DETERMINANTS OF ZONAL COMPETITIVENESS AND COMPARATIVE ECONOMIC ADVANTAGE OF RICE PRODUCTION IN UNGUJA AND PEMBA

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ABSTRACT

Rice is the main food staple in Zanzibar, accounting for about 54 percent of the total caloric intake. Zanzibar imports about 80 percent of its rice requirements. Based on the potential of 3 tons per hector in rain fed and 6 tons per hector in irrigated rice. The government of Zanzibar intends to reduce external dependency from current 80 to 40 percent as part of country's food self-sufficiency goal. This study intends to inform policy by providing quantitative evidence about farming system zones where the potential can be exploited to increase production profitably and by using domestic factors efficiently. The specific objectives of the study were: - (i) To determine technical and socio-economic characteristics that differentiate rice farmers in terms of yield in central north, central south and zone 3 Pemba farming system zones; (ii) To analyse the competitiveness of rice production under different technological packages in central north, central south and zone 3 Pemba; (iii) To analyse the comparative economic advantage of rice production under different technological packages in central north, central south and zone 3 Pemba; and (iv) To examine the level of protection of the rice sub-sector in central north, central south and zone 3 Pemba. The study used 3-stage sampling with stratification to draw 464 rice farmers. The analytical tools used to address the study objectives were: Descriptive analysis and Policy Analysis Matrix. The result shows that 90 percent of rice farmers using irrigation, improved seeds and fertilizer fall in the high yield category in all three zones, while rice farmers using rain fed and local seeds only are higher in low yield category in all farming system zones ($P<0.00$). Policy Analysis Matrix indicators show a positive financial profitability for rice farmers using irrigation improved seeds and fertilizer in all three zones. The Domestic Resource Cost value was less than 1 for rice farmers using irrigation, improved seeds and fertilizers in central north and central south zone only. The Domestic Resource Cost values for rice farmers in zone-3 Pemba are greater than one, implying that rice farming in zone 3 Pemba farming system zone has no comparative economic advantage in rice production under the prevailing technological packages, since the opportunity cost of using domestic factors in rice production is higher than value added generated at social prices. In general, the current government efforts are the better-off options to complement and support rice production in all ten farming system zones of Unguja and Pemba. But in the long-run, without putting much effort on central north and central south farming system zones, rice production might be unsustainable.

DECLARATION

I, HAJI ALI OMAR, do hereby declare to the Senate of Sokoine University of Agriculture that this thesis 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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The above declaration is confirmed

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DEDICATION

This work is dedicated to my late grandmother: Ms Mwanjabu Pongwa Mshenga for her concern and affectionate throughout my childhood regardless of all difficulties, hardworking and poverty she faced.

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LIST OF ABBREVIATIONS AND ACRONYMS

AfDB	African Development Bank
AGE	Age of Rice Farmer
AGRIEXT	Access to Agricultural Extension
ASDP/L	Agricultural Sector Development Programme/ Livestock
ASP	Agriculture Sector Policy
ASSET	Value of Agricultural Assets Owned
ASSP	Agricultural Service Support Programme
BOT	Bank of Tanzania
CIF	Cost Insurance and Freight
DRC	Domestic Resource Cost
EAC	East African Country
EDLEV	Education level of Rice Farmer
EEC	European Economic Community
EPC	Effective Protection Rate
EPC	Effective Protection Coefficient
FAO	Food and Agriculture Organization
FARMEXP	Years in Rice Farming Experience
FERP	First Economic Recovery Programme
FOB	Free on Board
GOZ	Government of Zanzibar
iAGRI	Innovative Agricultural Research Initiatives
INVOLV	Involvement in Farming Activities
MAINACT	Main Activities Performed by Rice Farmer
MALNR	Ministry of Agriculture, Livestock and Natural Resources

MANREC	Ministry of Agriculture, Natural Resources, Environment and Cooperatives
MDGs	Millennium Development Goals
MKUZA	*“Mkakati wa Kukuza Uchumi na Kupunguza Umasikini”*
MTAKULA	*“Mpango wa Taifa wa Kujitosheleza kwa Chakula”*
NAEP II	National Agricultural Extension Programme Phase II
NGOs	Non-Government Organizations
NPC	Nominal Protection Coefficient on Tradable Outputs
NPI	Nominal Protection Coefficient on Tradable Input
NSP	Net Social Profit
OCGS	Office of Chief Government Statistician
OER	Official Exchange Rate
PADEP	Participatory Agricultural Development Programme
PAM	Policy Analysis Matrix
PC	Profitability Coefficient
PCR	Private Cost Ratio
RDAs	Rain fed Development Areas
RRDP	Rain fed Rice Development Project
SCA	Sustainable Competitive Advantage
SCB	Social Cost-Benefit
SCF	Standard Conversion Factor
SER	Shadow Exchange Rate
SEX	Gender of Rice Farmer
SPFS	Special Programme for Food Security
SRP	Subsidy Ratio to Producers

Tech_pack 1	Irrigation, Improved Seeds and Fertilizer
Tech_pack 2	Irrigation, Local Seeds and Fertilizer
Tech_pack 3	Irrigation, Both Local and Improved Seeds Only
Tech_pack 4	Rain fed, Improved Seeds, Fertilizer and Herbicide
Tech_pack 5	Rain fed and local seeds only
Tech_pack 6	Rain fed Both local and improved seeds with herbicide
TRA	Tanzania Revenue Authority
TZS	Tanzania Shillings
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
US$	United States Dollar
WARDA	West Africa Rice Development Association
ZCCFSP	Zanzibar Cash Crops Farming Systems Project
ZFDB	Zanzibar Food and Drug Board
ZPRP	Zanzibar Poverty Reduction Plan
ZSGRP	Zanzibar Strategy For Growth and Poverty Reduction
ZURA	Zanzibar Utilities Regulatory Authority

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the Study

Rice is grown in over 75 percent of the African countries (Mnembuka *et al.*, 2010). In Zanzibar, rice is a staple food and has a significant contribution to food consumption and it provides 54 percent of total caloric intake, with the average annual per capita rice consumption of about 60 kg (GOZ, 2015). The consumption is nearly three times higher than that of Tanzania mainland, and it is considered to be the highest per capita rice consuming country among the East African Community (EAC) countries (Lazaro *et al.*, 2016). In addition, per capita rice consumption in Zanzibar has increased by more than 45 percent from 2010 to 2013 (GOZ, 2015). The total annual rice requirement is estimated at 80 000 tons of which 80 percent is imported (BoT, 2011).

Although the import share to the domestic supply is large, the country has a great potential of reducing it by increasing rice productivity and production as well as decreasing dependence on imported rice from 80 percent of country's needs to 40 percent (GOZ, 2010b). The potential level that exist is 3 tons/ha for rain fed rice and 6 tons/ha for irrigated rice, compared to the current rice yield of 1 ton/ha for rain-fed rice and 4 tons/ha for irrigated rice (GOZ, 2011).

In cognizance of the importance of rice in meeting the political objective of food self-sufficiency, considering the reliance on imported rice can make the country vulnerable to external shocks, such as price spikes that can overwhelm a country's import bills in a short period of time. For this reason, the government keeps on promoting rice production initiatives and competitive agriculture (GOZ, 2010c). The same is done by great nations like United States of America as shown by the following quote from President George W. Bush while addressing Young Farmers of America in 2001; “It’s important for our nation to grow foodstuffs to feed our people”. He further emphasised that “can you imagine a country that was unable to grow enough food to feed its people”. It will be a nation that will be subject to international pressure. It will be a nation at risk” (Bush, 2001).

Although many economists support free trade over food self-sufficiency through the concept of comparative advantage drawn from the classical trade theory outlined by David Ricardo in 1817, is often given as a rationale for this view. According to the theory, there will be gains from trade even if a country does not have comparative advantage in any particular good (Schumacher, 2013). However, the theory of Ricardo has been updated and refined by many researchers amongst are Monke and Person in 1989, Nguyen (2002) and Schumacher (2013) that for the agricultural context with different agro-ecological conditions within the same country, competitiveness and comparative economic advantage can be applied to domestic level.

In order to ensure food self-sufficiency, the Government of Zanzibar in collaboration with various Development Partners has been implementing various programmes since 1964 revolution. Such programmes include, the expansion of low land rice fields in 1966, Rice irrigation scheme in 1976 which was donated by United Nations Development Program (UNDP) under the expert supervision of Food and Agriculture Organization (FAO), Rice farming under a Programme for Food Self-Sufficiency, in Swahili acronym known as *“Mpango wa Taifa wa Kijitosheleza kwa Chakula”* (MTAKULA) in 1983 and Rain fed Rice Development Project (RRDP), established in 1987 funded by African Development Bank (ADB), other projects include; Pemba North Region Irrigation Project in 1994 under the funding of European Economic Community (EEC), Special Programme for

Food Security (SPFS) in 2000. Other recent projects which are considered to be important to rice farming were; Participatory Agricultural Development Programme (PADEP) in 2005, Rehabilitation of Irrigation Infrastructure Project in 2007 and Food Security and Nutrition Programme in 2008 (GOZ, 2011).

Moreover, the Government has put in place initiatives to support the rice sub sector across all ten farming system zones namely (i) Peri-urban; (ii) Central-north; (iii) Selem-makoba; (iv) Coral rag; (v) Central-south, located in Unguja and in Pemba; (vi) Zone-1; (vii) Zone-2; (viii) Zone-3; (ix) Zone-4,a&b and (x) Zone-5, as the National Rice Development Strategy, with the objective of transforming the existing subsistence-dominated rice sub-sector into a commercially viable production system (GOZ, 2011). The policy environment also provides tax exemptions for all agricultural inputs so as to support comparative economic advantage and competitiveness of rice production. In addition, rice farmers have further enjoyed the support of the Government Subsidy Programme, implemented from 2010 to date. The latter was also aimed at supporting rice farmers to take advantage of their comparative economic advantage in order to improve competitiveness of rice production to all farming system zones through access to agricultural inputs (GOZ, 2015).

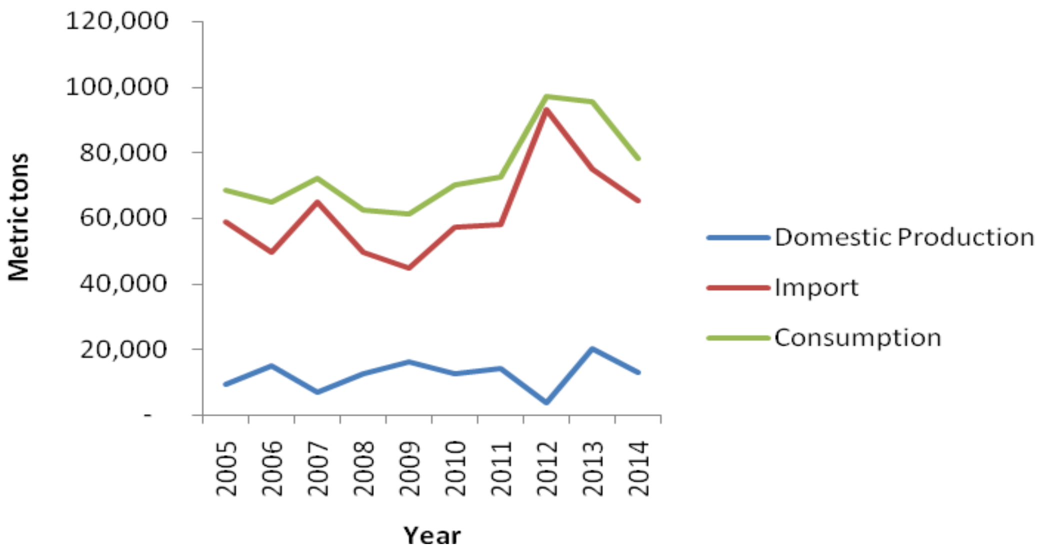

Figure 1: Domestic Rice Production, Import and Rice Consumption Trend in Zanzibar Source: (GOZ, 2015).

Despite all these efforts provided by the Government and Development Partners in supporting and promoting rice sub-sector, the sub-sector faces unfavourable policy environment that have a negative impact on local production such unfavourable policy environment include the low import tariff of 12.5 percent of c.i.f value of 100 US$ per metric ton, providing a narrow price margin in favour of imported rice over domestic rice (GOZ, 2015). Among other factors, this has been blamed for discouraging the competitiveness of domestic rice production and leaving no clear growth pattern in relation to consumption (Fig. 1). Following the several efforts the government also sets different policy frameworks to support the rice sub-sector.

1.2 Development Framework Relating to Rice Sub-sector in Zanzibar

The Vision 2020 together with other development frameworks including the Zanzibar Strategy for Growth and Reduction of Poverty (ZSGRP II), Millennium Development Goals (MDGs), Agricultural Sector Policy and strategic plans. All of them have taken on board issues of food security and food self-sufficiency particularly on competitiveness and comparative advantage of domestic agricultural production (GOZ, 2011).

1.2.1 Zanzibar vision 2020

The revised Zanzibar Development Vision 2020 provides the long term development framework for Zanzibar. The vision was reviewed in 2011 and has the overall objective of transforming Zanzibar into a middle income country. Among other things, the vision emphasizes the need for competitive agricultural and other productive socio-economic sectors to cope up with the challenges of the changing market and technological conditions in the world economy (GOZ, 2015).

The Government prepared the Zanzibar vision 2020 and concurrently launched the Zanzibar Poverty Reduction Plan (ZPRP) for implementing and operationalizing the vision. With regard to economic diversification and transformation, the revised vision noted that the process of the economic diversification should be directed at modernizing the agricultural sector, specifically the rice sub-sector which has great potential (GOZ, 2015). In this case, the vision focuses on the following: to encourage sustainable irrigation systems based on water use efficiency and rain water harvesting, community participation and sustainable use of natural resources (GOZ, 2015).

1.2.2 Zanzibar strategy for growth and poverty reduction (ZSGRP II)

Zanzibar strategy for growth and poverty reduction (ZSGRP II popularly known as MKUZA II in Kiswahili), the ZSGRP II (2010-2015) has three clusters; the Agricultural sector is included in the first cluster, which addresses economic growth challenges in Zanzibar. This cluster has one broad outcome, namely “achieved and sustained equitable pro poor growth”, along with four goals one among them was: to reduce income poverty and attain overall food security. The ZSGRP II has prioritized food self-sufficiency perspective and emphasising the inter-linkages and full comprehension of policy objectives of the overarching frameworks on poverty reduction and food security.

1.2.3 Agricultural sector policy (ASP) 2002

The Agricultural Sector Policy objectives are in line with the ZSGRP II and the revised Vision 2020. The ASP was formulated in February 2002 by the Ministry of Agriculture, Natural Resources, Environment and Cooperatives (MANREC) in collaboration with FAO. In this policy the main role of the MANREC was confined to policy implementation, management and promotion of an enabling environment for private sector production, trade and investment as well as competitive agricultural production (GOZ, 2010a).

The overall objective of the Policy was to increase the share of locally produced rice in domestic market to reach a target of 60 percent self-sufficiency by 2016 (GOZ, 2015). In supporting this effort, the in 2010 introduced subsidy program and it was equally implemented in all agricultural zones of Zanzibar regardless of the agro-ecological conditions of the zones with potential rice production (GOZ, 1995). The subsidy program was set to cover 26 600 hectors with 71 633 rice farming households in nine rural districts. The programme was expected to increase rice yield to an average of 3 tonnes/ha for rain-fed rice and 6 tons/ha for irrigated rice. With expected expansion of irrigation infrastructure for 4500ha through various programmes, it was anticipated to increase annual paddy production from 23 000 in 2011 tons to 85 000 tons by 2016 (GOZ, 2011). However, the policy objective of improving competitive rice production by supporting rice farmers in all agricultural zones have not been sufficiently realized, no significant improvements have been recorded to make any impact on yield (GOZ, 2015).

Despite good intention of the government to facilitate availability and the use of subsidized inputs, there was is a clear gap on the alignment and implementation of the overarching policy frameworks (GOZ, 2015).

1.3 Research Problem

Rice production has been playing a vital role and significant contribution to the caloric intake in urban, peri-urban and rural areas of Zanzibar (GOZ, 2011). Demand for rice is forecasted to increase due to increase in population size, urbanization and change in life style and dietary habits. Moreover rice is very popular food across the world and is considered to be a strategic crop for grain reserve toward food self-sufficiency (GOZ, 2010c). Thus with improvement in the standard of living as well as increase in population, more rice is likely to be produced or imported so as to feed the growing population and attain food security goals of the country.

The increasing demand for rice gives the rice sub-sector more credibility to meet the food security goals by producing rice in potential farming system zones. Thus, the potential of the rice sub-sector shows a great promise toward food self-sufficiency campaign and the sub-sector is considered to be viable enterprise which can effectively deal with the problem of increasing per capita rice consumption and food self-sufficiency (GOZ, 2011). In harnessing the potential level and food security goals, the issue of competitiveness and comparative economic advantage of rice production with the consideration of farming system zones with potential in rice production will be particularly important. However, the attainment of potential level and food self-sufficiency largely depends on determining technical and socio-economic characteristics that differentiate rice farmers in term of yield as well as competitiveness and comparative economic advantage of rice production improvement.

The Government of Zanzibar has been implementing different programmes for enhancing competitiveness and comparative economic advantage of rice production for more than three decades (GOZ, 2010c). This effort was the result of several studies which reported that the green revolution, which has saved many lives in Asia and South America, has bypassed Africa where hunger still prevails despite all the past research and development efforts (Holt-Gimenez *et al.,* 2013; Ogbe *et al.,* 2011).

However, Nobeji *et al.,* 2015 indicated that rice production has compatibility problems with agro-ecological conditions and household characteristics of rice farmers. In addition, the failure of Zanzibar rice production and productivity to keep pace with the increasing support of the government is attributed by inefficiently mainstreaming the issue of subsidy to rice farmers (GOZ, 2010c).

Despite the strategies put forward by the overarching development frameworks which put much emphasis on competitive agriculture toward 60 percent food self-sufficiency. This gap therefore, called for the need for policy makers to have full comprehension on the alignment and implementation of development frameworks, sector policy objectives, plans and strategies. This study observed such gap and rang a bell in order to provide information to policy markers to use the information from this research for promoting rice production activities effectively.

1.4 Justification of the Study

Many studies on competitiveness and comparative economic advantage were unevenly distributed geographically and skewed in focus-wise. Most of them are on the impact of regional rice production and productivity in West Africa and South Asia, and some on nutrition or non-agriculture based enterprises. For example, Swinnen and Vanderplas (2012) on rich consumers and poor producers; Abernathy *et al*. (2000) on the constraints of competitiveness of locally produced rice compared to imported rice and comparative disadvantage of locally produced rice; Nguyen and Heidhues (2014) examined the comparative advantage of rice production in Vietnam and Bangladesh by using Policy Analysis Matrix. The results of the study show that, the comparative advantage of rice was relatively higher and the use of domestic resources was efficient in economic terms, but their study did not analyse the competitiveness and comparative economic advantage among agricultural zone within the same country. Generally, there is little or no information on technical and socio-economic characteristics that differentiate rice farmers in terms of yield as well as competitiveness and comparative economic advantage for rice production zones in Unguja and Pemba.

This study intends to provide useful information that differs from previous studies in various ways. First, this study assess the determinants of competitiveness and comparative economic advantage on rice production, with a special focus on three farming system zones and not at aggregate level, the first study of its kind for Zanzibar. The disaggregated selection of zones will provide policymakers with information to guide food security policies in Zanzibar. The second unique feature of this study is determining technical and socio-economic characteristics that differentiate rice farmers in terms of yield. Third, this study shows a light for policy makers to have clear understanding on the alignment and application of development frameworks, which define the competitiveness and comparative economic advantage of rice production in Unguja and Pemba farming system zones.

1.5 Objectives

1.5.1 General objective

The general objective of this study was to assess the determinants of zonal competitiveness and comparative economic advantage of rice production in central north, central south and zone-3 Pemba of Unguja and Pemba, which will further contribute to policy and investment decisions on the part of government and also the private sector.

1.5.2 Specific objectives

The specific objectives of the study are to:

i. Determine technical and socio-economic characteristics that differentiate rice farmers in terms of yield in central north, central south and zone 3 Pemba farming system zones.
ii. Analyse the competitiveness of rice production under different technological packages in central north, central south and zone 3 Pemba.
iii. Analyse the comparative economic advantage of rice production under different technological packages in central north, central south and zone 3 Pemba.
iv. Examine the level of protection of the rice sub-sector in central north, central south and zone 3 Pemba.

1.5.3 Hypotheses

The study was guided by the following hypotheses:

i. Low and high yield rice farmers have the same technical and socio-economic characteristics.
ii. There is no zonal competitiveness of rice production under different technological packages

iii. None of the farming system zones has comparative economic advantage in rice production under different technological packages
iv. There are no differences in protection of the rice sub sector across the farming systems zones

1.6 Conceptual Framework

The conceptual framework in Figure 2 was adapted from the work of Kavcic *et al.* (2000), Nguyen (2002), Nguyen and Heidhues (2004) and Porter, (1990). Their approach is modified in order to link the objectives of this research. The conceptual framework indicates that, there are number of factors which determine competitiveness and comparative economic advantage of rice production in Zanzibar.

The first category of factors are grouped as a household and farm characteristics include sex of rice farmers, age of rice farmers, level of education of rice farmers, agricultural asset ownership, experience of rice farmers in years in rice farming, size of the rice farm, involvement of rice farmers in rice farming either full-time or part-time and the main activity performed by the farmer. Thus, rice yield is a function of tradable and non-tradable input since rice farmers are heterogeneous that can use different resource endowment at different farming system zones.

The second group consists of tradable and non-tradable inputs which are standardized into acre and tradable paddy are transformed into rice output. Overall, the technological package across farming systems zones and shehias are assumed to be affected by the household characteristics of rice farming household. However, households evaluate the profitability and efficient use of domestic resources on rice production with respect to the specific assistance offered from supporting institutions.

The conceptual framework in Figure 2 is also in line with the economic Isaiah of our time W. Edwards Demin. Demin (2000) states that, about 90 percent of the problems in organization are general problems comprised of bad systems. He further added that, only about 10 percent are specific problems with people. For that reason, many policy makers misinterpret such data thinking that, if they correct the issue of agro-mechanization, agro-inputs and subsidies the problems with rice farmers will go away. But, the reverse is actually true; if you correct 10 percent first, the other problems will go away, because rice farmers are the ones who form agricultural sector and they use mechanization and subsidies as the outward expressions of their own character and competence. This is why the study also focuses on determining socio-economic characteristics and technological packages that differentiate of rice farmers' yield levels.

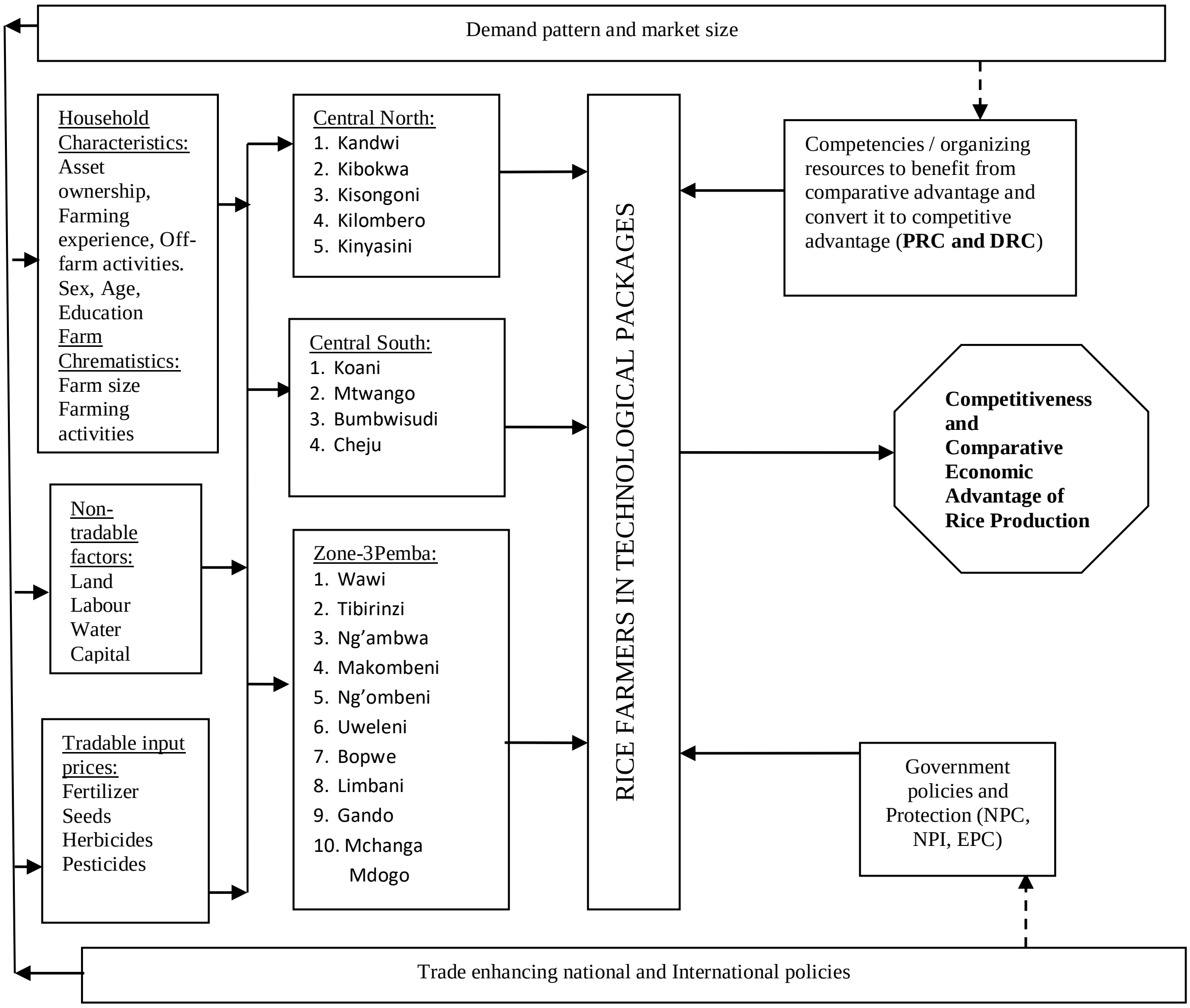

Figure 2: The conceptual framework of Determinants of Competitiveness and Comparative Economic Advantage for Rice Production in Zanzibar:

Source: Kavcic *et al.* (2000), Nguyen (2002), Nguyen and Heidhues (2004) and Porter, (1990).

1.7 Organization of the Thesis

The thesis is organized into five chapters. Chapter one begins with the general introduction. This chapter has a total of seven sections. Section one presents the background information of the study; section two explains the development framework of the rice sub-sector in Zanzibar. Research problem is presented in section three and section four explains the justification of the study. Overall objective of the study, hypotheses and specific objectives are presented in section five. Section six presents the conceptual framework of the study, while section seven explains how the thesis was organized.

Chapter two reviews the empirical literature for the determinants of competitiveness and comparative economic advantage for rice production. The chapter has eight sections. Section one presents the performance of rice production and the household characteristics and technical packages with rice yield, while section two presents the issue of food self-sufficiency and the right to prioritize food security. Section three explains the concept of competitiveness and comparative economic advantage. Empirical studies for competitiveness and comparative advantage estimation are reviewed in section four and section five reviews the level of protection and policy transfers on rice sub-sector. Section six reviews the concept of enterprise budget, while section seven presents sensitivity analysis. The chapter concludes by reviewing the strength and limitations of PAM approach in section eight.

Chapter three presents the methodology of the study. This chapter has a total of six sections. Section one presents the characteristics of the study areas, section two explains the theoretical model used in the study. Data processing and transformation are presented in section three and section four deals with methods of data analysis. Section five indicates the required data and sources. This chapter ends by explaining research design of the study in section eight.

Chapter three is followed by empirical findings and discussion in chapter four. The chapter consists of five sections. Sections one discusses how farming system zones, technological packages and socio-economic characteristics and technical packages of rice farmers associated with rice yield. Discussion of competitiveness, comparative economic advantage as well as level of protection and policy transfers for each zone is given in section two. Sensitivity analysis on different scenarios is given in section three. Section presents a summary of major findings, while section five concludes by outlining the limitation of the study. Chapter five presents the conclusions and recommendations based on the findings from the study. The chapter has two sections. Section one provides the main conclusions from the findings, while section two gives policy implication and recommendations by highlighting some aspects on how to improve competitiveness of rice production and offering suggestions for further research.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Socio-Economic Aspects Relating to Rice Yield and Production

According to Mohamed and Temu (2008), the majority of smallholder farmers in Zanzibar operate on landholdings of less than four acres which is also found to be associated with rice yield. This is in line with West African rice farmers that, most of them are of small to medium scale categories, the average farm size among the traditional rice farmers was about 3 acres categorized in yield while that of improved technology farmers was holding 16.3 acres (Zulkifli and Nunung, 2014). Abdullahi (2012) further noted that the average age of rice farmers using traditional technology was about 42 years while that of farmers using improved technology was 45 years, these age categories were associated with rice yield in high yield category. Average years of schooling for the traditional technology rice farmers associated with low yield category was 7 years, while that of the improved technology associated with high yield category was 8 years (Zulkifli and Nunung, 2014). Ayoola *et al.* (2011) showed that most of the rice farmers (69%) were either illiterate or semi-illiterate, with farm size between 0.1 to 0.3 ha, a situation that could be best described as small-scale. This was why, according to the report, two explanatory variables, level of education and farm size had no significant effect on the output of rice in the study area.

Instead Ayoola *et al.* (2011) observed that greater number (77.5%) of rice farmers had long years of experience of about 10 to 30 years; and large family size of about 10 to 25 members; with many wives and children (including their extended families), all served as family labour. In addition, the age of rice farmer has shown no significant association at 5 percent confidence level, productivity declined with advancement in age. According to

Nwinya *et al.* (2014), lowland rice production is more profitable than upland rice production. Although, upland rice is an alternative for small farmers with limited access to good quality land. They identified the following farmer characteristics that could influence rice cultivation: age of respondent, gender of respondent, years in school, marital status, experience in rice production, the size of the household, income from rice production, and whether or not the farmer sells rice. Age, gender and marital status characterize rice producers, and affect variety preferences.

A study conducted by Lancon (2001) on "Rice Competitiveness Case Studies from Western Niger" reported that the main features of the rural rice markets surveyed are that the majority of the rice traders are women rice retailers who mostly run their businesses as private ventures started with own capital.

2.2 Food Self-sufficiency and the Right to Prioritize Food Security over Trade

McMichael and Scheider (2011) contended that, earlier notions of food security prioritized national-level food supply as a key component of national security; this idea continues to vibrate many governments as part of their political strategy. They added that, the idea insists food self-sufficiency, or at least the capacity to be largely self-sufficient in food, remains at least nominally important for conceptions of national security. They further observed that, a number of developing countries take this viewpoint, as they do not wish to be vulnerable by relying on other countries for their food supply.

Muphy *et al.* (2012) studied association between national security and the capacity to self-produce food at a national level and found that there was a strong force that kept food as an exceptional case in the international trade regime for much of the twentieth century, arguing that it is the nation's sovereign right to pursue policies that ensure the food security of their population as a first priority, before undertaking measures to enhance trade in the sector. This includes the right of countries to increase the percentage of food that they produce domestically which can provide an important contingency against supply disruptions and price volatility as well as provide social assistance for development in rural areas (Schumacher, 2013).

Likewise, Moon (2011), analysed both the state-based and civil society-based approaches to sovereignty in food policy and found that, practices are not explicitly calling for complete food self-sufficiency where a country closes its borders to all food trade. Rather, advocates of this approach seek the right of both states and communities to pursue their own self-defined food policy, including in relation to trade. This may include, for example, an increase in the percentage of food a country produces domestically in relation to its consumption in order to reduce reliance on imports for this vital commodity. And it may involve the establishment of food policies that include some measures, such as guaranteed purchase prices and public stockholding arrangements, which others may deem to be trade distorting. He further observed that, those policies are defended by advocates of this viewpoint as being within the sovereign right of states and communities to prioritize food security over commercial concerns, including upholding and prioritizing the right to food and sustainability of the food production systems.

2.3 Competitiveness and Comparative Economic Advantage

Private profitability is the difference between gross revenues and total costs (Tradable and Non-tradable costs); all valued at market prices following the policy analysis matrix (PAM) methodology (Beghin and Fang, 2002). Positive private profitability indicates that the crop enterprise is competitive, making some financial gains that help the business to sustain itself and thus become financially viable. However, negative private profitability indicates that the private business is not competitive and thus may need some form of interventions to continue its operations.

Likewise, Competitiveness is the ability to earn profit and maintain market share. It is determined by commercial performance of the business. Profitability is the most important element of competitiveness, as it relates benefits (revenue) on one side and costs (expenditure) on the other. Anything that would increase profitability, therefore, would increase competitiveness (Porter, 1990).

Hoffman in year 2000 developed a concept of sustainable competitive advantage (SCA), based on Barney (1991), "sustainable competitive advantage is a prolonged benefit of implementing some unique value-creating strategy not simultaneously implemented by any current potential competitors along with the inability to duplicate the benefits."

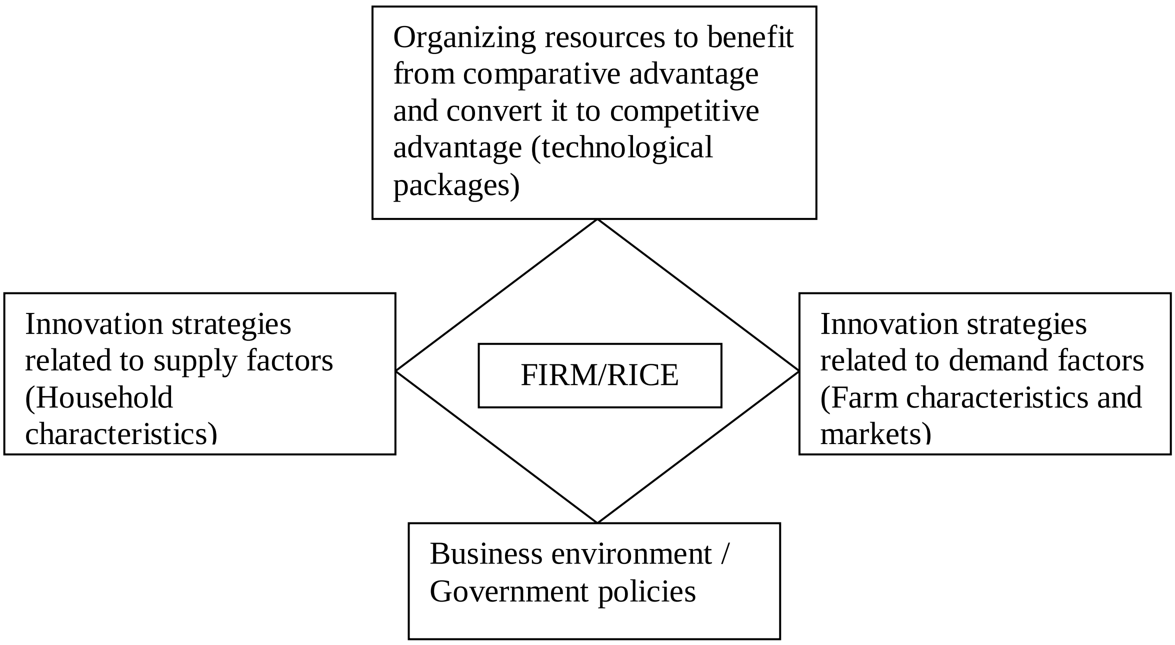

Figure 3: Determinants of Competitive Advantage

Source: (Porter, 1990 and Nguyen, 2002).

