NEWLY INTRODUCED AVRDC VEGETABLE TECHNOLOGIES IN REDUCTION OF INCOME POVERTY: BABATI DISTRICT, TANZANIA

VICTOR LAZARO PALLANGYO

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

2015

ABSTRACT

The use of traditional technologies is one of the reasons for the poor income generation in Tanzania for vegetable growers: The Tanzanian Government has prioritized agriculture sector as a major means to fight poverty, but little emphasis has been put on the cultivation of vegetables. Hence no technological advancement in vegetables, this situation leads to small amount of yield and consequently low supply of the product hence low income generation. However, the government has done less, but, some non-governmental organizations such as AVRDC, TAHA and others have helped to innovate, facilitate and also monitor vegetable activities (introduction of new technologies).

Although, non-governmental organizations have tried to introduce new technologies to farmers the problem remained cost effectiveness of technology towards income poverty reduction.

The present study was conducted in Babati District, Manyara Region, Tanzania; specifically the study was designed to assess the profitability of the newly introduced technologies towards income poverty reduction. A total of 77 farmers were investigated by interview method, purposive sampling technique was applied and Paired sample T-test was used to assess the effectiveness of technologies and the results of the study revealed that newly introduced technologies were significant at p-value = 0.028 and 0.028 for cost and revenue, respectively.

In conclusion, the study findings show that, newly introduced technologies can be adopted by vegetable producers because profit gained by using newly introduced technologies can dramatically reduce income poverty of vegetable producers.

DECLARATION

I, Victor Lazaro Pallangyo, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation 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.

_____ _____

Victor LazaroPallangyoDate

(MARD Candidate)

The above declaration is confirmed:

_____ _____

Dr. B. KazuzuruDate

(Supervisor)

ACKNOWLEDGEMENT

I thank God the Almighty for providing me with health, courage, strength, guidance, and patience for, I understand, without Him I could not have be able to accomplish this study. I wish to take the privilege to acknowledge a number of people who have greatly contributed to the final production of this thesis.

I would like to express my sincere appreciation to my supervisor Dr B. Kazuzuru, for his wise advice, constructive criticism, tireless guidance, time, encouragement and awesome commitment. Without him my academic dreams would not have become a reality, may the Almighty God grant you with his glory, peace and blessings.

I am profoundly grateful and indebted to Dr Victor Afari-Sefa, Agricultural Economist and Global Theme Leader-Consumption AVRDC - The World Vegetable Center Eastern and Southern Africa for his unwavering support, for financing this study through AVRDC and other support to make sure my career is nourished. I particularly thank Dr Srinivasulu Rajendran, a post doctoral scientist (Agricultural Economics) Eastern and Southern Africa AVRDC-The World Vegetable Centre, Philip Lukumay and Inviolate for their assistance particularly during data collection.

I wish to extend my sincere thanks to all academic members of staff of the Development Studies Institute and my colleagues for their moral support, advice, and for creating a harmonious environment during my stay at the University. I am also grateful to Mr. Eliaza Mkuna, Nina Tofte Hansen (Copenhagen University), Bria Giera(California University), Godson Justine and Gerald Kinisa for their encouragements. I am also

extending my gratitude to Jolenta, Zuena, Salome and Ziggy who assisted during data collection in Babati District.

Last but not least, I wish express my sincere appreciation to my lovely family, my father Rev. Lazaro Gamaliel, My mother Eliafile Lazaro, Emanuel Lazaro, Amasia Lazaro, Evaline Lazaro, and Tulo Lazaro. I thank all for their moral and material support, patience and encouragement which in one way or another made my study successful. Outstanding thanks are extended to my respondents, who were ready to listen and responded to my questions.

