and use of adopted agricultural technologies developed by HIMA project in Kilolo District, Iringa Region. The study revealed that HIMA project interventions were extended to farmers to use agricultural technologies (including terraces, agroforestry, crop rotation, improved seeds and others. The average number of trees owned by household before HIMA project had tremendously increased from 377 to 4155 which was more than ten times. Also, Mwanga (2010) reported that farmers could potentially increase their productivity through adoption of agricultural production innovation, practices and new input packages, if appropriate extension services are put in place. This study (Mwanga, 2010) was conducted to assess the extent of availability transfer and utilisation of selected cotton and maize agricultural production innovations in Kilosa District.

Mohamed (2009) assessed the linkage between access to credit and the adoption of agricultural technologies in Zanzibar. The findings show that the value of productive assets is important factors in influencing agricultural technology adoption among credit constrained households. Joseph (2008) assessed major factors influencing adoption of land management technologies in Tanga. The findings indicated that a significant proportion of farmers in the study area were aware of the existing forms of land degradation. Also, the finding shows that majority of the farmers (60%) did not successfully adopt the technologies due to various reasons.

The study by Gregory (2010) determined the adoption of QPM (quality protein maize) technology and examined factors that influence its adoption by farmers in Northern zone in Tanzania. The results indicated that adoption rate of QPM technology was low across the study area. Another study by Mwanga (2002) which assessed the adoption of improved technologies for production of sorghum and pearl millet conducted in Dodoma had shown that major factors which found to limit adoption of sorghum and millet innovations were lack of credit facilities, weak seed supply system, lack of appropriate extension messages, and demographic characteristics (e.g. age of household head).

### 2.9.5 Research gap

Despite the existing knowledge on the use of improved technologies in promoting agricultural production in smallholder farmers' performance, many of the reviewed studies in Tanzania have hinged on access and usage of improved technologies and did not successfully adopt the technologies contributions to the performance of agricultural based smallholder in the country. Similarly, even though studies by Joseph (2008) and Chuma (2009) assessed factors affecting adoption of land management technologies and investigated factors affecting the rate of adoption of selected agricultural technologies by small scale farmers. However, these studies dealt only with factors affecting adoption of technologies.

In this regard, Asfaw *et al.* (2012) and Abebaw and Haile (2013) evaluated the potential impact of adoption of improved legume technologies on rural household welfare measured by consumption expenditure in rural Ethiopia and Tanzania. They, also investigated the impact of cooperatives on adoption of agricultural technologies. Based on the reviewed literature, this study goes beyond most previous studies by assessing the factors leading to low production of coconut despite of the farmers adopted improved technologies in West District. In order to achieve better results Ministry of Agriculture should promote more efforts in order to improve agricultural technologies for increasing yield production among smallholder farmers.

## 2.10 Conceptual Framework

The conceptual framework is based on the assumption that introduction of improved technologies to smallholder farmers in coconut production intends to increase coconut production as well as raise the farmers income. Farmers' assessed attitude towards improved technology is determined by the knowledge about methods used. Institutions (though not part of this study) and other actors tend to influence willingness to adopt and use of improved agricultural technology, ultimately leading to improved production of coconut. The relationship among variables (Background, independent, intermediate and dependent) is shown in Fig. 1.

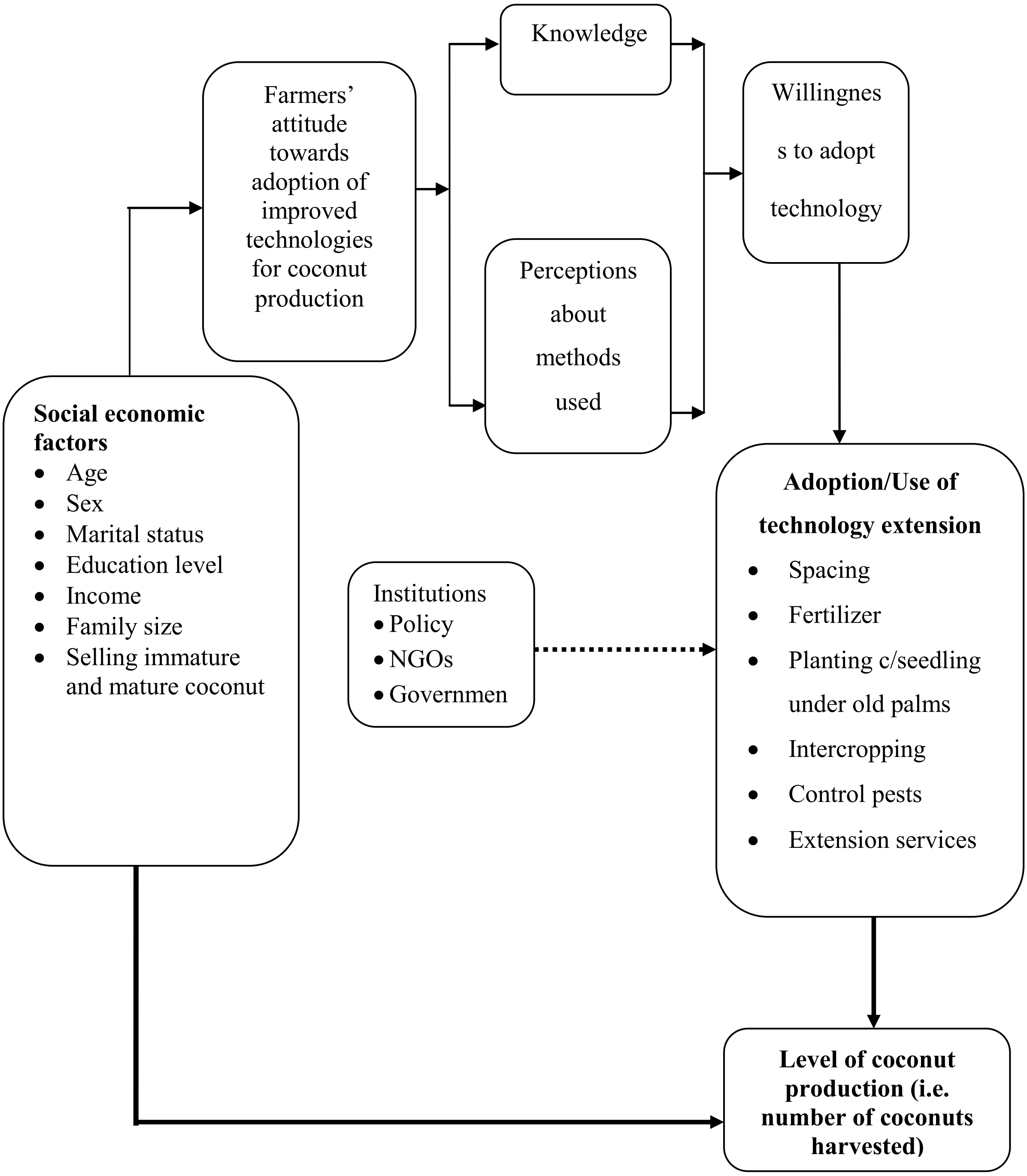


**Figure 1: Conceptual framework**

Key:

→ Influence the other variables

...........→ Institutions that influence adoption but it is not my focus

# CHAPTER THREE

## 3.0 METHODOLOGY

### 3.1 Description of the Study Area

The study was carried out in West District in Unguja Island of Zanzibar. About 60% of the people in West District are engaged in farming activities. The study area was selected purposively for the reason that adoption of improved agricultural technologies among the farmers is high, yet majority of the farmers are experiencing low coconut production (ZCRP, 2004). Other non-farm activities like small business, small scale carpentry, masonry, fisheries, public service employees and tourism industry have recently been established (NBS and OCGS, 2008).