According to Porter (1990), competitiveness depends on the capacity of its industry/sector to innovate and upgrade. Firms gain advantage against its best competitors because of pressure and challenges from a strong domestic rivals, aggressive home-based suppliers, and demanding local customers.

Innovation in every sphere of a firm's activities plays the central role in awarding competitive advantage to the firm in particular, to the industry in general. All these considerations, yielding competitive advantage to particular area under study as presented as a framework portrayed in the form of a diamond in Figure 3.

Masters (1995) contended that comparative advantage is an activity's marginal contribution to national income (or 'social profit'), an activity that generates positive social profit is said to be 'economically efficient', and to have some 'comparative advantage'. In other words, the comparative advantage of a particular zone under a certain crop production indicates how an enterprise or policy change will affect the whole economy.

As stated by Monke and Pearson (1989), social profitability is an efficiency measure because both the outputs and inputs are valued at prices that reflect the scarcity values or social opportunity costs. Therefore, positive social profitability indicates an efficient farming enterprise while negative social profitability indicates inefficient farming enterprise that would necessarily require some interventions to remain in activity.

According to Gupta (2004), there are different sources and/or determinants of comparative advantage for a given production zone/ country on a specific commodity. Some of the common sources include: - 1. Technological superiority: - industrially advanced nations produce new products by employing favourable technology which render the place to have comparative advantage over others applying unfavourable technologies. Technological advancement also enables zones/ countries' to attain economies of scale. Such economies of scale can also provide comparative advantage by lowering production costs. 2. Resource endowments: - availability of resources in a zone/ country provides another source of comparative advantage for zones that do not necessarily possess a superior technology. In addition, comparative advantage can be obtained due to differences in relative factor endowments. 3. Demand Patterns: - the role of demand in the area of production is considered as a stepping stone towards success to the markets.

According to Porter (1990), all of the above considerations, yielding comparative advantage, can be presented as a framework that can be portrayed in the form of a diamond shown in Figure 4. For the sake of this study, comparative advantage of rice production was based and estimated between three agricultural zones in Unguja and Pemba.

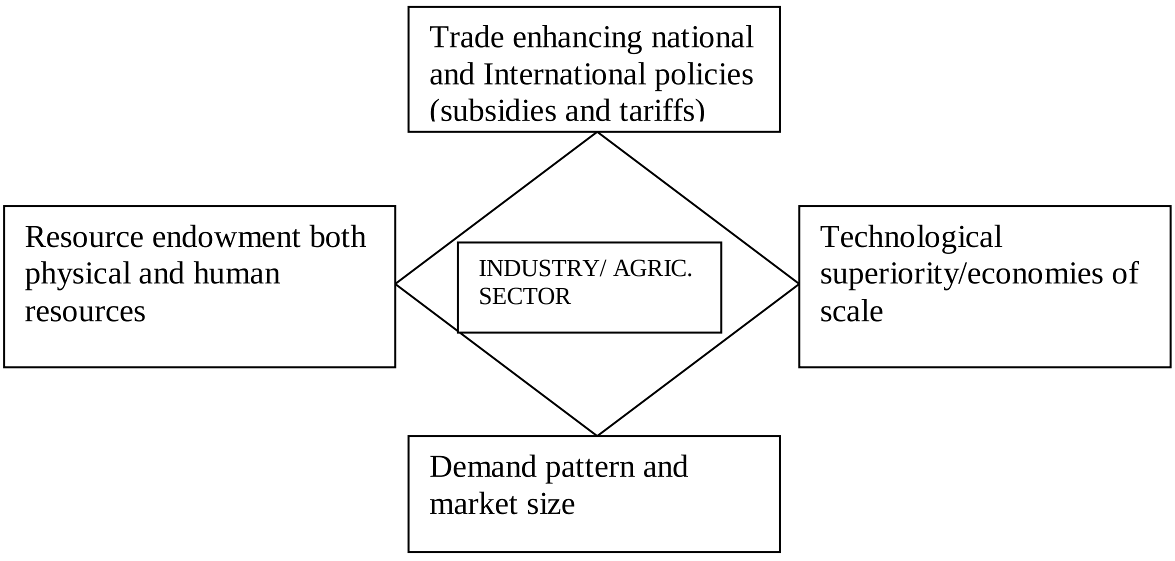

Figure 4: Determinants of comparative advantage

Source: (Porter, 1990 and Nguyen, 2002).

Competitiveness and comparative advantage would be the same only when the market is perfectly competitive in which there are no policy distortions and market failures. In the real world, however, the two assumptions typically diverge because of distortions in the input and output markets which are the results of direct and indirect government interventions (Kannapiran and Fleming, 1999; Beghin and Fang, 2002).

In general, competitiveness and comparative advantages are closely related to each other. This can be explained by the fact that competitiveness of a given firm or rice sub-sector is heavily relied on the comparative advantage of the industry or agricultural sector as a whole. In other words, benefits from comparative advantage can be converted to competitive advantages by firms through innovations in every sphere of a firm's activities. Furthermore, determinants of both competitiveness and comparative advantage usually reinforce each other in explaining a zone's advantage in whole production system in the nation (Hoffman, 2000).

Hence this study uses both concepts from Porter (1990) and Master (1995) and refined by Nguyen (2002) and Schumacher (2013), for its application in determining whether or not the rice sub-sector is profitable for the actors and the prospects for increased production and productivity from among the three farming system zones in Zanzibar. As discussed earlier, the rice sub-sector underwent several policy changes (structural adjustment, management transfer, agricultural sector policy, and fiscal policies). This change has affected the performance of the sector, necessitating regular reviews of the performances for policy interventions.

2.4 Competitiveness and Comparative Advantage Estimation

This section reviews how PAM analysis was used for individual commodity systems in different locations, farming business types, and technologies. The most commonly used tool to quantitatively examine production efficiency and profitability is the Domestic Resource Cost and the Profit Cost Ratio respectively. These measures are often calculated at different levels of the value chain of specific commodities and reported as summary indicators of the Policy Analysis Matrix (Croppenstedt *et al.,* 2007).

Gupta (2004) assessed the competitiveness of Nigerian rice and maize production ecologies using the Policy Analysis Matrix (PAM) on a sample of 122 farmers. Results of the PAM revealed that outputs from the production ecologies are taxed. This is further confirmed by the Effective Protection Coefficient (EPC) and Subsidy Ratio to Producers (SRP) values; however, the production ecologies are subsidized on the use of tradable inputs. The production ecologies show a strong competitiveness at the farm level (under irrigated rice, upland rice and upland maize) and a strong comparative advantage. Sensitivity analysis indicated that a 50 percent increase in output and a 13.3 percent depreciation of the currency will increase competitiveness and comparative advantage of rice and maize production in all ecologies. The study recommends that government should ensure a level of policy stability in the rice and maize sectors assist farmers with irrigated water scheme to ensure constant water supply, and increase the level of output through provision of improved seed varieties.

Zulkifli and Nunung, (2014) analysed the competitiveness and comparative advantage and the impact of government policy on competitiveness of rice farming in Bolaang Mongondow District in Indonesia. The use of PAM approaches to analyse data from 100 rice farmers showed that private and social profitability was positive. Private cost ratio was 0.69 and DRC of rice farming was 0.68, the output transfer and nominal protection coefficient of output indicated that the total value of input was 7 percent higher than the social price. The transfer output, nominal protection coefficient on input and transfer factor indicated that there is a protective policy to input tradable and non-tradable producers. The result of effective protection coefficient, profitability coefficient and subsidy ratio to producer on rice were 1.16, 1.11, and 0.03 respectively. The study concluded that rice commodities in Bolaang Mongondow have comparative and competitive advantages. In addition, the government policies on rice farming were beneficial to farmers in Bolaang Mongondow District.

Getachew *et al.* (2007) applied a Policy Analysis Matrix to assess the comparative advantage of Barley production in Ethiopia. The study results showed that malt has comparative advantage over its rival crops. They further analysed some of the potential changes and embarked in sensitivity analysis. The simulation result indicated that malt may lose its comparative advantage due to changes in the following parameters. (a) a reduction of rice f.o.b price by 8.46 - 25 percent; (b) a rise in soybean c.i.f price by 18.81 percent; (c) a rise of Mungbean c.i.f price by 9.97 percent; (d) an increase in labour cost by 158-176 percent; and (e) an increase in fertilizer price by 96-117 percent.

Joubert and Van Schalkwyk (2000) examine the impact of government policy on the South African Valencia fruit industry by applying Policy Analysis Matrix. The results of the study indicated that the Private Cost Ratio (PCR), which is estimated at 0.45, shows that the added value is relatively larger in comparison with the domestic factor costs implying that the industry is competitive. The Nominal Protection Coefficient on Tradable Outputs (NPC) is also calculated as 0.95 which indicates that the overall impacts of government policies were decreasing the market prices to a level of approximately 5 %

lower than the world price. In other words, fruit producers were implicitly taxed by 5 percent for their outputs. The Nominal Protection Coefficient on Tradable Input (NPI), which was calculated as 1.76, implying that policies increase tradable input costs by 76 percent larger than the world price. This means that producers are implicitly taxed by 76 percent for their tradable inputs. The Effective Protection Coefficient (EPC) was also calculated as 0.79 implying that production of Valencia fruits receives a higher return of 21 percnet if producers pay border prices for their inputs. Finally a Profitability Coefficient (PC) of 0.66 indicated that there is a net transfer of 34 percent from the private to social values.

Shahabuddin (2000) examined the comparative advantage of different crops in Bangladesh agriculture using net economic profitability and domestic resource cost ratio. The profitability and domestic resource cost ratio estimates suggested that except for a few import-competing crops, Bangladesh has comparative advantage in production of most crops. The analysis has important implications for the scope and incentives for crop diversification in the country. From the long term comparative advantage, assessed in terms of expected technological innovations and changes in future would market conditions, suggests that although the profitability of rice is likely to worsen in the future, substantial improvements in both financial and economic profitability can be expected for most of the other crops. The result of the study also argued that the existence of comparative advantage and the liberalization, under Uruguay agreements, were not likely to generate any significant benefit to Bangladesh agriculture on their own. What is essential is to enhance agricultural productivity, is to develop technologies and skills and create an effective policy regime to realize the potential benefits of the emerging trading opportunities.

Bahaeddin (2002) analysed the effect of government policies on wheat production in Iran by applying Policy Analysis Matrix. The study result showed that the Iranian government protective policies have had a negative impact on wheat producers' income. This has caused the cultivated land to decrease and imports to increase sharply toward the end of the period under the study. Findings of the study also indicated that wheat producers could earn higher profit in the absence of government intervention. The upward trend of DRC, NPC and NPI also indicated that although production of wheat has comparative advantage, as a result of government policies, its yield has been declined from year to year. The result of sensitivity analysis also suggested that a change in yield per hectare and change in foreign exchange value had a significant effect on comparative advantage of wheat.

Mangisoni (2003) applied PAM to measure the comparative economic advantage in the crop sector and financial analysis to explore the potential of investing in a fruit juice extraction plant in Malawi. The PAM result showed that farmers in Malawi have comparative economic advantage but they face negative incentives in the production and marketing their products. The NPC for both maize and beans were less than 1 while the Nominal Protection Coefficients on Tradable Inputs (NPI) were more than 1. Similarly, the Effective Protection Coefficients (EPCs) were less than 1, implying that the combined effect of transfers and tradable inputs is reducing the private profitability of the systems.

Nguyen and Heidhues (2004) assessed the comparative advantage of Vietnamese rice production using the PAM in conjunction with an econometric model. The results of the study showed that, in 1998 (the baseline scenario), the comparative advantage of rice was relatively higher and the use of domestic resources (i.e., land, labour, and water) was efficient in economic terms. The sensitivity analysis result also revealed that the estimated

DRC in respect of the world price and the shadow exchange rate in 1998 showed a considerably improved comparative advantage. In contrast, the estimated DRC for land rent, the social costs of labour, the import price of fertilizers and irrigation water charge resulted in deteriorating the comparative advantage of rice in Vietnam.

Kouakou (2015) used PAM for analysing the economic efficiency and comparative advantage of rice production in West Africa. The approach compares estimates of private profitability (difference between returns and costs in actual prices facing farmers, millers, or traders) with estimates of social profitability (residual remaining when costs and returns are evaluated in social prices). The reasoning behind this approach is that in the absence of distortions, market and accounting prices coincide, resulting in social benefits equaling social costs for all activities.

The criteria used to measure economic efficiency are the Net Social Profitability (NSP), Domestic Resource Cost ratio. Net social profitability uses only opportunity costs to assess the activity's level, by comparing the social value of its output to the social opportunity cost of the commodities and factors of production employed in producing it. The technique is said to be efficient if the social value is equal to or greater than the social opportunity cost. Activities with a DRC less than one are efficient in the sense that the domestic factors employed by them produce more value added at world prices than they would in the activities from which they are withdrawn. Alternatively, activities with a DRC larger than one are inefficient because they employ domestic factors whose opportunity cost is greater than the net income produced (Mucavele, 2000).

Beghin and Fang (2002) showed that capital investment and labour used had greater influence on rice output than other variables, fertilizer used had little or no impact.

However, it could be assumed that the quantity applied per hectare on the average fell short of the recommended rate and that farmers could not meet up with that rate because of its high cost. The result of the costs and return analysis showed that rice production enterprise was a profitable business.

The indicators of competitiveness, comparative economic advantage and protection has been used in a number of studies to assess the effects of policies and policy changes on agricultural production systems characterized by location, technology use, and crop management (levels of inputs use). Monke and Pearson (1989) states that, the primary objective of constructing PAM is to derive important policy parameters for analysis. Also, Pearson *et al.* (2003) applied PAM methodology to make an assessment of rice sectors and various related policies in several West African countries.

Since 1995 studies based on PAM indicators were conducted in Nigeria, Sierra Leone, Senegal, and Mali; and some training sessions were conducted in the Ivory Coast, Senegal, and Mali (Lançon, 2001). The indicators were also used to study the competitiveness and comparative economic advantage of rice production systems in Cote d'Ivore and have also been used as a decision-making tool in a rice and maize stratification project (Kauakou, 2015). In East Africa, several studies have used such indicators to measure the same on different commodities (Mucavele *et al.,* 2000).

2.5 Policy Transfers and Protection Coefficients

2.5.1 Policy transfers

In the PAM approach there are several indicators of policy transfers and protection coefficients that indicate the policy effects on agricultural systems producing one commodity (Gupta, 2004). It also enables to identify the effects of divergences by comparing market prices and world prices in order to identify how results obtained from actual market prices differ from results obtained from corresponding efficiency prices. The effects of divergences identified are the result of policy interventions; the effects of these divergences can be evaluated for the system's output transfer, tradable input transfer), and factor transfer (Pearson *et al*., 2003).

The work of Kavcic *et al.* (2000) showed that, the government of Slovenia changed factor costs with tax policies for the capital and labour, this created a divergence between private costs and social costs. Since market imperfections arising from imperfect information or underdeveloped institutions are often characteristic of developing country economies. Further Kavcic *et al.* 2000 found that, positive entries in the two cost categories, J and K, represent negative transfers because they reduce private cost.

Bahaeddin (2002) contended that, the output transfer of wheat production in Iran is positive, indicating that agricultural system is receiving an implicit subsidy or transfer of resources to the benefit of the system. He also found that, the system is protected from being taxed and the resources used for wheat production is not diverted from the system. In a similar way, social tradable input costs was different from private tradable input costs which signify subsidy to the system without divergence.

Nguyen and Heidhues (2004) recorded negative net policy transfers for Vietnamese rice which constitute a clear indication that the private prices for the use of tradable inputs and domestic factor cost are less than the world reference prices, confirming that the production system is protected. They further found that PC with negative values suggesting that a negative net transfer payment while the positive profitability coefficient indicates a positive net transfer payment for rice production.

A framework provided by PAM to evaluate price-based trade policy, is also used to analyse agricultural systems by comparing enterprise outcomes at market with social prices. As shown in Table 3, the difference between the two outcomes represents actual policy transfers between actors in the economy. The main assumption made in conducting such a comparison is that world prices are the best proxy measure of the scarcity value of tradable and domestic factors used in the rice production process. The scarcity values of tradable and domestic factors used constitute best alternative uses of resources mobilized in rice farming activities in Zanzibar.

A body of literature deals with the theoretical foundations, method of estimations, and potential limitations includes; Monke and Pearson (1989); Beghin and Fang (2002); Anderson (2003); and Masters (2003) have found that, the best alternative uses of resources indicate resource use efficiency, i.e. an optimal mix of inputs and factors of production that enable the generation of maximum output, is therefore a system which enjoys adequate performance levels and policy interventions.

Gupta (2004) and Fang and Beghin (2002) also stated that, there are policy interventions which alter agriculture system competitiveness and create distortions measured by various indicators of protection, this shows important information about policy effects on agricultural system performance (revenues, costs, and profit).

2.5.2 Protection coefficients

Mucavele (2010) found that the NPI for the selected crops were greater than a unit, implying that they received implicit subsidy of nearly 95 percent on average for the use of tradable inputs. He further found that EPC are a bit higher than NPC which imply that input transfer was insignificant. The EPC greater than a unit, indicating that the value added at market prices for the selected crops were higher than the value added would be at reference prices. He added that, when all effects of policy on the inputs and outputs of the crops under the study are considered, it can be seen that the value added evaluated at market prices, is greater than what it would be in the absence of policy effects (Mucavele, 2010).

Fang and Beghin (2002) puts forward that the method to assess divergence between market and reference price is the use of ratios for Chinese agricultural trade, which are free of currency or commodity distinctions. They further found that NPC values of less than one for the sampled agricultural enterprises. Their results indicated that policies were decreasing the market price to an average level of 55 percent, which suggests that production in various agricultural enterprises receive some policy protection.

However, as reported by Gonzalese *et al.* (2010) the EPC ignores the transfer effects of factor market policies and thus it was not a complete indicator of incentives for Indonesian food crop production. For this reason they used the PC instead. They used PC to measures the incentive effects of all policies and serves as a proxy for the net policy transfer as suggested by Monke and Pearson (1989).

Kauakou (2015) puts forward that the Subsidy Ratio to Producers (SRP) shows net transfers the overall measure of the difference between financial and economic valuations of revenues and costs in Cote d'Ivore rice farming. The observed SRP value from sampled farmers was greater than one. This suggests there was a decrease in gross revenue from the sampled rice farmers. SRP value stood at 60 percent which shows that the net policy transfers as a share of the social revenues. Therefore, it is an overall measure of the difference between private and social profit; it measures the overall effects of policies. For that reason, if efficient policies exactly offset market failures and all distorting policies are removed, divergences disappear and the net transfer becomes zero (Pearson *et al.*, 2003).

Anderson (2013); Anderson (2003); Anderson (2006b); Masters (2003) and Zulkifli and Nunung (2014) made a detailed review and analysis of the measurement of the effects of policy distortions; distortions which can be due to taxes or subsidies on imports or exports, or quantitative restrictions on trade volumes (including trade bans) or values, interventions in foreign exchange markets, and by several domestic interventions such as output, input and factor taxes and subsidies. This implies that the trade policies alter domestic prices and quantities of the targeted agricultural commodity (Pearson *et al.*, 2003).

2.6 Construction of Enterprise Budgets

Farm level issues receive most attention from PAM analysis which is concerned with the estimation of transfers induced by policy or market failures. These differing analytical objectives place new demands on the existing data. For example, the ministry requires only the total costs of intermediate inputs, whereas the PAM analyst is concerned with the price and quantity used of each input in order to measure the effects of price distortions or to assess the potential impacts of input substitution (Fang and Beghin, 2002). Consequently, in most instances, substantial data gathering efforts will be necessary to permit the construction of enterprise budgets for representative farm activities (Mankiw, 2004).

Monke and Pearson (1989) and Schumacher (2013) put forward that farm level budget data used to prepare PAM is the product of policy issues and choice of crops, level of aggregation, and selection of indicators to measure representativeness. Because of time and cost constraints on the research project, the principal role for farm level budget is the verification and modification of secondary data and the collection of appropriate private market prices. The most difficult pricing exercises usually involve primary inputs (especially labour and capital) and non-marketed goods. Some of the complications that arise in trying to evaluate economic value of physical farm structures like land and irrigation infrastructures, because many rice farmers produce multiple crops on the same land on different cropping calendar. The desegregation of ecological location and fixed inputs require some arbitrary assumptions. Agronomic constraints on crop rotation and perennial crops present further complications for the estimation of farm level budgets.

In addition, choices of farm activities are determined by the research problem and the scope of agricultural issues identified by the researcher. For example, if policy-makers are interested in the tax/subsidy impact of government policies on the agricultural sector, one or two representative budgets for each crop should be sufficient. If the research instead focuses on a single crop or technology, a more detailed specification of commodity production is needed and a larger number of representative budgets should be used (Winter-Nelson, 1995; Kanaka and Chinnadurai, 2015).

Within each group of commodity systems, analysts may still desire to characterize production heterogeneity in some detail. Regional classifications are perhaps the most common indicator of heterogeneity, because differences in agro-climatic zones characterized by soil fertility, topography, and access to water typically influence the choice of technology and the level of input use. Differences in farm size are a second source of heterogeneity. Small farms often use variable inputs, such as fertilizer and labour, with different intensities than large farms. Large-farm systems are often capital intensive and fixed costs account for a more substantial share of total costs (Schumacher, 2013; Monke and Pearson, 1989).

The development of a list of representative systems can draw on various information sources such as aggregate production estimates. Sometimes these estimates are decomposed by farm size or technological characteristics, for example in this circumstance, aggregate data can be used to specify the technological alternatives as well. But the identification of specific technologies usually requires first hand observation and the assistance of farm management personnel. Short field trips with expert observers are useful to give the researcher a better idea of the distinctions among commodity systems (Masters, 1995; Pearson *et al.*, 2003).

Monke and Pearson (1989) and Schumacher (2013) contended that, once representative firms have been identified, the estimation of budgets can proceed. Because PAM results are adversely affected by the omission of cost or revenue items, budgets should reflect a complete set of input and output activities. Preparation of the cropping calendar a time line that identifies the various tasks in crop production, such as land clearing and preparation, planting, fertilization, pest control, and harvesting reduces the likelihood of data omissions. A single visit to each type of farm is usually sufficient to gain an adequate picture of cultivation practices.

In addition Gonzalese *et al.* (2010) found that, the cropping calendar approach might overlook some infrastructural inputs, such as barns, silos, and primary irrigation works, necessary to farming but not directly involved in the field processes of production. They also realized that, in most studies only a portion of the costs of infrastructure were found be an attributes to the activity budget. For example, if the budget concerns costs and returns for one hectare of wheat, the analyst might choose a proportion factor, such as the inverse of farm size, as the share of the cost of the infrastructural input to allocate to the activity budget. They also found that the choice of a proportion factor is arbitrary. But they added that, infrastructural inputs are indivisible fixed costs for the farm, whereas the budget calculations require that farm costs be allocated among various cropping activities. Hence no correct allocation exists for such inputs. Because such inputs are indivisible, one activity may contribute more or less than others to the costs of infrastructure. Monke and Pearson (1989) puts forward that, the indivisibility of such inputs is not a problem for PAM construction and can even ignore the costs of primary irrigation works for small scale farming.

2.7 Sensitivity Analysis

Monke and Pearson (1989) stated that, it is worthwhile to examine the degree to which the efficiency measures estimated under the set of baseline assumptions which are likely to be affected by changes in the values of DRC, NPC, NPI, EPC, PC and SRP. Furthermore, Pearson *et al.* (2003) found that sensitivity analysis is warranted for two main reasons; first, the profitability analysis is based on certain simplifying assumptions regarding production technologies as reflected in the input-output coefficients, market conditions, prices (both financial and economic prices), government policies etc. Since the world prices of tradable inputs and outputs and the level of output obviously affect the analysis, it is important to know the extent to which the empirical results are sensitive to the simplifying assumptions that were made. Second, the efficiency rankings produced by the DRC framework are static in the sense that they represent a snapshot taken at a fixed point of time, whereas actual efficiency rankings are dynamic in the sense that they can, and do, change in response to changes in resource endowments, production technology, market conditions and government policies. Therefore, it is important to ascertain whether the results are likely to be affected by probable future changes.

2.8 Strength and Limitation of PAM

One of the main strength of PAM is that it allows disaggregation of the production activities and their costs (Gupta, 2004; Nguyen and Heidhues, 2004). The PAM analysis presents different activities in the form of simple accounting matrix where indicators of policy distortions and economic efficiency are estimated on a straight-forward basis resulting in a relatively reliable result. In most situations, according to Monk and Pearson (1989), the advantages of the PAM approach outweigh its shortcomings and results are comprehensible and easily understood by policy makers who are largely responsible for designing and testing a wide range of policy options for a given production system. The PAM approach also allows measurement of the effect of policies on producer's income as well as identification of transfers among key interest groups, i.e. producers, consumers, and policy makers.

Despite its strength, the PAM approach inherits some limitations. Firstly, it doesn't link the inherent economic relations between different farm activities. In other words, the PAM approach fails to explicitly incorporate the effects of changes in the profitability of one farm activity on input-output relationship of the other (Seini, 2004). In addition, PAM considers input-output coefficients at a given point of time. In other words, the PAM analysis fails to incorporate the dynamic effects of important input and output parameters on PAM indicators over time (Nguyen, 2002; Nguyen and Heidhus, 2004). In order to solve this problem, the study embarked on sensitivity analysis under two assumptions mentioned in section 2.6 following the recommendations made by Getachew *et al.* (2007); Ayalneh (2002); Nguyen and Heidhues (2004) and Gonzalese *et al.* (2000).

CHAPTER THREE

3.0 METHODOLOGY

3.1 The Study Area

3.1.1 Geographical location

Zanzibar consists of two main islands, Unguja and Pemba. The islands lie north to south direction from 4˚50'S to 6˚30'S and in east-west direction from 39˚10'E to 39˚50'E and between 30 to 50 km off the shore of the Mainland Tanzania in East Africa. The islands cover a total land area of 2332 km^2 whereas Unguja covers 1462 km^2 and Pemba covers 868 km^2.

3.1.2 Demographic patterns

According to the 2012 Census, Zanzibar had a population of 1.3 million inhabitants of whom 52 percent were females and 48 percent males. The population density of 530 persons per sq. km turns out to be one of the most densely populated areas in Africa. However, this population is not evenly distributed. Unguja, with 63 percent of the total land area, accommodates 69 percent of the population and Pemba has 31 percent of the population. The Pemba population, which is relatively more rural based, is much more evenly distributed compared to Unguja. Population growth rate is high at 2.8 percent per annum and the average household size is 5.1.

3.1.3 Agro-ecological conditions

The climate of Zanzibar is dominated by a bimodal rainfall pattern and influenced by trade winds: the northeast monsoon from December to February, the southeast monsoon from March to November (Fowler, 1997; Krain, 1998). The long rainy season (Masika) starts from end of March with heavy rain falls and lasts in early June. On average 900 – 1000 mm precipitation accumulates during this season (Fowler, 1997; Krain, 1998).

This season is more reliable than the more variable short rains (Vuli), which starts from October through December, with average of 400 – 500 mm of rainfall. In general, the pattern of rainfall of Unguja Island is similar to that of Pemba. However, Pemba receives more precipitation than Unguja (1900 mm compared with 1600 mm, respectively) (Fowler, 1997; Krain, 1998).

The highest temperature occurs during the short dry season with a monthly maximum mean of 33^{o}C in Unguja and 31.9^{o}C in Pemba. The cool season is between May and September. The relative humidity is high with a monthly average ranging from 87% in April (Masika) to 76% in November (Vuli) and a minimum at 60% during the dry season. Both islands (Unguja and Pemba) are dominated by low ridges running in a north-south direction. They are situated closer to the west coast of the islands while eastern halves are mainly flat. In the middle of Unguja the highest point reaches over 90 m above sea level, while the hills in Pemba reach only a height over 60 m above sea level. Pemba Island is dissected more by hills and ridges than Unguja Island and has a marked indented western coastline. The east coast of Unguja and Pemba is called the coral rag area. It has developed from ancient coral reefs which stretches along the eastern coastline and build up low cliffs. On the west coast steep sandy cliffs occur. In general the soils of both islands are deeper and richer on the western side and become shallow towards the eastern side (Krain, 1998) as sited by Mohamed and Temu (2008).

The main cultivated crops in Zanzibar are coconuts, cloves, cassava, banana, rice, sweet potato, pulses, maize sorghum, citrus and mango. More than 50 percent of the total land is used for crop production. These crops are mainly grown in an intercropping system. Some limited portions on the coral rag areas in the eastern part of Unguja Island are still practicing shifting cultivation, though with short fallow periods. In Unguja, the rice growing areas are concentrated on five extensive, flat and seasonally wet hydromorphic corridors. In Pemba, this crop is grown in over a hundred narrow valleys which tend to be wet all the year round. This corresponds with the research findings which indicate that 78 percent of the total sampled respondents in Pemba were under irrigation. In general, the agro-ecological conditions favour the production of both food and cash crops (Mohamed and Temu, 2008). Nevertheless, in order to improve agricultural productivity and production, the knowledge of competitiveness and comparative economic advantage for rice production becomes vital. Therefore, the development of key determinants of competitiveness and comparative economic advantage stimulates rice farmers and policy makers to improve the performance of the rice sub-sector.

3.1.4 Farming systems zones and sampled areas

Broadly, Zanzibar is classified into three major agro-ecological zones: the plantation zone, coral rag zone and hydromorphic valleys. These zones formed the basis for the classification of the farming systems zones made by the Zanzibar Cash Crops Farming Systems Project (ZCCFSP) in 1995. According to this classification, Zanzibar has 10 distinct farming systems zones, five in Unguja and five in Pemba. These farming systems zones are indicated in Figure 5 and 6 and the major characteristics of each farming systems zones are summarized in Table 11 and 12. In Unguja, the sampled areas fall in farming systems zones 2 and 5 which are commonly known as central north and central south respectively. Zone 1, 3 and 4 has not been covered because there are relatively less rice production activities. While in Pemba the sampled areas predominantly fall in Zone 3 as can be seen from Figure 6, this area is the most potential for agricultural activities (Mohamed and Temu, 2008). Besides, the selected Shehias (19) lies within three selected farming system zones see Figure 5 and 6.

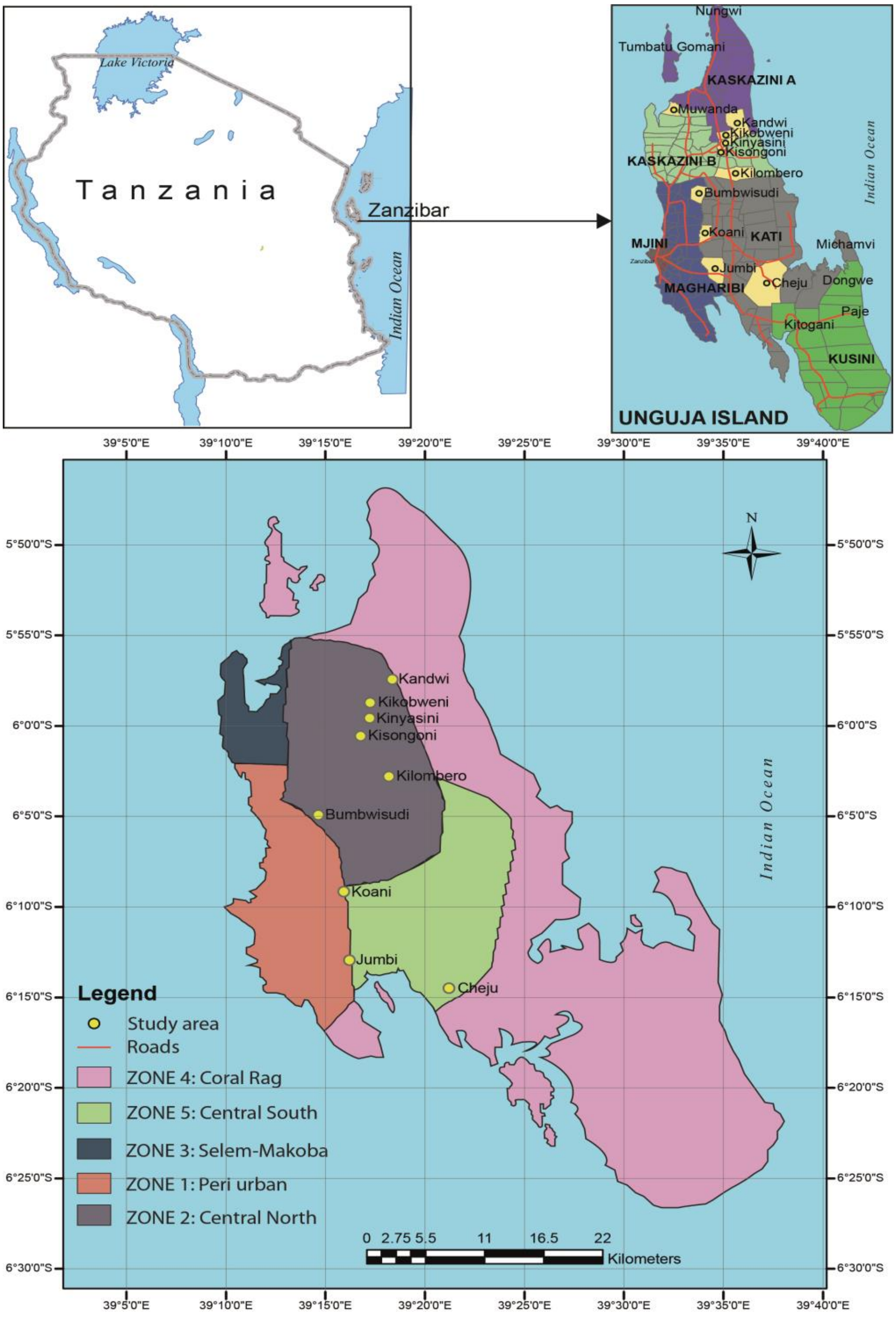

Figure 5: Map of farming system zones and study area of Unguja Island

Source: GOZ (1995).