COPYRIGHT

DEDICATION

I dedicate this piece of work to my mother Eliafile Lazaro and my father, Rev Lazaro G Pallangyo, my best friend Miss Suzana Samson Swila, to all my brothers and sisters for all their contributions.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

AVRDC	Asian Vegetable Research Development Centre
CBA	Cost Benefit Analysis
CIAT	Central International for Agricultural Tropical
COMTRADE	Commodity Trade
GDP	Gross Domestic Product
HODECT	Horticultural Development Tanzania
IPM	Integrated Pest Management
NBS	National Bureau of Statistics
NSGRP	National Strategy for Growth and Reduction of Poverty
TAHA	Tanzania Horticultural Association
URT	United Republic of Tanzania

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

For many decades, agriculture has been recognized as an important tool for the reduction of income poverty (Janvry and Sadoulet, 2009). According to URT (2010), agriculture deserves special consideration because of its importance in poverty reduction. Evidence from different studies (Anderson and Gugerty, 2011, Guyen, 2010, Godoy and Dewbre, 2010, Alexander e*t al.,* 2006) suggests that an increase in agricultural productivity can increase real income which will finally lead to poverty reduction. In Tanzania, agriculture remains the predominant sector and instrumental in poverty reduction (HODECT, 2010). The sector contributes 17.8% of the country GDP (URT, 2010).

The Tanzanian government has prioritized agricultural sector as a major means to fight poverty; most emphasis has been on the food crops such as maize and rice as well as cash crops such as cashew nuts, coffee and tea. Little emphasis has been put on the cultivation of vegetables (HODECT, 2005). With the use of improved technologies, vegetable crops can provide more income than cereal crops (Mubarik and Binch, 2001).

Although, the Government has given less emphasis in vegetable cultivation, some Non-Governmental Organizations such as AVRDC *(Asian Vegetable Research Development Centre),* TAHA (*Tanzania Horticultural Association*) and others have helped to innovate, facilitate and also monitor vegetable activities. For instance AVRDC Center, mobilizes resources from the public and private sectors to disseminate AVRDC's improved varieties and production methods in developing countries. The center helps farmers increase

vegetable harvests, raise incomes in poor rural and urban households, create jobs, and provide healthier more nutritious diets for families and communities (AVRDC, 2014).

AVRDC was founded in 1971 in Shanhua southern Taiwan, by the Asian Development Bank, Taiwan, Japan, the Philippines, Thailand, the United States and Vietnam. Its operations expanded into sub-Sahara African countries in 1992, including Tanzania, where the central office of central and southern Africa is located. AVRDC deals with research and conservation of Germplasm at the Regional Center for Africa in Arusha Tanzania. The focus of AVRDC is on vegetable species that are strategically important in the major regions of Africa with an aim of helping farmers to adopt new high yielding and high value varieties (Ojiewo *et al.,* 2010). AVRDC works with vegetable producers in different places in Tanzania including Babati District in Manyara Region, whereby AVRDC deals with the dissemination of newly improved technologies to farmers and farm management, specifically in vegetable production.

It is estimated that, globally horticulture annual average growth was 13% between 2001 and 2008 (HODECT, 2010) and worldwide annual growth rate of total horticultural components from 2001-2008 was 15.5 %, 14.3%, 12.3% and 20.8% in fruits, vegetable, cuts flowers, and spices respectively (COMTRADE, 2010). In spite of that, the failure of technological advancement is the major factor and has not allowed the Tanzanian horticultural industry to become established in high value international retail market channels, hence only poor returns (income) have been observed (HODECT 2010).

Vegetable production is among a strong source of income poverty reduction (Gari 2003, Weinberger and Msuya 2004, Weinberger and Lumpkin 2005; 2007, Afari- Sefa *et al*., 2012). In Tanzania, vegetable production faces two main challenges; (a) small-scale

farming and (b) use of traditional technologies which lead to poor income generation, hence producers cannot supply large buyers with sufficient quantities to make them attractive suppliers and sustain the market hence will generating enough income (HODECT, 2010).

Technological assistance seems to be so helpful, particularly through the adoption of new technologies; farmers can improve their productivity even if farmers are challenged by a shortage of land for cultivation (Uddin *et al.,* 2006). In addition, CIAT (2004) suggested that when the transformations are done in the agricultural sector from traditional form into modern, it contributes to communities' and nation's income development.

In Tanzania, specifically Babati, AVRDC through pilot study discovered that there are two groups of farmers, farmers who practice inter-cropping between vegetable and other crops (vegetable intervention) and another group of farmers who cultivate single crops, e.g. maize only (one crop producers), according to the baseline survey conducted by AVRDC in 2013, there was no significant income differences between one crop producers and vegetable intervention producers and this is the reason as to why AVRDC introduced new technologies to vegetable producers. Technological improvements from AVRDC include those on, land preparation, seeding, weed control, stacking, chemical fertilizer applications, manuring/composting, pesticide application, watering, harvesting, and packing. In addition, a study by Hallman *at el*. (2003) argues that the introduction of new technologies has an impact on female empowerment and nutritional status. The above argument indicates that the improvement of technologies on vegetable cultivation can increase indirect (income and dietary pattern) and direct profit.