#### 3.1.1 Climate

West District is dominated by bimodal rainfall patterns. There is a long rainy season which starts from March and ends in June with an average of 900 - 1 000 mm. In the District, the erratic short rains start from October through December with the average of 400 – 500 mm of rainfall. The average temperature of West District is around $25^{o}$ C and rise up to 30 $^{o}$C (June to September), (NBS and OCGS, 2008).

#### 3.1.2 Socio-economic Activities

West District has the fifth highest (11.4%) of area planted with permanent crops and the third highest (16%) of the area planted with coconuts. The District has the largest number of households practicing irrigation (2072) and the largest irrigated area (479 ha; 17%) in the long rainy season. In addition, it is recorded to be the second highest (56%) having households accessing extension services. Moreover, West District has the second highest average land area per household planted with coconut trees (0.42 ha) with the average yield of 2473 tonnes (produced 17%) (RGoZ, 2011).

Agriculture is also by far the most important source of employment in the Isles. On average, 70 percent of the population depends directly or indirectly on agriculture (OCGS, 2008). Agriculture sector is another mainstay of Zanzibar's economy, as well as having a key role in sustaining livelihoods on the islands. It is also a very climate-sensitive sector. This implies that the sector has high potential for tackling socio-economic challenges including high levels of income poverty and food insecurity (ZATI, 2010) and this remains a critical challenge for agricultural transformation in Zanzibar (ZATI, 2010). Coconut is an important oil crop that supports the livelihoods of the majority of coastal people in Tanzania and the sustainability of their environment. Apart from being one of the major sources of income for the coastal belt, coconuts grow well on the marginal soils of the fragile ecosystem of the coastal belt MARI (2012). Fig. 2 shows the physical location of the study area.

### 3.2 Research Design

The study employed a cross-sectional research design.  It was used on the basis that it allows collection of data to be at one point in time from a selected sample. This design is useful in determination of relationship between and among variables.  This kind of design can be used in descriptive study and determination of relationship of variables (IDRC, 2003).

### 3.3 Study Population, Sampling Procedure, Sampling Frame and Sample Size

This study involved smallholder famers growing coconut and adopted improved technologies. The sampling frame included farmers who producing coconut and adopted improved technology. The sampling unit was an individual farmer who grows coconut and had adopted improved technology.

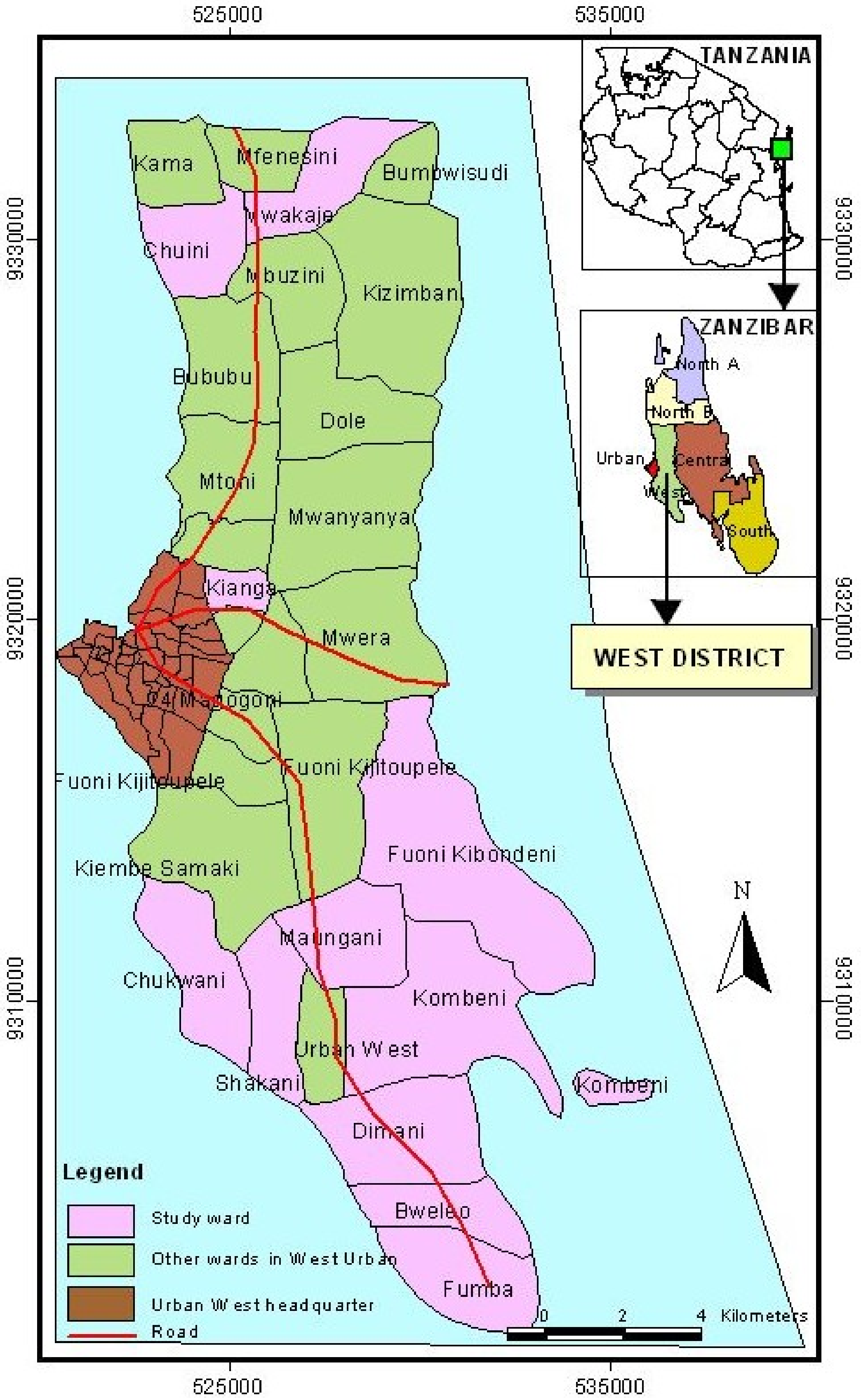


**Figure 2: The map of physical location of the study area**

A purposive sampling technique was used to select study villages and adopters. The respondents were chosen because they had particular feature, which adopted improved technologies in the study area including liable spacing, pest control, intercropping, fertilizer application and planting seedlings under old palms, which enabled detailed exploration and understanding of the central themes and puzzles, which the researcher wished to study (Ritchie and Lewis, 2003).