Table 1: Characteristics of Unguja farming system zones and crop enterprises

Name of Zone	Characteristics of the zone	Crop enterprises
Peri-Urban	• Mostly sandy soils • Average rainfall:-1 500 – 1 800 mm/year	Cassava, banana, sweet potatoes, yams, coco yams, vegetables
Central-North	• Deep Clay soils • Average rainfall:-1 200 – 1 800 mm/year	Fruit trees, cloves, coconuts, cassava, paddy, banana, sweet potatoes
Selem-Makoba	• Sandy soils are dominant • Average rainfall:-1 200 – 1 800 mm/year	Cassava, paddy, sweet potatoes, banana, maize, cowpeas, mango, citrus, groundnuts, cloves, coconuts, millet.
Coral rag	• Coral, rocky shallow soils • Average rainfall:-800 – 1 200 mm/year	Tomatoes, pumpkins, chillies, limes, papaya, pigeon peas, cucumber, cassava, paddy, sorghum, banana, maize, yams, pigeon peas, green gram, hyacinth, cowpeas.
Central-South	• Heavy clay soils • Average rainfall:-800 – 1 200 mm/year	Cassava, paddy, sweet potatoes, banana, millet, mango, vegetables and citrus

Source: GOZ (1995)

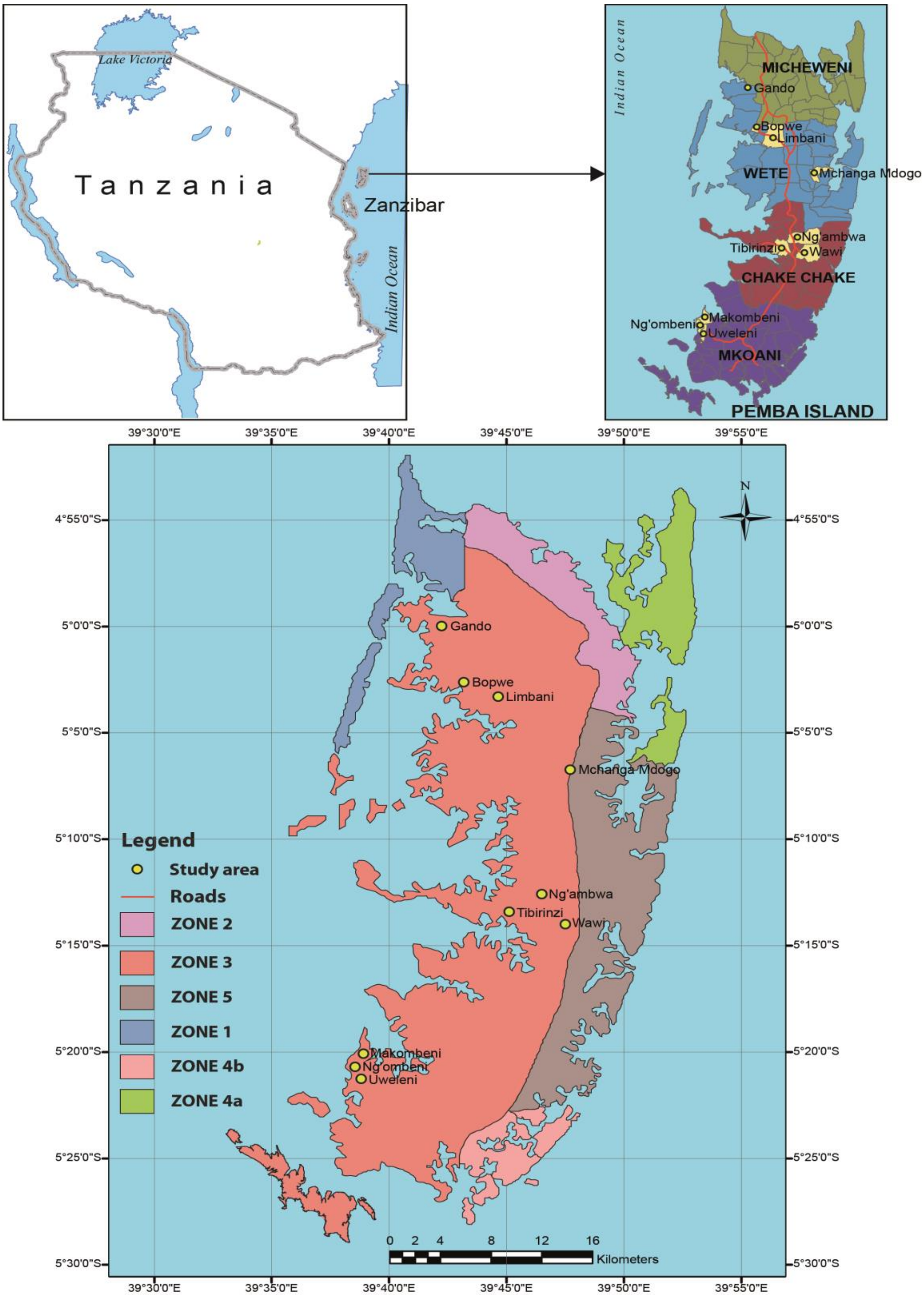

Figure 6: Map of farming system zones and study area of Pemba Island

Source: GOZ (1995).

Table 2: Characteristics of Pemba farming system zones and crop enterprises

Name of Zone	Characteristics of the zone	Crop enterprises
Zone 1	• Coral rag type soils, with high sand content • Average rain:-900 – 1 100 mm/year	Cassava, sweet potatoes, ground nuts, banana
Zone 2	• Mostly sand soils • Average rain:-900 – 1 100 mm/year	Cassava, paddy, sweet potatoes, banana, coconuts, mangoes, pine apples, ground nuts, citrus, bread fruit
Zone 3	• Sandy soils and heavy clay soils • Average rain:-1 600 – 1 900 mm/year	Cassava, banana, paddy, coco yams, sweet potatoes, cowpeas, fruits, cloves
Zone 4a	• Coral rag with deeper clay soils • Average rain:-900 – 1 100 mm/year	Cassava, millet, sorghum, banana, cowpeas, maize, bread fruit, pigeon peas, tomatoes, coconuts, mangoes
Zone 4b	• Coral rag with deeper clay soils • Average rain:-900 – 1 100 mm/year	Cassava, banana, cowpeas, millet, maize, paddy, turmeric, citrus, tomatoes, green gram, chillies,
Zone 5	• Sandy loam soils, heavy clay soils • Average rain:-1 400 – 1 700 mm/year	Cassava, banana, paddy, cowpeas, tomatoes, groundnuts, mangoes, vegetables, citrus

Source: GOZ (1995)

3.2 Theoretical Framework

The theory of general production function was used to support the empirical analysis of production and comparative economic advantage of rice production in Zanzibar. Equation 1 is a production function assumed to be continuous, quasi-concave and twice differentiable with respect to the inputs

$$Q = f(X^{T}, X^{NT}) \qquad (1)$$

$$\frac{\partial Q}{\partial X_i^T} > 0, \quad \frac{\partial^2 Q}{Q X_i^{T^2}} < 0 \text{ ; i=1, 2, 3}$$

$$\frac{\partial Q}{\partial X_j^{NT}} > 0, \quad \frac{\partial^2 Q}{\partial X_j^{NT^2}} < 0 \text{ j=1, 2, 3}$$

Where X^T is a column vector of tradable inputs (fertilizer, rice seeds, herbicides and fuel) and X^{NT} is a column vector of domestic factors (land, labour, irrigation water and transportation). Land productivity is defined as average land productivity or yield is one of the principal factors that can be changed to increase domestic rice production and reduce the share of rice imports to domestic supply. Let X^{NT} be decomposed into two subsets, namely X_1^{NT} and X_2^{NT}, where X_1^{NT} is land and X_2^{NT} is the column vector of the remaining inputs from Equation 1. Therefore the following yield Equation is obtained;

$$\frac{Q}{X_1^{NT}} = f^*\left(\frac{X^T}{X_1^{NT}}, \frac{X_2^{NT}}{X_1^{NT}}\right) \quad or\ Q^* = f^*\left(X^{*T}, X_2^{*NT}\right) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

Where:

Q^* = yield of rice per acre

X^{*T} = is a column vector of tradable inputs per acre

X^{*NT} = is a vector of the domestic factors per acre

From Equation 2, a yield Equation per ith holding is defined as;

$$Q_i^* = f_i^*\left(X_i^{*T}, X_i^{*NT}\right) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3)$$

i = 1, 2, … n

In practice, farmers differ in term of production technology used and efficiency of transforming production inputs into output. This implies that when using cross sectional data, more than one production function is involved. The differentiation factors are; type of seed, rice variety used, agronomic practice used and biophysical condition. The differences leading to the underlying factors leading to observed difference include level of education (having many years of schooling position rice farmers in low or high yield?), access to extension services for rice production (access to extension position rice farmers in low or high yield?), farming occupation of rice farmers (being full time rice farmer position rice farmers in low or high yield?), primary occupation of rice farmer (having off-farm activity position rice farmers in low or high yield?), experience in years on rice farming (having many years in rice farming position rice farmers in low or high yield?), value of Agricultural assets owned by rice farmer (having high valued agricultural assets position rice farmers in low or high yield?), age of rice farmer (being old position rice farmers in low or high yield?) and sex of rice farmer (being male of female position rice farmers in low or high yield?). These factors are detailed in Table 4 and used to differentiate rice farmers' productivity performance in term of low and high yield terciles in objective one.

Apart, the PAM used to determine simultaneously the competitiveness and comparative economic advantage of rice production. The major indicators used to measure comparative economic advantage are the Domestic Resource Cost and Cost Benefit Ratio. The DRC and SCB formula are derived from general production function in Equation 1. Thus;

Let P^s and P = social and market prices for Q; and P_1^s , P_2^s , P_1 , P_2 be vectors of social and market price for tradable inputs and domestic factors.

Based on Equation 1 and the price vectors, the profit at social prices are defined in Equation 4:

$$\Pi^{s} = P^{s}Q - \sum_{i=1}^{n=1} P_i^{s} X_i^{T} - \sum_{j=1}^{m=1} P_j^{s} X_j^{NT} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(4)$$

$$\Pi = PQ - \sum_{i=1}^{n=1} P_i \; X_i^{T} - \sum_{j=1}^{m=1} P_j \; X_j^{NT} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(5)$$

From Equations 4 and 5 PAM is obtained and by using the same notation from Equation 4 and 5 indicators of comparative economic advantage, competitiveness and protection are obtained.

Since it is known that the ideal measure for comparison would be Net Social Profit (NSP) since;

$$NSP(Q) = P^{S}Q - \sum_{i=1}^{n=1} P_i^{S} X_i^{T} - \sum_{j=1}^{m=1} P_j^{S} X_j^{NT} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(6)$$

To derive DRC from Equation 6, $\sum_{j=1}^{m=1} P_j^{S} X_j^{NT}$ is isolated and divide both sides by tradable value added, $P^{S}Q - \sum_{i=1}^{n=1} P_i^{S} X_i^{T}$ to gives

$$\frac{\sum_{j=1}^{m=1} P_j^{S} X_j^{NT}}{P^{S}Q - \sum_{i=1}^{n=1} P_i^{S} X_i^{T}} = 1 - \frac{NSP(Q)}{P^{S}Q - \sum_{i=1}^{n=1} P_i^{S} X_i^{T}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(7)$$

The left-hand side of Equation 7 is the DRC ratio. If net social profit is zero, the DRC is one. For rice farming technology to be economically profitable, DRC value is supposed to be between zero and one. But rice farming technology becomes economically unprofitable if DRC value is greater than one. Thus, the value added (the difference between the gross revenues generated in the rice production and its related tradable inputs costs evaluated at their social prices) generated by rice farmers is lower than the opportunity cost of domestic resources used in the rice production.

Likewise the indicator of competitiveness by using Private Cost Ratio (PCR) can be derived from Equation 5.

To derive PCR from Equation 5, $\sum_{j=1}^{m=1} P_j X_j^{NT}$ is isolate and divide both sides by tradable value added, $PQ - \sum_{i=1}^{n=1} P_i X_i^T$ to gives

$$\frac{\sum_{j=1}^{m=1} P_j X_j^{NT}}{PQ - \sum_{i=1}^{n=1} P_i X_i^T} = 1 - \frac{PRIVATE\ PROFIT}{PQ - \sum_{i=1}^{n=1} P_i X_i^T} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..\ldots\ldots\ldots\ldots\ldots(8)$$

The left-hand side of Equation 8 is the PCR ratio. If private profit is zero, the PCR is one. For profitable rice farming technology, PCR value is supposed to be between zero and one. But rice farming technology is unprofitable if PCR value is greater than one. Thus, if value added generated by rice farmers evaluated at market price is lower than the cost of domestic resources used in the rice production. Based on Equations 4 and 5 and following Monke and Pearson (1989), the PAM presented in Table 3 are obtained.

Table 3: Policy Analysis Matrix

Measure	**Revenue**	**Cost of Tradable Inputs**	**Cost of Domestic Factors**	**Profit**
Budget at Private Prices	$A = PQ$	$B = \sum_{i=1}^{n} P_i X_i^T$	$C = \sum_{j=1}^{m} P_j X_j^{NT}$	$D = PQ - \sum_{i=1}^{n} P_i X_i^T - \sum_{j=1}^{m} P_j X_J^{NT}$
Budget at Social Prices	$E = P^s Q$	$F = \sum_{i=1}^{n} P_i^s X_i^T$	$G = \sum_{j=1}^{m} P_j^s X_j^{NT}$	$H = P^s Q - \sum_{i=1}^{n} P_i^s X_i^T - \sum_{j=1}^{m} P_j^s X_j^{NT}$
Divergences	$I = \frac{PQ}{P^s Q}$	$J = \frac{\sum_{i=1}^{n} P_i X_i^T}{\sum_{i=1}^{n} P_i^s X_i^T}$	$K = \frac{\sum_{j=1}^{m} P_j X_j^{NT}}{\sum_{j=1}^{m} P_j^s X_j^{NT}}$	$L = \frac{PQ - \sum_{i=1}^{n} P_i X_i^T - \sum_{j=1}^{m} P_j X_j^{NT}}{P^s Q - \sum_{i=1}^{n} P_i^s X_i^T - \sum_{j=1}^{m} P_j^s X_j^{NT}}$

Source: Hundermark and Toure, (2003); Pearson *et al.* (2003); Monke and Pearson (1989).

The matrix entries A, B, and C are the sum of products of market prices (P) and quantities (Q), representing all of an activity's outputs, tradable inputs (subscript i) and non-tradable domestic factor inputs (subscript j). Entries E, F, and G use the same quantities but are valued at social opportunity costs or shadow prices (P^S). The bottom row I, J and K is the difference between the other two rows; the last column is benefit minus costs.

The term 'private' refers to observed revenues and costs reflecting actual market prices received or paid by rice farmers, traders, or processors in the rice farming sub-sector. The private profitability calculations show the competitiveness of the agricultural system, given the technological packages and input and output values. The cost of capital, defined as the pre-tax return that rice farmers require to maintain the production process, is included in domestic costs (C); hence, profit (D) are excess profit-above-normal returns to rice farmers. If private profit are negative (D<0), rice farmers are earning a subnormal rate of return and thus can be expected to exit from production process unless something changes to increase profit to at least a normal level (D=0). Alternatively, positive private profit (D>0) are an indication of normal returns and should lead to future expansion of the system, unless the farming area cannot be expanded or substitute crops are more privately profitable. The competitive advantage is evaluated by PCR ratio. For example, PCR less than one in a particular zone indicates that rice farming enterprise is competitive in producing rice using domestic resources. PCR ratio greater than one indicates rice enterprise is not competitive and thus requires particular policy interventions (Monke and Pearson, 1989).

Secondly, the social profitability, this measures the comparative economic advantage or efficiency of the rice farming in zones. Efficient outcomes were achieved when an economy's resources are used in activities that create the highest levels of output and income. Social profit, H, are an efficiency measure because outputs, E, and inputs, F+G, were valued in prices that reflect scarcity values or social opportunity costs. Social profit, like the private analogue, are the difference between revenues and costs, all measured in social prices that is H= (E-F-G), for tradable outputs (E) and tradable inputs (F). In the PAM indicators, the comparative advantage is evaluated by the DRC ratio. For DRC less than one in a particular zone indicates that rice farming enterprise has a comparative advantage in producing local rice using domestic resources. DRC ratio greater than one indicates rice enterprise does not have comparative economic advantage. Thus, it requires particular policy interventions (Monke and Pearson, 1989).

The third row presents the effect of divergences of the accounting matrix concerns with the differences between private and social valuations of revenues, costs, and profit. For each entry in the matrix-measured vertically, any divergence between the observed private price and the estimated social price were explained regarding the effects of policy or by the existence of market failures (Caballero *et al*., 2000). Through PAM methodology, policy effects were estimated by a comparison of the existing levels of private to social revenues, costs, and profit. On the basis of results obtained, important policy indicators were derived relating to private profitability, social profitability (including competitiveness and comparative economic advantage indicators), and policy transfers (protection coefficients).

3.3 Data Processing and Transformation

3.3.1 Data transformation

To facilitate the analysis, a) the paddy equivalent is calculated using the conversion rate of paddy into milled rice (100% paddy to 60% milled rice). This study adopted the conversion ratio used by Caballero *et al.* (2000) and its derived economic parity prices from financial parity prices. b) The amount of all inputs and outputs used were standardised into an acre (Mahoney *et al.*, 2007). c) Determination of social prices for tradable inputs and outputs, the social prices of tradable inputs and outputs were determined by using world price data from different sources in line with Peason *et al.*, (2003). For this reason, this study used opportunity cost methods for estimating world price method for tradable. In this regard the world price approach, the conversion method and the tariff protection method were used to calculate the social price of tradable. The conversion method entails that the world price of goods and services are determined and adjusted with the cost-insurance-and-freight component of imported goods and services. The approach is denoted by the following equation (Nguyen, 2002).

CIFWij = (IntPij + TransCij + Insij) × ExhRij…………………………………………..(9)

Where;

CIFWij = Cost-insurance-freight-value of imports in domestic prices;

IntPij = International market price in US$;

TransCij = Transport cost;

Insij = Insurance;

ExhRij = Exchange rate in local currency/US$;

i = product identification; and

j = year.

Hence the theoretical world price calculations were done and shown in Appendix 6 to 11. However, the analysis has ignored incorporating government support (irrigation scheme construction) mechanisms to each rice farmer using irrigation, considering the infrastructural inputs are indivisible fixed cost for different crop enterprises in different cropping calendar (Monke and Pearson, 1989) d) Determination of social price of factors cost. The services provided by domestic factors of production-labour, capital, and land-do not have world prices because the markets for these services are considered to be domestic.

The social valuation of each factor service is found by estimation of the net income forgone because the factor is not employed in its best alternative use. Therefore, social costs of labour were assumed to be the shadow wage of labour at construction sector which is 5 500 TZS per day based from the labour force survey given by the Chief Government Statistician, Zanzibar (GOZ, 2008). This is because labour is mobile factors that can move from agriculture to other sectors of the economy, such as industry, services, and energy and for that prices are determined by aggregate supply and demand forces. Because alternative uses for these factors are available throughout the economy, the social value of labour is determined at a national level, not solely within the agricultural sector (Gittinger, 1982).

The opportunity cost of land with competitive rental markets, opportunity cost of land would be reflected by the rental value (Mahoney, 2007). Since land under rice production in due season has no alternative/challenger crops. Therefore, the land with such attributes falls below critical land market and ultimately the social cost of such land is value at zero (Mahoney, 2007; Silvia and Pamola, 2004). e) Determination of fixed cost, rice farmers in Zanzibar were observed to use small tools as their fixed assets including hand hoes, bush knives, wheel barrow, blankets and knives. These tools are used until the end of their useful life. Therefore, the salvage value for type of this fixed asset is valued at zero. This calculation is in line with the study by Silvia and Pamola (2014).

The theory used for calculation is a linear depreciation in Equation 10:

$$D = \frac{(Ov - Sv)}{n} \quad \text{...}(10)$$

Where:

D is the annual depreciation, Ov is the original value of the asset, Sv is the salvage or residual value and n is the useful life of an asset expressed in number of years. f) Estimation of shadow exchange rate, this was done in order to derive the economic import parity prices of commodities, estimating the shadow exchange rate is very important. The shadow exchange rate (SER), which is the rate that would have prevailed in the absence of any trade interventions, is defined as the weighted average of the demand price for foreign exchange paid by importers and the supply price of foreign exchange received by exporters (Lagman-Martin, 2004). The shadow exchange rate also reflects the consumption worth of an extra unit of foreign exchange in terms of the domestic currency (Nguyen, 2002). The shadow exchange rate, therefore, can be considered as the opportunity cost of foreign exchange.

Based on the methodology adopted by Gittinger (1982), the general formula used to calculate shadow exchange rate (SER) is presented in Equation 11:

$$SER = \frac{OER}{SCF} \quad \text{...}(11)$$

Where,

SER is the shadow exchange rate,

OER is the official exchange rate,

SCF is the standard conversion factor.

Following the methodology suggested by Lagman-Martin (2004), Goldin (2005) and Jamie and Balcombe (2002), with the assumption that distortions in the domestic market prices are entirely due to tariffs imposed on tradable commodities, the crude approximation of standard conversion factor (SCF) is calculated using the following formula.

$$SCF = \frac{X + M}{(X - t_x) + (M + t_m)} \qquad \text{.....(12)}$$

Where,

X is the total average annual value of exported rice,

M is the total average annual values of imported rice,

tx is the total annual tax on rice exports,

tm is the total annual tax on rice imports.

The data used for estimation of SCF, in this study, was obtained from TRA in which the total volume of imported rice is valued at their world (c.i.f) prices. However, since Zanzibar does not export rice so the value of exports is cancelled, all export taxes (tx) are taken as zero. Using the above information, SCF is estimated as:

$$SCF = \frac{0 + 13\,795\,215.77}{(0) + (13\,795\,215.77 + 1\,290\,948.96)} = 0.91$$

The shadow exchange rate (SER) was then estimated as:

$$SER = \frac{OER}{SCF} = \frac{1\,646.84}{0.91} = 1\,800.94$$

Therefore, the rate used was 1 646.83 TZS per 1 US$ as the mean rate reflecting 2013/2014 cropping season.

3.4 Methods of Data Analysis

3.4.1 Enterprise budgets

In constructing enterprise budgets for use in PAM methodology so as to estimate policy effects on rice production, two important aspects were considered in this study: 1) a price adjustment process to estimate financial and social import parity prices of tradable goods and services, and 2) the use of an appropriate exchange rate to convert international prices to local currencies. The exchange rate constitutes one of the major links between the national and world economies. Other important factors were international prices of tradable, international transport costs, domestic prices and trade policy measures. As stated by Monke and Pearson (1989) and Schumacher (2013), this information is found in the enterprise budget for developing PAM. Other important information used includes rice output, input requirements, and the market prices of inputs and output. The data of transportation costs, processing costs, storage costs, port charges, production/input subsidies, and import tariffs were also used to derive the social prices. In addition, the components of enterprise budgets were entered in PAM in Tanzania shillings per physical unit for yield, tradable inputs and the services provided by domestic factors.

The service provided by domestic factors of production including; labour, capital (for small scale rice farmers capital are referred to financial resources used to buy agricultural implements). The social valuation of each factor service was estimated net income forgone because the factor is not employed in its best alternative use. Therefore, the practice of social valuation of domestic factors began with a distinction between mobile and fixed factors of production in the budgets.

Mobile factors, for this study was capital and labour, considered as the factors that can move from agriculture to other sectors of the economy, such as industry and services where prices were determined by aggregate supply and demand forces. Because alternative uses for these factors are available throughout the economy, the social values of financial resources and labour were determined at a national level. Fixed, or immobile, factors of production were the factors whose private or social opportunity costs were determined within a rice farming sub-sector in Zanzibar. The value of agricultural land, for example, is usually determined only by the land's worth in growing alternative crops. But, for the case of rice farming in Zanzibar and budget construction the social price of land was zero since it has no challenger crops in due season. Considering the land is immobile and its value is not directly affected by events in the industrial and service sectors of the Zanzibar economy. Hence, the social opportunity cost of such farmland under rice farming is difficult to estimate (Schumacher, 2013; Monke and Pearson, 1989).

The enterprise budgets of this study presents a complete set of costs and revenues; input and output activities pertaining to zonal classification, stratification of rice farming condition linked with technological packages of rice farmers so as to ensure representativeness. Furthermore, the budgets also includes various agronomic practices, such as land clearing and preparation, planting, gap filling, weeding, fertilizer application, pest and diseases control, bird scaring and harvesting. All these information was based on 2013/2014cropping season. Detailed descriptions of the study enterprise budgets are shown in Appendix 12 to 37.

3.4.2 Objective 1: To determine technical and socio-economic characteristics that differentiate rice farmers in terms of yield in central north, central south and zone 3 Pemba farming system zones

3.4.2.1 Descriptive analysis

Measures of central tendency and dispersion including arithmetic mean were used to differentiate rice farmers' technical and socio-economic characteristics in terms of rice yield. Following the theory of general production function in Equation 2, the technical and socio-economic characteristics that differentiate yield in low tercile and in high tercile were determined.

3.4.2.2 Statistical test for hypothesis 1:

Low and high yield rice farmers have the same technical and socio-economic characteristics.

Table 4: Description of the social-economic characteristics of rice farmers

Variable	Description
Involvement in farming activities (INVOLV)	For rice farmers whose involvement is full-time in rice farming were expected to be larger proportion in high yield tercile, while larger proportion of rice farmers whose involvement in rice farming is part-time were expected in low yield tercile. Hence, significant P value is expected in high yield tercile to full-time rice farmers.
Education level of rice farmer (EDLEV)	Formal education is assumed to improve awareness on profitability and resource use efficiently towards better rice yield. It is assumed that better educated rice farmers perform better in their production activities. Thus better educated rice farmers are usually considered to be aware and risk taker. On the other hand, it could also be assumed that better educated rice farmers may have variety of off-farm activities which make them not be available fulltime on the farm. Thus an uncertain P value is anticipated.
Access to agric. extension (AGRIEXT)	This can be in two scenarios. On the one hand, large proportions of rice farmers who receive agricultural extension are expected in high yield tercile. On the other hand, large proportion of rice farmers who had no access to agricultural extension was expected in low yield tercile. With these two scenarios therefore, it is possible to predict the P-value to be less than 0.05 to rice farmers with access to extension in high yield tercile.
Age of rice farmer (years) (AGE)	It is assumed that the majority of rice farmers in age category of less than 50 years rice farming were expected to be in high yield tercile. On the other hand, majority of rice farmers in age category of higher than 50 years were expected in low yield tercile. However, majority of young rice farmers have multiple roles, which are likely to hinder their effective participation in rice production activities. While on the other hand older rice farmers are more risk averse because of old age. Thus, an uncertain P value is anticipated.
Gender (Male = 1, Female = 0) (SEX)	Sex of the rice farmer is also important factor for profiling rice yield. In this study, it is assumed that large proportion of female rice farmers were expected in low yield tercile. This is because of the traditions and customs of women in Zanzibar; women have multiple roles in the family with less access to agricultural productive assets than their male counterparts. For this reason, the significant P-value is expected in high yield tercile to male rice farmers.
Years in rice farming experience (FARMEXP)	This variable has three categories, rice farmers with farming experience of less than 10 years were expected to be in low yield tercile. It is assumed that, rice farmers who have more than 20 years in rice farming would have gained knowledge through experience on the work. But will be assumed to have old age. Those with less than 10 years were assumed to be constrained with access to agricultural productive assets. For this assumption, significant P-value was anticipated in high yield tercile to rice farmers in the category of between 11-20 years of rice farming experience.
Value of agricultural asset ownership (ASSET)	Rice farmer with high valued agricultural assets assumed to be in high yield tercile. This is because high valued agricultural assets reflect high income position of rice farmer. Rice farmers with low valued agricultural assets assumed to be in low yield tercile. For this reason, the significant P-value is expected in high yield tercile to rice farmers with high valued agricultural assets.
Main activities performed by rice farmer (MAINACT)	Large proportion of rice farmers whose primary occupation is rice farming were expected in high yield tercile. On the other hand, large proportions of rice farmers who have off-farm activities were expected in low yield tercile. However, having off-farm activities is assumed to be a good reflection of having high production level. If rice farmers have off-farm activities the possibility of using off-farm income to boost rice farming or investing in farm output is higher, other factors remain the same. Abdillahi, (2012) support the idea that rice farmers having other occupation generated extra income to support rice production, leading to increase in yield. Therefore, significant P-value was expected to rice farmers with off-farm activities.

3.4.3 Objective 2: To analyse the competitiveness of rice production under different technological packages in central north, south and zone 3 Pemba

3.4.3.1 Indicators of competitiveness

Hypothesis 2: *There is no zonal competitiveness of rice production under different technological packages*

PAM allows judging the profitability of the crop enterprise based on profit generated at market prices (D) in order to determine whether the enterprise is competitive or non-competitive, the PCR was used following Equation 8. Therefore, competitiveness of rice production under different technological packages were measured by comparing the cost of domestic factors (land, labour, capital and electricity and water) used for rice production with the difference between the gross revenues generated in the rice production and its related tradable inputs (fertilizer, seeds, herbicides and fuel) costs evaluated at market prices.

3.4.4 Objective 3: To analyse the comparative economic advantage of rice production under different technological packages in central north, south and zone 3 Pemba

3.4.4.1 Indicators of comparative economic advantage

Hypothesis 3: *None of the farming system zones has comparative economic advantage in rice production under different technological packages*

The fundamental indicator used to test this hypothesis is the DRC, which is the major indicator of comparative economic advantage. Based on the theoretical formulation of Equation 7, comparative economic advantage of rice production under different technological packages were obtained by comparing the opportunity cost of domestic factors (land, labour, capital and electricity and water) used for rice production with the difference between the gross revenues generated in the rice production and its related tradable inputs (fertilizer, seeds, herbicides and fuel) costs evaluated at their social prices.

3.4.5 Objective 4: To examine the level of protection and policy transfers of the rice sub-sector

3.4.5.1 Indicators of protection

Hypothesis 4: *There are no differences in protection of the rice sub sector across the farming systems zones*

Monke and Pearson (1989) defined several indicators of protection that indicate policy effects on agricultural systems. The best protection indicators used to test hypothesis 4 are: NPC, NPI, EPC, PC and SRP (Pearson *et al.*, 2003; Monke and Pearson, 1989; Beghin and Fang, 2002; Anderson, 2003; and Masters, 2003). These indicators will differ or will not differ depending on how much or what type of coefficient used in rice production process, such that;

Nominal Protection Coefficient on tradable output:

The NPC can differ much with other indicators given that, NPC greater than one indicates that rice sub-sector is not protected in particular farming system zone. To obtain NPC greater than one domestic price of rice output should be greater than socio price of rice output.

$$NPC = \frac{A}{E} = \frac{PQ}{P^{s}Q} \qquad (13)$$

Nominal Protection Coefficient on tradable input:

The NPI is obtained by comparing the value of tradable input evaluated at market prices for certain rice farmers using certain technological package in a particular farming system zone with the value of tradable input evaluated at social prices for the same rice farmers.

Thus, NPI greater than one meaning that the activity is protected, signifying that the market prices of tradable inputs are lower than social prices.

$$NPI = \frac{B}{F} = \frac{\sum_{i=1}^{n} P_i X_i^T}{\sum_{i=1}^{n} P_i^s X_i^T} \text{ ....(14)}$$

Effective Protection Coefficient:

EPC was obtained by comparing the difference between the gross revenues generated in the rice production and its related tradable inputs costs evaluated at their market prices and the difference between the gross revenues generated in the rice production and its related tradable inputs costs evaluated at their social prices. Thus, EPC greater than one meaning that the sub-sector is protected, indicating that the value added at market price is higher than at social price.

$$EPC = \frac{(A-B)}{(E-F)} = \frac{(PQ - \sum P_1 X_1)}{(P^* Q - \sum P_1^* X_1)} \text{ ....(18)}$$

Profitability Coefficient:

The PC is obtained by comparing the private profit with socio profit of a certain rice farmers in the sub-sector. The positive value indicates the activity is protected.

$$PC = \frac{D}{H} = \frac{\left(PQ - \sum_{i=1}^{n} P_i X_i^T - \sum_{j=1}^{m} P_j^s X_j^{NT} \right)}{\left(P^s Q - \sum_{i=1}^{n} P_i^s X_i^T - \sum_{j=1}^{m} P_j^s X_j^{NT} \right)} \text{ ....(16)}$$

Subsidy Ratio to Producers:

The SRP compares gross revenue with social revenue of certain rice farmer in the sub-sector. If the obtained value is greater than one, it indicates that the activity is not protected due to decrease in gross revenue as a share of total social cost.

$$SRP = \frac{L}{E} = \frac{\left(\frac{\left(PQ - \sum_{i=1}^{n} P_i X_i^T - \sum_{j=1}^{m} P_j^s X_j^{NT}\right)}{\left(P^s Q - \sum_{i=1}^{n} P_i^s X_i^T - \sum_{j=1}^{m} P_j^s X_j^{NT}\right)}\right)}{\left(P^s Q\right)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(17)$$

3.4.6 Sensitivity analysis

One of the basic assumptions underlying PAM is the use of fixed input-output coefficients (Gupta, 2004; Pearson *et al.*, 2003). However, coefficients change due to different reasons. Therefore, it should be essential to undertake a sensitivity analysis in order to provide policy makers with sufficient information about the full range of potential outcomes. Even though a full sensitivity analysis gives more indicative results of profitability and competitiveness analysis, it is difficult to handle and usually excluded in most applied economic analysis (Ayalneh, 2002). Hence, it is important to limit the sensitivity analysis to inputs and output coefficients that are considered to be of particular importance. Therefore, based on Gezahegn (2000), Ayalneh (2002) and Nguyen and Heidhues (2014), Fresenbet (2005) and Befikadu (2007), sensitivity analysis will be examined on NPC, EPC, DRC and NPI change, when price of output and tradable inputs as well as the level of output are changed by 5 to 20 percent. In addition, the approach employed in this study is therefore, a partial sensitivity analysis in which changes in the PAM indicators is estimated by varying a single coefficient leaving other coefficients kept at their baseline values.

3.5 Data Required and Sources

This study used two main types of data, namely primary and secondary data. Primary data were first-hand information collected and therefore they were original in character.

While secondary data came from various documentary sources. Both primary and secondary data were found to complement each other.

3.5.1 Primary data

The main data sets obtained from the primary source include:

i. Demographic data: age, sex, education, marital status, particulars of all household members including relationship with household head, sex, age, education, status of their involvement in rice farming, main farm and off-farm activity and years of experience in rice farming of the household head.

ii. Plot characteristics and land use: size, location, ownership, status of use, form of use, area for each form of use.

iii. Agricultural inputs used: seed, fertilizer, herbicides and pesticides (type/variety, quantity used, price per unit and source).

iv. Mechanization services: field operations, timing of operation, source of power, type of labour used and its associated costs.

v. Processing activity: sun drying, storing, milling, bagging and type of labour used.

vi. Transportation costs

vii. Marketing information: sales of rice output

viii. Agricultural assets owned: type, amount, market value

ix. Institutional support: access to credit, access to extension services, access to marketing information.

3.5.2 Secondary data

The types of data obtained from secondary sources were:

i. Rice yield and import: domestic rice production, rice consumption and rice import from 2005 to 2014.

ii. Type of seeds used in Zanzibar: improved and local seeds

iii. Import parity prices: CIF value per metric ton, Exchange rate (TZS/USD), custom declaration, import duty, trade levy, stamp duty, wharfage, clearing charges, transport cost, loading and off-loading (godown) cost, importer's margin, trader's margin and retailer's margin on rice, fertilizers, seeds, herbicides and in Dar es Salaam; weighted average platt's f.o.b, weighted average premium, wharfage, customs processing fee, weights & measure fee, TBS charge, TIPER fee, Actual demurrage cost, surveyor cost, financing cost and warehousing charges for fuel.