This study's main objective was to assess the costs and benefits of production between traditional farm practices (old) compared to newly introduced farming technologies in Babati District, Tanzania.

1.2 Problem Statement

Vegetable farming can offer opportunities for income poverty reduction, because its production can be done with little capital investment, nonetheless, technological problem remains as a major hindrance (Tijani *et al*., 2014). Despite several efforts done by development programmes to ensure an increase in vegetable production as a good source of income, technologies are still a problem. According to NSGRP (2005), Tanzania can improve agriculture through promotion of modern technologies, especially in rural areas. Improvement in the use of technologies could help even the farmers' raise productivity of the neglected crops (vegetable) i.e. those which have not been given much emphasis by the government. AVRDC has introduced new technologies to farmers in Babati District but, the introduction of technologies is not enough unless they are economically effective for farmers; therefore, this study was designed to assess profitability of AVRDC newly introduced technologies towards income poverty reduction.

1.3 Significance of the Study

Efforts made by AVRDC to introduce new technologies for vegetable production in Babati District were yet to be verified among the farmers as to whether they are economically viable or not. However, very few technological profitability studies have so far been conducted in Tanzania particularly Manyara Region as a whole, so the findings of this study will help farmers to understand the economic effectiveness of newly introduced vegetable technologies compared to the traditional farming practices of the farmers in Babati District. To that effect recommendations would be made for a wider adoption of the technologies across the country in case the technologies are found to be

economically beneficial. The findings of this study will be shared with different stakeholders such as smallholder farmers, policy makers and development partners,in order to help with quick eradication of extreme poverty and hunger as well as to meet Millennium Development Goal 1.

1.4 Objectives of the Study

1.4.1 General objectives

To assess the economic benefits of AVRDC vegetable technologies compared to traditional farming practice in Babati District.

1.4.2 Specific objectives

I. To examine how newly introduced technologies have contributed to vegetable yield.
II. To compare cost and benefit between vegetable interventions basing on newly introduced technologies against traditional farming practices.
III. To assess farmers' perception on the quality of the vegetables produced under the new technologies.

1.5 Hypothesis (H_0)

I. Vegetable yields produced under AVRDC technologies do not differ from vegetable yield produced under traditional farming practices.
II. AVRDC introduced technologies are not more economically viable for vegetable production compared to traditional farming practices.

1.6 Research Question

What is the farmers' perception on the quality of vegetables produced under AVDRC technologies compared with that of vegetables produced under traditional farming practices?

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 definitions of key concepts

Vegetables are plants with edible parts, especially leaves or fleshy parts that are used mainly for soup or salad, or to accompany main courses, (Encarta 2008). According to Akter *et al.,* (2011), vegetables are herbaceous plants whose fruits, seeds, roots, tubers, leaves, etc., are used as food. Both exotic and indigenous vegetables are cultivated in Tanzania but there is no emphasis from the government which results into low motivation and uses of the poor technologies

2.2 Theory of the study

The study was guided by the theory of cost-benefit analysis (CBA) which is a theory and also a tool. The theory emerged from the field of welfare economics, and the principal of CBA is projects would only be undertaken if accrued benefits exceeded accrued costs (Musgrave, 1969). This theory has been used by other authors such as Bayefsky (2014) in dignity as a value in agency cost-benefit analysis, also Del Bo and Florio (2011) Public enterprises, policy adoption and planning. So this study will use the social Cost Benefit Analysis (CBA) theory to explore the profitability of technologies.