In the study area, there were 110 farmers who have adopted coconut production technologies; the researcher decided to pick 100 farmers. The reason for using purposive sampling technique is that it helped to choose respondents that had adopted improved technology and to investigate factors that influenced low coconut production. The list of the households who adopted the technologies was taken from the Coconut Development Division in Zanzibar. The sample size for this study was 100 respondents from West District, Zanzibar, because they were the only available adopters of coconut farmers in the study area, while the remaining 10 farmers were not available.

## 3.4 Data Collection

Both primary and secondary data were collected for the study. Primary data were collected from household using questionnaire survey and focus group discussions (FGDs).

### 3.4.1 Primary data

i. **Household Questionnaire Survey**

Household questionnaire survey method was used to collect data from the selected respondents. The questionnaire as tool used both open and closed ended questions and was administered to the respondents. Among other types of information collected in this method were demographic characteristics, farmers' attitudes toward improved technologies in coconut production, challenges facing farmers in using of improved technologies, coconut yield before the year 2000 and after the year 2000 and factors influencing coconut production.

**ii. Focus Group Discussion (FGD)**

FGDs were used to collect primary data from 30 participants in three groups through directed discussions. Each group had 10 participants randomly selected among coconut new technologies adopters, in order to determine factors influencing coconut production. The rationale for the choice of focus group discussion method was that it helped to capture in-depth information. The main types of information gathered during the FGDs were importance of coconut technologies, problems facing the production of coconut and situation of coconut yields. Also, focus group discussion created a situation in which participants were more willing to disclose information on agricultural technologies in coconut production and their related challenges.

### 3.4.2 Secondary Data

Secondary data sources included published and unpublished information from internal reports in the Ministry of Agriculture and Natural Resources, Zanzibar under Coconut Development Division and Zanzibar Coconut Grower Association. The information concerning the villages targeted was inquired. The information about the study population/respondents was also obtained. Journals, previous reports of the project of National Coconut Development Programme (NCDP) and, NBS and OCGS were used. Information on number of new coconut technologies adopters, level of harvest and challenges were obtained from Zanzibar Coconut Development Division.

### 3.5 Data Analysis

Quantitative data were analyzed by the assistance of SPSS version16. Qualitative data were analyzed using "content analysis" technique that mainly involved transcription of the information into sub-themes. A likert scale of twelve statements was used to capture farmers' attitude in objective 1. A five point Likert Rating Scale (LRS) was graded from 5 to 1 scores as follows, 5=Strongly Agree, 4=Agree, 3=Neutral, 2=Disagree and1=Strongly Disagree. Respondents were asked to grade their responses into one of the above grades against each likert statement, however, the scale was later on merged into three likert rating scale as follows: 3=Agree, 2=Neutral and 1=Disagree in order to bring meaningful results. The level of agreement determining factors, the minimum (disagree scores) which are considered as the lowest cut-off point. These were 1 × 12 =12, whereas the average (neutral scores) and maximum (agreed scores) 3 × 12 = 36 as the highest cut-off point.

$$= \left(\frac{\text{minimum}}{2} + \frac{\text{maximum}}{2}\right) \quad \frac{12 + 36}{2} = 24$$

Thus 1= disagree denoted by 12 – 23 indicates negative attitude, while 2 = neutral denoted by 24 indicates moderate and 3 = agree denoted by 25 – 36 indicates positive attitudes respectively. In objective 2; it was analyzed using paired sample t-test to capture the harvest of coconut before and after adoption of improved technologies. The main reason for doing this was to assess either the improved technologies increased coconut production or not. In objective 3, the descriptive was analysis by using frequency distribution and percentages for analyzing the challenges of using adopted technologies among the smallholder farmers on coconut production and experience of the low production. For the objective 4 descriptive statistics (i.e. frequency and percentages) were used to determine the impact of improved technologies in coconut production. Finally, objective 5 was employed to determine factors influencing coconut production were analyzed using a multiple linear regression. The case model was specified as follows:

$$\text{In } Y = \alpha + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \ldots + \varepsilon_i$$

Whereby:

Y is a dependent variable, which is the coconut yield in terms of number of nuts.

$y_i$ = number of coconut harvested by the $i^{th}$ farmer in a year

$\beta_o$, $\beta_1$ ............. $\beta_7$ = Constants

$X_1$ = Age measured in years

$X_2$ = Farmer (If a farmer is a male = 1, If a farmer is a female = 0)

$X_3$ = Education level measured in years of schooling

$X_4$ = Farm size (ha)

$X_5$ = Income from the coconut

$X_6$ = Fertilizer application (1 = applied; 0 = not applied)

$X_7$= Pest control (1 = applied; 0 = not applied)

# CHAPTER FOUR

## 4.0 RESULTS AND DISCUSSIONS

### 4.1 Characteristics of Respondents

The most important demographic characteristics dealt with were: sex, marital status, age, household size, level of education and farm size as presented in Table 1.

#### 4.1.1 Sex

Findings as presented in Table 1 show that majority (91%) of the farmers involved in this study were males when compared to just a few (9%) females. Sex is essential characteristic when it comes to adoption of improved technology and land ownership. In most Zanzibar communities men are endowed with abundance access to land resources thus, owning enough land for coconut farming is relative to that. Adoption of improved farming practices is an outcome of how large the area under cultivation is: the larger the area under cultivation the higher the adoption of farming technologies. With this background men are more likely to adopt than their women counterpart.

#### 4.1.2 Marital status

Two categories (married and unmarried) were used to classify marital status of the farmers involved in this study. Table 1 therefore, indicate that majority (92%) of the farmers were married when compared to just few (8%) who reported to be unmarried. This finding suggests that married farmers are dominant in coconut production. Therefore, their engagement in coconut production is conceived to be the means of livelihoods to sustain their families. This implies that married farmers are highly dependent on coconut farming than their counterparts, while it is argued that the higher the dependency increases the rate of adoption. Similar observation was reported by Senya (2009), in the study conducted in Pangani.

**Table 1: Characteristics of respondents (n=100)**

| Socio-demographic characteristics | Frequency | Percent |
|---|---|---|
| **Sex** | | |
| Female | 9 | 9.0 |
| Male | 91 | 91.0 |
| **Marital status** | | |
| Unmarried | 8 | 8.0 |
| Married | 92 | 9 2.0 |
| **Age (years)** | | |
| 21 – 30 | 2 | 2 |
| 31 – 40 | 7 | 7 |
| 41 – 50 | 19 | 19 |
| 51 – 60 | 37 | 37 |
| 61 – 70 | 16 | 16 |
| 71 – 80 | 17 | 17 |
| 81 and above | 2 | 2 |
| **Household size** | | |
| 2-5 | 39 | 39 |
| 6-9 | 32 | 32 |
| 10-13 | 20 | 20 |
| 13 and above | 9 | 9 |
| **Educational level** | | |
| No formal education | 13 | 13.0 |
| Primary education | 25 | 25.0 |
| Secondary education | 60 | 60.0 |
| Tertiary education | 2 | 2.0 |
| **Farm size (ha)** | | |
| ≤4 | 92 | 92.0 |
| >4 | 8 | 8.0 |

### 4.1.3 Age of the respondents

It is important to present the age distribution of the sample since most of the demographic events that determine coconut production such as dependency ratio and mobility and access to land resources as well as physical strength are highly associated with the age. Therefore, findings show the mean age of 58 years ranging from 25 to 91 years, relatively, most (37%) of the respondents were adults ranging between 51 and 60 years while 35% were above 61 years and 28% were between 21 and 50 years. This implies that most of the farmers engaged in coconut farming were in old age category.