3.6 Research Design

3.6.1 Target population and sample size

Four hundred and sixty four rice farmers (464), which accounted for nearly forty six percent of 1 018 target population of rice farmers, were surveyed. During a follow up survey, Nineteen out of 286 Shehias from nine districts of Zanzibar were selected based on the agro-ecological conditions and farming systems of the target area (GOZ, 1995). From each district, a minimum of one and a maximum of three Shehia were selected based on the rice production potential of the area which corresponds to farming system zones. Sample rice farmers were drawn from 19 Shehias in line with Yamane (2001) who provides a simplified formula to calculate sample size in Table 5.

$$n = \frac{N}{1 + N(e)^2} \quad \text{.....(18)}$$

A 95% confidence level and P = 0.5 were assumed for equation 21.

Where:

N = Total number of rice farmers

n = Total number of rice farmers in the sample

e = Level of precision

N_h = Size of the h^{th} stratum

n_h = Sample size of the h^{th} stratum

3.6.2 Sampling design

The study used both probability and non-probability sampling design; non-probability sampling design was used when selecting districts and shehias across farming system zones, while probability sampling was used to draw rice farming households.

Table 5: Sampled rice farmers from target population

District	Shehia	Farming System Zones	Farming Condition Rain fed	Farming Condition Irrigation	Total rice farmers	Sampled rice farmers Rain fed	Sampled rice farmers Irrigation
Kaskazini "A"	Kandwi	CENTRAL ZONE	120	8	128	55	4
Kaskazini "B"	Kibokwa		27	0	27	13	0
	Kisongoni		40	0	40	20	0
	Kilombero		16	0	16	8.0	0
	Kinyasini		53	0	53	25	0
Kati	Koani	CENTRAL SOUTH	14	4.0	18	7.0	2
	Mtwango		21	6.0	27	10	3
	Bumbwisudi		55	11	66	25	5
	Cheju		46	32	78	22	15
Chake chake	Wawi	ZONE 3 PEMBA	31	48	79	12	18
	Tibirinzi		12	38	50	4	14
	Ng'ambwa		8	42	50	3	16
Mkoani	Makombeni		33	61	94	12	23
	Ng'ombeni		23	37	60	9	14
	Uweleni		24	17	41	9	6.0
Wete	Bopwe		5	80	85	2	31
	Limbani		4	70	74	1	26
	Gando		5	74	79	2	28
	Mchanga mdogo		3	51	54	1	19
Total	**19**		**439**	**579**	**1 018**	**240**	**224**

3.6.3 Selection of districts, shehias and rice farmers

This study involves 3 stage sampling with stratification, the first stage involved selection of districts, the second shehias linked with farming system zones and the third stage involves the sampling of rice farming households (Table 5 and 6).

In selecting districts, Kaskazini “A”, Kaskazini “B”, Kati, Chake chake, Mkoani and Wete districts (Fig. 5 and Fig. 6) were selected from ten districts of Zanzibar in order to establish the determinants of competitiveness and comparative economic advantage for rice production. This is due to the reasons explained in section 3.1.3 and 3.1.4. According to 1995 farming system zones classification, the three potential rice production zones namely central north, central south and zone 3 Pemba has large concentration of rice farmers and cut across these six administrative districts compared with other districts (Fig.5 and Fig.6).

In selecting shehia, Kandwi shehia was selected from Kaskazini “A” while Kibokwa, Kisongoni, Kilombero and Kinyasini Shehias were selected from Kaskazini “B” district which corresponds with central north zone. Koani, Mtwango, Bumbwisudi and Cheju were selected from Kati district which matches central south zone. On the other hand, Wawi, Tibirinzi and N’gambwa were selected from Chake chake districts; Makombeni, N’gombeni and Uweleni were selected from Mkoani district and Bopwe, Limbani, Gando and Mchanga mdogo were selected from Wete district all of these Shehias corresponds to zone 3 Pemba. In addition, the reason of selecting these Shehias is the agro-ecological condition and concentration of rice farmers in the area.

In sampling rice farmers, stratified random sampling was employed to select rice farmers for the survey. The criterion used for stratification was based on farming conditions namely irrigation and rain fed, the farming system zones and the use of tradable inputs forming technological packages. Shehias were selected based farming system zones and observed to have many rice farmers than if it could be selected district-wise (Figure 5 and 6). Farming system zones differ in respect to agricultural production potential, rainfall pattern, soil conditions and temperature. Table 5 shows the proportion of sampled rice farmers in each district, Shehia and farming condition where later post stratified in Table 6 according homogeneity on the use of tradable input, farming condition and the farming system zones they exist.

Table 6: Post stratified rice farmers according to farming system zones and technological packages

Rice Production Technology	Farming system zone Central North	 Central South	 Zone -3 Pemba	 n=464
Irrigation, improved seeds and fertilizer (Tech_pack 1)	16	13	92	121
Irrigation, local seeds and fertilizer (Tech_pack 2)	0	0	64	64
Irrigation, Both local and improved seeds only (Tech_pack 3)	0	0	39	39
Rain fed, improved seeds, fertilizer and herbicide (Tech_pack 4)	21	9	0	30
Rain fed and local seeds only (Tech_pack 5)	66	30	34	130
Rain fed Both local and improved seeds with herbicide (Tech_pack 6)	41	18	21	80

Sample rice farmers were randomly drawn from a list of rice farmers available in respective Shehia register. Each name of rice farmer was sequentially written in columns and then given numbers. Sample rice farmers who were given numbers were drawn by systematically picking every third name $\left(\frac{N}{n}\right)$ in irrigation stratum and every second name $\left(\frac{N}{n}\right)$ in rain fed stratum (Table 5). Random selection of rice farmers was done separately for each Shehia. The use of stratified random sampling was advantageous in this study because it ensure the inclusion, for example rice farmers who use irrigation in Mtwango and Koani shehias would have omitted by other sampling methods because of their relatively fewer number in the population. Data obtained from questionnaire and checklist was used to make post stratification of average rice farmers with their technological packages. Rice farmers according to their technological packages were then posted into financial and economic enterprise budgets.

3.6.4 Data collection instruments

A structured questionnaire was used to collect primary data from rice farmers. The questionnaire was designed to capture both qualitative and quantitative data from the respondents. The questionnaire (Appendix 59) was made up of five main sections. The first section was designed to collect household characteristics. The second section covered characterization of land and agronomic practices, while the third section dealt with the transportation and institutional support. The information on processing and storage aspects was recorded in section four. The final section was designed to capture information on marketing. The collection of information from the key stakeholders was carried out through the use of a checklist of questions (Appendix 60). The collected data from the selected institutions and importers were processed and used in PAM estimation.

3.6.5 Data collection

Primary data on rice farming activities were collected from January to April, 2015. The questionnaire was administered once per sampled rice farmer to capture the information of rice production during 2013/14 cropping season in line with Monke and Pearson (1989). In each selected Shehia, a team of 20 enumerators 10 in Unguja and 10 in Pemba plus agricultural officer and a local leader assisted the researcher. For the purpose of ensuring enumerators understand clearly the objectives of the study and able to administer the questionnaire, adequate group training was provided prior to starting the interviews. After training the questionnaire pre-testing was conducted in two shehias;

namely Kibonde mzungu and Kwarara. The pre-testing provided the enumerators with the confidence and familiarize with the questionnaire before the actual survey.

The actual interviews were conducted at farmsteads with rice farmers. Time of the interview to each rice farmer did not exceed 25 minutes. During the survey operations, local leader and agricultural extension officer were around to make sure the enumerators reach the respondents' farm plots. The respondents were interviewed once and their responses were recorded directly. All interviews were conducted in Kiswahili, which is well understood by both enumerators and respondents. In the discussions with key informants, the researcher and his assistant used the checklists to capture information. These discussions were held at the interviewees' offices.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Socio-economic characteristics and production technologies that differentiate rice farmers in terms of yield performance

The technical and socio-economic characteristics are assumed to affect rice farming households, either by increasing or decreasing yield performance. However, rice farmers evaluate their production capacity based on the influence and assistance offered by supporting institutions.

4.1.1 The distribution of sampled rice farmers by farming system zones

Majority of rice farmers in all zones believe that the support provided by the government includes mechanization services and subsidies are the outward expressions of their own character and competence. The percentage of rice farmers by production technologies and farming system zones are shown in Table 7. The results in Table 7 indicate that 76 percent of the rice farmers using tech_pack1 fall under zone-3 Pemba with an average yield of about 2600 kg/acre followed by 13 percent in central north with an average annual yield above 2800 kg/acre. However, the highest average annual yield was observed in central south farming system zone.

Rice farmers using tech_pack 2 and 3 were only found in zone-3 Pemba with an average annual yield above 1 590 kg/acre and 768 kg/acre respectively Table 7. Nevertheless, the distribution of rice farmers using tech_pach 4 in central north were almost two times higher than rice farmers in central south using same technology. The results in Table 7 observed a slight difference in average annual yield in central north and central south farming system zones. Likewise, the percentage of rice farmers using tech_pack 5 were

51 percent in central north which is nearly two times higher than the percentage of rice farmers in central south and zone-3 Pemba in the same production technology. The average annual yield obtained from all three farming system zones by rice farmers using tech_pack 5 were below 140 kg/acre. This finding indicates that this type of technological package has the least production level across all zones. However, the sampled rice farmers using tech_pack 6 their average annual yield was below 380 kg/acre across all farming system zones.

4.1.2 Description of rice farmers' technological packages on rice yield

Rice production technologies used in this study involves the use of inputs at different agronomic practices at various growth stages (Appendix 2). The main identified technological packages for rice production in the study areas include; using 1) irrigation, improved seeds, and fertilizer (tech_pack 1), 2) irrigation and local seeds and fertilizer (tech_pack 2), 3) irrigation and mixed varieties only (tech_pack 3), 4) rain fed, improved seeds, fertilizer and herbicides (tech_pack 4), 5) rain fed and local seeds only (tech_pack 5) and 6) rain fed, mixed variety and herbicides (tech_pack 6). Three technological packages are used in all three farming system zones, namely; 1) irrigation, improved seeds and fertilizer (tech_pack 1), 2) rain fed and local seeds only (tech_pack 5) and 3) rain fed, mixed variety of seeds and herbicides (tech_pack 6).

Table 7: Distribution of rice farmers' technological package by farming system zones

Rice production technology		Farming System Zones: Central North	Central South	Zone-3 Pemba	All
Irrigation	Tech_pack 1	13 (16)	11 (13)	76 (92)	100 (121)
	Average annual rice yield (kg/acre)	2 798	3 092	2 600	2 680
	Tech_pack 2			100 (64)	100 (64)
	Average annual rice yield (kg/acre)			1 590	1 590
	Tech_pack 3			100 (39)	100 (39)
	Average annual rice yield (kg/acre)			768	768
Rain fed	Tech_pack 4	70 (21)	30 (9)		100 (30)
	Average annual rice yield (kg/acre)	647	658		650
	Tech_pack 5	51 (66)	23 (30)	26 (34)	100 (130)
	Average annual rice yield (kg/acre)	100	92	231	133
	Tech_pack 6	51 (41)	23 (18)	26 (21)	100 (80)
	Average annual rice yield (kg/acre)	340	416	423	379
Total		**31 (144)**	**15 (70)**	**54 (250)**	**100(464)**

Figures in parentheses are frequencies

Two technological packages; tech_pack 2 and 2) tech_pack 3 were observed only to rice farmers in zone-3 Pemba, as well as rice farmers using tech_pack 4 were not identified in zone-3 Pemba. However, only rice farmers using tech_pack 1 in central north and central south farming system zones found to conforms to the recommendations in Appendix 1. Even though, the knowledge of rice production technological packages does not guarantee the positive influences on rice production. This is could be due to the existence of social and economic barriers. In this regards, the following sections describe socio-economic characteristics and technological packages that differential rice farmers' yield levels.

Rice is a hydrophilic plant, thus adequate water supply is the first priority for rice production (Bernstein, 2014). Among all inputs, varietal selection attracts more attention of the farmers since this activity is important to initiate rice production enterprise; additionally rice farmers in the study area were aware on the importance of applying chemical fertilizer. Overall, more than 90 percent of rice farmers using tech_pack 1 fall under high yield category while rice farmers under the same category were less than 5 percent in medium yield category (Table 8). The survey result indicates that majority of rice farmers (56 percent) using tech_pack 2 fall under medium yield category. This implies that almost half of the rice farmers used non-recommended seed have low productivity given that local seed has low response to productive inputs.

Table 8: Rice Yield by Type of Technological Packages

	Rice yield terciles (kg/acre)			
	Low (n=155)	**Medium (n=155)**	**High (n=154)**	**All (n=464)**
Mean Yield (kg/acre)	122	502	1288	636
Standard Deviation (kg/acre)	76	139	301	523
Median (kg/acre)	120	480	1200	480
Technological factors				
Tech_pack 1(% of HH)	0	4.1	95.9	100
Tech_pack 2(% of HH)	3.1	56.3	40.6	100
Tech_pack 3(% of HH)	28.2	69.2	2.6	100
Tech_pack 4(% of HH)	0	66.7	33.3	100
Tech_pack 5(% of HH)	86.2	13.8	0	100
Tech_pack 6(% of HH)	37.5	61.3	1.3	100

The results in Table 8 show that among the identified technological packages, Rice farmers using tech_pack 5 were 86.2 percent in low yield category. However, large proportions (69 percent) of rice farmers using tech_pack 3 fall under medium yield category. But very few were (3 percent) observed in high yield category. The proportion of rice farmers using tech_pack 4 were relatively higher (67 percent) in medium yield category than rice farmers using tech_pack 2. This finding gave an indication that, water in combination with other inputs has crucial effects on rice production and productivity.

4.1.3 Description of rice farmers' socio-economic characteristics on rice yield

Socio-economic characteristics of rice farmers in the study includes; level of education, sex of respondent, involvement in rice farming activities, primary occupation of rice farmer, age of rice farmer, years in rice farming, value of agricultural asset owned and access to agricultural extension. The result in Table 9 shows that rice farmers having no formal education are higher in high yield category than those attained formal education. Age of rice farmers as well as the number of years in rice farming was also found to have no difference in low, medium and high yield category. This finding is in line with the results obtained by Igbiji *et al.* (2015) and Nwinya *et al.* (2014). Formal education of rice farmers were not an important factor with rice yield and productivity. But with educational qualification of rice farmers bore positive increase in yield. This is also in line with the results obtained by Igbiji *et al.* (2015). But it is contrary with Anigbogu and Agbasi (2015).

Sex of the rice farmers and rice yield found to have significant value in high yield tercile (p value 0.047). The proportion of male rice farmers in high yield tercile is higher (37 percent) than in medium and low yield terciles, while the proportions of female rice farmers is higher in the medium and low yield terciles. These results are in conformity with the findings obtained by Igboji *et al.* (2015), Anigbogu and Agbasi (2015), Ayoola *et al.* (2011), Nwinya *et al.* (2014), Lawal *et al.* (2013a) and Okoi *et al.* (2014). It is also indicated in Table 9 that a large proportion (45 percent) of part-time rice farmers found in low yield tercile. However, the proportion of full-time rice farmers in high yield tercile is nearly two times higher than full-time rice farmers in medium and low yield terciles respectively. This finding implies that recommended technological packages for rice production in Zanzibar need serious commitment ($P<0.000$).

Table 9: Description of rice farmers' socio-economic characteristics on rice yield

	n	Rice yield terciles Low	Medium	High	All
Socio-economic factors					
Education Level					
No formal education (% of HH)	112	33	30	37	100
Primary education and above (% of HH)	342	34	35	32	100
		Chi square 1.169 df 2 p-value 0.557			
Sex of HH					
Male (% of HH)	308	32	31	37	100
Female (% of HH)	156	36	38	26	100
		Chi square 6.097 df 2 p-value 0.047			
Farming occupation					
Full-time on farm (% of HH)	171	14	29	57	100
Part-time on farm (% of HH)	293	45	36	19	100
		Chi square 77.017 df 2 p-value 0.000			
Primary occupation					
Crop farming (% of HH)	162	25	27	48	100
Off-farm activities (% of HH)	302	38	37	25	100
		Chi square 25.173 df 2 p-value 0.000			
Age in years					
Below 50 (% of HH)	222	32	35	33	100
Above 50 (% of HH)	242	35	32	33	100
		Chi square 0.469 df 2 p-value 0.791			
Farming experience (years)					
Below 10 (% of HH)	139	33	36	31	100
11-20 (% of HH)	174	30	30	40	100
Above 20 (% of HH)	151	38	35	27	100
		Chi square 7.021 df 4 p-value 0.135			
Value of agric. assets owned (TSH)					
Less than 100,000 TZS (% of HH)	290	45	37	18	100
Above 100,000 TZS (% of HH)	174	14	28	58	100
		Chi square 84.851 df 2 p-value 0.000			
Access to agricultural extension					
Have access to extension (% of HH)	310	28	34	38	100
No access to extension (% of HH)	154	43	32	25	100
		Chi square 12.249 df 2 p-value 0.002			

The results in Table 9 also show the proportion of rice farmers engaged in crop farming as their primary occupation were nearly 2 times larger in high yield tercile than in the medium and low yield terciles respectively. Rice farmers who had off-farm activities as their primary occupation were relatively larger in low yield tercile; the identified off-farm activities were livestock keeping, fishing, civil service, trading and private sector engagement. These findings imply that rice farmers with less productivity level have off-farm activities which made them to be less effective on rice production. Nevertheless, the rice farmers using productive technological packages were assumed to be engaged fully on crop farming as their primary occupation (P<0.000).

Majority of rice farmers with the value of agricultural assets less than 100 000 TZS in low yield tercile were nearly 3 times higher than rice farmers in high yield tercile. The converse holds true for the case of rice farmers who had agricultural assets of above 100 000 TZS. The result as well shows the percentage of rice farmers in the high yield tercile is nearly 4 and 2 times higher than farmers in low and medium yield terciles respectively. The findings indicate that rice farmers with agricultural assets above 100 000 TZS adopted a set of productive technological packages are linked with high yield tercile (95 percent) in Table 8. The value above 100 000 TZS is 58 percent in high yield tercile which is significant at P<0.000.

Regarding access to agricultural extension services, the majority of rice farmers (43 percent) in the category without access to extension are found in low yield tercile. The contrary holds true for the case in the category with access to extension services are found in high yield tercile which is 38 percent (P<0.000).

4.2 Competitiveness, Comparative Economic Advantage and Level of Protection and Policy Transfers for Central North

Out of six identified technological packages, four were observed to have been used by rice farmers in this zone; including rice farmers using tech_pack 1, 4, 5 and 6. Each technological package exported into PAM for ratio estimation, protection and policy transfers. PRC and DRC are the main used indicator of competitiveness and comparative economic advantage of rice production.

4.2.1. Competitiveness of rice production under different technological packages in central north farming system zone

The result from Table 10 shows that the highest private profit was observed to rice farmers using tech_pack 1 measured by private prices. Rice farmers using tech_pack 1 in this zone are then competitive than other using tech_pack 4, 5 and 6 (Table 10). PCR was evaluated at 0.23 and 0.95 for rice farmers using tech_pack 1 and Tech_pack 4 respectively, implying a high profitability level for the activity found to rice farmers using technological package 1. Though, the rice farming using tech_pack 4 has recorded low private profit as well as relatively higher private cost ratio, which imply the low profitability level for the technological package in particular.

Rice farmers using tech_pack 5 and 6 in this zone recorded negative financial profitability. In sum, the private profitability indicators, being the results of the sum of outcomes of farm profit indicates that under existing policies, the rice production activities using tech_pack 1 and tech_pack 4 are competitive and that are making positive financial gains. It can therefore be expressed that sampled rice farmers in the central north farming system zone using tech_pack 1 are more competitive.

4.2.2 Comparative economic advantage of rice production under different technological packages in central north farming system zone

Positive economic profit of 64 634.88 TZS per acre were observed for rice farmers using tech_pack 1 compared to a negative economic profit per acre for the remaining average rice farmers (Table 10). The remuneration of the domestic factor costs per acre for farmers using tech_pack 4, 5 and 6 exceeds the value added per acre by more than 100 percent when computed at social prices, Nevertheless, in all other cases DCR is below one for the observed average rice farmers using tech_pack 1, pointing to the ability of this specific farming technology to create value for the growers and also to add to the national income at social prices.

Table 10: Competitiveness, Comparative Economic Advantage, Transfers and Policy indicators in Central North Farming System Zone

Indicators/transfers	Tech_pack 1	Tech_pack 4	Tech_pack 5	Tech_pack 6
Competitiveness				
Private Profit	2 192 410.23	14 453.60	-331 324.39	-210 673.83
PCR	0.23	0.95	1.86	3.18
Comparative economic advantage				
Social Profit	64 634.88	-1 574 870.99	-1 876 681.52	-3 135 358.52
DRC	0.97	5.97	130.9	25.0
Transfers				
Output transfers	559 600.00	64 700.00	30 000.00	102 000.00
Tradable inputs	-45 015.85	61 635.41	131 608.77	136 132.01
Non-tradable inputs	-1 523 159.50	-1 586 260.00	-1 646 965.90	-2 958 816.70
Net policy transfers	2 127 775.35	1 589 324.59	1 545 357.13	2 924 684.69
Protection				
NPC	1.22	1.11	1.33	1.33
NPI	0.84	1.23	2.26	1.78
EPC	1.27	1.01	8.14	0.74
PC	33.91	-0.01	0.18	0.07
SRP	0.84	2.73	17.17	9.56

DRC ratio of less than one for rice farmers using tech_pack 1 implies that the value added (the difference between the gross revenues generated by the activity and its related tradable inputs costs evaluated at their social prices) generated by rice farmers is higher than the opportunity cost of domestic resources used in the rice production. Thus, it constitutes an economic activity that uses domestic resources efficiently.

4.2.3 Level of protection and policy transfers of the rice sub-sector in central north farming system zone

The summary results in Table 10 give positive values for the net policy transfers for outputs in all technological packages, and negative tradable input transfers only in tech_pack 1. Likewise, PAM results show that the net policy transfer indicators are positive per acre in all technological packages. These constitute clear indications that the private profit for the observed average rice farmers are higher than the social profit, suggesting that the market prices for outputs were higher than their comparable world prices, indicating an implicit tax of the outputs. Since the net policy transfers are also an indication of the sum of the system's output transfer, tradable inputs transfer, and non-tradable inputs transfer, the positive net policy transfers therefore also mean that the overall policy transfers for tradable input are positive except in tech_pack 1. This implies a diversion of resources away from the system except in tradable input for rice farmers using technological package 1.

Nominal Protection Coefficient of output found to be greater than one to all sampled rice farmers across all technological packages (Table 10) which implies that domestic output price is greater than the world reference price. Similarly, the NPI for tech_pack 4, 5 and 6 are greater than one, implying that they receives an implicit subsidy of 23, 126 and 78 percent for the use of tradable inputs respectively.

The EPC figures are greater than one in all technological packages except for rice farmers using tech_pack 6. As the EPC is less than one, indicating that the value added at market prices for these technological packages were less than what the value added would be at reference prices. In other words, when all the effects of policies on rice output and input markets are considered, it can be seen that the value added, evaluated at market prices, is less than what it would be in the absence of these policy effects. Furthermore, on average, the policy effect is not accurately applicable for the observed rice farmers using tech_pack 5 due to its attributes (Appendix 2). Thus, the reality reveals that producers using tech_pack 1 and 4 are protected, while EPC is less than one for rice farmers using tech_pack 6 signifying that, they are not protected which could be due to its attributes.

The Profitability Coefficient is also used as a proxy measure of the net policy transfer. The PC for the rice farmers using tech_pack 4 recorded negative value. Indicating that, in most cases the private revenues are higher than the revenues evaluated at reference prices. The observed PC values suggests a negative net transfer payment for technological package 4, and a positive net transfer payment for the observed rice farmers using tech_pack 1, 5 and 6.

Subsidy Ratio to Producers in Table 10 indicated the net policy transfer as a share of the total social revenues which stood at 84 for rice farmers using tech_pack 1. Other remaining four technological packages have indicated SRP values of greater than one. This suggests that there was a decrease in gross revenue. If market failures were not an important component of the divergences, the SRP shows the extent to which a system's revenues have been increased or decreased because of policy.

4.3 Results from PAM Estimation for Central South Farming System Zone

In this zone only four technological packages were observed to be used by rice farmers; each technological package was extracted from relative enterprise budget which was then exported into PAM ratio estimation, protection and policy transfers for each technological package used. Primary estimation of competitiveness and comparative economic advantage of rice production used were PRC and DRC respectively.

4.3.1 Competitiveness of rice production under different technological packages in central south farming system zone

Further analysis of competitiveness for rice production was also carried out in central south farming system zone. The result shows that, rice production is an activity which generates positive financial profit in all technological packages used except for rice farmers using tech_pack 5. However, the result in Table 11 indicates that rice farmers using tech_pack 1 was more profitable than others. At the margin, positive private profit for rice farmers using tech_pack 4 and 6 were observed. This can further be confirmed from their PCR values less than one in Table 11.

Table 11: Competitiveness, Comparative Economic Advantage, Transfers and Policy Indicators in Central South Farming System Zone

Indicators/transfers	Tech_pack 1	Tech_pack 4	Tech_pack 5	Tech_pack 6
Competitiveness				
Private Profit	2 441 646.01	297 262.10	-307 814.70	49 008.40
PCR	0.20	0.36	2.31	0.86
Comparative economic advantage				
Social Profit	659 198.09	-1 322 941.66	-2 037 457.69	-2 135 580.89
DRC	0.73	5.55	78.02	10.72
Transfers				
Output transfers	618 400.00	197 400.00	55 200.00	249 600.00
Tradable inputs	-26 953.43	23 951.84	122 417.31	126 977.41
Non-tradable inputs	-1 137 094.50	-1 446 755.60	-1 796 860.30	-2 061 966.70
Net policy transfers	1 782 447.93	1 620 203.76	1 729 642.99	2 184 589.29
Protection				
NPC	1.22	1.33	1.67	1.67
NPI	0.93	1.08	2.13	1.82
EPC	1.27	1.60	3.61	1.56
PC	3.70	-0.22	0.15	-0.02
SRP	0.64	2.74	20.89	5.83

On the contrary, rice farmers using tech_pack 5 were unprofitable and lack competitiveness, this is due to negative profitability and PCR greater than one. In General, the private profitability indicators, being the results of the sum of outcomes of farm profit indicates that under existing policies, the rice production activities using tech_pack 1 are competitive and that farmers are making the highest positive financial gains followed by rice farmers using tech_pack 4 and tech_pack 6. Therefore, only rice farmers using tech_pack 5 were financially unprofitable in this farming system zone.

4.3.2 Comparative economic advantage of rice production under different technological packages in central south farming system zone

The result indicates a negative social profit for rice farmers using tech_pack 4, 5 and 6 and positive value for rice farmers using tech_pack 1 (Table 11). This implies that rice farmers using tech_pack 1 in central zone utilize domestic resources efficiently in the production of rice, and that the farming system generates social profit at the margin. There was however, a positive divergence between private and social profit in all technological packages except tech_pack 5 due to some missing attributes possessed by this package.

Table 11 shows that the economic profitability indicator is less than one for rice farmers using tech_pack 1. The DRC ratio of less than a unit indicates that, the locally produced rice using this package is economically profitable. Which imply that, the remuneration of domestic factor costs per acre for rice farmers using tech_pack 1 does not exceed the value added per acre, which create value for growers and also to the national income. However, DRC for rice farmers using tech_pack 4, 5 and 6 are significantly greater than one, pointing to the comparative economic disadvantage. Implying that the value added generated by rice farmers is lower than the opportunity cost of domestic resources used in the rice production.

4.3.3 Level of protection and policy transfers of the rice sub-sector in central south farming system zone

PAM results show that output transfer and net policy transfer are positive per acre to rice farmers on tradable inputs and non-tradable inputs use (Table 11). These constitute clear indications that the private prices on outputs are higher than the reference world prices, while the opportunity cost of using domestic factors are higher than in domestic rice production, the world reference price of tradable input are higher than the observed market price as well. It implies that, this zone receives subsidy on using tradable inputs.

The summary of ratios of protection coefficient of rice production in central south farming system zone found in Table 11 shows that, NPC values greater than one were observed from all rice farmers in this zone. The results indicates that policies are increasing the market price to a level of approximately 22, 33, 67 and 67 percent below the world price for the rice farmers using tech_pack 1, 4, 5 and 6 respectively. This indicates production in the various technological packages is not protected by policy and that substantial output tax applies. NPI indicated that, NPI values are less than one for rice farmers using tech_pack 1. Signifying that the input cost are lower than the world reference price. Therefore, the cost of tradable inputs are found to be lower than the world prices by 7, percent for tech_pack 1, implying that there are subsidy for the use of tradable inputs.

The EPC indicates the degree of protection accorded to the value added process had values greater than unit for rice farmers using tech_pack 1, 4 and 6, implying that producers were protected by 27, 60 and 56 percent respectively. Likewise, rice farmers using tech_pack 5 recorded extreme values. Indicating deficiency on package attributes. PC shows a mixed indication on net transfers. Whereas negative net transfers are observed for rice farmers using tech_pack 4 and 6, while positive net transfer are observed to rice farmers using tech_pack 1 and 4. The observed PC with negative values indicate a negative net transfer payment while a positive value a positive net transfer payment.

The SRP values are greater than one for tech_pack 4, 5 and 6. This implies that there is a decrease in gross revenue if a market failure is not an important component of the divergences. SRP value for rice farmers using tech_pack 1 shows that the net policy transfers as a share of the total social revenues are at 64 percent.

4.4 Results from PAM Estimation for zone-3 Pemba

Out of six identified technological packages, zone-3 Pemba have five namely; tech_pack 1, 2, 3, 5 and 6. Rice farmers using tech_pack 1, 2 and 3 were using irrigation technologies, while 5 and 6 rain fed technologies.

4.4.1 Competitiveness of rice production under different technological packages in zone-3 Pemba farming system zone

The study result in Table 12 indicates that rice farming is competitive in the areas covered by irrigation. However, the analysis per technological package shows that rice farmers using tech_pack 1, 2 and 3 are competitive. The negative private profit observed to rice farmers using tech_pack 5 and 6. With regard to these results, most of rice farmers in

Pemba are financially profitable. This is because majority of rice farmers are located in swampy areas. Nevertheless, Pemba receives more precipitation and tends to be wet all year around than Unguja (Krain, 1998).

The PCR in Table 12 indicates that all irrigated technological packages were less than one. PCR being the indicator of the sum of outcomes of farm profit indicates that under existing policies, the rice production activities in zone-3 Pemba by using tech_pack 1, 2 and 3 are competitive and that rice farmers earned positive return. Conversely, rice farmers using tech_pack 5 and 6 are unprofitable and lack competitiveness due to their negative profitability and PCR greater than one.

Table 12: Competitiveness, Comparative Economic Advantage, Transfers and Policy indicators in Zone-3 Pemba Farming System Zone

Indicators/transfers	Tech_ pack1	Tech_ pack2	Tech_ pack3	Tech_ pack5	Tech_ pack6
Competitiveness					
Private Profit	1 938 495.29	1 011 123.00	225 856.73	-358 389.70	-159 214.93
PCR	0.24	0.35	0.70	4.60	1.47
Comparative economic advantage					
Social Profit	-762 055.21	-1 151 932.62	-1 625 322.78	-2 612 242.21	-2 432 251.14
DRC	1.40	1.96	3.56	23.42	12.80
Transfers					
Output transfers	260 000.00	159 000.00	74 800.00	69 300.00	126 900.00
Tradable inputs	-213 308.40	-193 566.32	-35 083.51	86 378.19	-5 411.61
Non-tradable inputs	-2 227 242.10	-1 810 489.30	-1 741 296.00	-2 270 930.70	-2 140 724.60
Net policy transfers	2 700 550.50	2 163 055.62	1 851 179.51	2 253 852.51	2 273 036.21
Protection					
NPC	1.10	1.11	1.11	1.33	1.33
NPI	0.19	0.17	0.08	1.95	0.97
EPC	1.23	1.29	1.17	0.85	1.64
PC	2.54	0.88	-0.14	-0.14	-0.07
SRP	1.15	1.51	2.75	8.13	5.97

4.4.2 Comparative economic advantage of rice production under different technological packages in zone-3 Pemba farming system zone

In zone-3 Pemba, economic profitability estimated by DRC are found to be greater than one for all rice farmers using tech_pack 1, 2, 3, 5 and 6; this indicates that the locally produced rice is economically unprofitable. Likewise, negative social profitability indicates inefficient farming enterprise that would necessarily require some interventions to remain in activity. Following the same logical reasoning, the rice farmers recorded negative economic profit per acre (Table 12).

The remuneration of the domestic costs per acre for rice farmers using tech_pack 1 and 2 exceeds the value added per acre by 40 and 96 percent and extreme values recorded for rice farmers using tech_pack 3, 5 and 6 when computed at social prices. This is explained by the fact that all rice farmers in zone 3 Pemba are economically unprofitable in producing rice. Table 12 shows that DRC ratio is greater than one for rice farmers in zone 3 Pemba, which implies that value added generated by rice enterprise is lower than the opportunity cost of domestic resources used in the rice production. Thus, it constitutes an economic activity that utilizes domestic resources inefficiently.

4.4.3 Level of protection and policy transfers of the rice sub-sector in zone-3 Pemba farming system zone

The study result in Table 12 shows the net policy transfer values are positive in all five identified technological packages. The transfer indicators are negative per acre for using tradable inputs except for rice farmers using tech_pack 5 and negative for domestic factors. These constitute clear indications that the private prices for the use of tradable inputs and factor cost are less than the world reference prices and opportunity cost of using domestic factors, suggesting that the system is under subsidy.

Table 12 presents the summary of ratios of protection for rice production in zone-3 Pemba. The Table shows that NPC values identified for rice farmers in all technological packages are greater than a unit. Indicating that policy are increasing the market price of output to a level of approximately 10, 11, 11, 33 and 33 percent above the world reference price for tech_pack 1, 2, 3, 5 and 6 respectively. This imply that rice productions using tech_pack 1, 2, 3, 5 and 6 in zone-3 Pemba are not protected by policy and implicit tax applied on rice output. The EPC which exposes the degree of protection accorded to the value added process also have values greater than one for tech_pack 1, 2, 3, and 6 and value less than one for rice farmers using tech_pack 5. Similarly, NPI values less than one imply that input costs for using tech_pack 1, 2, 3 and 6 are lower than the world reference price indicating the system is under subsidy on using tradable inputs.

Based on indicators in Table 12, the cost of tradable inputs found to be lower than the world prices by 81, 83, 92, and 3 percent for rice farmers using tech_ pack1, 2, 3 and 6. The PC shows negative net transfers for farmers using tech_pack 3, 5 and 6. The observed PC with negative values indicates a negative net transfer payment while the PC with positive values indicates a positive net transfer payment in respective technological packages. The highest profitability coefficient is 2.54 indicating policy transfers have permitted profit two times greater than social profit.

All five identified technological packages have indicated SRP values greater than one. This implies that there is a decrease in gross revenue. If market failures are not an important component of the divergences, the SRP shows the extent to which a system's revenues have been increased or decreased because of policy. In this zone, SRP value for rice farmers shows that the net policy transfer as a share of the total social revenues stood at more than 100 percent.

Furthermore, the study embarked on sensitivity analysis under two assumptions. Following Ogbe *et al.* (2011), the analyses are conducted to test whether the result will be affected by changing 5 to 20 percent increase or decrease in the costs of tradable inputs, world price of output and level of output produced in Central North and Central South and in zone-3 Pemba farming system zone.