2.3 Understanding of New Technology

The evidence suggests that there are multiple pathways through which income poverty reduction can be handled to vegetable producers; firstly, increases in agricultural productivity can reduce poverty through improving real income and employment generation. But this is not a simple task if improved technologies will not be used by

farmers. Several studies (NSGRP, 2005, HODECT, 2010, Tijani*et al*., 2014,) suggest that, income poverty can be reduced by using improved technologies. Rogers (1983) stated that, technology is a design for instrumental action that reduced the uncertainty in the cause and effect relationships involved in achieving a desired outcome, while Ingold (2002), argued that technology intent is to embrace the totality of human works, in all societies and during all epochs. Improved technology is the fundamental determinant of agricultural productivity and profitability. Technology plays a vital role in agricultural activities towards human welfare; by understanding that attention has been given by the AVRDC organization through the introduction of new improved technologies to vegetable producers. For AVRDC, new technologies were on land preparation, seeding, weed control, stacking, applications of chemical fertilizer, manuring/composting, pesticide application, watering, harvesting, and packing.

2.4 Assessment of Costs and Revenues in Vegetable Production

Cost benefit analysis of Several good studies, by other scholars also conducted to assess costs and revenues of different vegetables, (Chowdhury, 1996a; Hossain, 1997; Mowla, 1998; Naher, 1998; Islam, 2000; Ahmed, 2001a, Sultana, 2005; Akhter, 2006;) However, very few technological profitability studies have so far been conducted in Tanzania particularly in Babati Manyara. However, few studies conducted on technological profitability, but, Akter *et al*., (2011), argues that, vegetables are generally crops which offer considerable promise for generating increased rural employment opportunities. In addition, Weinberger and Lumpkin (2007) vegetable production provides an employment and generation of income more than most starchy staple crop productions, and AVRDC (2001), vegetable cultivation is not the only source of nutrients, but it also creates more employment opportunities than that of growing other crops such as cereals.

Although, some NGOs try to support vegetable production by introducing modern technologies, the main challenge is that not every technology adopted can be useful because of different barriers like expensiveness of inputs, climatic change and farmer characteristics (perception and practices). Subsequently, it is more economical when costs of production are less than the revenue, and action should be taken towards modern ways against the traditional practice if the cost of production is less than or equal to the revenue generated. Factors, such climatic change and traditional farming systems (difficult to control climatic change and transfer from their daily practice i.e. traditional farming) might be an obstacle of using new technologies (Enete and Amusa 2010). Technologies which are less expensive have higher chance of being adopted by smallholder farmers (Muzari *et al*, 2012). This implies that, because most new technologies are expensive, large farmers adopt new technologies and small farmers do not. Finally introduction of new technologies leaves small farmers worse off than before (Shaner *et al*., 1982). Therefore, assessment of cost and revenue in vegetable production should be highly considered for the farmers to generate more income towards poverty income reduction.

2.5 The Importance of Improved Farming Technologies

Ilemona (2012) in Nigeria examined the adoption of improved agricultural technologies before and after and results show that the revenue of farmers after the adoption of innovations is better than that before adoption. Additionally, the same results attest to the importance of increasing agricultural productivity to farmers from 2009-2010 and finally it is clearly seen that the improvement in agricultural technology development has a great economic impact.

According to Pena and Hughes (2007) good management practices have the potential to raise the yield of vegetables grown under hot and wet conditions to ensure appropriate

availability of nutrients to plants. Moreover, Cechura (2012) assessed the contribution of technological change to technical efficiency and total productivity in Czech Republic. The results show that the technological change did not contribute significantly to the development of efficiency in production. Likewise, Makurira *et al.* (2010) conducted a study in the Makanya catchment in northern Tanzania to assess the effectiveness of newly introduced technologies and findings show that crops grown under the new improved farming system are more profitable compared to the traditional farming system.

The above, cited literature proves that new introduced technologies to farmers can either be profitable or not. In that case, assessment of new adopted technologies should be examined so that technologies may help a farmer to generate more income and finally the income poverty reduction. For instance, new technologies were introduced in Bangladesh to vegetable farmers (about 60,000 tons) and after a short period of time there was a remarkable increase in quantity, whereby the quantity increased by 258 tons. As a result farmers generated more revenue after selling their produce (revenue exceeded cost used in production). Finally newly introduced technologies lead to a reduction in income poverty because technologies were profitable to farmers (Uddin *et al.*, 2006).

2.6 AVRDC Technologies and Vegetable Productivity

Empirical literature (Afari-Sefa *et al, (*2012), Genova *et al.* (2013) proves that, the introduction of new technologies has helped vegetable producers in productivity and income generation; the World Vegetable Center has developed technologies to alleviate production challenges in different places in order to enhance nutrient availability to plants and improvement of income to farmers.