### 4.1.4 Household size

Household size was determined by considering all members who were present in each household including parents, children and other dependants. Findings presented in Table 1 show that household category (2-5) has the highest percentage (39%) followed by 6-9 people with 32% and 9-13 household size with 20%. Only few respondents (9%) have households size of above 13 people. Most of the coconut smallholder farmers have an average household size of 6 people, which differs slightly with the average household size of 5 people for Zanzibar Island (NBS, 2012).

### 4.1.5 Education level of the respondents

In terms of education background, about 60% of the respondents have secondary education, followed by primary education (25%) and non-formal education (13%). Only 2% of the respondents have post-secondary education. This implies that majority of the respondents engaged in coconut production in the study area were literate capable of adopting new coconut production technologies. A study conducted by Hall and Khan (2003), confirmed that education is positively associated with adoption level. It indicates that as the education level of smallholder increases adoption level also increases.

### 4.1.6 Farm size

Majority (92%) of the respondents had farm size below 4 ha, while few respondents (8%) owned farm size above 4 ha. However, the average land holding in the study area was 2.2 ha, which differs from the 1.2 ha plots under the Land Distribution Decree (PD5/66) distributed to people (FAO, 1999). This shows that most of the coconut farmers in Zanzibar are smallholder farmers.

## 4.2 Farmers Attitude towards Improved Technologies in Coconut Production

To determine how smallholder farmers perceive improved technologies in coconut production a Likert scale of twelve statements were constructed. Finally, the general attitude of all respondents was presented after computing the averages scores of the agreed, neutral and disagrees.

Findings as presented in Table 2 indicate that, majority (81%) of the respondents disagreed with the statement that new technology is not required for weeding while 9% agreed and 10% reported to be undecided. This may provide impression that weeding technologies are important in coconut production. Furthermore, the findings indicate that 80% of the respondents agreed that dissemination of planting materials had increased and improved coconut production, while 8% disagreed with the statement and 12% respondents were undecided. This fact is supported by one of the farmer from FGDs who was quoted saying:

> *"Insufficient of coconut seedlings hinder effective production of coconut. Therefore, there is a need of having better dissemination of planting materials to coconut farmers in order to increase and improve coconut production"* (female farmers participant in FGDs)

Furthermore, these findings are similar with those of Limbu (1999), which suggests that in order to promote economic growth, there is a need to develop, introduce and disseminate agricultural technologies which create markets and respond to future economic opportunities as well as maintaining the long term sustainability of the natural resource base. In addition, 87% of the respondents agreed that increasing line spacing produce more coconut, whereas 6% of the respondents disagreed with the statement. This was also noted during focus group discussion that, one of the male farmers said:

*"Using recommended spacing during planting increases coconut yield"*

From the statement that frequent visits by extension workers are not needed, 82% of the respondents did not agree while, very few (8%) agreed with the statement. This implies that regular visits by extension worker are important in improving coconut production. Many respondents (84%) disagree that intercropping of coconut and other type of crops is not preferable, while 8% of the respondents agreed and few respondents (8%) were neutral. This shows that intercropping coconut trees and with other crops is needed by many farmers with the assumption that it improves coconut production.

**Table 2: Farmers' attitude towards improved technologies in % (n= 100)**

| Statement | Disagree (1) | Neutral (2) | Agree (3) |
|---|---|---|---|
| In order to increase and improve coconut production dissemination of planting materials is required | 8 | 12 | 80 |
| Increasing line spacing improves coconut yield | 6 | 7 | 87 |
| Organic manure is most preferable because it increase coconut yield | 6 | 4 | 90 |
| Most farmers have adoption behavior of improved technologies | 4 | 5 | 91 |
| Improved varieties are productive | 12 | 11 | 77 |
| Improved technology requires more capital outlay | 7 | 21 | 72 |
| Frequent visits by extension workers are not needed by coconut farmers | 82 | 10 | 8 |
| Adoption of improved agricultural technologies cannot increase income of household | 91 | 4 | 5 |
| Changing of weather condition cannot affect coconut yield | 90 | 4 | 6 |
| Intercropping of coconut and other crops is not preferable | 84 | 8 | 8 |
| New technology is not required for weeding | 81 | 10 | 9 |
| It is necessary to use NPK/Urea fertilizer in coconut production | 67 | 19 | 14 |

### 4.2.1 Overall farmers' attitudes towards improved technologies

The findings in Table 3 show that 37% of the respondents had negative attitude, while those with positive attitude were 35% and neutral attitude were 28%. This indicates that some farmers have both negative and positive attitude towards improved technologies for coconut production. Most of them have same attitude for the reason that they were knowledgeable to the introduced technologies as they could improve coconut yields. Further, the findings may be interpreted that the farmers have difficulties on affordability and practicability of the technologies utilization. The slight differences between positive and negative attitudes may further be explained that all the farmers used the technologies, but yields differed based on various factors influencing the coconut production. This may also explain that attitudes are assessed basing on personal views, which differ among individuals.

**Table 3: Overall farmers' attitudes towards improved technology for coconut production (n = 100)**

| Level of attitude | n | % |
|---|---|---|
| Negative | 37 | 37 |
| Neutral | 28 | 28 |
| Positive | 35 | 35 |

### 4.2.2 Improved technologies in coconut production

Various improved technologies for coconut production have been introduced in the study area. However the study picked six most commonly used improved technologies that included improved variety (EAT) East African Tall, intercropping, liable spacing, pests control, fertilizer application and planting seedlings under old palm.

Improved variety is varieties already tested and tried and demonstrate by researchers at on-station and on-farm plots. In response to this question, all respondents (100%) reported that they used improved seed varieties. This variety was highly used by the smallholder farmers in the study area. During FGDs, many participants said that they were using these varieties, but they did not give high yield.

**Table 4: Distribution of improved agricultural technologies for coconut production (n = 100)**

| Type of improved technology | Yes (%) | No (%) | Level of improved technology (%) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Never use | Very low | Low | Moderate | High | Very high |
| Improved variety | 100 | 0 | 0 | 2 | 9 | 25 | 64 | 0 |
| Intercropping | 99 | 1 | 1 | 1 | 14 | 20 | 63 | 1 |
| Liable spacing | 98 | 2 | 2 | 3 | 14 | 20 | 37 | 0 |
| Pests control | 79 | 21 | 21 | 4 | 22 | 14 | 38 | 1 |
| Fertilizer application | 74 | 26 | 26 | 3 | 14 | 20 | 37 | 0 |
| Planting seedling under old palm | 49 | 51 | 51 | 0 | 16 | 11 | 22 | 0 |

Intercropping is the agricultural practice of cultivating two or more crops in the same space at same time. It is very common in Zanzibar to find farmers intercropping coconut with host plants like citrus family, mangoes, avocado, guava and others with the aim of increasing more production. It was very encouraging to note that 99% of the adopters were trying to use the technology on their farms. Additionally, host plants make more efficient use of land (i.e. producing more than one crop on the same piece of land) and the harvests from these host plants provide additional yields. These host plants can also serve as reservoir for inhabiting natural predators of insect pests like weaver ants that are efficient biological control agents of the coconut coreid bug, an important pest limiting coconut production. Related study by Ohler and Griffee (1999) showed that the adoption of CBFS encourages improved husbandry practices (like intercropping), increases productivity of coconut land, and enhances viability of coconut ventures. In addition, coconut monocrop is not very much remunerative.