4.3 Sensitivity Analysis for Different Scenarios

The ratios estimated under the set of baseline assumptions are slightly affected by changes in the values of key coefficients. Therefore, it is important to ascertain whether the results are likely to be affected by probable future changes in these coefficients.

4.3.1 Scenario I: Change in world prices of output for central north farming system zone

In this scenario, assuming other parameters remain constant, the impact of change in the price of outputs on the protection level and comparative advantage coefficients of rice production in four identified technological packages were investigated. In this zone, two simulations, a 20 percent increase and/or decrease in price of outputs, cost of tradable inputs and the level of outputs had been undertaken to make comparison with the baseline scenario.

Table 13: Sensitivity of PAM indicators due to change in world prices of output for central north

	NPC	EPC	DRC	NPI
Tech_pack 1				
Baseline values	1.22	1.27	0.97	0.84
20% Increase	1.02	1.03	0.79	0.84
20% Decrease	1.53	1.64	1.26	0.84
Tech_pack 4				
Baseline values	1.11	1.01	5.97	1.23
20% Increase	0.93	0.74	4.43	1.23
20% Decrease	1.39	1.53	9.10	1.23
Tech_pack 5				
Baseline values	1.33	-8.14	130.9	2.26
20% Increase	1.11	-2.34	37.65	2.26
20% Decrease	1.67	5.51	88.64	2.26
Tech_pack 6				
Baseline values	1.33	0.74	25.00	1.78
20% Increase	1.11	0.53	17.83	1.78
20% Decrease	1.67	1.25	41.82	1.78

Table 13 shows that a 20 percent increase in the price of rice resulted in a decrease in NPC from 1.22 (the baseline scenario) to 1.02 (16.4 percent), 1.11 (baseline) to 0.93 (16.2 percent), 1.33 (baseline) to 1.11 (16.5 percent) and 1.33 (baseline) to 1.11 (16.5 percent), for technological package 1, 4, 5 and 6 respectively. In other words, rice farming from central north was slightly taxed on their rice output and the tax rate is estimated to be reduced by 16.4, 16.2, 16.5 and 16.5 percent, respectively. On contrary, the value of NPI remains unchanged.

Moreover, a 20 percent rise in price resulted in declining in EPC for rice farming by using technological package 1, 4, and 6 from 1.27, in the base line scenario, to 1.03 (18.9 percent), 1.01 (baseline) to 0.74 (26.7 percent) and 0.74 (baseline) to 0.53 (28.4 percent) respectively, implying that the implicit tax on output and tradable inputs was increased by 18.9, 26.7, and 28.4 percent respectively. As to the DRC ratio, a 20 percent increases in world prices reduced the DRC values of rice farming by using technological package 1, 4, 5 and 6 from 0.97 (base line scenario) to 0.79, 5.97 (baseline) to 4.43, 130.9 (baseline) to 37.65 and 25.0 (baseline) to 17.83 respectively, implying that the comparative advantage of rice production in this zone could be improved by such modification. Conversely, if the world price is reduced by 20 percent, the DRC value increases implying that the comparative advantage deteriorates. Particularly, in rain fed technologies, the DRC values are greater than a unit, implying that production of rice domestically by reducing 20 percent world price will not favour rice farmers in this zone.

4.3.2 Scenario II: Change in the cost of tradable inputs for central north

The current subsidy rate of tradable inputs in Zanzibar is estimated at about 80 percent less the market price (GOZ, 2015). Thus, the study used a subsidy rate from 5-20 percent in the calculations of sensitivity analysis which is in line with (Benin *et al.*, 2012). With this background, in this scenario, a 20 percent increase in cost of tradable inputs was used to analyze the sensitivity of such changes in policy indicators for this zone.

The result of the sensitivity analysis, as presented in Table 14 shows that the change in the cost of tradable inputs doesn't have direct effects on NPC ratio as a result the NPC values were unchanged. In contrast, the NPI, EPC and DRC ratios vary from the base line values. Thus , a 20 percent increase in the cost of tradable inputs in technological package 1, 4, and 6 resulted in an increase in EPC from 1.27, in the base line, to 1.30 (2.31 percent), from 1.01 (baseline) to 1.18 (16.8 percent) and 0.74 (baseline) to 0.93 (25.7 percent) respectively. These results imply that the implicit tax on rice production in this zone was decreased by 2.31, 16.8 and 25.7 percent respectively. As to NPI values, a 20 % increase in tradable inputs in technological package 1, 4, 5 and 6 resulted in a decrease in NPI from 0.84, in the baseline, to 0.70 (16.67 percent), 1.23 (baseline) to 1.03 (16.3 percent), 2.26 (baseline) to 1.89 (16.4 percent) and 1.78 (baseline) to 1.45

(18.5 percent) respectively, implying that rice farmers in this zones received an increase in implicit taxes ranging between 16 to 18 percent.

Table 14: Sensitivity of PAM indicators due to change in price of tradable inputs for central north

	NPC	EPC	DRC	NPI
Tech_pack 1				
Baseline values	1.22	1.27	0.97	0.84
20% Increase	1.22	1.30	0.99	0.70
Tech_pack 4				
Baseline values	1.11	1.01	5.97	1.23
20% Increase	1.11	1.18	6.98	1.03
Tech_pack 5				
Baseline values	1.33	-8.14	130.9	2.26
20% Increase	1.33	6.37	102.52	1.89
Tech_pack 6				
Baseline values	1.33	0.74	25.0	1.78
20% Increase	1.33	0.93	31.34	1.45

As to the DRC values, a 20 percent increase in cost of tradable inputs in technological package 1, 4 and 6 resulted in increasing the DRC ratio from 0.97, in the baseline, to 0.99 (2.06 percent), 5.97 (baseline) to 6.98 (16.9 percent) and 25.0 (baseline) to 31.34 (25.36 percent) respectively, implying that the comparative advantage of rice production deteriorates by 2 to 25 percent. However, in this simulation, the DRC values were significantly approaching 1 for tech_pack 1 showing no improvement rather deteriorating, implying that increase in 20 percent in the cost of tradable inputs for rice production to this zone will even economically harrm rice farmers using tech_pack 1.

Table 15: Sensitivity of PAM indicators due to change in output level for central north

	NPC	EPC	DRC	NPI
Tech_pack 1				
Baseline values	1.22	1.27	0.97	0.84
20% Increase	1.22	1.26	0.79	0.84
20% Decrease	1.22	1.29	1.26	0.84
Tech_pack 4				
Baseline values	1.11	1.01	5.97	1.23
20% Increase	1.11	1.05	4.43	1.23
20% Decrease	1.11	0.91	9.10	1.23
Tech_pack 5				
Baseline values	1.33	-8.14	130.9	2.26
20% Increase	1.33	-1.85	37.66	2.26
20% Decrease	1.33	-6.89	88.64	2.26
Tech_pack 6				
Baseline values	1.33	0.74	25.0	1.78
20% Increase	1.67	1.49	27.20	1.78
20% Decrease	1.67	0.41	90.70	1.78

4.3.3 Scenario III: Change in output level for central north

As indicated in Table 15, since the change in the level of output does not have direct effect on the protection level of tradable inputs, NPI remains unchanged in all simulations. Likewise, NPC recorded no changes due to the relative change between the private and social revenues of rice production along technological packages. In these simulations, the implicit tax on output shows no effects.

Even though the EPC values of output from both simulation seem to be insensitive to changes in the level of output, they are actually changing only with insignificant fractions in tech-pack1 and 4 which indicates that the net disincentive effect of policies and market failures on rice production were not significant for an increase or decrease in the level of output. The simulation result also revealed that an increase in the level of output leads to a decrease in DRC values. For instance, a 20 percent increase in the level of output results in a decrease in DRC values from 0.97, in the baseline simulation, to 0.79 (18.6 percent) or an improvement in the comparative advantage by 18.6 percent for rice farmers using tech_pack 1, 5.97 (baseline) to 4.43 (25.80 percent) for tech_pack 4 and extreme values were recorded for tech_pack 5 and 6. On contrary, the comparative advantage of rice farmers using techn_pack1 seem to deteriorates by 30 percent due to 20 percent decrease in the level of output and lead to economic disadvantage.

4.3.4 Scenario IV: Change in the world prices of output for central south

Assuming other parameters remain constant, the impact of change in the price of output on the protection level and comparative advantage coefficients of rice production in four identified technological packages were investigated. Two simulations; a 5 percent increase and/or decrease in price of output, level of output and 20 percent increase in the cost of tradable inputs had been undertaken to make comparison with the baseline scenario. 5 percent increase and/or decrease in world prices and level of output were used based on the study by Ogbe *et al.* 2011 which depends the level of distortion in specific area.

Table 16 shows that a 5 percent increase in the world price of rice in relation to rice farming by using tech_pack 1, 4, 5 and 6 resulted in a slight decrease in NPC from baseline scenario. In other words, rice farmers from central south are insignificantly taxed on their output but tax rate is estimated to be reduced by 5 percent. In contrast, a 5 percent reduction in world price of rice leads to an increase in implicit tax to rice farming using tech_pack 1, 4, 5 and 6 by approximately 5.74, 5.26, 4.79 and 4.79 percent respectively.

On contrary, the value of NPI remains unchanged. Moreover, a 5 percent increase in price resulted in insignificant decline in EPC for rice farmers using tech_pack 1, 4 and 6 from 1.27 in the base line scenario to 1.21 (4.72 percent), 1.60 (baseline) to 1.13 (29.38 percent) and 1.56 (baseline) to 0.56 (100 percent) respectively, implying that the implicit tax on output and tradable inputs was increased by 4.72, 29.38 and 100 percent respectively.

Table 16: Sensitivity of PAM indicators due to change world prices of outputs for central south

	NPC	EPC	DRC	NPI
Tech_pack 1				
Baseline values	1.22	1.27	0.73	0.93
5% Increase	1.16	1.21	0.69	0.93
5% Decrease	1.29	1.35	0.77	0.93
Tech_pack 4				
Baseline values	1.33	1.60	5.55	1.08
5% Increase	1.27	1.13	3.94	1.08
5% Decrease	1.40	2.72	9.44	1.08
Tech_pack 5				
Baseline values	1.67	3.61	78.02	2.13
5% Increase	1.59	3.61	79.53	2.13
5% Decrease	1.75	3.53	76.51	2.13
Tech_pack 6				
Baseline values	1.67	1.56	10.72	1.82
5% Increase	1.59	0.56	3.85	1.82
5% Decrease	1.75	2.00	13.70	1.82

As to the DRC ratio, a 5 percent increases in world prices reduced the DRC values of rice farming by using tech_pack 1, 4, 5 and 6 from 0.73 (base line scenario) to 0.69 (5.5 percent), 5.55 (baseline) to 3.94 (29.0 percent), 78.02 (baseline) to 79.53 (1.94 percent) and 10.72 (baseline) to 3.85 (64.09 percent), respectively. Implying that, the comparative advantage of rice production was stable only to tech_pack 1. Conversely, if the world price is reduced by 5 percent, the DRC value increases implying that the comparative advantage deteriorates. DRC smaller than one in both simulation were observed only in tech_pack 1, implying that production of rice domestically by reducing 5 percent world price will not hurt rice farmers using tech_pack 1 in this zone.

4.3.5 Scenario V: Change in the cost of tradable inputs for central south

The result of the sensitivity analysis, as presented in Table 17 shows that the change in the cost of tradable inputs doesn't have direct effects on NPC ratio as a result the NPC values were unchanged. Conversely, the NPI, EPC and DRC ratios vary from the base line values. Thus, a 20 % increase in the cost of tradable inputs for tech_pack 1, 4, and 6 resulted in an increase in EPC from 1.27 in the base line to 1.31 (3.15 percent), from 1.60 (baseline) to 3.48 (117.5 percent) and 1.56 (baseline) to 0.26 (83.33 percent) respectively.

Table 17: Sensitivity of PAM indicators due to change in tradable inputs for central south

	NPC	EPC	DRC	NPI
Tech_pack 1				
Baseline values	1.22	1.27	0.73	0.93
20% Increase	1.22	1.31	0.75	0.77
Tech_pack 4				
Baseline values	1.33	1.60	5.55	1.08
20% Increase	1.33	3.48	12.44	0.89
Tech_pack 5				
Baseline values	1.67	3.61	78.02	2.13
20% Increase	1.67	2.79	61.00	1.78
Tech_pack 6				
Baseline values	1.67	1.56	10.72	1.82
20% Increase	1.67	0.26	1.81	1.51

As to NPI values, a 20 percent increase in tradable inputs in tech_pack 1, 4, and 6 resulted in a decrease in NPI from 0.93 in the baseline to 0.77 (17.2 percent), 1.08 (baseline) to 0.89 (17.60 percent), and 1.82 (baseline) to 1.51 (17.03 percent) respectively, implying that rice farmers in this zones were subjected to an increase of implicit taxes by 17 percent. A 20 percent increase in cost of tradable inputs, resulted in increasing the DRC values only for rice farmers using tech_pack 1 and 4 from 0.73 in the base line, to 0.75 (2.74 percent), 5.55 (baseline) to 12.44 (124.14 percent) respectively, implying that the comparative advantage of rice production deteriorates by 2 to more than 100 percent.

However, in this simulation, the DRC value is less than 1 for rice farmers using tech_pack 1.

4.3.6 Scenario VI: Change in the level of output for central south

As indicated in Table 18, since the change in the level of output does not have direct effect on the protection level of tradable inputs, NPI remains unchanged in all simulations. Likewise, NPC recorded no changes due to the relative change between the private and social revenues of rice production in all technological packages. In these simulations, the implicit taxes on output have shown no effects. Even though the EPC values of output from both simulation seems to be insensitive to the change in the level of output, they are actually changing only with insignificant fractions which indicates that the net disincentive effect of policies and market failures on rice production in this zone, this result implies that the implicit tax on rice production in this zone were insignificant.

The simulation result also shows that an increase in the level of output leads to a decrease in DRC values. For instance, a 5 percent increase in the level of output results in a decrease in DRC values from 0.73 in the baseline simulation to 0.68 (6.85 percent) or an improvement in the comparative advantage by approximately 6.85 percent for rice farmers using tech_pack 1 and 5.55 (baseline) to 3.94 (29.01 percent), and 10.72 (baseline) to 3.85 (64.09 percent) for rice farmers using tech_pack 4 and 6 respectively. On contrary, the comparative advantage of rice farmers using tech_pack 1 seem to be insignificantly deteriorates at 5 percent decrease in the level of output. Similarly, the comparative advantage of rice farmers using tech_pack 4, 5 and 6 deteriorates significantly. However, in both simulations, the DRC values for rice farmers using tech_pack 1 is less than one, implying that rice production using tech_pack 1 in central north is economically profitable.

Table 18: Sensitivity of PAM indicators due to change in output level for central south

	NPC	EPC	DRC	NPI
Tech_pack 1				
Baseline values	1.22	1.27	0.73	0.93
5% Increase	1.22	1.27	0.68	0.93
5% Decrease	1.22	1.27	0.77	0.93
Tech_pack 4				
Baseline values	1.33	1.60	5.55	1.08
5% Increase	1.33	1.23	3.94	1.08
5% Decrease	1.33	2.49	9.47	1.08
Tech_pack 5				
Baseline values	1.67	3.61	78.02	2.13
5% Increase	1.67	3.36	76.51	2.13
5% Decrease	1.67	3.77	79.53	2.13
Tech_pack 6				
Baseline values	1.67	1.56	10.72	1.82
5% Increase	1.67	0.61	3.85	1.82
5% Decrease	1.67	1.81	13.70	1.82

4.3.7 Scenario VII: change in the world price of output for zone-3 Pemba

Table 19 identified rice farmers in zone-3 Pemba with five technological packages. In this scenario, assuming other coefficients remain constant, the impact of change in the price of output on the protection level and comparative advantage coefficients of rice production to rice farmers using tech_pack 1, 2, 3, 5 and 6 were investigated.

The results in Table 19 shows that a 20 percent increase in the world price of output led to a decrease in NPC from 1.10 (the baseline scenario) to 0.92 (16.36 percent), 1.11 (baseline) to 0.93 (16.22 percent), 1.11 (baseline) to 0.93 (16.22 percent), 1.33 (baseline) to 1.11 (16.54 percent) and 1.33 (baseline) to 1.11 (16.54 percent), for rice production using tech_pack 1, 2, 3, 5 and 6 respectively. In other words, rice farming in zone-3 Pemba to some extent taxed on their output and the tax rate is estimated to be reduced by 16 percent for all technological packages. In contrast, a 20 percent reduction in world price of output leads to an increase in implicit tax between 18 to 25 percent for all technological packages. On contrary, the value of NPI remains unchanged.

Moreover, a 20 percent rise resulted in declining in EPC in rice farming by using tech_pack 1, 2 and 3 from 1.23, (baseline), to 1.03 (16.3 percent), 1.29 (baseline) to 0.61 (52.71 percent) and 1.17 (baseline) to 0.97 (17.1 percent) respectively, implying that the implicit tax on output and tradable inputs was increased by 16.3, 52.71 and 17.1 percent.

Table 19: Sensitivity of PAM indicators due to change in world price of output for zone-3 Pemba

	NPC	EPC	DRC	NPI
Tech_pack 1				
Baseline values	1.10	1.23	1.40	0.19
20% Increase	0.92	1.03	1.12	0.19
20% Decrease	1.38	1.63	1.80	0.19
Tech_pack 2				
Baseline values	1.11	1.29	1.96	0.17
20% Increase	0.93	0.61	1.57	0.17
20% Decrease	1.39	1.70	2.56	0.17
Tech_pack 3				
Baseline values	1.11	1.17	3.56	0.08
20% Increase	0.93	0.97	2.93	0.08
20% Decrease	1.39	1.49	4.60	0.08
Tech_pack 5				
Baseline values	1.33	0.85	23.42	1.95
20% Increase	1.11	0.67	18.39	1.95
20% Decrease	1.67	0.26	7.15	1.95
Tech_pack 6				
Baseline values	1.33	1.64	12.80	0.97
20% Increase	1.11	0.98	7.49	0.97
20% Decrease	1.67	5.61	43.72	0.97

Furthermore, Table 19 shows that 20 percent increases in world prices of output reduced the DRC values for using tech_pack 1, 2, 3, 5 and 6 from 1.4 (baseline) to 1.12, 1.96 (baseline) to 1.57, 3.56 (baseline) to 2.93, 23.42 (baseline) to 18.39 and 12.80 (baseline) to 7.49, respectively. The results imply that the comparative advantage of rice production by 20 percent increase in zone-3 Pemba does not improve the DRC values in all technological packages applied. Apparently, DRC values is greater than a unit in all simulations to all to rice farmers in this zone, implying that using domestic resources for growing rice in zone-3 Pemba is not efficient.

4.3.8 Scenario VIII: change in the cost of tradable inputs for zone-3 Pemba

The result from sensitivity analysis as presented in Table 20, shows that the change in the cost of tradable inputs does not have direct effects on NPC ratio as a result the NPC values were unchanged. On the other hand, NPI, EPC and DRC ratios slightly vary from the baseline values. Thus, 20 percent increase in the cost of tradable inputs for tech_pack 1, 2, 3 and 6 resulted in an increase in EPC from 1.23, in the baseline, to 1.30 (5.7 percent), from 1.29 (baseline) to 1.35 (4.65 percent), 1.17 (baseline) to 1.19 (1.71 percent) and 1.64 (baseline) to 3.12 (90.24 percent). These results imply that the implicit tax on rice production in this zone is decreased by 5.7, 4.7, 1.2 and 90 percent respectively.

Table 20: Sensitivity of PAM indicators due to change in cost of tradable inputs for zone-3 Pemba

	NPC	EPC	DRC	NPI
Tech_pack 1				
Baseline values	1.10	1.23	1.40	0.19
20% Increase	1.10	1.30	1.43	0.16
Tech_pack 2				
Baseline values	1.11	1.29	1.96	0.17
20% Increase	1.11	1.35	2.04	0.15
Tech_pack 3				
Baseline values	1.11	1.17	3.56	0.08
20% Increase	1.11	1.19	3.61	0.07
Tech_pack 5				
Baseline values	1.33	0.85	23.42	1.95
20% Increase	1.33	0.25	6.74	1.67
Tech_pack 6				
Baseline values	1.33	1.64	12.80	0.97
20% Increase	1.33	3.12	26.00	0.81

As to NPI values, 20 % increase for tech_pack 1, 2, 3, and 6 resulted in a percentage decrease by 15.81, 11.76, 12.5 and 16.5 respectively. Since the value of NPI were less than unit, therefore results imply that, rice farmers in zone-3 Pemba were not affected from the increase in implicit taxes.

A 20 percent increase in cost of tradable inputs, resulted in increasing the DRC values in tech_pack 1 and 2 from 1.40 in the base line, to 1.43 (2.14 percent), 1.96 (baseline) to 2.04 (4.08 percent) respectively, implying that the comparative advantage of rice production continue to deteriorates. However, there could be no other way to simulation the scenario by 20% decrease provided that the system was under subsidy programme.

Table 21: Sensitivity of PAM indicators due to change in output level for zone-3 Pemba

	NPC	EPC	DRC	NPI
Tech_pack 1				
Baseline values	1.10	1.23	1.40	0.19
20% Increase	1.10	1.24	1.12	0.19
20% Decrease	1.10	1.29	1.80	0.19
Tech_pack 2				
Baseline values	1.11	1.29	1.96	0.17
20% Increase	1.11	1.26	1.57	0.17
20% Decrease	1.11	1.35	2.56	0.17
Tech_pack 3				
Baseline values	1.11	1.17	3.56	0.08
20% Increase	1.11	1.16	2.95	0.08
20% Decrease	1.11	1.19	4.53	0.08
Tech_pack 5				
Baseline values	1.33	0.85	23.42	1.95
20% Increase	1.33	1.04	18.39	1.95
20% Decrease	1.33	0.11	7.15	1.95
Tech_pack 6				
Baseline values	1.33	1.64	12.80	0.97
20% Increase	1.33	1.25	7.49	0.97
20% Decrease	1.33	3.76	43.72	0.97

4.3.9 Scenario VIV: change in the level of output for zone-3 Pemba

The impact of change in the level of output on policy indicators of rice production by using tech_pack 1, 2, 3, 5 and 6 was examined in Table 21. Furthermore, a 20 percent increase and/or decrease in the level of output were used to analyse the sensitivity of such changes.

In these simulations NPI and NPC remain unchanged; the implicit taxes on output have shown no effects. Although, the EPC values of rice farmers using tech_ pack1, 2 and 3 from both simulation seems to be insensitive to the change in the level of output, they are actually changing only with insignificant fractions which indicates that the net disincentive effect of policies and market failures on rice production. The simulation result shows that regardless of 20 percent increase in the level of output to all technological packages in zone-3 Pemba, DRC values remains greater than one. Implying that rice production in this zone is economically not profitable.

Table 22: Summary of the determinants of zonal competitiveness and comparative economic advantage of rice production in Unguja and Pemba

Technological Packages	High yield tercile; 1 288kg/acre (n=154)	Competitive	CEA
Tech_pack 1	95.9 (116)	All Three Zones	Central south and north
Tech_pack 2	40.6 (26)	Zone 3 Pemba	
Tech_pack 3	2.6 (1)	Zone 3 Pemba	
Tech_pack 4	33.3 (10)	Central North and Central South	
Tech_pack 5	0 (0)		
Tech_pack 6	1.3 (1)	Central South	

4.4 Summary of Major Findings

Chapter four presented the study findings and discussion. The results show that the selected three rice potential production zones, rice farmers using tech_pack 1 are found to utilize domestic resources efficiently in central south and central north farming system zone of Unguja Island only. However, under certain sensitivity simulation in scenario I, II and III, a 20 percent increase or decrease in tradable inputs, world price and level of output made all rice farmers in central north economically unprofitable. Likewise, all rice farmers in zone-3 Pemba are economically unprofitable regardless of sensitivity analysis simulations of 20 percent increase or decrease.

4.5 Study Limitations

The first major constraint to the study is the shortage of reliable secondary data. The national rice production statistics from OCGS were not consistent with the data obtained from the Ministry of Agriculture, Natural resources, Livestock and fisheries and the import parity prices of agricultural inputs from Zanzibar Port Authority and the Ministry of Trade, Industry and Marketing were not readily available. There was the general unavailability of published secondary information from all the stakeholders. However, efforts were made to make the data representative to the rice sub sector in Zanzibar despite resource constraints.

Secondly, the study was based on a primary data from 464 sampled rice farming households with in the selected three rice potential production zones. Although there are many useful variables and methodologies for assessing the determinants of competitiveness and comparative economic advantage of rice production in Zanzibar, this study used PAM approach and focused on socio-economic characteristics and the most common technological packages used by rice farmers. The analysis was also limited to technology packages that were on practice in central north, central south and zone-3 Pemba in 2013/2014 cropping season.

CHAPTER FIVE

5.0 CONCLUSIONS, POLICY IMPLICATIONS AND AREAS FOR FURTHER RESEARCH

5.1 Conclusions

The general objective of this study was to assess the determinants of zonal competitiveness and comparative economic advantage of rice production in central north, central south and zone-3 Pemba of Unguja and Pemba. More specifically the study intended to examine the competitiveness and comparative economic advantage of rice production farming system zone with potential for the production of the crop toward attaining food security goals and increasing food-self sufficiency. The study intended to address the following specific objectives: (i) To determine socio-economic characteristics and production technologies that differentiate rice farmers' yield levels in central north, central south and zone 3 Pemba farming system zones; (ii) To analyse the competitiveness of rice production under different technological packages in central north, central south and zone 3 Pemba; (iii) To analyse the comparative economic advantage of rice production under different technological packages in central north, central south and zone 3 Pemba; and To (iv) To examine the level of protection and policy transfers of the rice sub-sector in central north, central south and zone 3 Pemba.

5.1.1 Socio-economic characteristics that differentiate rice farmers in terms of yield

Socio-economic characteristics of rice farmers differ with rice yield depending on level of yield and technological package of individual rice farmer. In general, rice yield were categorized into low, medium and high yield terciles. The evidence showed that majority of rice farmers whose primary occupation is not rice farming; part-time rice farmers; have no access to extension services; female rice farmers and have low valued agricultural assets were in low yield tercile in all farming system zones, yet their agronomic practices does not match with the recommendation as well as technological packages combination. Although, rice farmers with access to agricultural extension, male rice farmers and those rice farmers with high valued agricultural assets, full-time rice farmers were successful in high yield tercile in all farming system zones. Hence, they correspond with Ministry of Agriculture’s recommended rates of input use in appendix 1. In addition, these farmers match with rice farmers using tech_pack 1 in high yield tercile.

5.1.2 Competitiveness, comparative economic advantage and protection of rice production in central north, central south and zone-3 Pemba farming system zone

In central north farming system zone, rice farmers using tech_pack 1 and 4 were found to be competitive with positive private profit implying that they meet recommendations required in this zone. However, DRC indicator shows that, rice farmers using tech_pack 1 were efficient in using domestic resources in rice production hence possess comparative advantage. Furthermore, rice farmers using tech_pack 4, 5 and 6 were found to be inefficient in using domestic resources for rice production. This was mainly due to deficiency in their technological packages, signifying the need to upgrade their packages so as to grow rice to potential levels, which is necessary for the sub-sector transformation.

Regarding other PAM indicators all technological packages indicates that the domestic farm gate price is greater than the world price for rice output, The NPI ratios indicate that rice farming in general were protected, since the private prices of tradable inputs were lower than world reference prices. Similarly, the EPC indicates that only rice farmers using tech_pack 6 were protected through policy intervention on value added processes, while on the other hand, other rice farmers in central north were using inputs at market prices. But in most cases the supply was erratic and they were forced to pay high prices through black market transactions, as a result lack incentive to use tradable inputs efficiently in favour of domestic factors in rice production.

In central south farming system zone, Rice farmers using tech_pack 1, 4 and 6 were financial profitable; this is due to low input cost they face in the market. However, Protection indicators show that, rice farmers in this zone received similar treatment like that of central north zone. Likewise, DRC values in this zone indicates that the use of domestic resources in rice production were socially profitable for rice farmers using tech_pack 1 only.

For zone-3 Pemba, rice farmers using tech_pack 1, 2 and 3 were financial profitable, indicating PCR less than one. Nevertheless, the social profitability and DRC indicates that growing rice in zone-3 Pemba is economically unprofitable and hence all rice farmers were inefficient on using domestic resources in rice production. However, the study found that the cost of tradable inputs were significantly lower than rice farmers in central north and central south farming system zones of Unguja. Low cost of tradable inputs was said to be associated with government subsidy programme, as a result some farmers diverge the use of the intended subsidized inputs to other crops.

5.1.3 Sensitivity analysis of PAM indicators

The result from the sensitivity analysis showed that due to change in world prices of output, tradable inputs and level of output, DRC values were significantly approaching 1 for tech_pack 1 showing no improvement rather deteriorating, implying that increase in 20 percent in the cost of tradable inputs for rice production in central north farming system zone will economically hurt rice farmers using tech_pack 1. Though the EPC values of output seem to be insensitive to changes in the level of output, they were actually changing only with insignificant fractions in tech_pack 1 and 4 which indicates that the net disincentive effect of policies and market failures on rice production were not significant for an increase or decrease in the level of output. On contrary, the comparative economic advantage of rice farmers using techn_pack1 seem to deteriorates due decrease in the level of output and lead to economic disadvantage. Likewise, for zone-3 Pemba the results imply that the comparative economic advantage of rice production does not improve the DRC values in all technological packages applied in all sensitivity simulations, implying that using domestic resources for growing rice in zone-3 Pemba is not economically profitable.

In general, however the government effort currently is the better-off option to complement rice production. But, in the long term without focusing on potential rice production zones, technological packages which are compatible with socio-economic characteristics of rice farmers associated with rice in high yield category, in the long-run the rice production might be unsustainable.

5.2 Policy Implications and Recommendations

5.2.1 Improving competitiveness and comparative economic advantage of rice production

The trade in rice is an economic activity, but it is also an activity deeply tied to food-self sufficiency, rural livelihoods, culture, ecology, and politics. To date, most studies on competitiveness and comparative advantage have tended to focus on trade between countries. This study has focused finding out in which farming systems zone with potential for rice production can rice be provided by using efficiently and profitable the domestic factors of land, labour and water., PCR as used to compare farming systems zones in terms of competitiveness and DRC in terms of costs of domestic factors in social prices to generate a unit of added in social prices.

Based on the findings the following policy recommendations are made:

i. The study recommend that greater attention should be paid to environmental sustainability implication of international trade policy and practice, as rice demand increases, and as climate change affects farming system zones, it is vital to ensure that food security needs are met sustainably. Failure to do so will harm not only the natural resource base on which food production draws, but also food self-sufficient initiatives itself will be compromised. Therefore, more attention needs to be paid to the broader environmental implications of food policy, in particular what kinds of agricultural methods are promoted by different kinds of trade models.

ii. Policy should take initiative to strike a balance between the needs of rice farmers and consumers within trade and agricultural policy. It is especially important to consider the rice needs and requirements of Zanzibar, that have a significant proportion of the populations engaged in rice production, at the same time that urban consumers' needs should be taken into account.

iii. Ensuring the Zanzibar trade policy does not cause harm to rice producers, while balancing the ability of rice producers in central south and central north to pursue longer-term strategic goals of rice sub-sector development and food self-sufficiency. It is important that, the country should not be locked into certain types of agricultural production or prevented from pursuing domestic food security policies that are unique to Zanzibar situation.

iv. Serious actions should also be taken to review the agricultural sector policy of 2002 and the Zanzibar farming system zones of 1995 and to put in place an effective institutional coordination mechanism for the smart agricultural subsidy programme in potential rice production zones.

v. In order to increase the efficiency of rice sub-sector and improve effectiveness of rice farmers, there is a need to foster inter-departmental collaboration within the sectors and promote efficient use domestic resources in rice production. The reviewed farming system zones should also be encouraged to help policy makers to promote crop production in relevant zone so as to speed-up the development of rice sub-sector in Zanzibar.

vi. It is recommended that the government and private sectors should facilitate the participation of rice farmers using tech_pack 1 in expanding area under rice production, most desirable in central north, central south farming system zones. Considering that these zones have potential as well as financially and economically profitable when using technological package one.

vii. The divergence between private and social profit, which is usually caused by the net policy effects and market failures, should be minimized by taking appropriate protection measures in order to correct the inefficiency influence of some factors such as rural finance and institutional underdevelopments.

viii. It is therefore recommended that the determinants of competitiveness and comparative economic advantage established by this study should be approved by the Ministry of Agriculture so that extension interventions are implemented hand in hand with other interventions aimed at increasing rice production and productivity. Implementing recommended technological packages will not only improve the efficiency of rice farmers but will also enhance the effectiveness of the Ministry of Agriculture and the country at large.

ix. It is recommended that the government should create a mechanism of monitoring policy objectives of all sectors so as to facilitate proper understanding of the Zanzibar Development Frameworks.

5.2.2 Suggestions for future research

The recommendations of this study are specific for three farming system zones in rice sub-sector, since the study did not evaluate the determinants of competitiveness and comparative economic advantage of other food crops. Therefore, further research is suggested on establishing key determinants of competitiveness and comparative economic advantage of major food crops grown in Zanzibar. Moreover, the study did not focus on demand side/ consumer needs, as consumers have different utility needs and preferences, as they are associated with cultural transformation and urbanization due to climate change and environmental degradation. Thus, further research on the prospects of rice production in relation to environmental and climate changes especially in Pemba Island which experience frequent sea water intrusion into rice farms.