Afari-Sefa *et al, (*2012) combination of integrated community-based innovative tools and approaches in Mali helped to raise awareness of successful technology on vegetable cultivation based on variety and technology dissemination from 2008-2010 and agronomic trials of the hot pepper varieties in the seven countries suggested marketable yield range. Finally farmers requested seeds of the three new pepper varieties for planting, this intervention proved that it is possible; sometimes people are reluctant to use a technology because they don't have awareness about the ability of the technology to improve their livelihoods. Newly introduced technologies may help farmers to change their attitude and objective because of good results.

According to Genova *et al.* (2013), AVRDC introduced tomato grafting in Vietnam in 2002 through training and extension activities that facilitated the adoption process. Because of these efforts as well as the profitability of the technique to farmers, the adoption of tomato grafting by farmers in Vietnam rapidly increased since its introduction in 2002 to 100% in 2012. Furthermore, introduction by AVRDC and adoption of new improved seed and varieties in Indonesia, Malaysia, the Philippines, and Thailand resulted significant in the reduction of pesticide use that drastically reduced the cost of production and enhanced environmental health (Srinivasan, 2001).

Tomato production and its importance to household's income

How about numbering this sub-topic?

Tanzania's level of production of fresh vegetables is increasing and there is still huge production potential; however, Tanzania does not contribute much in the vegetable export market despite the fact that she is among the top 20 producers. Nonetheless, foreign exchange generated by the horticultural industry has increased from USD 46.7 million per annum in 2006/07 to USD 112.6 million in 2008/09 and USD 127.7 million in 2010/11

(MAFSC 2012). Tomatoes are among those fresh vegetables produced in Tanzania. Tomato is a very important vegetable crop in Tanzania. It has been said that tomatoes contribute a large part of the income to vegetable producers compared to other types of vegetables.

Different scholars such as Blum *et al*. (2005),Blum and Karem (2006), Barceloux *et al.* (2009), Freeman and Reimers (2010), Polívková *et al.*(2010), Shidfar *et al*. (2011), through different studies it has been discovered that tomatoes are very important to humans, for instance, tomatoes contain large amount of vitamin C, one of the most well-known tomato eating benefit is its' Lycopene content. Lycopene is a vital anti-oxidant that helps in the fight against cancerous cell formation as well as other kinds of health complications and diseases. Tomatoes also contain vitamins, A, B and C - tomatoes are the third source of vitamin C in our diet and the fourth for vitamin A, through its content in beta-carotene or pro vitamin A; - phytosterols, compounds that help to keep cholesterol under control - folic acid, which helps eliminate homocysteine, an amino acid whose metabolism is dependent on the metabolism of vitamins B complex, especially that of folic acid. Findings revealed the importance of tomatoes in many ways, and scholars suggested that, the uses of tomatoes can insure more health and income generation for producers.

The above arguments prove that, the introduction of new technologies can lead to high productivity and sustainable agriculture, particularly for vegetables. It is very important to inspire farmers with new technology and frequent training will direct them toward higher productivity and income.

2.7 Newly Introduced Technologies from AVRDC

During training by AVRDC on good practices to farmers, supervision was extended from the very early stage to the last stage. Observation and regulations were on four types of vegetables i.e. Tomatoes, African eggplant, Amaranth and sweet pepper. Basically, AVRDC taught farmers new technologies based on the following activities:-

2.6.1 Planting materials

2.6.1.1 Nursery preparation

2.6.1.2 Use of quality seeds and healthy seedlings free pathogens

- Sowing methods
- Direct sowing
- Transplanting and crop management
- Spacing

2.6.1.3 Choice of site

2.6.1.4 Land preparation

2.6.1.5 Crop field management

2.6.1.6 Plant Protection – Pest and Diseases

2.6.1.7 Harvesting

2.6.1.8 Records Keeping

2.6.1.9 Reviewing Results

2.6.1.10 Field Hygiene

2.7 Conceptual Framework

Technologies used in vegetable farming can be profitable if the cost of the input is less than the cost of the output, so farmers will make choices towards adoption of profitable technologies either traditional or modern farming. The newly introduced technologies

such as pest management, fertilizers application, quality seeds, nutrient management, and water management may influence profitability of vegetable production. Profitability of technologies will result into high yield and high quality which will lead to better price and expansion of markets, hence income generations and finally poverty reduction.