Liable spacing is a type of improved technologies and it is important to use recommended spacing during planting the seedlings in order to produce more production. Another advocated technology is liable spacing. The findings have indicated that 98% of the respondents were using this type of improved technology. Despite the use of this technology, the yield of coconut remained low. Increased human population and areas used for infrastructures has resulted to reducing spacing of planting coconut trees.

Pest control is a system that concentrates on controlling pests through informed use of cultural and biological control and host plants resistance characteristic to minimize crop loss. The findings show that 79% of the adopters used different measures to control pests. The remaining 21% of the adopters seemed to have no alternative management options in controlling the pests (Table 4). Farmers mentioned that they used some integrated pest management (IPM) strategies for controlling pests like coreid bug *(bungu wa minazi*), Rhinoceros beetle (*mdudu chonga*) and termites (*mchwa*). Among the IPM strategies mentioned include fire stick (hook) and by intercropping host plants with the aim of introducing biological control agents, weaver ants (*majimoto*). In addition to these mentioned strategies, a contact insecticide (Marshaal suScon) was used in controlling termites when necessary. There were few cases where farmers reported to be using only the cultural methods (fire stick/ hook and octopus water) of pest control. The methods they used included fire stick (hook) to weaken the Rhinoceros beetle. Some farmers used octopus water in controlling rhinoceros beetle and ashes for controlling termites. Coconut coreid bug, Rhinoceros beetle and termites are the three most important destructive pests of coconut in Zanzibar.

This is partly attributed to reasons that the pests become resistant to the pesticides and the coconut trees become high in way that the farmers fail to apply the pesticides (URT 2004). This indicates that to achieve higher coconut yields, it is important to identify the most damaging pests in the area and measures to control them by using cultural methods (fire stick/hook). Seguni *et al.* (2008) suggested that the pest control strategy should be initiated in the areas to identify major pests and their control, for example, introduction of predator weaver ant and other proper measures should be introduced to farmers.

The findings show that 74% of the respondents used fertilizers in their farms especially during planting period. Majority of the respondents reported to use organic fertilizers (mainly cattle manure, chicken manure and rotten leaves) and the remaining use inorganic fertilizers during planting. Fertilizer use contributes to increased produce in coconut production, because coconut palms become well established. A study conducted by Suharto (2000) indicated that bio-farming or sustainable farming provides ample opportunities for cost reduction in managing a coconut garden. The general principle is to eliminate or reduce the use of chemical fertilizers, herbicides and pesticides and replace them with organic material. Some of the nutrients required for plant growth could be derived from vegetable material and animal litter while pests could be controlled with other beneficial insects.

Planting new seedlings under old palm is among the types of improved technologies; also it is important to planting new seedlings in order to replace the old one. The findings show that 49% of the respondents have adopted the technology of planting coconut seedlings under old palms with the aim of improving coconut production. They further, mentioned that they adopted the technology because old palms could not produce anymore, so in the long run the seedling under the old palms could take their place and produce more yields.

Majority (51%) of the respondents have never adopted this technology because they mentioned that old palms might destroy the newly planted coconut seedlings especially when they fall down.

### 4.3 Coconut yield before the year 2000 and after the year 2000

Before the year 2000, the yield of coconuts was high due to the use of improved variety (EAT), intercropping and the use of liable spacing (URT, 2000). According to MARI (2012), the main constraint of coconut subs-sector is low production. Based on the author the main factors for low production are limited land for more expansion and lack of rehabilitation of the area under coconuts. Results from the paired sample t- test show that there was statistical significant difference in coconut production during the period before and after the year 2000 ($P < 0.001$). The mean coconut yield of 41.08 nuts per palm per year and 17.74 nuts per palm per year before and after the year 2000 respectively indicate there is a decrease in coconut yield. The total number of harvested nuts before the year 2000 was 10 900 nuts per farmer per year and after the year 2000 was 1564 per farmer per year. This shows that there is statistical difference ($P < 0.001$). The mean decrease in nuts yield was 9343.2. These results reflect that adoption of improved technologies after the year 2000 did not improve coconut yield at the household level. This was also revealed during focus group discussions as one participant said:

> *"Before the year of 2000, most of the smallholder farmers adopted the improved technologies on coconut production were high. After the year of 2000 the coconut yield was decrease due to pests' infestation and senile palms* (*old palms*)*".*

**Table 5: Results for t-test for coconut yield before and after the year 2000 (n = 100)**

| Values compared | N | Mean | t- value | Sig (p-value) |
|---|---|---|---|---|
| Coconut yield before 2000 | 100 | $1.09 \times 10^4$ | 3.702 | < 0.0001 |
| Coconut yield after 2000 | 100 | $1.5639 \times 10^3$ | | |
| Coconut average yield/palm before 2000 | 100 | 41.08 | 4.1 | < 0.0001 |
| Coconut average yield/palm after 2000 | 100 | 17.74 | | |

The differences in harvested status before the year 2000 and after the year 2000 were high as the p-value was <0.0001, which shows statistically significant difference at the 99% level of confidence interval. Therefore, from these results the null hypothesis which stated that, there is no difference in coconut production before and after the year 2000 despite of existing adoption of improved technologies is rejected and alternative hypothesis is confirmed.

### 4.4 Challenges Faced by Smallholder Farmers on the Use of Improved Technologies

This section describes the results on the challenges faced by smallholder farmers who adopted improved technologies in coconut production. Among the challenges facing farmers in the use of improved technologies were unreliable spacing, intercropping, unaffordable of fertilizer, control pests, unavailability of improved variety/seedlings under old palms.

The findings show that farmers faced the challenge of unaffordable of fertilizer to be used during planting. Sixty one respondents mentioned that one of the challenges leading to low yield was unaffordable of fertilizer attributed by low purchasing power among the smallholder farmers in the study area. Majority of the respondents argued that availability of inorganic fertilizer is very difficult as opposed to organic fertilizer.

**Table 6: Challenges of smallholder farmers in coconut production in % (n = 100)**

| Challenges in coconut production | Yes | No |
|---|---|---|
| Unreliable spacing | 58 | 42 |
| Unaffordable of fertilizer | 61 | 39 |
| Insufficient land for intercropping | 38 | 62 |
| Difficulty on controlling pests | 57 | 43 |
| Unavailability of improved variety/seedlings under old palms | 56 | 44 |

The findings show that 58 of the respondents have the problem of using reliable spacing due to scarcity of land and coral. The average land holding by smallholder farmers is 5 acres which makes farmers to be unable to have reasonable spacing for planting coconut palms in straight lines.

Coconut palms are affected by wide range of pests most of them being difficult to control. However, there are serious pests that affect the production of coconuts; these include coreid bug, rhinoceros beetle, termites and mites. The finding shows that 57 of the respondents have the problem of controlling the major pests of coconut trees like coreid bug, rhinoceros beetle and termites. The coreid bug is the most serious pest compared to the others and it is difficult to be controlled as mentioned by the farmers. Also the farmers indicated there was unavailability of pesticides. They also pointed out that they lack advanced technology in controlling these pests, especially coreid bug in the palm with highest height as they currently use tradition and low level of pest control methods.