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APPENDICES

Appendix 1: Recommended rates of inputs for rice production in Zanzibar

Particulars	Amount per acre
Irrigation	
Seeds: SUPA India, SUPA BC, BKN SUPA, SARO, TXD 88 and Subang.	12kg
Fertilizers: -Triple Super Phosphate (TSP)	52kg
-Urea	64kg
-Mechanization, water and labour charge	560 000 TZS
-Rice yield	1 560 kg
Rain fed	
Seeds: SUPA India, BKN SUPA and TXD 88	25-30kg
Fertilizer: -Triple Super Phosphate (TSP)	50kg
-Urea	50kg
Herbicide: Basagran	3lt
Mechanization and other labour charges	100 000 TZS
-Rice yield	1 050 kg

Source: GOZ, 1993

Appendix 2: Description of the observed inputs used by the sampled rice farmers in the study area per acre

Technological package		Description	n	Mean	SD	Median
Irrigation	Improved seeds and fertilizer	Land (acres)	121	0.53	0.58	0.25
		Man-days/acre	121	67	73	31
		Seeds (kg/acre)	121	18	8	20
		Fertilizer (kg/acre)	121	102	9	120
	Local seeds and fertilizer	Land (acres)	64	0.51	0.31	0.5
		Man-days/acre	64	64	39	63
		Seeds (kg/acre)	64	18	6	20
		Fertilizer (kg/acre)	64	164	95	173
	Both local and improved seeds only	Land (acres)	39	0.78	0.55	0.5
		Man-days/acre	39	97	69	62
		Seeds (kg/acre)	39	16	5	15
Rain fed	Improved seeds, fertilizer and herbicide	Land (acres)	30	0.82	0.53	0.63
		Man-days/acre	30	102	67	79
		Seeds (kg/acre)	30	28	12	26
		Fertilizer (kg/acre)	30	86	49	92
		Herbicide lt/acre	30	3	3	2
	Local seeds only	Land (acres)	130	1.14	0.70	1.00
		Man-days/acre	130	142	88	125
		Seeds (kg/acre)	130	32	23	20
	Both local and improved seeds with herbicides	Land (acres)	80	0.90	0.72	0.75
		Man-days/acre	80	113	90	94
		Seeds (kg/acre)	80	39	34	30
		Herbicide lt/acre	80	3	2	3

Appendix 3: Average annual rice yield by technological packages and farming system zones (kg/acre)

	Zone-2 Central north			Central south			Zone-3 Pemba			All		
Technological packages	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median
Irrigation, improved seeds and fertilizer (tech_pack 1)	2 798	224	2 880	3 092	200	3 120	2 600	310	2 400	2 680	300	2 640
Irrigation, local seeds and fertilizer (tech_pack 2)	N/A	N/A	N/A	N/A	N/A	N/A	1 590	335	1 440	1 590	334	1 440
Irrigation, mixed variety only (tech_pack 3)	N/A	N/A	N/A	N/A	N/A	N/A	768	176	900	768	176	900
Rain fed, improved seeds, fertilizer and herbicides (tech_pack 4)	647	205	667	658	208	600	N/A	N/A	N/A	650	202	600
Rain fed, local seeds only (tech_pack 5)	100	115	60	92	58	80	231	123	180	133	122	96
Rain fed, mixed variety and herbicides (tech_pack 6)	340	182	280	416	210	360	423	132	369	379	180	360

Appendix 4: Improved varieties of seed used in Zanzibar

S/N	Name	Attributes
1	SUPA BC	Higher tillering ability up to 70/stool Medium plant height Large panicle size Pale yellow grain colour Slight aromatic Medium grain size Higher yield 2.4 tons / acre Flowering time is 120 days
2	SUPA India	Low tillering ability less than 50/stool Tall plant height Large panicle size Pale yellow grain colour Aromatic Medium grain size Low yield 1.6 tons / acre Flowering time is 120 days
3	BKN/SUPA	Low tillering ability less than 50/stool Tall plant height Small panicle size Pale yellow grain colour Aromatic Medium grain size Low yield 1.6 tons / acre Flowering time is 90 days
4	SARO	Higher tillering ability up to 70/stool Medium plant height Large panicle size Pale yellow grain colour Slight aromatic Medium grain size Highest yield 2.8 tons / acre Flowering time is 120 days
5	TXD 88	Higher tillering ability up to 70/stool Medium plant height Large panicle size Pale yellow grain colour Non aromatic Medium grain size Highest yield 2.4-3.2 tons / acre Flowering time is 120 days
6	SUBANG	Higher tillering ability up to 70/stool Medium plant height Large panicle size Pale yellow grain colour Slight aromatic Medium grain size Higher yield 2 tons / acre Flowering time is 120 days

Source: GOZ, 1993

Appendix 5: Local varieties of seed used in Zanzibar

S/N	Name	Attributes
1	KIDULA	Low tillering ability< 40/stool Tall plant height Large panicle size Pale yellow grain colour Slight aromatic Medium grain size Lower yield < 1.2 tons / acre Flowering time is 125 days
2	BARAMATA	Low tillering ability< 40/stool Tall plant height Large panicle size Pale yellow grain colour Highly aromatic Large grain size Higher yield < 1.2 tons / acre Flowering time is 125 days
3	NIWAHI	Low tillering ability< 50/stool Tall plant height Large panicle size Pale yellow grain colour Slight aromatic Medium grain size Lower yield < 1.2tons / acre Flowering time is 90 days
4	UCHUKI	Low tillering ability< 40/stool Tall plant height Large panicle size Pale yellow grain colour Slight aromatic Medium grain size Lower yield < 1.2 tons / acre Flowering time is 125 days
5	KIVULE	Low tillering ability< 40/stool Tall plant height Large panicle size Pale yellow grain colour Slight aromatic Medium grain size Lower yield <1.2 / acre Flowering time is >125 days
6	KIHASAN	Higher tillering ability up to 70/stool Medium plant height Large panicle size Pale yellow grain colour Slight aromatic Medium grain size Higher yield 2 tons / acre Flowering time is 120 days

7	SUPA	Low tillering ability< 40/stool Tall plant height Large panicle size Pale yellow grain colour Highly aromatic Medium grain size Lower yield <1.2 tons /acre Flowering time is 125 days
8	RINGA	Low tillering ability< 40/stool Tall plant height Large panicle size Pale yellow grain colour Slight aromatic Medium grain size Lower yield <1.2 tones /acre Flowering time is 130 days

Source: GOZ, 1993

Appendix 6: Import parity price of rice (2014)

Description	**Private prices**	**Social prices**
CIF Value per Metric tonne (USD)	210	
Exchange rate TZS/USD	1 646.83	1 800.94
Custom duty 10% CIF value per tonne (USD)	21	
Farm gate price/metric tonne (TZS)	642 263.70	702 366.60
custom declaration (TZS)	345 834.30	378 197.40
Import duty 10% CIF value per tonne (TZS)	34 583.43	37 819.74
Trade levy of 2% on declaration	6 916.69	7 563.95
Stamp duty 1.5% on declaration	5 187.51	5 672.96
Shipping cooperation	770	770
Distuffing charges	1 600	1 600
Wharfage	2 150	2 150
Clearing charge	2 080	2 080
Transport cost	4 000	4 000
ZFDB 0.5%	1 729.17	1 890.99
Other charges (loading and off-loading Godown)	4 000	4 000
Total cost	709 280.50	773 914.24
importer's margin per 50kg	2 000.00	2 000.00
trader's margin per 50 kg	2 000.00	2 000.00
Retailers' margin per 50kg	2 000.00	2 000.00
Cost per 50kg bag	35 464.03	38 695.71
Retail price TZS/kg	830.00	900.00

Source: (Own computation)

Appendix 7: Import parity price of fuel (Diesel; 2014)

	Description	**Unit price**	**Private price**	**Social price**
	Weighted Average platt's FOB	TZS/Litre	358.52	392.07
Plus	Weighted Average Premium as Per Quotation (Freight + Insurance + Premium)	TZS/Litre	50.04	54.72
Total	**COST CIF DAR**	**TZS/Litre**	**408.56**	**446.79**
	Local Costs Payable In Dar			
	Wharfage $10/MT + 18% VAT	TZS/Litre	16.22	17.74
	Customs Processing Free (TZS 4.80/Lt)	TZS/Litre	4.8	4.8
	Weights & Measures Fee (TZS 1.00/Lt)	TZS/Litre	1	1
	TBS Charge	TZS/Litre	1.24	1.24
	TIPER Fee + 18%VAT	TZS/Litre	0.2	0.2
	Actual Demurrage Cost (USD 1.461/MT)	TZS/Litre	2.61	2.85
	Surveyors Cost (Actual Tendered Rate:GO=USD 0.051/MT	TZS/Litre	0.07	0.073
	Financing Cost (1.00%CIF)	TZS/Litre	4.09	4.47
	Evaporation Losses (0.5%MSP) CIF	TZS/Litre	1.23	1.34
	Warehousing Charges	TZS/Litre	16.38	16.38
	TOTAL LOCAL COSTS (LC)	**TZS/Litre**	**47.84**	**50.09**
	Secondary Transportation Costs (DAR - ZNZ)			
	Secondary Freight and Handling	TZS/Litre	85.00	85.00
	Transportation Losses (Receiving, storing, discharge losses)	TZS/Litre	10.71	10.71
	Duty on Unlanded Cargo - Average	TZS/Litre	3.79	4.15
	Wharfage	TZS/Litre	1.11	1.22
	Total Secondary Transpiration Costs (TSTC)	**TZS/Litre**	**100.62**	**101.07**
Total	**COST CIF ZNZ**	**TZS/Litre**	**557.01**	**597.95**
	GOVERNMENT TAXES			
	Excise Duty	TZS/Litre	30	30
	Road License Fee	TZS/Litre	35	35
	Infrastructure Tax	TZS/Litre	100	100
	Petroleum Levy	TZS/Litre	350	350
	Road Development Fund	TZS/Litre	100	100
Sub -total	**Total Government Taxes**	**TZS/Litre**	**615**	**615**
	OTHER CHARGES			
plus plus	Regulatory Levy Importer's/Wholesalers Margins	TZS/Litre TZS/Litre	10 110	10 110
Sub-total	**Total Other Charges**	**TZS/Litre**	**120**	**120**
Sub-total	**Wholesale Price**	**TZS/Litre**	**1 292.01**	**1 332.95**
Plus	Retailers Margins	TZS/Litre	90	90
Plus	Transport Charges (Local)	TZS/Litre	10	10
	Sub Total	**TZS/Litre**	**100**	**100**
price	**RETAIL PRICES**	**TZS/Litre**	**1 392.01**	**1 432.95**

Appendix 8: Import parity price of fertilizer (UREA)

Description	**Private prices**	**Social prices**
Exchange rate TZS/USD	1 646.83	1 800.94
Farm gate price/metric tone	916 666.67	1 002 448.14
Trade levy of 2% on declaration	-	-
Stamp duty 1.5% on declaration	-	-
Shipping cooperation	770.00	770.00
Distuffing charges	1 600.00	1 600.00
Wharfage	2 150.00	2 150.00
Clearing charge	2 080.00	2 080.00
Transport cost	4 000.00	4 000.00
ZFDB 0.5%	-	-
Other charges (loading and off-loading Godown)	4 000.00	4 000.00
Total cost	931 266.67	1 017 048.14
Cost per 50kg bag	46 563.33	50 852.41
Retail price/kg	931.27	1 017.05

Appendix 9: Import parity price of fertilizer (TSP)

Description	**Private prices**	**Social prices**
Exchange rate TZS/USD	1 646.83	1 800.94
Farm gate price/metric tone	1 200 000.00	1 312 295.74
Trade levy of 2% on declaration	-	-
Stamp duty 1.5% on declaration	-	-
Shipping cooperation	770.00	770.00
Distuffing charges	1 600.00	1 600.00
Wharfage	2 150.00	2 150.00
Clearing charge	2 080.00	2 080.00
Transport cost	4 000.00	4 000.00
ZFDB 0.5%	-	-
Other charges (loading and off-loading Godown)	4 000.00	4 000.00
Total cost	1 214 600.00	1 326 895.74
Cost per 50kg bag	60 730.00	66 344.79
Retail price TZS/kg	1 214.60	1 326.90

Appendix 10: Import parity price of herbicide (Basagran)

Description	Private prices	Social prices
Exchange rate TZS/USD	1 646.83	1 800.94
Farm gate price/metric tone	17 543 666.67	19 185 399.25
custom declaration (TZS)	-	-
Trade levy of 2% on declaration	-	-
Stamp duty 1.5% on declaration	-	-
Shipping cooperation	770	770
Distuffing charges	1 600	1 600
Wharfage	2 150	2 150
Clearing charge	2 080	2 080
Transport cost	4 000	4 000
Other charges (loading and off-loading Godown)	4 000	4 000
Total cost	17 558 266.67	19 199 999.25
Retail price TZS/lt	17 558.27	19 200.00

Appendix 11: Import parity price of Seeds (SUPA BC)

Description	Private prices	Social prices
Exchange rate	1 646.83	1 800.94
Farm gate price/metric tone	2 200 000.00	2 405 875.53
Trade levy of 2% on declaration	-	-
Stamp duty 1.5% on declaration	-	-
Shipping cooperation	770	770
Distuffing charges	1 600	1 600
Wharfage	2 150	2 150
Clearing charge	2 080	2 080
Transport cost	4 000	4 000
Other charges (loading and off-loading Godown)	4 000	4 000
Total cost	2 214 600.00	2 420 475.53
Cost per 50kg bag	110 730.00	121 023.78
Retail price TZS/kg	2 214.60	2 420.48

Appendix 12: Financial Enterprise Budget for Central North (Tech_pack 1)

Budget for rice production per acre during 2013/14 cropping season for Central North					
Irrigation, improved seeds and fertilizer: Tech_pack_1					
Component	**Unit**	**Price**	**Quantity**		**Value of output**
Gross Revenue	kg	1 100.0	2 798.0		**3 077 800.0**
Variable Cost			**Quantity**		**Total cost**
Fertilizer	kg	250	212.4		53 100.0
Agrochemicals	lt	0	0		-
Seeds	kg	200	16.3		3 260.0
sub-total					**56 360.0**
Irr. Water charges	TZS				54 000.0
Mechanization services	TZS				187 010.70
Transportation cost	TZS				41 500.0
sub-total					**282 510.7**
Labour type			**Family**	**Hired**	
Ploughing	man days	8 640.7	-	12.0	103 688.4
Harrowing	man days	9 650.3	-	7.0	67 552.1
Nursery preparation	man days		1.5	-	-
Transplanting	man days	2 500	5.0	7.0	17 500.0
Gap filling	man days	3 500	20.0	9.1	31 850.0
Sowing	man days		-	-	-
Fertilizer Application	man days		7.0	-	-
First weeding	man days	8 500	10.0	10.0	85 000.0
Second weeding	man days	5 000	10.0	9.0	45 000.0
Bird scaring	man days		-	-	-
Harvesting and Threshing	man days	6 500	10.0	10.0	65 000.0
sub-total			63.5	64.1	**415 590.5**
Total Variable Cost					**754 461.2**
Gross Margin (TZS per acre)					**2 323 338.8**
Fixed cost	**Initial value**	**Salv. value**	**E.life (yrs)**	**Tools**	
Cost of land					-
Farm implements	152 750.0	-	7	6	130 928.6
Total fixed Cost					**130 928.6**
Total cost					**885 389.8**
Profit (TZS per acre)					**2 192 410.2**

Appendix 13: Financial Enterprise Budget for central north (Tech_pack 4)

Budget for rice production per acre during 2013/14 cropping season for Central North					
Rain fed, improved seeds, fertilizer and herbicide: Tech_pack_4					
Component	**Unit**	**Price**	**Quantity**		**Value of output**
Gross Revenue	kg	1 000.0	647		**647 000.0**
Variable Cost			**Quantity**		**Total cost**
Fertilizer	kg	250	94.6		23 650.0
Agrochemicals	lt	10 000.0	2.7		27 000.0
Seeds	kg	200	24.8		4 960.0
sub-total					**55 610.0**
Irr. Water charges	TZS				
Mechanization services	TZS				271 754.4
Transportation cost	TZS				3 381.0
sub-total					**275 135.4**
Labour type			**Family**	**Hired**	
Ploughing	man days		10.0	-	-
Harrowing	man days		12.0	-	-
Nursery preparation	man days		-	-	-
Transplanting	man days		-	-	-
Gap filling	man days		7.0	-	-
Sowing	man days	7 500.0	2.6	3.2	24 000.0
Fertilizer Application	man days		10.0	-	-
First weeding	man days	5 000.0	7.0	10.0	50 000.0
Second weeding	man days	8 000.0	10.0	15.0	120 000.0
Bird scaring	man days		-	-	-
Harvesting and Threshing	man days	7 500.0	7.0	10.0	75 000.0
sub-total			65.6	38.2	**269 000.0**
Total Variable Cost					**599 745.4**
Gross Margin (TZS per acre)					**47 254.6**
Fixed cost	**Initial value**	**Salv. value**	**E.life (yrs)**	**Tools**	
Cost of land					-
Farm implements	45 921.4	-	7	5	32 801.0
Total fixed Cost					**32 801.0**
Total cost					**632 546.4**
Profit (TZS per acre)					**14 453.6**

Appendix 14: Financial Enterprise Budget for central north (Tech_pack 5)

Budget for rice production per acre during 2013/14 cropping season for Central North					
Rain fed, local seeds only : Tech_pack_5					
Component	**Unit**	**Price**	**Quantity**		**Value of output**
Gross Revenue	kg	1 200.0	100		**120 000.0**
Variable Cost			**Quantity**		**Total cost**
Fertilizer	kg				-
Agrochemicals	lt				-
Seeds	kg		25.3		-
sub-total					**-**
Irr. Water charges	TZS				-
Mechanization services	TZS				235 836.8
Transportation cost	TZS				1 021.2
sub-total					**236 858.0**
Labour type			**Family**	**Hired**	
Ploughing	man days				
Harrowing	man days				
Nursery preparation	man days		-	-	-
Transplanting	man days		-	-	-
Gap filling	man days		12.0	-	-
Sowing	man days	5 000	3.5	4.2	21 000.0
Fertilizer Application	man days		7.0	-	-
First weeding	man days	5 235	7.0	10.0	52 348.5
Second weeding	man days	2 133	7.0	10.0	21 333.3
Bird scaring	man days		2.0	-	-
Harvesting and Threshing	man days	9 870	15.0	10.0	98 702.3
sub-total			64.5	64.2	**193 384.1**
Total Variable Cost					**430 242.1**
Gross Margin (TZS per acre)					**(310 242.1)**
Fixed cost	**Initial value**	**Salv. value**	**E.life (yrs)**	**Tools**	
Cost of land					**-**
Farm implements	29 515.2	-	7	5	21 082.3
Total fixed Cost					**21 082.3**
Total cost					**451 324.4**
Profit (TZS per acre)					**(331 324.4)**

Appendix 15: Financial Enterprise Budget for central north (Tech_pack 6)

Budget for rice production per acre during 2013/14 cropping season for Central North					
Rain fed, both local and improved seeds with herbicides : Tech_pack_6					
Component	**Unit**	**Price**	**Quantity**		**Value of output**
Gross Revenue	kg	1 200.0	340		**408 000.0**
Variable Cost			**Quantity**		**Total cost**
Fertilizer	kg				-
Agrochemicals	lt	10 000.0	3		30 000.0
Seeds	kg	200	30.9		6 180.0
sub-total					**36 180.0**
Irr. Water charges	TZS				-
Mechanization services	TZS				275 334.7
Transportation cost	TZS				1 804.9
sub-total					**277 139.6**
Labour type			**Family**	**Hired**	
Ploughing	man days		20.0	-	-
Harrowing	man days		24.4	-	-
Nursery preparation	man days		-	-	-
Transplanting	man days		-	-	-
Gap filling	man days		15.0	-	-
Sowing	man days	4 000	2.7	2.0	8 000.0
Fertilizer Application	man days			-	-
First weeding	man days	4 500	15.0	7.0	31 500.0
Second weeding	man days				
Bird scaring	man days		3.0	-	-
Harvesting and Threshing	man days	8 552	15.0	26.7	228 333.3
sub-total			95.1	35.7	**267 833.3**
Total Variable Cost					**581 152.9**
Gross Margin (TZS per acre)					**(173 152.9)**
Fixed cost	**Initial value**	**Salv. value**	**E.life (yrs)**	**Tools**	
Cost of land					-
Farm implements	52 529.3	-	7	5	37 520.9
Total fixed Cost					**37 520.9**
Total cost					**618 673.8**
Profit (TZS per acre)					**(210 673.8)**

Appendix 16: Financial Enterprise Budget for Central South (Tech_pack 1)

Budget for rice production per acre during 2013/14 cropping season for Central South					
Irrigation, improved seeds and fertilizer: Tech_pack_1					
Component	**Unit**	**Price**	**Quantity**		**Value of output**
Gross Revenue	kg	1 100.0	3 092		3 401 200.0
Variable Cost			**Quantity**		**Total cost**
Fertilizer	kg	250	268.4		67 100.0
Agrochemicals	lt	0	0		-
Seeds	kg	200	17.3		3 460.0
sub-total					**70 560.0**
Irr. Water charges	TZS				147 128.2
Mechanization services	TZS				277 333.3
Transportation cost	TZS				18 407.7
sub-total					**442 869.2**
Labour type			**Family**	**Hired**	
Ploughing	man days	32 666.7	10.0	5.0	163 333.3
Harrowing	man days	8 000.0	5.0	7.0	56 000.0
Nursery preparation	man days		0.8	-	-
Transplanting	man days	9 052	7.0	10.0	90 522.2
Gap filling	man days	2 200	-	5.0	11 000.0
Sowing	man days		-	-	-
Fertilizer Application	man days		6.1	-	-
First weeding	man days		5.0	-	-
Second weeding	man days		7.0	-	-
Bird scaring	man days		-	-	-
Harvesting and Threshing	man days	7 600	10.0	10.0	76 000.0
sub-total			50.9	37.0	**396 855.5**
Total Variable Cost					**910 284.7**
Gross Margin (TZS per acre)					**2 490 915.3**
Fixed cost	**Initial value**	**Salv. value**	**E.life (yrs)**	**Tools**	
Cost of land					-
Farm implements	68 977.0	-	7	5	49 269.3
Total fixed Cost					**49 269.3**
Total cost					**959 554.0**
Profit (TZS per acre)					**2 441 646.0**

Appendix 17: Financial Enterprise Budget for Central South (Tech_pack 4)

Budget for rice production per acre during 2013/14 cropping season for Central South					
Rain fed, improved seeds, fertilizer and herbicide: Teck_pack_4					
Component	**Unit**	**Price**	**Quantity**		**Value of output**
Gross Revenue	kg	1 200.0	658		789 600.0
Variable Cost			**Quantity**		**Total cost**
Fertilizer	kg	250	54.3		13 575.0
Agrochemicals	lt	10 000.0	4		40 000.0
Seeds	kg	200	48.7		9 740.0
sub-total					**63 315.0**
Irr. Water charges	TZS				-
Mechanization services	TZS				261 943.6
Transportation cost	TZS				3 388.9
sub-total					**265 332.5**
Labour type			**Family**	**Hired**	
Ploughing	man days		15.0	-	-
Harrowing	man days		15.0	-	-
Nursery preparation	man days		-	-	-
Transplanting	man days		-	-	-
Gap filling	man days		12.2	-	-
Sowing	man days		2.4	-	-
Fertilizer Application	man days		13.8	-	-
First weeding	man days		15.0	-	-
Second weeding	man days		10.0	-	-
Bird scaring	man days		2.0	-	-
Harvesting and Threshing	man days	9 630	13.0	15.0	144 444.4
sub-total			98.4	15.0	**144 444.4**
Total Variable Cost					**473 091.9**
Gross Margin (TZS per acre)					**316 508.1**
Fixed cost	**Initial value**	**Salv. value**	**E.life (yrs)**	**Tools**	
Cost of land					-
Farm implements	26 944.4	-	7	5	19 246.0
Total fixed Cost					**19 246.0**
Total cost					**492 337.9**
Profit (TZS per acre)					**297 262.1**

Appendix 18: Financial Enterprise Budget for central south (tech_pack 5)

Budget for rice production per acre during 2013/14 cropping season for Central South					
Rain fed, local seeds only: Tech_pack 5					
Component	**Unit**	**Price**	**Quantity**		**Value of output**
Gross Revenue	kg	1 500.0	92		138 000.0
Variable Cost			**Quantity**		**Total cost**
Fertilizer	kg				-
Agrochemicals	lt				-
Seeds	kg		27.1		-
sub-total					**-**
Irr. Water charges	TZS				-
Mechanization services	TZS				231 002.20
Transportation cost	TZS				4 563.3
sub-total					**235 565.5**
Labour type			**Family**	**Hired**	
Ploughing	man days		10.0	-	-
Harrowing	man days		15.0	-	-
Nursery preparation	man days		-	-	-
Transplanting	man days		-	-	-
Gap filling	man days		5.0	-	-
Sowing	man days		4.0	-	-
Fertilizer Application	man days		-	-	-
First weeding	man days	3 639	15.0	10.0	36 388.8
Second weeding	man days	4,400	10.0	5.0	22 000.0
Bird scaring	man days		4.0	-	-
Harvesting and Threshing	man days	10 175	10.0	10.0	101 750.9
sub-total			73.0	25.0	**160 139.7**
Total Variable Cost					**395 705.2**
Gross Margin (TZS per acre)					**(257 705.2)**
Fixed cost	**Initial value**	**Salv. value**	**E.life (yrs)**	**Tools**	
Cost of land					-
Farm implements	70 153.3	0	7	5	50 109.5
Total fixed Cost					**50 109.5**
Total cost					**445 814.7**
Profit (TZS per acre)					**(307 814.7)**

Appendix 19: Financial Enterprise Budget for central south (Tech_pack 6)

Budget for rice production per acre during 2013/14 cropping season for Central South					
Rain fed, both local and improved seeds with herbicides :Tech_pack 6					
Component	**Unit**	**Price**	**Quantity**		**Value of output**
Gross Revenue	kg	1 500.0	416		624 000.0
Variable Cost			**Quantity**		**Total cost**
Fertilizer	kg				-
Agrochemicals	lt	10 000.0	2.4		24 000.0
Seeds	kg	200	27.1		5 420.0
sub-total					**29 420.0**
Irr. Water charges	TZS				-
Mechanization services	TZS				252 222.30
Transportation cost	TZS				4 889.0
sub-total					**257 111.3**
Labour type			**Family**	**Hired**	
Ploughing	man days		-	-	-
Harrowing	man days		-	-	-
Nursery preparation	man days		-	-	-
Transplanting	man days		-	-	-
Gap filling	man days		6.3	-	-
Sowing	man days		2.0	-	-
Fertilizer Application	man days		-	-	-
First weeding	man days	4 558	15.0	11.7	53 333.3
Second weeding	man days		7.8	-	-
Bird scaring	man days		-	-	-
Harvesting and Threshing	man days		15.0	15.0	176 000.0
sub-total			46.1	26.7	**229 333.3**
Total Variable Cost					**515 864.6**
Gross Margin (TZS per acre)					**108 135.4**
Fixed cost	**Initial value**	**Salv. value**	**E.life (yrs)**	**Tools**	
Cost of land					-
Farm implements	82 777.8	0	7	5	59 127.0
Total fixed Cost					**59 127.0**
Total cost					**574 991.6**
Profit (TZS per acre)					**49 008.4**

Appendix 20: Financial Enterprise Budget for zone-3 Pemba (Tech_pack 1)

Budget for rice production per acre during 2013/14 cropping season for Zone-3 Pemba					
Irrigation, improved seeds and fertilizer : Tech_pack 1					
Component	**Unit**	**Price**	**Quantity**		**Value of output**
Gross Revenue	kg	1 000.0	2 600.0		**2 600 000.0**
Variable Cost			**Quantity**		**Total cost**
Fertilizer	kg	250	186.8		46 700.0
Agrochemicals	lt				-
Seeds	kg	200	18.5		3 700.0
sub-total					**50 400.0**
Irr. Water charges	TZS				30 431.2
Mechanization services	TZS				-
Transportation cost	TZS				15 896.7
sub-total					**46 327.9**
Labour type			**Family**	**Hired**	
Ploughing	man days	15 806	15.5	10.0	158 058.6
Harrowing	man days	17 790	5.0	7.0	124 533.3
Nursery preparation	man days		0.9	-	-
Transplanting	man days	15 219	5.0	7.0	106 530.6
Gap filling	man days		7.0	-	-
Sowing	man days		-	-	-
Fertilizer Application	man days		6.7	-	-
First weeding	man days	5 450	15.0	7.0	38 149.7
Second weeding	man days	3 229	11.8	10.0	32 285.7
Bird scaring	man days		2.0	-	-
Harvesting and Threshing	man days		15.0	-	-
sub-total			83.9	41.0	**459 557.9**
Total Variable Cost					**556 285.8**
Gross Margin (TZS per acre)					**2 043 714.2**
Fixed cost	**Initial value**	**Salv. value**	**E.life (yrs)**	**Tools**	
Cost of land					**-**
Farm implements	122 755.4	0	7	6	105 218.9
Total fixed Cost					**105 218.9**
Total cost					**661 504.7**
Profit (TZS per acre)					**1 938 495.3**

Appendix 21: Financial Enterprise Budget for zone-3 Pemba (Tech_pack 2)

Budget for rice production per acre during 2013/14 cropping season for Zone-3 Pemba,					
Irrigation, local seeds and fertilizer: Tech_pack 2					
Component	**Unit**	**Price**	**Quantity**		**Value of output**
Gross Revenue	kg	1 000.0	1 590.0		**1 590 000.0**
Variable Cost			**Quantity**		**Total cost**
Fertilizer	kg	250	164		41 000.0
Agrochemicals	lt				-
Seeds	kg		17.5		-
sub-total					**41 000.0**
Irr. Water charges	TZS				39 541.7
Mechanization services	TZS				-
Transportation cost	TZS				4 351.6
sub-total					**43 893.3**
Labour type			**Family**	**Hired**	
Ploughing	man days	14 444	10.0	10.0	144 444.4
Harrowing	man days	57 093	5.0	2.0	114 185.2
Nursery preparation	man days		1.0	-	-
Transplanting	man days	16 870	10.0	5.0	84 347.8
Gap filling	man days		10.0	-	-
Sowing	man days		-	-	-
Fertilizer Application	man days		7.6	-	-
First weeding	man days	2 000	10.0	15.0	30 000.0
Second weeding	man days	4 133	5.0	10.0	41 333.3
Bird scaring	man days		2.0	-	-
Harvesting and Threshing	man days		15.0	-	-
sub-total			75.6	42.0	**414 310.7**
Total Variable Cost					**499 204.0**
Gross Margin (TZS per acre)					**1 090 796.0**
Fixed cost	**Initial value**	**Salv. value**	**E.life (yrs)**	**Tools**	
Cost of land					-
Farm implements	111 542.2	0	7	5	79 673.0
Total fixed Cost					**79 673.0**
Total cost					**578 877.0**
Profit (TZS per acre)					**1 011 123.0**

Appendix 22: Financial Enterprise Budget for zone-3 Pemba (Tech_pack 3)

Budget for rice production per acre during 2013/14 cropping season for Zone-3 Pemba						
Irrigation, both local and improved seeds only: Tech_pack 3						
Component	**Unit**	**Price**	**Quantity**		**Value of output**	
Gross Revenue	kg	1 000.0	748		**748 000.0**	
Variable Cost			**Quantity**		**Total cost**	
Fertilizer	kg		0		-	
Agrochemicals	lt		0		-	
Seeds	kg	200	15.8		3 160.0	
sub-total						**3,160.0**
Irr. Water charges	TZS					41 188.0
Mechanization services	TZS					-
Transportation cost	TZS					1 846.2
sub-total						**43,034.2**
Labour type			**Family**	**Hired**		
Ploughing	man days	14 692	15.0	10.0		146 918.4
Harrowing	man days	21 038	10.0	5.0		105 188.8
Nursery preparation	man days		1.6	-		-
Transplanting	man days	9 079	5.0	5.0		45 396.8
Gap filling	man days		7.0	-		-
Sowing	man days		-	-		-
Fertilizer Application	man days		-	-		-
First weeding	man days	12 000	15.0	5.0		60 000.0
Second weeding	man days	9 200	10.0	5.0		46 000.0
Bird scaring	man days		3.0	-		-
Harvesting and Threshing	man days		15.0	-		-
sub-total			81.6	30.0		**403 504.0**
Total Variable Cost						**449 698.2**
Gross Margin (TZS per acre)						**298 301.8**
Fixed cost	**Initial value**	**Salv. value**	**E.life (yrs)**	**Tools**		
Cost of land						**-**
Farm implements	101 423.1	0	7	5		72 445.1
Total fixed Cost						**72 445.1**
Total cost						**522 143.3**
Profit (TZS per acre)						**225 856.7**

Appendix 23: Financial Enterprise Budget for zone-3 Pemba (Tech_pack 5)

Budget for rice production per acre during 2013/14 cropping season for Zone-3 Pemba					
Rain fed, local seeds only: Tech_pack 5					
Component	**Unit**	**Price**	**Quantity**		**Value of output**
Gross Revenue	kg	1 200.0	231		**277 200.0**
Variable Cost			**Quantity**		**Total cost**
Fertilizer	kg		0		-
Agrochemicals	lt				-
Seeds	kg		20		-
sub-total			**-**		
Irr. Water charges	TZS				
Mechanization services	TZS				177 777.70
Transportation cost	TZS				5 801.5
sub-total					**183 579.2**
Labour type			**Family**	**Hired**	
Ploughing	man days	13 231	15.0	10.0	132 307.7
Harrowing	man days	23 128	10.0	5.0	115 641.0
Nursery preparation	man days		-	-	-
Transplanting	man days		-	-	-
Gap filling	man days		14.0	-	-
Sowing	man days		2.4	-	-
Fertilizer Application	man days		-	-	-
First weeding	man days	8 200	15.0	10.0	82 000.0
Second weeding	man days		10.0		
Bird scaring	man days		3.0	-	-
Harvesting and Threshing	man days	10 932	10.0	10.0	109 320.6
sub-total			79.4	35.0	**439 269.3**
Total Variable Cost					**622 848.5**
Gross Margin (TZS per acre)					**(345 648.5)**
Fixed cost	**Initial value**	**Salv. value**	**E.life (yrs)**	**Tools**	
Cost of land					**-**
Farm implements	22 297.10	0	7	4	12 741.2
Total fixed Cost					**12 741.2**
Total cost					**635 589.7**
Profit (TZS per acre)					**(358 389.7)**

Appendix 24: Financial Enterprise Budget for zone-3 Pemba (Tech_pack 6)

Budget for rice production per acre during 2013/14 cropping season for Zone-3 Pemba					
Rain fed, both local and improved seeds with herbicides : Tech_pack 6					
Component	**Unit**	**Price**	**Quantity**		**Value of output**
Gross Revenue	kg	1 200.0	423		**507 600.0**
Variable Cost			**Quantity**		**Total cost**
Fertilizer	kg		0		-
Agrochemicals	lt	10 000.0	2		20 000.0
Seeds	kg	200	38.5		7 700.0
sub-total					**27 700.0**
Irr. Water charges	TZS				
Mechanization services	TZS				141 466.70
Transportation cost	TZS				8 352.4
sub-total					**149 819.1**
Labour type			**Family**	**Hired**	
Ploughing	man days	12 748	15.0	10.0	127 479.4
Harrowing	man days	18 687	7.0	5.0	93 435.2
Nursery preparation	man days		-	-	-
Transplanting	man days		-	-	-
Gap filling	man days		5.0	-	-
Sowing	man days		3.0	-	-
Fertilizer Application	man days		-	-	-
First weeding	man days	8 942	10.0	15.0	134 133.3
Second weeding	man days		10.0	-	-
Bird scaring	man days		4.0	-	-
Harvesting and Threshing	man days	11 573	10.0	10.0	115 727.5
sub-total			64.0	40.0	**470 775.4**
Total Variable Cost					**648 294.5**
Gross Margin (TZS per acre)					**(140 694.5)**
Fixed cost	**Initial value**	**Salv. value**	**E.life (yrs)**	**Tools**	
Cost of land					**-**
Farm implements	25 928.60	0	7	5	18 520.4
Total fixed Cost					**18 520.4**
Total cost					**666 814.9**
Profit (TZS per acre)					**(159 214.9)**

Appendix 25: Economic Enterprise Budget for Central North (Tech_pack 1)