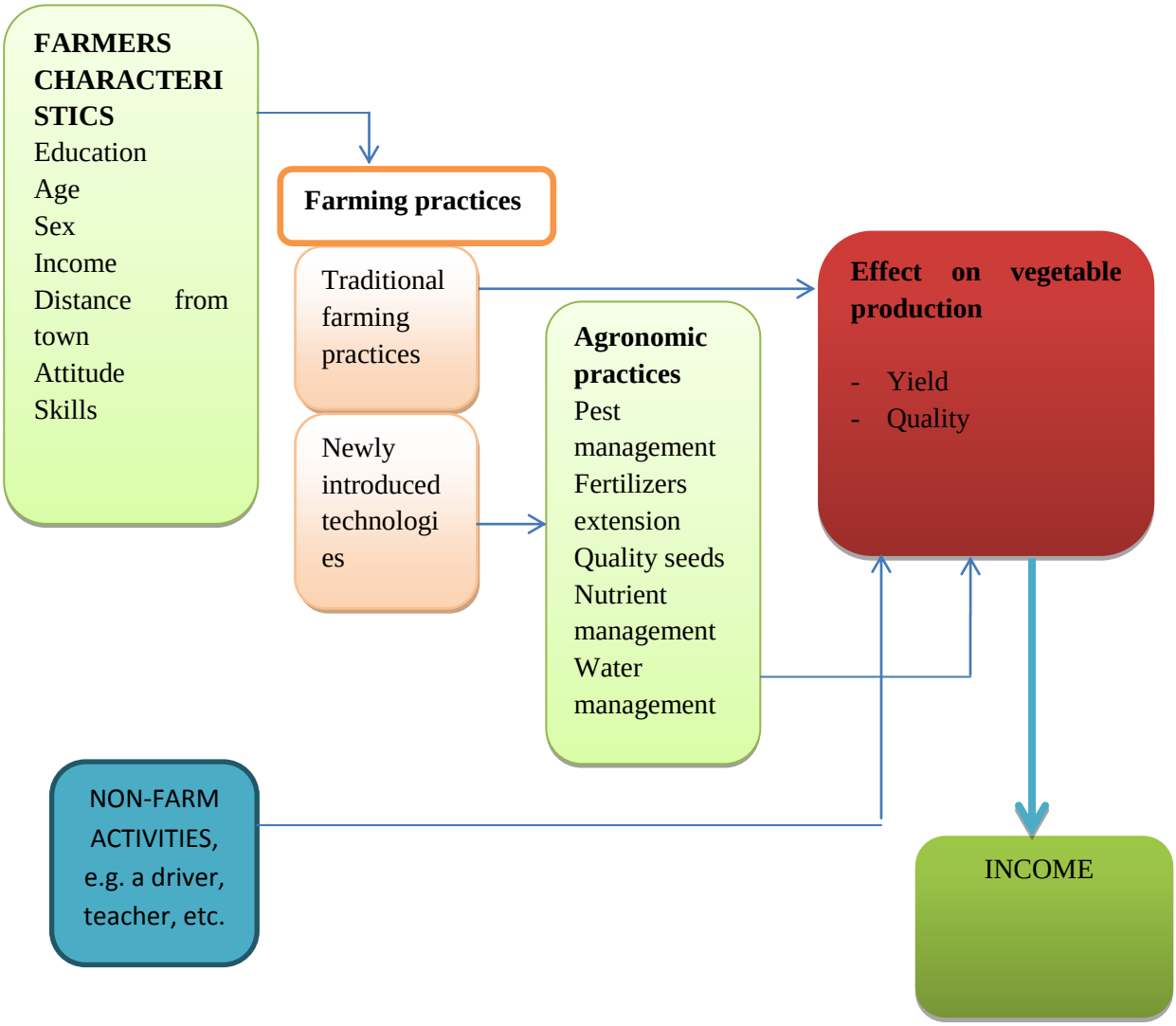


Figure 1: Conceptual framework

Farmer's characteristics, such as education, age, sex, income, distance from town, attitude and skills helps to understand the nature of farmers who participate in vegetables cultivation

and how (characteristics) they associate with income and if in one way or another might contribute to lower or higher their productivity and income.