Improved varieties have become important in producing improved planting materials (seedlings). The improved variety is EAT. The findings show that 56 of the respondents had faced the challenge of unavailability of improved varieties/seedlings and livestock raids. In addition, respondents mentioned that they had the problem of unavailability of seedlings particularly during the period of planting the seedlings in their farms. This was due to the government nurseries producing few seedlings. They also mentioned that cattle, goats and mice were browsing the seedlings during planting, which may lead to declining the number of plants which in turn reduces the yield. In addition, the respondents mentioned that unavailability of seedlings was caused by the seedlings not reaching the farmers in time. Sometime, the farmers got them after rain season.

Intercropping technique has become an important improved technology in agriculture especially coconut palm cultivation. Instead of harvesting various types of crops in the same field, a farmer can gain in biological control of pests for all host plants. Thirty eight respondents indicated that they insufficient of land for intercropping (Table 6). They also face the problem of the animals eating other crops and inadequate of seedlings of tree crop. Few of the respondents lack enough spacing for intercropping because they have insufficient land or small areas. This shows that intercropping is a practice that most farmers in Zanzibar use.

Among other challenges in coconut production mentioned by smallholder farmers in this study were as follows:

### i. Unpredictable Weather Conditions

This study has shown that majority (75%) of the respondents mentioned the reason of low production was unpredictable weather condition that has direct effect in influencing the yield production. Among the contributing factors, they mentioned the current shortage of rain when compared to previous years. This has resulted into prolonged droughts and outbreak of pests. Supporting the above statement, Limbu (1999) mentioned that unpredictable weather conditions can radically alter rainfall patterns and therefore require the migration of people and shifts in agricultural practices.

### ii Farm Area used for Infrastructure

The farm areas are currently being used for infrastructures like electricity, roads and building residential houses especially in West District. The findings indicate that most of the respondents (72%) pointed out the coconut farm area was used for infrastructure. This contributed to reduce the number of coconuts from the coconut field. It was also noted during focus group discussion that the issue of infrastructure had contributed to reduced yield (from 41.08 nuts per palm per year to 17.74 nuts per palm per year) in coconut production because of the reduced number of coconut trees. Similar study by Maswaga (2001) reported that, the reasons for poor adoption of recommended agricultural technologies are many and vary from one place to another.

### iii Old Aged Palms

It has been found out that 62% of the respondents reported that, the old age of coconut palms had great contribution towards low production of coconut yields. Also, felling of coconut trees for timber business and lime production have greatly contributed to reduced production of coconut. According to Muyengi (2012), some of existing trees are aged such that the production capability is low. It has been observed that out of 10 coconut trees, a range of 4-6 trees are older than 70 years of age. Related to the study to Mwinjaka *et al.* (1999), coconut production declines at the age between 30-50 years. Coconuts commence full production at the age of 10 to 16 years and go on producing at an increasing rate up to between 30 and 40 years. Over 40 years, coconut production starts to decline (Kumar *et al.,* 2008).

### iv Theft

The findings show that 55% of the respondents mentioned that theft was among the contributing factors towards low coconut yields. They reported that mid age group within the range of 15-20 years are directly involved in theft in West District. In some cases, a coconut may bear heavily, but the nuts may be stolen while still young or matured in the absence of the owner. This forces farmers to harvest their nuts before being matured hence was fetching low market prices.

### 4.5 Impact of Adoption of Improved Technologies in Coconut Production

This section deals with the impact of adoption of improved technologies on coconut production in West District. The level of adoption is presented by categorizing the specific items i.e. 1 = positive, 2 = negative and 3 = no changes.

#### 4.5.1 Amount of produce from coconut farm

The finding shows that 97% of the respondents mentioned that, adoption of improved technology decreased the amount of produced from the farm. This shows that improved technologies decreased coconut production among smallholder farmers. The average amount produced is 17.74 nuts per palm per year. The amount produced is below 40-60 yields per palm per year. However before the year 2000, the average amount produced was 41 nuts per palm per year. Zanzibar Coconut Research Project (2004) indicated the average yield was 40-60 nuts per palm per year. Only 2% of the respondents indicated no changes in the amount produced from the farm and 1% observed an increase of the produced from the farm. Before the year 2000, the average yield of coconut per farmer per year was 10 900 nuts, while after 2000, production of coconut was 1564 nuts per farmer per year.

Based on the given coconut production before and after the year 2000, there various reasons on the production. This is based on the fact that the improved technologies in coconut production were introduced during 1980s. After the introduction of the technologies, the coconut production started to increase on the average of 40-60 nuts per palm per year (URT, 2000). But after the year 2000 production started decline to 25-30 nuts per palm per year due to unaffordable fertilizer, unreliable spacing and unavailability of improved variety/ seedling under old palm (Zanzibar Coconut Research Project, 2004).

**Table 7: Effects of adoption of improved technology in coconut production (n = 100)**

| Related Factors | Positive change (%) | Negative change (%) | No change (%) |
|---|---|---|---|
| Affected level of household income | 4 | 94 | 2 |
| Changes in amount of produce from farm | 1 | 97 | 2 |
| Affected by settlement pattern | 2 | 55 | 43 |
| Changes in size of the farm | 1 | 52 | 47 |
| Changes in the costs incurred in farming activities | 1 | 96 | 3 |
| Farmer to farmer adoption of technology | 5 | 81 | 14 |
| Management of major pests | 3 | 82 | 3 |
| Affected by livestock keepers | 3 | 95 | 2 |
| Attraction of investors in agriculture | 14 | 77 | 9 |

### 4.5.2 Effect on farm activities costs

Majority of the respondents (96%) indicated that adoption of improved technologies had changed the cost incurred in farm activities negatively. This involved that improved technologies had changed the costs incurred in farm activities and the cost before the year 2000 was Tsh. 63 000 and after the year 2000 was Tsh. 113 000 for weeding and harvesting. Before the year 2000 farm costs were low, after the year 2000, the production cost was high. Few respondents (3%) observed no change in the cost incurred in farming activities, only 1% had positively changed in the costs incurred in farming activities.

### 4.5.3 Effect on household income

Majority of the respondents (94%) indicated that the adoption of improved technologies affected their household income negatively. While few respondents had positive change (4%) and (2%) of the respondents had no change on their level of household income. This is following the reason that coconut has been declining. This result implies that improved technologies decreased household income among coconut smallholder farmers and before year the 2000, the average production cost for nuts was 2 773 500 Tsh. (9245 nuts x @ 300 Tsh.) per farmer per year and after the year 2000 production cost was 2 358 000 Tsh. (4716 nuts x @ 500Tsh.) per farmer per year.

### 4.5.4 Effect on management of major pests

Majority of the respondents (82%) specified that adoption of improved technology had failed to change the management of major pests of coconut. This entails that despite the adoption of improved technology, farmers fail to control pests (coreid bug, rhinoceros beetle and termites) in coconut production, while 15% of the respondents indicated that there were no changes in management of the major pests and 3% of the respondents had managed to control the pests.