Budget for rice production per acre during 2013/14 cropping season for Central North					
Irrigation, improved seeds and fertilizer: Tech_pack 1					
Component	**Unit**	**Price**	**Quantity**		**Value of output**
Gross Revenue	kg	900	2 798.0		**2 518 200.0**
Variable Cost			**Quantity**		**Total cost**
Fertilizer	kg	1 172.0	212.4		248 932.8
Agrochemicals	lt	-	0		-
Seeds	kg	2 420.5	16.3		39,453.8
sub-total					**288 386.6**
Irr. Water charges	TZS				54 000.0
Mechanization services	lt	1 433.0	30		42 990.0
Transportation cost	TZS				41 500.0
sub-total					**138 490.0**
Labour type			**Family**	**Hired**	
Ploughing	man days	5 500.0	-	12.0	66 000.0
Harrowing	man days	5 500.0	-	7.0	38 500.0
Nursery preparation	man days	5 500.0	1.5	-	8 250.0
Transplanting	man days	5 500.0	5.0	7.0	192 500.0
Gap filling	man days	5 500.0	20.0	9.1	-
Sowing	man days	-	-	-	-
Fertilizer Application	man days	5 500.0	7.0	-	38 500.0
First weeding	man days	5 500.0	10.0	10.0	550 000.0
Second weeding	man days	5 500.0	10.0	9.0	495 000.0
Bird scaring	man days	-	-	-	-
Harvesting and Threshing	man days	5 500.0	10.0	10.0	550 000.0
sub-total			63.5	64.1	**1 938 750.0**
Total Variable Cost					**2 365 626.6**
Gross Margin (TZS per acre)					**152 573.4**
Fixed cost	**Initial value**	**Salv. value**	**E.life (yrs)**	**Tools**	
Cost of land					-
Farm implements	152 750.0	-	7	6	130 928.6
Total fixed Cost					**130 928.6**
Total cost					**2 496 555.1**
Profit (TZS per acre)					**21 644.9**

Appendix 26: Economic Enterprise Budget for Central North (Tech_pack_4)

Budget for rice production per acre during 2013/14 cropping season for Central North					
Rain fed, improved seeds, fertilizer and herbicide: Tech_pack 4					
Component	**Unit**	**Price**	**Quantity**		**Value of output**
Gross Revenue	kg	900	647		**582 300.0**
Variable Cost			**Quantity**		**Total cost**
Fertilizer	kg	1 172.0	94.6		110 871.2
Agrochemicals	lt	19 200.0	2.7		51 840.0
Seeds	kg	2 420.5	24.8		60 027.8
sub-total					**222 739.0**
Irr. Water charges	TZS				
Mechanization services	lt	1 433.0	30		42 990.0
Transportation cost	TZS				3 381.0
sub-total					**46 371.0**
Labour type			**Family**	**Hired**	
Ploughing	man days	5 500.0	10.0	-	55 000.0
Harrowing	man days	5 500.0	12.0	-	66 000.0
Nursery preparation	man days	-	-	-	-
Transplanting	man days	-	-	-	-
Gap filling	man days	5 500.0	7.0	-	38 500.0
Sowing	man days	5 500.0	2.6	3.2	45 760.0
Fertilizer Application	man days	5 500.0	10.0	-	55 000.0
First weeding	man days	5 500.0	7.0	10.0	385 000.0
Second weeding	man days	5 500.0	10.0	15.0	825 000.0
Bird scaring	man days	-	-	-	-
Harvesting and Threshing	man days	5 500.0	7.0	10.0	385 000.0
sub-total			65.6	38.2	**1 855 260.0**
Total Variable Cost					**2 124 370.0**
Gross Margin (TZS per acre)					**(1 542 070.0)**
Fixed cost	**Initial value**	**Salv. value**	**E.life (yrs)**	**Tools**	
Cost of land					**-**
Farm implements	45 921.4	-	7	5	32 801.0
Total fixed Cost					**32 801.0**
Total cost					**2 157 171.0**
Profit (TZS per acre)					**(1 574 871.0)**

Appendix 27: Economic Enterprise Budget for Central North (Tech_pack 5)

Budget for rice production per acre during 2013/14 cropping season for Central North					
Rain fed, local seeds only: Tech_pack 5					
Component	**Unit**	**Price**	**Quantity**		**Value of output**
Gross Revenue	kg	900	100		**90 000.0**
Variable Cost			**Quantity**		**Total cost**
Fertilizer	kg	1 172.0	0		-
Agrochemicals	lt				-
Seeds	kg	2 420.5	25.3		61 238.0
sub-total					**61 238.0**
Irr. Water charges	TZS				-
Mechanization services	lt	1 433.0	30		42 990.0
Transportation cost	TZS				1 021.2
sub-total					**44 011.2**
Labour type			**Family**	**Hired**	
Ploughing	man days	-	-	-	-
Harrowing	man days	-	-	-	-
Nursery preparation	man days	-	-	-	-
Transplanting	man days	-	-	-	-
Gap filling	man days	5 500.0	12.0	-	66 000.0
Sowing	man days	5 500.0	3.5	4.2	80 850.0
Fertilizer Application	man days	5 500.0	7.0	-	38 500.0
First weeding	man days	5 500.0	7.0	10.0	385 000.0
Second weeding	man days	5 500.0	7.0	10.0	385 000.0
Bird scaring	man days	30 000.0	2.0	-	60 000.0
Harvesting and Threshing	man days	5 500.0	15.0	10.0	825 000.0
sub-total			64.5	64.2	**1 840 350.0**
Total Variable Cost					**1 945 599.2**
Gross Margin (TZS per acre)					**(1 855 599.2)**
Fixed cost	**Initial value**	**Salv. value**	**E.life (yrs)**	**Tools**	
Cost of land					**-**
Farm implements	29 515.2	-	7	5	21 082.3
Total fixed Cost					**21 082.3**
Total cost					**1 966 681.5**
Profit (TZS per acre)					**(1 876 681.5)**

Appendix 28: Economic Enterprise Budget for Central North (Tech_pack 6)

Budget for rice production per acre during 2013/14 cropping season for Central North					
Rain fed, both local and improved seeds with herbicides: Tech_pack 6					
Component	**Unit**	**Price**	**Quantity**		**Value of output**
Gross Revenue	kg	900	340		**306 000.0**
Variable Cost			**Quantity**		**Total cost**
Fertilizer	kg	1 172.0	0		-
Agrochemicals	lt	19 200.0	3		57 600.0
Seeds	kg	2 420.5	30.9		74 792.7
sub-total					**132 392.7**
Irr. Water charges	TZS				-
Mechanization services	lt	1 433.0	30		42 990.0
Transportation cost	TZS				1 804.9
sub-total					**44 794.9**
Labour type			**Family**	**Hired**	
Ploughing	man days	5 500.00	20.0	-	110 000.0
Harrowing	man days	5 500.0	24.4	-	134 200.0
Nursery preparation	man days	-	-	-	-
Transplanting	man days	-	-	-	-
Gap filling	man days	5 500.0	15.0	-	82 500.0
Sowing	man days	5 500.0	2.7	2.0	29 700.0
Fertilizer Application	man days	-		-	-
First weeding	man days	5 500.0	15.0	7.0	577 500.0
Second weeding	man days	-			-
Bird scaring	man days	30 000.0	3.0	-	90 000.0
Harvesting and Threshing	man days	5 500.0	15.0	26.7	2 202 750.0
sub-total			95.1	35.7	**3 226 650.0**
Total Variable Cost					**3 403 837.6**
Gross Margin (TZS per acre)					**(3 097 837.6)**
Fixed cost	**Initial value**	**Salv. value**	**E.life (yrs)**	**Tools**	
Cost of land					**-**
Farm implements	52 529.3	-	7	5	37 520.9
Total fixed Cost					**37 520.9**
Total cost					**3 441 358.5**
Profit (TZS per acre)					**(3 135 358.5)**

Appendix 29: Economic Enterprise Budget for Central South (Tech_pack 1)

Budget for rice production per acre during 2013/14 cropping season for Central South					
Irrigation, improved seeds and fertilizer: Tech_pack 1					
Component	**Unit**	**Price**	**Quantity**		**Value of output**
Gross Revenue	kg	900	3 092.0		2 782 800.0
Variable Cost			**Quantity**		**Total cost**
Fertilizer	kg	1 172.0	268.4		314 564.8
Agrochemicals	lt	-	0		-
Seeds	kg	2 420.5	17.3		41 874.2
sub-total					**356 439.0**
Irr. Water charges	TZS				147 128.2
Mechanization services	lt	1 433.0	30		42 990.00
Transportation cost	TZS				18 407.7
sub-total					**208 525.9**
Labour type			**Family**	**Hired**	
Ploughing	man days	5 500.0	10.0	5.0	275 000.0
Harrowing	man days	5 500.0	5.0	7.0	192 500.0
Nursery preparation	man days	5 500.0	0.8	-	4 400.0
Transplanting	man days	5 500.0	7.0	10.0	385 000.0
Gap filling	man days	5 500.0	-	5.0	27 500.0
Sowing	man days	-	-	-	-
Fertilizer Application	man days	5 500.0	6.1	-	33 550.0
First weeding	man days	5 500.0	5.0	-	27 500.0
Second weeding	man days	5 500.0	7.0	-	38 500.0
Bird scaring	man days	-	-	-	-
Harvesting and Threshing	man days	5 500.0	10.0	10.0	550 000.0
sub-total			50.9	37.0	**1 533 950.0**
Total Variable Cost					**2 098 914.9**
Gross Margin (TZS per acre)					**683 885.1**
Fixed cost	**Initial value**	**Salv. value**	**E.life (yrs)**	**Tools**	
Cost of land					-
Farm implements	68 977.0	-	7	5	49 269.3
Total fixed Cost					**49 269.3**
Total cost					**2 148 184.2**
Profit (TZS per acre)					**634 615.8**

Appendix 30: Economic Enterprise Budget for Central South (tech_pack_4)

Budget for rice production per acre during 2013/14 cropping season for Central South					
Rain fed, improved seeds, fertilizer and herbicide: Tech_pack 4					
Component	**Unit**	**Price**	**Quantity**		**Value of output**
Gross Revenue	kg	900	658		592 200.0
Variable Cost			**Quantity**		**Total cost**
Fertilizer	kg	1 172.0	54.3		63 639.6
Agrochemicals	lt	19 200.0	4		76 800.0
Seeds	kg	2 420.5	48.7		117 877.2
sub-total					**258 316.8**
Irr. Water charges	TZS				-
Mechanization services	lt	1 433.0	30		42 990.0
Transportation cost	TZS				3 388.9
sub-total					**46 378.9**
Labour type			**Family**	**Hired**	
Ploughing	man days	5 500.0	15.0	-	82 500.0
Harrowing	man days	5 500.0	15.0	-	82 500.0
Nursery preparation	man days	-	-	-	-
Transplanting	man days	-	-	-	-
Gap filling	man days	5 500.0	12.2	-	67 100.0
Sowing	man days	5 500.0	2.4	-	13 200.0
Fertilizer Application	man days	5 500.0	13.8	-	75 900.0
First weeding	man days	5 500.0	15.0	-	82 500.0
Second weeding	man days	5 500.0	10.0	-	55 000.0
Bird scaring	man days	30 000.0	2.0	-	60 000.0
Harvesting and Threshing	man days	5 500.0	13.0	15.0	1 072 500.0
sub-total			98.4	15.0	**1 591 200.0**
Total Variable Cost					**1 895 895.7**
Gross Margin (TZS per acre)					**(1 303 695.7)**
Fixed cost	**Initial value**	**Salv. value**	**E.life (yrs)**	**Tools**	
Cost of land					**-**
Farm implements	26 944.4	-	7	5	19 246.0
Total fixed Cost					**19 246.0**
Total cost					**1 915 141.7**
Profit (TZS per acre)					**(1 322 941.7)**

Appendix 31: Economic Enterprise Budget for Central South (Tech_pack 5)

Budget for rice production per acre during 2013/14 cropping season for Central South					
Rain fed, local seeds only: Tech_pack 5					
Component	**Unit**	**Price**	**Quantity**		**Value of output**
Gross Revenue	kg	900	92		**82 800.0**
Variable Cost			**Quantity**		**Total cost**
Fertilizer	kg	1 172.0			-
Agrochemicals	lt	19 200.0			-
Seeds	kg	2 420.5	27.1		65 594.9
sub-total					**65 594.9**
Irr. Water charges	TZS				-
Mechanization services	lt	1 433.0	30		42 990.0
Transportation cost	TZS				4 563.3
sub-total					**47 553.3**
Labour type			**Family**	**Hired**	
Ploughing	man days	5 500.0	10.0	-	55 000.0
Harrowing	man days	5 500.0	15.0	-	82 500.0
Nursery preparation	man days	-	-	-	-
Transplanting	man days	-	-	-	-
Gap filling	man days	5 500.0	5.0	-	27 500.0
Sowing	man days	5 500.0	4.0	-	22 000.0
Fertilizer Application	man days	-	-	-	-
First weeding	man days	5 500.0	15.0	10.0	825 000.0
Second weeding	man days	5 500.0	10.0	5.0	275 000.0
Bird scaring	man days	30 000.0	4.0	-	120 000.0
Harvesting and Threshing	man days	5 500.0	10.0	10.0	550 000.0
sub-total			73.0	25.0	**1 957 000.0**
Total Variable Cost					**2 070 148.2**
Gross Margin (TZS per acre)					**(1 987 348.2)**
Fixed cost	**Initial value**	**Salv. value**	**E.life (yrs)**	**Tools**	
Cost of land					-
Farm implements	70 153.3	0	7	5	50 109.5
Total fixed Cost					**50 109.5**
Total cost					**2 120 257.7**
Profit (TZS per acre)					**(2 037 457.7)**

Appendix 32: Economic Enterprise Budget for Central South (Tech_pack 6)

Budget for rice production per acre during 2013/14 cropping season for Central South					
Rain fed, both local and improved seeds with herbicides: Tech_pack 6					
Component	**Unit**	**Price**	**Quantity**		**Value of output**
Gross Revenue	kg	900	416		**374 400.0**
Variable Cost			**Quantity**		**Total cost**
Fertilizer	kg	1 172.0			-
Agrochemicals	lt	19 200.0	2.4		46 080.0
Seeds	kg	2 420.5	27.1		65 594.9
sub-total					**111 674.9**
Irr. Water charges	TZS				-
Mechanization services	lt	1 433.0	30		42 990.00
Transportation cost	TZS				4 889.0
sub-total					**47 879.0**
Labour type			**Family**	**Hired**	
Ploughing	man days	-	-	-	-
Harrowing	man days	-	-	-	-
Nursery preparation	man days	-	-	-	-
Transplanting	man days	-	-	-	-
Gap filling	man days	5 500.0	6.3	-	34 650.0
Sowing	man days	5 500.0	2.0	-	11 000.0
Fertilizer Application	man days	-	-	-	-
First weeding	man days	5 500.0	15.0	11.7	965 250.0
Second weeding	man days	5 500.0	7.8	-	42 900.0
Bird scaring	man days	-	-	-	-
Harvesting and Threshing	man days	5 500.0	15.0	15.0	1 237 500.0
sub-total			46.1	26.7	**2 291 300.0**
Total Variable Cost					**2 450 853.9**
Gross Margin (TZS per acre)					**(2 076 453.9)**
Fixed cost	**Initial value**	**Salv. value**	**E.life (yrs)**	**Tools**	
Cost of land					-
Farm implements	82 777.8	0	7	5	59 127.0
Total fixed Cost					**59 127.0**
Total cost					**2 509 980.9**
Profit (TZS per acre)					**(2 135 580.9)**

Appendix 33: Economic Enterprise Budget for Zone-3 Pemba (Tech_pack 1)

Budget for rice production per acre during 2013/14 cropping season for Zone-3 Pemba					
Irrigation, improved seeds and fertilizer: Tech_pack 1					
Component	**Unit**	**Price**	**Quantity**		**Value of output**
Gross Revenue	kg	900	2 600.0		**2 340 000.0**
Variable Cost			**Quantity**		**Total cost**
Fertilizer	kg	1 172.0	186.8		218 929.6
Agrochemicals	lt	-	0		-
Seeds	kg	2 420.5	18.5		44 778.8
sub-total					**263 708.4**
Irr. Water charges	TZS				30 431.2
Mechanization services	lt				-
Transportation cost	TZS				15 896.7
sub-total					**46 327.9**
Labour type			**Family**	**Hired**	
Ploughing	man days	5 500.0	15.5	10.0	852 500.0
Harrowing	man days	5 500.0	5.0	7.0	192 500.0
Nursery preparation	man days	5 500.0	0.9	-	4 950.0
Transplanting	man days	5 500.0	5.0	7.0	192 500.0
Gap filling	man days	5 500.0	7.0	-	38 500.0
Sowing	man days	-	-	-	-
Fertilizer Application	man days	5 500.0	6.7	-	36 850.0
First weeding	man days	5 500.0	15.0	7.0	577 500.0
Second weeding	man days	5 500.0	11.8	10.0	649 000.0
Bird scaring	man days	30 000.0	2.0	-	60 000.0
Harvesting and Threshing	man days	5 500.0	15.0	-	82 500.0
sub-total			83.9	41.0	**2 686 800.0**
Total Variable Cost					**2 996 836.3**
Gross Margin (TZS per acre)					**(656 836.3)**
Fixed cost	**Initial value**	**Salv. value**	**E.life (yrs)**	**Tools**	
Cost of land					-
Farm implements	122 755.4	0	7	6	105 218.9
Total fixed Cost					**105 218.9**
Total cost					**3 102 055.2**
Profit (TZS per acre)					**(762 055.2)**

Appendix 34: Economic Enterprise Budget for Zone-3 Pemba (Tech_pack_2)

Budget for rice production per acre during 2013/14 cropping season for Zone-3 Pemba,					
Irrigation, local seeds and fertilizer: Tech_pack 2					
Component	**Unit**	**Price**	**Quantity**		**Value of output**
Gross Revenue	kg	900	1 590.0		**1 431 000.0**
Variable Cost			**Quantity**		**Total cost**
Fertilizer	kg	1 172.0	164		192 208.0
Agrochemicals	lt	-	0		-
Seeds	kg	2 420.5	17.5		42 358.3
sub-total					**234 566.3**
Irr. Water charges	TZS				39 541.7
Mechanization services	lt				-
Transportation cost	TZS				4 351.6
sub-total					**43 893.3**
Labour type			**Family**	**Hired**	
Ploughing	man days	5 500.0	10.0	10.0	550 000.0
Harrowing	man days	5 500.0	5.0	2.0	55 000.0
Nursery preparation	man days	5 500.0	1.0	-	5 500.0
Transplanting	man days	5 500.0	10.0	5.0	275 000.0
Gap filling	man days	5 500.0	10.0	-	55 000.0
Sowing	man days	-	-	-	-
Fertilizer Application	man days	5 500.0	7.6	-	41 800.0
First weeding	man days	5 500.0	10.0	15.0	825 000.0
Second weeding	man days	5 500.0	5.0	10.0	275 000.0
Bird scaring	man days	30 000.0	2.0	-	60 000.0
Harvesting and Threshing	man days	5 500.0	15.0	-	82 500.0
sub-total			75.6	42.0	**2 224 800.0**
Total Variable Cost					**2 503 259.6**
Gross Margin (TZS per acre)					**(1 072 259.6)**
Fixed cost	**Initial value**	**Salv. value**	**E.life (yrs)**	**Tools**	
Cost of land					**-**
Farm implements	111 542.2	0	7	5	79 673.0
Total fixed Cost					**79 673.0**
Total cost					**2 582 932.6**
Profit (TZS per acre)					**(1 151 932.6)**

Appendix 35: Economic Enterprise Budget for Zone-3 Pemba (Tech_pack_3)

Budget for rice production per acre during 2013/14 cropping season for Zone-3 Pemba					
Irrigation, both local and improved seeds only: Tech_pack 3					
Component	**Unit**	**Price**	**Quantity**		**Value of output**
Gross Revenue	kg	900	748		**673 200.0**
Variable Cost			**Quantity**		**Total cost**
Fertilizer	kg	1 172.0			-
Agrochemicals	lt	-	0		-
Seeds	kg	2 420.5	15.8		38 243.5
sub-total					**38 243.5**
Irr. Water charges	TZS				41 188.0
Mechanization services	lt				-
Transportation cost	TZS				1 846.2
sub-total					**43 034.2**
Labour type			**Family**	**Hired**	
Ploughing	man days	5 500.0	15.0	10.0	825 000.0
Harrowing	man days	5 500.0	10.0	5.0	275 000.0
Nursery preparation	man days	5 500.0	1.6	-	8 800.0
Transplanting	man days	5 500.0	5.0	5.0	137 500.0
Gap filling	man days	5 500.0	7.0	-	38 500.0
Sowing	man days	-	-	-	-
Fertilizer Application	man days	-	-	-	-
First weeding	man days	5 500.0	15.0	5.0	412 500.0
Second weeding	man days	5 500.0	10.0	5.0	275 000.0
Bird scaring	man days	30 000.0	3.0	-	90 000.0
Harvesting and Threshing	man days	5 500.0	15.0	-	82 500.0
sub-total			81.6	30.0	**2 144 800.0**
Total Variable Cost					**2 226 077.7**
Gross Margin (TZS per acre)					**(1 552 877.7)**
Fixed cost	**Initial value**	**Salv. value**	**E.life (yrs)**	**Tools**	
Cost of land					-
Farm implements	101 423.1	0	7	5	72 445.1
Total fixed Cost					**72 445.1**
Total cost					**2 298 522.8**
Profit (TZS per acre)					**(1 625 322.8)**

Appendix 36: Economic Enterprise Budget for Zone-3 Pemba (Tech_pack 5)

Budget for rice production per acre during 2013/14 cropping season for Zone-3 Pemba					
Rain fed, local seeds only: Tech_pack 5					
Component	**Unit**	**Price**	**Quantity**		**Value of output**
Gross Revenue	kg	900	231		**207 900.0**
Variable Cost			**Quantity**		**Total cost**
Fertilizer	kg				-
Agrochemicals	lt				-
Seeds	kg	2 420.5	20		48 409.5
sub-total					**48 409.5**
Irr. Water charges	TZS				
Mechanization services	TZS				42 990.0
Transportation cost	TZS				5 801.5
sub-total					**48 791.5**
Labour type			**Family**	**Hired**	
Ploughing	man days	5 500	15.0	10.0	825 000.0
Harrowing	man days	5 500	10.0	5.0	275 000.0
Nursery preparation	man days	-	-	-	-
Transplanting	man days	-	-	-	-
Gap filling	man days	5 500.0	14.0	-	77 000.0
Sowing	man days	5 500.0	2.4	-	13 200.0
Fertilizer Application	man days	-	-	-	-
First weeding	man days	5 500.0	15.0	10.0	825 000.0
Second weeding	man days	5 500.0	10.0		55 000.0
Bird scaring	man days	30 000.0	3.0	-	90 000.0
Harvesting and Threshing	man days	5 500.0	10.0	10.0	550 000.0
sub-total			79.4	35.0	**2 710 200.0**
Total Variable Cost					**2 807 401.0**
Gross Margin (TZS per acre)					**(2 599 501.0)**
Fixed cost	**Initial value**	**Salv. value**	**E.life (yrs)**	**Tools**	
Cost of land					-
Farm implements	22 297.10	0	7	4	12 741.2
Total fixed Cost					**12 741.2**
Total cost					**2 820 142.2**
Profit (TZS per acre)					**(2 612 242.2)**

Appendix 37: Economic Enterprise Budget for Zone-3 Pemba (Tech_pack_6)

Budget for rice production per acre during 2013/14 cropping season for Zone-3 Pemba,					
Rain fed, both local and improved seeds with herbicides: Tech_pack 6					
Component	**Unit**	**Price**	**Quantity**		**Value of output**
Gross Revenue	kg	900	423		**380 700.0**
Variable Cost			**Quantity**		**Total cost**
Fertilizer	kg				-
Agrochemicals	lt	19 200.0	2		38 400.0
Seeds	kg	2 420.5	38.5		93 188.3
sub-total					**131 588.3**
Irr. Water charges	TZS				
Mechanization services	TZS				42 990.00
Transportation cost	TZS				8 352.4
sub-total					**51,342.4**
Labour type			**Family**	**Hired**	
Ploughing	man days	5 500	15.0	10.0	825 000.0
Harrowing	man days	5 500	7.0	5.0	192 500.0
Nursery preparation	man days	-	-	-	-
Transplanting	man days	-	-	-	-
Gap filling	man days	5 500	5.0	-	27 500.0
Sowing	man days	5 500	3.0	-	16 500.0
Fertilizer Application	man days	-	-	-	-
First weeding	man days	5 500	10.0	15.0	825 000.0
Second weeding	man days	5 500	10.0	-	55 000.0
Bird scaring	man days	30 000	4.0	-	120 000.0
Harvesting and Threshing	man days	5 500	10.0	10.0	550 000.0
sub-total			64.0	40.0	**2 611 500.0**
Total Variable Cost					**2 794 430.7**
Gross Margin (TZS per acre)					**(2 413 730.7)**
Fixed cost	**Initial value**	**Salv. value**	**E.life (yrs)**	**Tools**	
Cost of land					-
Farm implements	25 928.60	0	7	5	18 520.4
Total fixed Cost					**18 520.4**
Total cost					**2 812 951.1**
Profit (TZS per acre)					**(2 432 251.1)**

Appendix 38: Policy Analysis Matrix of Rice Farming in Central North

TZS /acre	Revenue	Tradable inputs	Non tradable inputs	Profit
Private Prices	**A**	**B**	**C**	**D**
Tech_pack 1	3 077 800.00	243 370.70	642 019.07	2 192 410.23
Tech_pack 4	647 000.00	327 364.40	305 182.00	14 453.60
Tech_pack 5	120 000.00	235 836.80	215 487.59	-331 324.39
Tech_pack 6	408 000.00	311 514.70	307 159.13	-210 673.83
Social Prices	**E**	**F**	**G**	**H**
Tech_pack 1	2 518 200.00	288 386.55	2 165 178.57	64 634.88
Tech_pack 4	582 300.00	265 728.99	1 891 442.00	-1 574 870.99
Tech_pack 5	90 000.00	104 228.03	1 862 453.49	-1 876 681.52
Tech_pack 6	306 000.00	175 382.69	3 265 975.83	-3 135 358.52
Divergences	**I**	**J**	**K**	**L**
Tech_pack 1	559 600.00	-45 015.85	-1 523 159.50	2 127 775.35
Tech_pack 4	64 700.00	61 635.41	-1 586 260.00	1 589 324.59
Tech_pack 5	30 000.00	131 608.77	-1 646 965.90	1 545 357.13
Tech_pack 6	102 000.00	136 132.01	-2 958 816.70	2 924 684.69

Appendix 39: Policy Analysis Matrix of Rice Farming in Central South

TZS / acre	Revenue	Tradable inputs	Non tradable inputs	Profit
Private Prices	**A**	**B**	**C**	**D**
Tech_pack 1	3 401 200.00	347 893.30	611 660.69	2 441 646.01
Tech_pack 4	789 600.00	325 258.60	167 079.30	297 262.10
Tech_pack 5	138 000.00	231 002.20	214 812.50	-307 814.70
Tech_pack 6	624 000.00	281 642.30	293 349.30	49 008.40
Social Prices	**E**	**F**	**G**	**H**
Tech_pack 1	2 782 800.00	374 846.73	1 748 755.19	659 198.09
Tech_pack 4	592 200.00	301 306.76	1 613 834.90	-1 322 941.66
Tech_pack 5	82 800.00	108 584.89	2 011 672.80	-2 037 457.69
Tech_pack 6	374 400.00	154 664.89	2 355 316.00	-2 135 580.89
Divergences	**I**	**J**	**K**	**L**
Tech_pack 1	618 400.00	-26 953.43	-1 137 094.50	1 782 447.93
Tech_pack 4	197 400.00	23 951.84	-1 446 755.60	1 620 203.76
Tech_pack 5	55 200.00	122 417.31	-1 796 860.30	1 729 642.99
Tech_pack 6	249 600.00	126 977.41	-2 061 966.70	2 184 589.29

Appendix 40: Policy Analysis Matrix of Rice Farming in Zone-3 Pemba

TZS / acre	Revenue	Tradable inputs	Non tradable inputs	Profit
Private Prices	**A**	**B**	**C**	**D**
Tech_pack 1	2 600 000.00	50 400.00	611 104.71	1 938 495.29
Tech_pack 2	1 590 000.00	41 000.00	537 877.00	1 011 123.00
Tech_pack 3	748 000.00	3 160.00	518 983.27	225 856.73
Tech_pack 5	277 200.00	177 777.70	457 812.00	-358 389.70
Tech_pack 6	507 600.00	169 166.70	497 648.23	-159 214.93
Social Prices	**E**	**F**	**G**	**H**
Tech_pack 1	2 340 000.00	263 708.40	2 838 346.81	-762 055.21
Tech_pack 2	1 431 000.00	234 566.32	2 348 366.30	-1 151 932.62
Tech_pack 3	673 200.00	38 243.51	2 260 279.27	-1 625 322.78
Tech_pack 5	207 900.00	91 399.51	2 728 742.70	-2 612 242.21
Tech_pack 6	380 700.00	174 578.31	2 638 372.83	-2 432 251.14
Divergences	**I**	**J**	**K**	**L**
Tech_pack 1	260 000.00	-213 308.40	-2 227 242.10	2 700 550.50
Tech_pack 2	159 000.00	-193 566.32	-1 810 489.30	2 163 055.62
Tech_pack 3	74 800.00	-35 083.51	-1 741 296.00	1 851 179.51
Tech_pack 5	69 300.00	86 378.19	-2 270 930.70	2 253 852.51
Tech_pack 6	126 900.00	-5 411.61	-2 140 724.60	2 273 036.21

Appendix 41: Sensitivity Analysis 20% increase of world prices of outputs in central north

TZS /acre	Revenue	Tradable inputs	Non tradable inputs	Profit
Private Prices	**A**	**B**	**C**	**D**
Tech_pack 1	3 077 800.00	243 370.70	744 948.40	2 089 480.90
Tech_pack 4	647 000.00	327 364.40	273 750.00	45 885.60
Tech_pack 5	120 000.00	235 836.80	194 405.30	-310 242.10
Tech_pack 6	408 000.00	311 514.70	269 638.20	-173 152.90
Social Prices	**E**	**F**	**G**	**H**
Tech_pack 1	3 021 840.00	288 386.55	2 165 178.57	568 274.88
Tech_pack 4	698 760.00	265 728.99	1 891 442.00	-1 458 410.99
Tech_pack 5	108 000.00	104 228.03	1 862 453.49	-1 858 681.52
Tech_pack 6	367 200.00	175 382.69	3 265 975.83	-3 074 158.52
Divergences	**I**	**J**	**K**	**L**
Tech_pack 1	55 960.00	-45 015.85	-1 420 230.17	1 521 206.02
Tech_pack 4	-51 760.00	61 635.41	-1 617 692.00	1 504 296.59
Tech_pack 5	12 000.00	131 608.77	-1 668 048.19	1 548 439.42
Tech_pack 6	40 800.00	136 132.01	-2 996 337.63	2 901 005.62

Appendix 42: Sensitivity Analysis 20% decrease of world prices of outputs in central north

TZS /acre	Revenue	Tradable inputs	Non tradable inputs	Profit
Private Prices	**A**	**B**	**C**	**D**
Tech_pack 1	3 077 800.00	243 370.70	744 948.40	2 089 480.90
Tech_pack 4	647 000.00	327 364.40	273 750.00	45 885.60
Tech_pack 5	120 000.00	235 836.80	194 405.30	-310 242.10
Tech_pack 6	408 000.00	311 514.70	269 638.20	-173 152.90
Social Prices	**E**	**F**	**G**	**H**
Tech_pack 1	2 014 560.00	288 386.55	2 165 178.57	-439 005.12
Tech_pack 4	465 840.00	265 728.99	1 891 442.00	-1 69 330.99
Tech_pack 5	72 000.00	104 228.03	1 862 453.49	-1 894 681.52
Tech_pack 6	244 800.00	175 382.69	3 265 975.83	-3 196 558.52
Divergences	**I**	**J**	**K**	**L**
Tech_pack 1	1 063 240.00	-45 015.85	-1 420 230.17	2 528 486.02
Tech_pack 4	181 160.00	61 635.41	-1 617 692.00	1 737 216.59
Tech_pack 5	48 000.00	131 608.77	-1 668 048.19	1 584 439.42
Tech_pack 6	163 200.00	136 132.01	-2 996 337.63	3 023 405.62

Appendix 43: Sensitivity Analysis 20% Increase in cost of tradable inputs in central north

TZS /acre	Revenue	Tradable inputs	Non tradable inputs	Profit
Private Prices	**A**	**B**	**C**	**D**
Tech_pack 1	3 077 800.00	243 370.70	744 948.40	2 089 480.90
Tech_pack 4	647 000.00	327 364.40	273 750.00	45 885.60
Tech_pack 5	120 000.00	235 836.80	194 405.30	-310 242.10
Tech_pack 6	408 000.00	311 514.70	269 638.20	-173 152.90
Social Prices	**E**	**F**	**G**	**H**
Tech_pack 1	2 518 200.00	346 063.86	2 165 178.57	6 957.57
Tech_pack 4	582 300.00	318 874.79	1 891 442.00	-1 628 016.79
Tech_pack 5	90 000.00	125 073.64	1 862 453.49	-1 897 527.12
Tech_pack 6	306 000.00	210 459.23	3 265 975.83	-3 170 435.06
Divergences	**I**	**J**	**K**	**L**
Tech_pack 1	559 600.00	-102 693.16	-1 420 230.17	2 082 523.33
Tech_pack 4	64 700.00	8 489.61	-1 617 692.00	1 673 902.39
Tech_pack 5	30 000.00	110 763.16	-1 668 048.19	1 587 285.02
Tech_pack 6	102 000.00	101 055.47	-2 996 337.63	2 997 282.16

Appendix 44: Sensitivity Analysis 20% Decrease in cost of tradable inputs in central north

TZS /acre	Revenue	Tradable inputs	Non tradable inputs	Profit
Private Prices	**A**	**B**	**C**	**D**
Tech_pack 1	3 077 800.00	243 370.70	744 948.40	2 089 480.90
Tech_pack 4	647 000.00	327 364.40	273 750.00	45 885.60
Tech_pack 5	120 000.00	235 836.80	194 405.30	-310 242.10
Tech_pack 6	408 000.00	311 514.70	269 638.20	-173 152.90
Social Prices	**E**	**F**	**G**	**H**
Tech_pack 1	2 518 200.00	230 709.24	2 165 178.57	122 312.19
Tech_pack 4	582 300.00	212 583.19	1 891 442.00	-1 521 725.19
Tech_pack 5	90 000.00	83 382.42	1 862 453.49	-1 855 835.91
Tech_pack 6	306 000.00	140 306.15	3 265 975.83	-3 100 281.98
Divergences	**I**	**J**	**K**	**L**
Tech_pack 1	559 600.00	12 661.46	-1 420 230.17	1 967 168.71
Tech_pack 4	64 700.00	114 781.21	-1 617 692.00	1 567 610.79
Tech_pack 5	30 000.00	152 454.38	-1 668 048.19	1 545 593.81
Tech_pack 6	102 000.00	171 208.55	-2 996 337.63	2 927 129.08