### 4.5.5 Effects on farmers to farmers' adoption of technologies

Findings show that majority of the respondents (81%) indicated that adoption of improved technologies were low, due to low production and difficult to change mindset to imitate from others. While about 14% of the smallholder farmers revealed that there were uncertain about the level of adoption. Furthermore, 5% reported that adoption of improved coconut production technologies were high.

### 4.5.6 Attraction of investors

Majority of the respondents (77%) indicated that adoption of improved technology did not attract investors in coconut production. This implies that adoption of improved technology has not attracted investors in agricultural sector of coconut production. Some of the respondents (14%) indicated that some investors were attracted by the introduction of improved technologies, while 9% of the respondents did not indicate whether the improved technologies attracted the investors or not. During FGDs, some participants said that:

> "*Few investors had been attracted in production of coconut."* They said further that: *The private investors should be encouraged so as to raise the production of coconut"*.

Due to pest infestations which lead to low yield, hence the investors were not attracted in coconut production. The findings of this study oppose the National Agriculture policy which supports greater involvement of the private sector in the production and provision of support services to the farming community (URT, 2013).

### 4.5.7 Settlement pattern

More than half (55%) of the respondents indicated that settlement had negatively affected coconut production, and on other hand, 43% of the respondents indicated that coconut production was not affected by settlement patterns, while 2% indicated to be affected by the settlement patterns. Empirically, the settlement pattern affects coconut production. This was also supported by one of the smallholder farmers that:

> "*Settlement patterns reduce the farm sizes for coconut production. Some of the smallholder farmers sold their farm areas to build houses hence changing the settlement pattern."*

### 4.5.8 Farm size

Almost more than half of the respondents (52%) specified that adoption of improved technology affected the farm size by reducing land for cultivation due to the infrastructure construction like roads, electricity and settlement pattern while 47% of the respondents said that they were not affected by changing the size of the farm. This implies that improved technology had reduced (negatively) the farm size of the farmers. The average of the farm size was 5 acres; the farm size owned by the households affects coconut production negatively in the study area. Kilave (2010) contended the same with the study findings that the size of the farm is one of the factors that often influence adoption level.

### 4.6 Factors Influencing Coconut Production

To examine the factors which were hypothesized to have influence on production of coconut among smallholder farmers, a multiple linear regression model was employed. Farmers' characteristics (age, sex and education), income from coconut, farm size, fertilizer application and pests control were estimated in the model equation as independent variables. Therefore, the equation examined the influence of the mentioned independent variables to the dependent variable 'coconuts harvested'.

The results as presented in Table 8 indicate that age of respondents had no significant influence ($p=0.105$) on the coconut yield, but it had positive relationship to the dependent variable. This implies that an increase in age of the respondents increased coconut yield by 0.062. Age of coconut farmers in the study area ranged between 21 and 60 years, which one may interpret that age influenced ability of the farmers to adopt improved technologies in coconut production. However, this study has observed that adoption of improved technology was not a matter of farmers' age since the sample for this study was drawn from small holder farmers who had adopted improved technologies.

**Table 8: Results of regression analysis for factors influencing coconut production (n = 100)**

| Variables | β | Std. Error | ǀtǀ | p | Tolerance | VIF |
|---|---|---|---|---|---|---|
| Constant | 0.065 | 407.421 | -1.781 | 0.078 | - | - |
| Age of respondent | 0.062 | 5.027 | -1.637 | 0.105 | 0.646 | 1.547 |
| Education level | 0.097 | 16.420 | -2.404 | 0.018* | 0.569 | 1.755 |
| Sex of respondents | 0.030 | 184.179 | 0.974 | 0.333 | 0.947 | 1.056 |
| Income from coconut | 0.853 | 0.000 | 26.151 | <0.0001*** | 0.873 | 1.145 |
| Farm size (acres) | 0.226 | 12.673 | 6.929 | <0.0001*** | 0.871 | 1.147 |
| Fertilizer application | -0.031 | 138.804 | -0.954 | 0.343 | 0.887 | 1.127 |
| Pests control | 0.005 | 136.365 | 0.170 | 0.865 | 0.919 | 1.087 |

**SS = 259270161; MS = 37038594; F = 140.741; R = 0.956; p < 0.0001**

Respondents' education level was found to have significant influence on coconut yield (p=0.018) and caries an anticipated positive relationship with the dependent variable (β=0.097). This implies that education attainment of the farmers enhances efficiency in coconut production. These results therefore, suggest that any additional year of the study by the farmer would increase coconut yield by 0.097. This finding is congruent with the study by Hall and Khan (2003) which argued that, education is highly associated with adoption.

Sex of respondents was indicated to have less influence on the coconut yield (p=0.333) but it was positively related to it. This is because coconut farming is dominated by male compared to female farmers. The study by Njenga *et al*. (2012) shows that access to productive land is an impediment for both the youth (male) and some women in agricultural sector. For married, whereas they may have access to productive land from their husbands, they often do not have control over its usage. Results in Table 8 shows that income from coconuts have significant effect on the coconut yield (p<0.01) and was positively related to it. The results suggest that farmers who realize massive profit from coconut production have a greater chance of increasing their production compare to their counterpart.

On the other hand, farm size was found to have significant influence on the coconut yields ($p<0.01$) and possesses a positive relation to the dependent ($\beta=0.226$). This result suggests that an increase in the land under improved technology would increase coconut yield. Therefore, farmers with more land under improved technology increase their chance of realising higher coconut yield. Similar argument was given in the study by Mnemwa and Maliti (2010), who suggested that the government should harmonise the land tenure system and ensure adequate access to land by small holder farmers in order to improve their production. On the other hand, fertilizer application was found to have no statistical significant influence on coconut yield ($p=0.343$) and it was negatively related to the yield ($\beta=-0.031$). This is probably due to the fact that application of fertilizers in coconut production is normally applied during planting only.

Furthermore, regression results revealed that, pest control had no significant influence on the coconut yield ($p=0.865$) however, it was positively related to it ($\beta=0.005$). This may be interpreted that the control of pests influences coconut yield. This finding is similar to Mwachiro and Gakure (2011), whose study found that pest control, contributes to the increase of coconut yield.

The adjusted $R^2$ value of 0.956 implies that 96% of the parameters estimated in the model explain the predicted variable. Therefore, the remaining 4% (parameter) is opened for further investigations. The results as presented in Table 8 show that the F-value of 140.741

was significant at the 99 % level of confidence ($p<0.0001$), it also indicates that all predictor variables estimated in the model equation were well fitted and contain an influence to the dependent variables. Results presented in Table 8 indicate that, tolerance values were not approaching zero and VIF values for independent variables were below 10 which validate that there is no multicollinearity in the model.

# CHAPTER FIVE

## 5.0 CONCLUSION AND RECOMMENDATIONS

The general objective of this study was to examine factors influencing low production of coconut among smallholder in West District. The study, therefore examined factors influencing production of coconut among smallholder farmers who adopted improved technologies. The study also investigated famers' attitude towards improved technologies, level of harvest before and after adoption of improved technologies in coconut production, challenges of using adopted technologies among smallholder famers and determined the impact of adoption of improved agricultural technologies on the level of coconut production.