Appendix 45: Sensitivity Analysis 20% Increase in output level in central north

TZS /acre	Revenue	Tradable inputs	Non tradable inputs	Profit
Private Prices	**A**	**B**	**C**	**D**
Tech_pack 1	3 693 360.00	243 370.70	744 948.40	2 705 040.90
Tech_pack 4	776 400.00	327 364.40	273 750.00	175 285.60
Tech_pack 5	144 000.00	235 836.80	194 405.30	-286 242.10
Tech_pack 6	489 600.00	311 514.70	269 638.20	-91 552.90
Social Prices	**E**	**F**	**G**	**H**
Tech_pack 1	3 021 840.00	288 386.55	2 165 178.57	568 274.88
Tech_pack 4	698 760.00	265 728.99	1 891 442.00	-1 458 410.99
Tech_pack 5	108 000.00	104 228.03	1 862 453.49	-1 858 681.52
Tech_pack 6	367 200.00	175 382.69	3 265 975.83	-3 074 158.52
Divergences	**I**	**J**	**K**	**L**
Tech_pack 1	671 520.00	-45 015.85	-1 420 230.17	2 136 766.02
Tech_pack 4	77 640.00	61 635.41	-1 617 692.00	1 633 696.59
Tech_pack 5	36 000.00	131 608.77	-1 668 048.19	1 572 439.42
Tech_pack 6	122 400.00	136 132.01	-2 996 337.63	2 982 605.62

Appendix 46: Sensitivity Analysis 20% decrease in output level in central north

TZS /acre	Revenue	Tradable inputs	Non tradable inputs	Profit
Private Prices	**A**	**B**	**C**	**D**
Tech_pack 1	2 462 240.00	243 370.70	744 948.40	1 473 920.90
Tech_pack 4	517 600.00	327 364.40	273 750.00	-83 514.40
Tech_pack 5	96 000.00	235 836.80	194 405.30	-334 242.10
Tech_pack 6	326 400.00	311 514.70	269 638.20	-254 752.90
Social Prices	**E**	**F**	**G**	**H**
Tech_pack 1	2 014 560.00	288 386.55	2 165 178.57	-439 005.12
Tech_pack 4	465 840.00	265 728.99	1 891 442.00	-1 691 330.99
Tech_pack 5	72 000.00	104 228.03	1 862 453.49	-1 894 681.52
Tech_pack 6	244 800.00	175 382.69	3 265 975.83	-3 196 558.52
Divergences	**I**	**J**	**K**	**L**
Tech_pack 1	447 680.00	-45 015.85	-1 420 230.17	1 912 926.02
Tech_pack 4	51 760.00	61 635.41	-1 617 692.00	1 607 816.59
Tech_pack 5	24 000.00	131 608.77	-1 668 048.19	1 560 439.42
Tech_pack 6	81 600.00	136 132.01	-2 996 337.63	2 941 805.62

Appendix 47: Sensitivity Analysis 5% increase of world prices of outputs in central south

TZS / acre	Revenue	Tradable inputs	Non tradable inputs	Profit
Private Prices	**A**	**B**	**C**	**D**
Tech_pack1	3 401 200.00	347 893.30	611 660.69	2 441 646.01
Tech_pack4	789 600.00	325 258.60	167 079.30	297 262.10
Tech_pack5	138 000.00	231 002.20	214 812.50	-307 814.70
Tech_pack6	624 000.00	281 642.30	293 349.30	49 008.40
Social Prices	**E**	**F**	**G**	**H**
Tech_pack1	2 921 940.00	374 846.73	1 748 755.19	798 338.09
Tech_pack4	621 810.00	301 306.76	1 613 834.90	-1 293 331.66
Tech_pack5	86 940.00	108 584.89	2 011 672.80	-2 033 317.69
Tech_pack6	393 120.00	154 664.89	2 355 316.00	-2 116 860.89
Divergences	**I**	**J**	**K**	**L**
Tech_pack1	479 260.00	-26 953.43	-1 137 094.50	1 643 307.93
Tech_pack4	167 790.00	23 951.84	-1 446 755.60	1 590 593.76
Tech_pack5	51 060.00	122 417.31	-1 796 860.30	1 725 502.99
Tech_pack6	230 880.00	126 977.41	-2 061 966.70	2 165 869.29

Appendix 48: Sensitivity Analysis 5% decrease of world prices of outputs in central south

TZS / acre	Revenue	Tradable inputs	Non tradable inputs	Profit
Private Prices	**A**	**B**	**C**	**D**
Tech_pack1	3 401 200.00	347 893.30	611 660.69	2 441 646.01
Tech_pack4	789 600.00	325 258.60	167 079.30	297 262.10
Tech_pack5	138 000.00	231 002.20	214 812.50	-307 814.70
Tech_pack6	624 000.00	281 642.30	293 349.30	49 008.40
Social Prices	**E**	**F**	**G**	**H**
Tech_pack1	2 643 660.00	374 846.73	1 748 755.19	520 058.09
Tech_pack4	562 590.00	301 306.76	1 613 834.90	-1 352 551.66
Tech_pack5	78 660.00	108 584.89	2 011 672.80	-2 041 597.69
Tech_pack6	355 680.00	154 664.89	2 355 316.00	-2 154 300.89
Divergences	**I**	**J**	**K**	**L**
Tech_pack1	757 540.00	-26 953.43	-1 137 094.50	1 921 587.93
Tech_pack4	227 010.00	23 951.84	-1 446 755.60	1 649 813.76
Tech_pack5	59 340.00	122 417.31	-1 796 860.30	1 733 782.99
Tech_pack6	268 320.00	126 977.41	-2 061 966.70	2 203 309.29

Appendix 49: Sensitivity Analysis 20% Increase in cost of tradable inputs in central south

TZS / acre	Revenue	Tradable inputs	Non tradable inputs	Profit
Private Prices	**A**	**B**	**C**	**D**
Tech_pack1	3 401 200.00	347 893.30	611 660.69	2 441 646.01
Tech_pack4	789 600.00	325 258.60	167 079.30	297 262.10
Tech_pack5	138 000.00	231 002.20	214 812.50	-307 814.70
Tech_pack6	624 000.00	281 642.30	293 349.30	49 008.40
Social Prices	**E**	**F**	**G**	**H**
Tech_pack1	2 782 800.00	449 816.07	1 748 755.19	584 228.74
Tech_pack4	592 200.00	361 568.11	1 613 834.90	-1 383 203.01
Tech_pack5	82 800.00	130 301.86	2 011 672.80	-2 059 174.66
Tech_pack6	374 400.00	185 597.86	2 355 316.00	-2 166 513.86
Divergences	**I**	**J**	**K**	**L**
Tech_pack1	618 400.00	-101 922.77	-1 137 094.50	1 857 417.27
Tech_pack4	197 400.00	-36 309.51	-1 446 755.60	1 680 465.11
Tech_pack5	55 200.00	100 700.34	-1 796 860.30	1 751 359.96
Tech_pack6	249 600.00	96 044.44	-2 061 966.70	2 215 522.26

Appendix 50: Sensitivity Analysis 20% Decrease in cost of tradable inputs in central south

TZS / acre	Revenue	Tradable inputs	Non tradable inputs	Profit
Private Prices	**A**	**B**	**C**	**D**
Tech_pack1	3 401 200.00	347 893.30	611 660.69	2 441 646.01
Tech_pack4	789 600.00	325 258.60	167 079.30	297 262.10
Tech_pack5	138 000.00	231 002.20	214 812.50	-307 814.70
Tech_pack6	624 000.00	281 642.30	293 349.30	49 008.40
Social Prices	**E**	**F**	**G**	**H**
Tech_pack1	2 782 800.00	299 877.38	1 748 755.19	734 167.43
Tech_pack4	592 200.00	241 045.40	1 613 834.90	-1 262 680.30
Tech_pack5	82 800.00	86 867.91	2 011 672.80	-2 015 740.71
Tech_pack6	374 400.00	123 731.91	2 355 316.00	-2 104 647.91
Divergences	**I**	**J**	**K**	**L**
Tech_pack1	618 400.00	48 015.92	-1 137 094.50	1 707 478.58
Tech_pack4	197 400.00	84 213.20	-1 446 755.60	1 559 942.40
Tech_pack5	55 200.00	144 134.29	-1 796 860.30	1 707 926.01
Tech_pack6	249 600.00	157 910.39	-2 061 966.70	2 153 656.31

Appendix 51: Sensitivity Analysis 5% Increase in output level in central south

TZS / acre	Revenue	Tradable inputs	Non tradable inputs	Profit
Private Prices	**A**	**B**	**C**	**D**
Tech_pack1	3 571 260.00	347 893.30	611 660.69	2 611 706.01
Tech_pack4	829 080.00	325 258.60	167 079.30	336 742.10
Tech_pack5	144 900.00	231 002.20	214 812.50	-300 914.70
Tech_pack6	655 200.00	281 642.30	293 349.30	80 208.40
Social Prices	**E**	**F**	**G**	**H**
Tech_pack1	2 921 940.00	374 846.73	1 748 755.19	798 338.09
Tech_pack4	621 810.00	301 306.76	1 613 834.90	-1 293 331.66
Tech_pack5	86 940.00	108 584.89	2 011 672.80	-2 033 317.69
Tech_pack6	393 120.00	154 664.89	2 355 316.00	-2 116 860.89
Divergences	**I**	**J**	**K**	**L**
Tech_pack1	649 320.00	-26 953.43	-1 137 094.50	1 813 367.93
Tech_pack4	207 270.00	23 951.84	-1 446 755.60	1 630 073.76
Tech_pack5	57 960.00	122 417.31	-1 796 860.30	1 732 402.99
Tech_pack6	262 080.00	126 977.41	-2 061 966.70	2 197 069.29

Appendix 52: Sensitivity Analysis 5% decrease in output level in central south

TZS / acre	Revenue	Tradable inputs	Non tradable inputs	Profit
Private Prices	**A**	**B**	**C**	**D**
Tech_pack1	3 231 140.00	347 893.30	611 660.69	2 271 586.01
Tech_pack4	750 120.00	325 258.60	167 079.30	257 782.10
Tech_pack5	131 100.00	231 002.20	214 812.50	-314 714.70
Tech_pack6	592 800.00	281 642.30	293 349.30	17 808.40
Social Prices	**E**	**F**	**G**	**H**
Tech_pack1	2 643 660.00	374 846.73	1 748 755.19	520 058.09
Tech_pack4	562 590.00	301 306.76	1 613 834.90	-1 352 551.66
Tech_pack5	78 660.00	108 584.89	2 011 672.80	-2 041 597.69
Tech_pack6	355,680.00	154,664.89	2,355,316.00	-2,154,300.89
Divergences	**I**	**J**	**K**	**L**
Tech_pack1	587 480.00	-26 953.43	-1 137 094.50	1 751 527.93
Tech_pack4	187 530.00	23 951.84	-1 446 755.60	1 610 333.76
Tech_pack5	52 440.00	122 417.31	-1 796 860.30	1 726 882.99
Tech_pack6	237 120.00	126 977.41	-2 061,966.70	2 172,109.29

Appendix 53: Sensitivity Analysis 20% increase of world prices of outputs in zone-3 Pemba

TZS / acre	Revenue	Tradable inputs	Non tradable inputs	Profit
Private Prices	**A**	**B**	**C**	**D**
Tech_pack 1	2 600 000.00	50 400.00	611 104.71	1 938 495.29
Tech_pack2	1 590 000.00	41 000.00	537 877.00	1 011 123.00
Tech_pack3	748 000.00	3 160.00	518 983.27	225 856.73
Tech_pack5	277 200.00	177 777.70	457 812.00	-358 389.70
Tech_pack6	507 600.00	169 166.70	497 648.23	-159 214.93
Social Prices	**E**	**F**	**G**	**H**
Tech_pack1	2 808 000.00	263 708.40	2 838 346.81	-294 055.21
Tech_pack2	1 717 200.00	234 566.32	2 348 366.30	-865 732.62
Tech_pack3	807 840.00	38 243.51	2 260 279.27	-1 490 682.78
Tech_pack5	249 480.00	91 399.51	2 728 742.70	-2 570 662.21
Tech_pack6	456 840.00	174 578.31	2 638 372.83	-2 356 111.14
Divergences	**I**	**J**	**K**	**L**
Tech_pack1	-208 000.00	-213 308.40	-2 227 242.10	2 232 550.50
Tech_pack2	-127 200.00	-193 566.32	-1 810 489.30	1 876 855.62
Tech_pack3	-59 840.00	-35 083.51	-1 741 296.00	1 716 539.51
Tech_pack5	27 720.00	86 378.19	-2 270 930.70	2 212 272.51
Tech_pack6	50 760.00	-5 411.61	-2 140 724.60	2 196 896.21

Appendix 54: Sensitivity Analysis 20% decrease of world prices of outputs in zone-3 Pemba

TZS / acre	Revenue	Tradable inputs	Non tradable inputs	Profit
Private Prices	**A**	**B**	**C**	**D**
Tech_pack1	2 600 000.00	50 400.00	611 104.71	1 938 495.29
Tech_pack2	1 590 000.00	41 000.00	537 877.00	1 011 123.00
Tech_pack3	748 000.00	3 160.00	518 983.27	225 856.73
Tech_pack5	277 200.00	177 777.70	457 812.00	-358 389.70
Tech_pack6	507 600.00	169 166.70	497 648.23	-159 214.93
Social Prices	**E**	**F**	**G**	**H**
Tech_pack1	1 872 000.00	263 708.40	2 838 346.81	-1 230 055.21
Tech_pack2	1 144 800.00	234 566.32	2 348 366.30	-1 438 132.62
Tech_pack3	538 560.00	38 243.51	2 260 279.27	-1 759 962.78
Tech_pack5	166 320.00	91 399.51	2 728 742.70	-2 653 822.21
Tech_pack6	304 560.00	174 578.31	2 638 372.83	-2 508 391.14
Divergences	**I**	**J**	**K**	**L**
Tech_pack1	728 000.00	-213 308.40	-2 227 242.10	3 168 550.50
Tech_pack2	445 200.00	-193 566.32	-1 810 489.30	2 449 255.62
Tech_pack3	209 440.00	-35 083.51	-1 741 296.00	1 985 819.51
Tech_pack5	110 880.00	86 378.19	-2 270 930.70	2 295 432.51
Tech_pack6	203 040.00	-5 411.61	-2 140,724.60	2 349,176.21

Appendix 55: Sensitivity Analysis 20% Increase in cost of tradable inputs in zone-3 Pemba

TZS / acre	Revenue	Tradable inputs	Non tradable inputs	Profit
Private Prices	**A**	**B**	**C**	**D**
Tech_pack1	2 600 000.00	50 400.00	611 104.71	1 938 495.29
Tech_pack2	1 590 000.00	41 000.00	537 877.00	1 011 123.00
Tech_pack3	748 000.00	3 160.00	518 983.27	225 856.73
Tech_pack5	277 200.00	177 777.70	457 812.00	-358 389.70
Tech_pack6	507 600.00	169 166.70	497 648.23	-159 214.93
Social Prices	**E**	**F**	**G**	**H**
Tech_pack1	2 340 000.00	316 450.08	2 838 346.81	-814 796.89
Tech_pack2	1 431 000.00	281 479.59	2 348 366.30	-1 198 845.89
Tech_pack3	673 200.00	45 892.22	2 260 279.27	-1 632 971.49
Tech_pack5	207 900.00	109 679.41	2 728 742.70	-2 630 522.11
Tech_pack6	380 700.00	209 493.97	2 638 372.83	-2 467 166.80
Divergences	**I**	**J**	**K**	**L**
Tech_pack1	260 000.00	-266 050.08	-2 227 242.10	2 753 292.18
Tech_pack2	159 000.00	-240 479.59	-1 810 489.30	2 209 968.89
Tech_pack3	74 800.00	-42 732.22	-1 741 296.00	1 858 828.22
Tech_pack5	69 300.00	68 098.29	-2 270 930.70	2 272 132.41
Tech_pack6	126 900.00	-40 327.27	-2 140 724.60	2 307 951.87

Appendix 56: Sensitivity Analysis 20% Decrease in cost of tradable inputs in zone-3 Pemba

TZS / acre	Revenue	Tradable inputs	Non tradable inputs	Profit
Private Prices	**A**	**B**	**C**	**D**
Tech_pack1	2 600 000.00	50 400.00	611 104.71	1 938 495.29
Tech_pack2	1 590 000.00	41 000.00	537 877.00	1 011 123.00
Tech_pack3	748 000.00	3 160.00	518 983.27	225 856.73
Tech_pack5	277 200.00	177 777.70	457 812.00	-358 389.70
Tech_pack6	507 600.00	169 166.70	497 648.23	-159 214.93
Social Prices	**E**	**F**	**G**	**H**
Tech_pack1	2 340 000.00	210 966.72	2 838 346.81	-709 313.53
Tech_pack2	1 431 000.00	187 653.06	2 348 366.30	-1 105 019.36
Tech_pack3	673 200.00	30 594.81	2 260 279.27	-1 617 674.08
Tech_pack5	207 900.00	73 119.61	2 728 742.70	-2 593 962.31
Tech_pack6	380 700.00	139 662.65	2 638 372.83	-2 397 335.47
Divergences	**I**	**J**	**K**	**L**
Tech_pack1	260 000.00	-160 566.72	-2 227 242.10	2 647 808.82
Tech_pack2	159 000.00	-146 653.06	-1 810 489.30	2 116 142.36
Tech_pack3	74 800.00	-27 434.81	-1 741 296.00	1 843 530.81
Tech_pack5	69 300.00	104 658.09	-2 270 930.70	2 235 572.61
Tech_pack6	126 900.00	29 504.05	-2 140 724.60	2 238 120.55

Appendix 57: Sensitivity Analysis 20% Increase in output level in zone-3 Pemba

TZS / acre	Revenue	Tradable inputs	Non tradable inputs	Profit
Private Prices	**A**	**B**	**C**	**D**
Tech_pack1	3 120 000.00	50 400.00	611 104.71	2 458 495.29
Tech_pack2	1 908 000.00	41 000.00	537 877.00	1 329 123.00
Tech_pack3	897 600.00	3 160.00	518 983.27	375 456.73
Tech_pack5	332 640.00	177 777.70	457 812.00	-302 949.70
Tech_pack6	609 120.00	169 166.70	497 648.23	-57 694.93
Social Prices	**E**	**F**	**G**	**H**
Tech_pack1	2 808 000.00	263 708.40	2 838 346.81	-294 055.21
Tech_pack2	1 717 200.00	234 566.32	2 348 366.30	-865 732.62
Tech_pack3	807 840.00	38 243.51	2 260 279.27	-1 490 682.78
Tech_pack5	249 480.00	91 399.51	2 728 742.70	-2 570 662.21
Tech_pack6	456 840.00	174 578.31	2 638 372.83	-2 356 111.14
Divergences	**I**	**J**	**K**	**L**
Tech_pack1	312 000.00	-213 308.40	-2 227 242.10	2 752 550.50
Tech_pack2	190 800.00	-193 566.32	-1 810 489.30	2 194 855.62
Tech_pack3	89 760.00	-35 083.51	-1 741 296.00	1 866 139.51
Tech_pack5	83 160.00	86 378.19	-2 270 930.70	2 267 712.51
Tech_pack6	152 280.00	-5 411.61	-2 140 724.60	2 298 416.21

Appendix 58: Sensitivity Analysis 20% decrease in output level in zone-3 Pemba

TZS / acre	Revenue	Tradable inputs	Non tradable inputs	Profit
Private Prices	**A**	**B**	**C**	**D**
Tech_pack1	2 080 000.00	50 400.00	611 104.71	1 418 495.29
Tech_pack2	1 272 000.00	41 000.00	537 877.00	693 123.00
Tech_pack3	598 400.00	3 160.00	518 983.27	76 256.73
Tech_pack5	221 760.00	177 777.70	457 812.00	-413 829.70
Tech_pack6	406 080.00	169 166.70	497 648.23	-260 734.93
Social Prices	**E**	**F**	**G**	**H**
Tech_pack1	1 872 000.00	263 708.40	2 838 346.81	-1 230 055.21
Tech_pack2	1 144 800.00	234 566.32	2 348 366.30	-1 438 132.62
Tech_pack3	538 560.00	38 243.51	2 260 279.27	-1 759 962.78
Tech_pack5	166 320.00	91 399.51	2 728 742.70	-2 653 822.21
Tech_pack6	304 560.00	174 578.31	2 638 372.83	-2 508 391.14
Divergences	**I**	**J**	**K**	**L**
Tech_pack1	208 000.00	-213 308.40	-2 227 242.10	2 648 550.50
Tech_pack2	127 200.00	-193 566.32	-1 810 489.30	2 131 255.62
Tech_pack3	59 840.00	-35 083.51	-1 741 296.00	1 836 219.51
Tech_pack5	55 440.00	86 378.19	-2 270 930.70	2 239 992.51
Tech_pack6	101 520.00	-5 411.61	-2 140,724.60	2 247,656.21

Appendix 59: Survey Questionnaire

DATE…………………………… FARMER NO………………………………………

DISTRICT………..……………SHEHIA/VILLAGE……………………………………

NAME OF ENUMERATOR…………………………………………………………………

BIOPHYSICAL CONDITION: LOW LAND RICE ……………… HIGH LAND RICE

Section A: Household Characteristics

S/N		
1.	Name of Household head	
2.	Name of respondent	
3.	Relationship of respondent to Household head	
4.	Number of years in farming activities	
5.	Sex of household head (Male = 1, Female = 2)	

Codes for row no. 3

1= Head of Household, 2= Spouse, 3= Son/Daughter, 4= Father/Mother

5= Grandson/Granddaughter, 6= Other relative.

6. Particulars of all household members

S/N	Name of household members **(1)**	Relationship to Resp. **(2)**	Sex M=1 F=2 **(3)**	Age **(4)**	Education Level reached **(5)**	Involvement in farming **(6)**	Main activity (for aged 5 & above) **(7)**
1							
2							
3							
4							
5							
6							
7.							
8							
9							
10							

Codes

2	5	6	7
1 = Head of household 2 = Spouse 3= Son/daughter 4= Father/Mother 5=Grandson/Daughter 6=Other relative	1= Primary 2 = Secondary 3= Tertiary 4=Adult Education 5=Not applicable	1 = Fulltime on farm 2=Part-time on farm 3=Rarely works on farm 4=Never works on farm	1=Crop farming 2=Livestock keeping 3=Fishing 4=Government employee 5=Private NGO etc. 6=Self employed 7=Not working & available 8=Student not working 9=Student working 10= Others (specify)

7. Characterization of Land under rice production

Plot Number	Size (acres)	Location (1)	Ownership/ form of access (2)	Status of Use (3)	Source of water 2013/14 (4)	Distance from home to farmstead (5)

Codes

(1)	(2)	(3)	(4)
1=Upland 2=Lowland	1= Free lease from Gvt 2=Inherited 3=Bought 4=Rented 5=Borrowed 6=Family plot 7=Government 3-acre plot	1=Under crop 2=Fallow	1=Rain 2=Irrigation

8. LAND USE

Area operated by household under different forms of land use during 2013/14 cropping season.

Plot Number (1)	Form of Use (2)	Area (for each form of use) (3)

Codes for col. 2

1=Rice production, 2=Permanent crops, 3=Mixed crops (e.g. banana, cassava & trees) 4=Intercropping (e.g. Banana & cassava), 5=Fallow, 6=Natural Bush, 7=Planted trees 8=Unusable, 9=Uncultivated usable

9. Inputs used for rice in 2013/14 Cropping Season

a) Seed

Plot number	Variety	Unit	Quantity	Price/Unit	Source

b) Fertilizer

Plot number	Type	Unit	Quantity	Price/Unit	Source

c) Herbicides

Plot number	Type	Unit	Quantity	Price/Unit	Source

Codes on source of inputs

1=Government, 2=Private sector, 3=Own, 4=Fellow farmer

Codes for rice varieties

1= BKN-Super	4= Super BC
2= Super India	5= SARO
3=TXD-88	6= Others (Specify) ………………………………

10. Field operation

10.1Mechanization

Plot No. ……..

Operation	**Timing of operation**	**Source of power (1=Hand hoe, 2=Animal Traction, 3=Tractorization, 4= Power tiller)**	**Source (1=Govt, 2=Private Sector, 3=Cooperative Union, 4=fellow farmer 5=own**	**Cost (TZS)**
Ploughing				
Harrowing				
Levelling				

11. Labour

Plot No. ……

Operation	Family labour				Hired labour				
	No. of days	Av. No. of hours/ day	No. of Adults	No. of children	No. of days	Av. No. of hours/ day	No. of Adults	No. of children	Cost
Ploughing									
Harrowing									
Levelling									
Basal Application									
Sowing									
Nursery preparation									
Transplanting									
Thinning									
Canal maintenance									
1st Weeding									
1st Irrigation									
2nd Weeding									
2nd Irrigation									
Top dressing									
Bird scaring									
Harvesting									

Plot No. ……

Operation	Family labour				Hired labour				
	No. of days	Av. No. of hours/ day	No. of Adults	No. of children	No. of days	Av. No. of hours/ day	No. of Adults	No. of children	Cost
Ploughing									
Harrowing									
Levelling									
Basal Application									
Sowing									
Nursery preparation									
Transplanting									
Thinning									
Canal maintenance									
1st Weeding									
1st Irrigation									
2nd Weeding									
2nd Irrigation									
Top dressing									
Bird scaring									
Harvesting									

Plot No. ……

Operation	Family labour				Hired labour				
	No. of days	Av. No. of hours/ day	No. of Adults	No. of children	No. of days	Av. No. of hours/ day	No. of Adults	No. of children	Cost
Ploughing									
Harrowing									
Levelling									
Basal Application									
Sowing									
Nursery preparation									
Transplanting									
Thinning									
Canal maintenance									
1st Weeding									
1st Irrigation									
2nd Weeding									
2nd Irrigation									
Top dressing									
Bird scaring									
Harvesting									

12. Irrigation costs

	Unit (2)	TZS per plot (3)	Total cost(TZS) (4)
Electricity charge			
Others …(specify)			

13. Transport Plot No. ……… Approx. distance from farm to homestead …………

Means of transport	Unit	Quantity	Family labour				Hired labour				
			No. of days	Av. No. of hours/ day	No. of Adults	No. of children	No. of days	Av. No. of hours/ day	No. of Adults	No. of children	Cost
Head											
Bicycle											
Ox-cart											
Truck											
Other											

Plot No. ……… Approximate distance from farm to homestead …………………

Means of transport	Quantity	Unit	Family labour				Hired labour				
			No. of days	Av. No. of hours/ day	No. of Adults	No. of children	No. of days	Av. No. of hours/ day	No. of Adults	No. of children	Cost
Head											
Bicycle											
Ox-cart											
Truck											
Other											

Plot No. ……… Approximate distance from farm to homestead

Means of transport	Quantity	Unit	Family labour				Hired labour				
			No. of days	Av. No. of hours /day	No. of Adults	No. of children	No. of days	Av. No. of hours/ day	No. of Adults	No. of children	Cost
Head											
Bicycle											
Ox-cart											
Truck											
Other											

…………………………

14. Labour Used for Processing Activities
Plot No. ………

Activity	Family labour				Hired labour				
	No. of days	Av. No. of hours/day	No. of Adults	No. of children	No. of days	Av. No. of hours/day	No. of Adults	No. of children	Cost
Sun drying									
Storing									
Milling									
Bagging									
Other									

15. Transportation costs from homestead to the market

Type of Transport	**Average unit price per trip (in TZS)**	**Total costs (in TZS)**
Bicycle		
Ox-cart		
Car		
Others... (Specify)		

16. Marketing costs

16.1 Costs of Agents and Middlemen (if any)

No	Activity	Unit	Price/unit (TZS)	Total costs in TZS

17. Outputs

17.1 Sales of Paddy

Number of plot	Variety (1=Improved, 2= Local)	Total harvest per plot	Farm-gate price per unit	Total revenue (TZS)

18. Sales of Rice

Number of plot	Variety (1=Improved, 2=local)	Unit	Unit price (TZS)	Total revenue (TZS)

Section B Agricultural Equipment Owned

1. What type of agricultural equipment owned. Indicate type, number and market value

Equipment	Number (Qty)	Estimated Value

SECTION C: INSTITUTIONAL SUPPORT

1. (a) Do you have an access to any credit source?

1 Yes…………………………………………………………………

2 No………………………………………………………………….

2. (a) If YES, what are your main source(s) of credit:

1. Cooperative society (SACCOS)…………………………….
2. Commercial banks……………………………………….
3. Community Development project………………………….
4. Government run credit scheme……………………………..
5. Microfinance NGOs………………………………………
6. Neighbour, friends, relatives…………………………………
7. Other (specify)…………………………………………………

3 (a). How many times did you receive credit from each source for the last cropping season and for what purpose? Also indicate total amount requested and the amount received: 2013/14

Source	**No. Of Times**	**Purpose**	**Amount Requested (TZS)**	**Amount Received**	**Cash/Kind**

(b) If No, what are your main reason(s) for being unable to access credit from credit sources?

Reasons	**Rank**
1. Could not fulfil loan conditions	
2. Procedure is too complicated	
3. Interest rate is too expensive	
4. No need, enough private money	
5.Afraid of going to an organization	
6. Religious restrictions	
7. Lack of awareness	
8. Don’t like have credit	
9. Others restrictive conditions (specify)	

4. Have you ever received advice on agriculture from extension services?

1. Yes
2. No

If No, go to Question 7

5. (a) from which source(s) do you get the extension advice

1= Government system

2= NGOs

3= Contact Farmer

4= Trader

If you have contact with an extension services, how frequent is it:

1= Very frequent - Once per every 2 weeks

2= Frequent - Once per month

3= Not frequent - Once per 3 months

4= Irregular - When I have a problem

6. What type of advice received?

a) ……………………………………………………………

b)……………………………………………………………

7. Do you read agriculture bulletin, newsletter or magazine?

1. Yes
2. No

8. Do you listen to agricultural programmes aired in radio or TV?

1. Yes
2. No

9. Are you a member of Farmers organization or any informal group?

1. Yes
2. No

SECTION D: PROCESSING AND STORAGE ASPECTS

1. What kind of material do you use on packaging your produce? ....

Plastic bags……………………………………………………1
Plastic containers……………………………………….……..2
Sacks…………………………………………………………..3
Others (specify)………………………………………………..4

2. Where do you store the processed crop before selling? ……………………………………………

1= Market warehouse 2= Warehouse at home 3= Store/granary 3=Others (specify)

3. What is the capacity of the storage house? ……………………….. (tone)
4. Do you rent storage house? …………….. 1= Yes, 2= No
5. If yes, how much do you pay per month for the rent? ……………. TZS/month
6. Are different produce types/varieties stored separately? ………… 1= Yes, 2= No

7. How long is the storage period?

Name of crop	**Frequency of processing (1= weekly, 2=monthly, 3=others)**	**Minimum period of storage (in days)**	**Maximum period of storage (in days)**	**Average quantity stored (kg)**	**Average cost of storage (TZS)**
Paddy					

8. What preservation measures are done before crop storage? ………………….

1= Sun drying 2= Use of fungicide 3= Air blowing 4= others (specify)

9. What preservation measure is done during storage? ………………………….

1= Sun drying 2= Use of fungicide 3= Air blowing 4= others (specify)

SECTION E: MARKETING ASPECTS

1. Did you sell harvested rice during 2013/14 cropping season
    1. Yes
    2. No

If yes, go to Question 2

2. Which product do you sell?

Product (1)	Where do you sell (2)	To whom do you sell (3)	Quantity sold (4)	Price/unit (5)	Revenue (6)
Rice					
Paddy					

Codes

(2)	(3)
1=At farm, 2=At home, 3=Street 4=Market, 5=Retail shops 6=Others (specify)	1=Consumers, 2=Traders, 3=Retailers 4=Processors, 5= Others (specify)

If No what was the reason for not selling your crop? …………………….............

1= Low price, 2= Low production, 3= High transport cost, 4= Cumbersome procedures, 5= Other (specify)

3. What is the perception of the respondent on marketing produce (harvested rice?)

Channels of marketing information	**Adequacy** 1=Adequate 2=Partial 3=Inadequate	**Relevance** 1=Highly relevant 2=Relevant 3=Irrelevant 4=Highly irrelevant	**Quality** 1=High quality 2=Average 3=Low quality
Television			
Radio			
Newspaper			
Extension Agent			
Farmer to Farmer			

4. What is the average distance from farm to the market? (Location of the buyer)

1= 0-0.5 km from city/town centre, 2= 0.5-5km from city/town centre 3= Over 5 km from city/town centre.

5a. what are the major problems the household facing on marketing of their produce?

Codes

Low price…………………………………………..1 Low production……………………………………2 No transport……………………………………….3 High transaction cost………………………………4 No Buyer…………………………………………..5 Lack of market information………………………6 Other (specify)……………………………………7

b. Among the mentioned market problems please list the three most important problems

1…………………………………………………………………

2…………………………………………………………………

3…………………………………………………………………

Appendix 60: Checklists

Determinants of Competitiveness and Comparative Advantage for Rice Production in Zanzibar

Zanzibar Port Authority

1) What is the fob price at your listed location? (in metric ton)
2) Port charges associated with the unloading the consignment
3) Storage charges and demurrage charges
4) Other duties and fees subject to Zanzibar rice import
5) What is your storage capacity?
6) Volume of rice import per day/month/year?

Determinants of Competitiveness and Comparative Advantage for Rice Production in Zanzibar

Ministry of Agriculture and Natural Resources-Zanzibar

1. Policies and strategy documents related to: Pricing, Marketing, Irrigation, Extension, Public investment and others concerning with rice production
2. Number rice plots and area covered under low land farming system (irrigation)
3. Number of rice plots and area covered under high land farming system (rain fed)
4. Total number of rice farmers in Zanzibar
5. Total number of rice farmers under irrigation system
6. Total number of rice farmers under rain fed system
7. Number and location of registered and unregistered millers
8. What are the basic attributes of different variety of rice grown in Zanzibar?
9. What is the conversion ratio of paddy to rice for the common variety grown in Zanzibar?

Determinants of Competitiveness and Comparative Advantage for Rice Production in Zanzibar

Ministry of Trade, Industry and Marketing, Shipping Companies & Importers

1) Transportation cost associated with rice import
2) The quality and quantity of foreign produced rice (in metric tons per year)
3) Duties and fees subject to importing fertilizers, herbicides and other agro-inputs
4) What is the price of International transport and Insurance costs differences between your listed ports? (E.g. Thailand, Vietnam, USA etc.)
5) What is the fob price at your listed location? (in metric ton)
6) Cif value and tariff rate at our country port? (per metric ton)
7) Port charges associated with the unloading the consignment
8) Storage charges and demurrage charges
9) Other duties and fees subject to Zanzibar rice import

Determinants of Competitiveness and Comparative Advantage for Rice Production in Zanzibar

Ministry of Finance and Planning

1) Exchange rate (US$ against TZS) for the period of 14 years i.e. from 2000-2014
2) What is the inflation rate and the cost of capital for the same period of time?
3) What is a foreign bill of exchange for rice import in Zanzibar?
4) What determines the c.i.f value and import duty stability on rice import?
5) How c.i.f value and import duties are set on rice import in Zanzibar?

Determinants of Competitiveness and Comparative Advantage for Rice Production in Zanzibar

BANK OF TANZANIA, TRA and OCGS

1. Exchange rate (USD against TZS) for the period of 14 years i.e. from 2000-2014

2. What is the inflation rate and the cost of capital for the same period of time?

3. What is a foreign bill of exchange for rice import in Zanzibar?

Imports and Exports from 2010 to 2015 (Rice)

	2010	**2011**	**2012**	**2013**	**2014**	**2015**
Value of imported goods in USD						
Total tax on imported goods						
Quantity in metric ton						
Exchange rate						
Value of exported goods						
Total tax on exported goods						