### 5.1 Conclusions

The findings from the study show that, many smallholder farmers have negative and positive attitude towards improved technologies on coconut production. The negative attitude may implicate that that more sensitization is required in order to raise their awareness on improved coconut production technologies; hence increase production for more income. However majority of the smallholder farmers who adopted the improved technologies in coconut production until the year 2000 had produced high yield of nuts, however after the year 2000 nearly all farmers production declined due to the fact that currently most of the farm land is becoming shrinking due to construction of infrastructures like electricity, roads and building of residential houses. Pest infestation and senile palms (old palms) are also affecting coconut production in West District.

The finding of this study concludes that the major challenges faced by smallholder farmers who adopted improved technologies in coconut production were inadequate fertilizer, unreliable spacing, difficulty in controlling pests and unavailability of improved variety of seedlings under old palms. Other challenges were unpredictable weather condition; farms are used for infrastructure, old age palm and theft. Nevertheless, the regression results revealed that farm size, income from coconut and education level of the respondents have strong influence on coconut production. This implies that there is a need for the government, development partners and all stakeholders in general to ensure that smallholder farmers are entitled to adequate land in order to improve production and productivity.

## 5.2 Recommendations

Based on the above discussions and conclusions the study recommends as follows:

i. The extension officers should provide frequent training on the use of improved technologies such as fertilizers, seedlings and pesticides so as to increase coconut yields.
ii. The government under the Ministry of Agriculture should support training, dissemination of improved technologies, extension officers and smallholder farmers.
iii. The government must ensure accessibility of agricultural inputs including fertilizers and improved seedlings.
iv. RADO/DALDO offices give priority of subsidizing agricultural inputs to smallholder farmers.

## 5.3 Further Research

Studies are needed to look at the factors apart from ones reported in this study to reveal answers for reduction of coconut yield despite the farmers have adopted the improved technologies in coconut production. These studies could be either in agronomic point of view and institutional (formal and informal) factors.

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# APPENDICES

## Appendix 1: Questionnaire for Farmers

Study topic: Adoption of Improved Technologies in Coconut Production by Smallholder Farmers in West District of Zanzibar

### SECTION A: DEMOGRAPHIC CHARACTERISTICS

Questionnaire number [ ]

1. Name of respondent: (Option) ____________________
2. Name of village:________________________________
3. Name of District:_______________________________
4. Age of respondent __________ years
5. Sex of respondent [ ] 1.Male, [ ] 0. Female
6. Marital status [ ] 1. Married, [ ] 0. Unmarried
7. Education level (mention the number of years you spent in formal schools)______________
8. Family size__________________________
9. How many total of land do you own? ______________acres
10. How many total of land owned is used to grow coconut trees? _________________acres
11. How did you obtain the land for growing coconut trees?
    a. [ ] 1= Inherited [ ] 2= Buying [ ] 3= Borrowing [ ] 4= others
    b. (Specify)_______

**SECTION B: FARMERS' PERCEIVED ATTRIBUTE TOWARDS IMPROVED TECHNOLOGIES FOR COCONUT PRODUCTION.**

12. Farmers' perceived attribute towards improved technology for coconut production

| Attitude statement | Disagree | Undecided | Agree |
|---|---|---|---|
| 1. It is necessary to use NPK/Urea fertilizer on coconut production | | | |
| 2. Intercropping of coconut and other crops are not preferable | | | |
| 3. Improved varieties are productive | | | |
| 4. New technology is not required for weeding | | | |
| 5. In order to increase and improve coconut production dissemination of planting materials is required | | | |
| 6. Organic manure most preferable because increase coconut yield | | | |
| 7. Increasing line spacing produces more coconut Production | | | |
| 8. Adoption of improved agricultural cannot increased income of household | | | |
| 9. Most farmers have adoption behavior of improved technologies | | | |
| 10. Frequent visit by extension workers is not needed by coconut farmers | | | |
| 11. Improved technology requires more capital outlay | | | |
| 12. Changing of weather condition can not affect coconut yield | | | |

13. Which type of improved agricultural technology do you use in coconut production?

| Type of improved technology | Yes | No | Very low | Low | Moderate | High | Very high |
|---|---|---|---|---|---|---|---|
| Liable spacing | | | | | | | |
| Fertilizer application | | | | | | | |
| Planting coconut seedling under old palm | | | | | | | |
| Intercropping | | | | | | | |
| Control pests | | | | | | | |
| Variety | | | | | | | |

## SECTION C: COCONUT YIELD BEFORE THE YEAR 2000 AND AFTER THE YEAR 2000

14. Indicate your production level before the year 2000 and after 2000

| | Before 2000 | After 2000 |
|---|---|---|
| Average number of nuts harvested per palm per year | | |
| Number of coconut trees harvested | | |

15. What is your income level?

| Source of income | Amount per month | Amount per season | Amount per year |
|---|---|---|---|
| Coconut | | | |

## SECTION D: CHALLENGES OF FACED BY SMALLHOLDER FARMERSON THE USE OF IMPROVED TECHNOLOGIES.

16a. From the given list what major challenges do you face in using improved agricultural technology in coconut production?

| Type of technology | Yes | No | If Yes, Challenge faced |
|---|---|---|---|
| Unreliable spacing | | | |
| Inadequate of fertilizers | | | |
| Planting coconut seedling | | | |
| Insufficient of land for Intercropping | | | |
| Difficulty on controlling pests | | | |
| Unavailability of improved seedlings under old palm | | | |

**Other challenges those facing smallholder farmers**

16b. Challenges facing smallholder farmers in coconut production.

| Type of challenge | Yes | No |
|---|---|---|
| Unpredictable weather condition | | |
| Farm area used for infrastructure | | |
| Theft | | |
| Old aged palms | | |

**SECTION E: COCONUT PRODUCTION AND ITS RELATED FACTORS AT HOUSEHOLD LEVEL**

17. Since the adoption of improved technology for coconut production by adopted farmers in West District how do you assess the role of the following? Indicate 1 for positive change and 2 for negative changes and 3 for no changes

| | **Positive change** | **Negative changes** | **No changes** | **Before 2000 (amount)** | **After 2000 (amount)** |
|---|---|---|---|---|---|
| Changes in amount of produce from the farm (figure needed) | | | | | |
| Affected level of household income (figure needed) | | | | | |
| Farmer to farmer adoption of technology | | | | | |
| Affected by settlements pattern | | | | | |
| Changes in size of the farm cultivated (figure needed) | | | | | |
| Changes in the costs incurred in farming activities (figure needed) | | | | | |
| Management of major pests | | | | | |
| Affected by livestock keepers | | | | | |
| Attraction of investors in agricultural sectors | | | | | |

**Appendix 2: Interview Guide for Focus Group Discussion**

1. In your opinion, what are the advantages of improved technologies in coconut production?
2. In your opinion, what are the disadvantages of improved technologies of coconut production?
3. Why the yield production of coconut is low compared to the past period?
4. What is the difference in the level of coconut production before and after the adoption of technology?
5. What are the specific improved agricultural technologies which are used in coconut production here in Zanzibar?
6. What do you consider as the role of the adopted agricultural technology to coconut production?
7. How does the improved agricultural technology in coconut production contribute to the economic development of Zanzibar?
8. What challenges are faced by farmers when using improved agricultural technology in coconut production?