Farming practices

These are two practices, one from AVRDC and another one is traditional farming, traditional practice is farming which does not involve technical procedure or in other words, we can say this is a farming system which does not have good agricultural practices. Basically, new introduced practices, involve, Pest management, Fertilizers extension, Quality seeds, Nutrient management and Water management.

Effect on vegetable production

Both traditional and newly introduced practices can lead to vegetable production, but this study was intended to assess the impact of new introduced technologies towards vegetable production in comparison to traditional by measuring yields and quality. Under this section, newly introduced technologies are expected to bring positive change by increasing yields and quality of vegetables.

Income

This study intended to assess income and change in income, but it depends on yield produced and its quality, whereby high yield and quality will make assurances of market availability. The most important thing is the cost of production versus revenue for both traditional and new introduced technologies by AVRDC.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Area of the Study

This study was conducted in Babati District, Tanzania. Babati is among the five districts in Manyara Region with a total population of 312 392 whereby rural dwellers are 296 203 and urban dwellers are 16 189 (NBS, 2013). It is located in the North East of Tanzania and lies between the Latitude 30- 50 south of the Equator and Longitude 350 – 370 East of Greenwich. It borders the following districts; Monduli to the North, Karatu to the North-West, Mbulu to the West, Hanang to the South-West, Kondoa to the South and Simanjiro to the East.

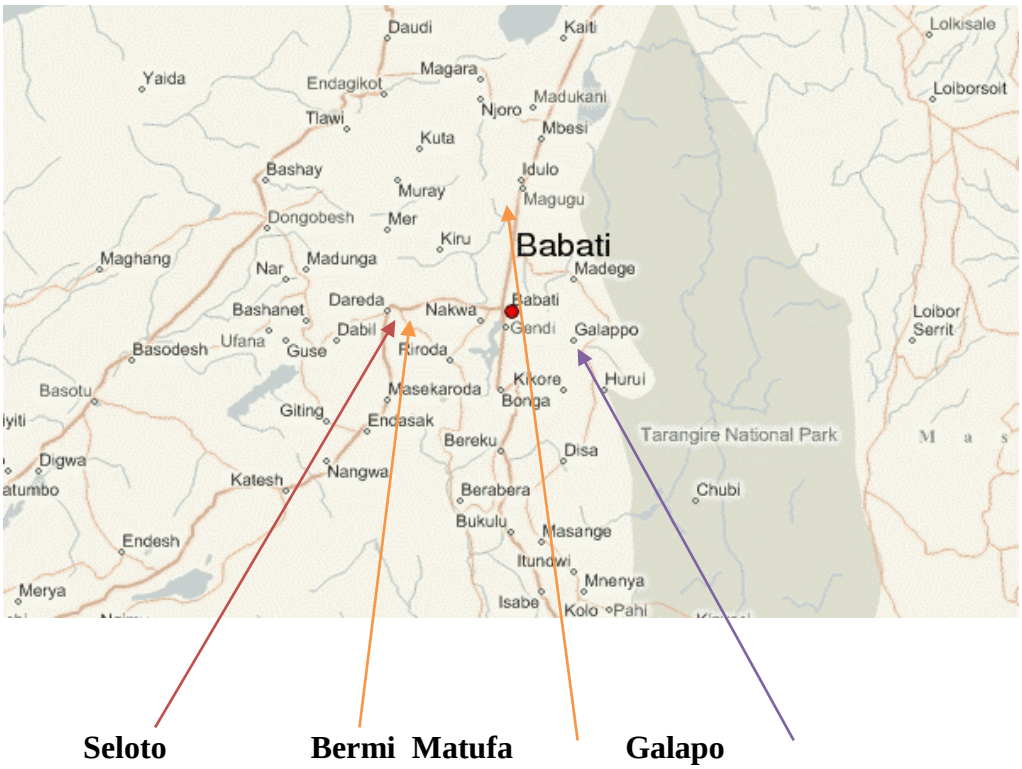


Figure 2:a map showing villages where research was conducted

Babati District has a land area of 5 608.14 square kilometres, which is equal to 92.4 % of the total area of the District. It has been estimated that, more than 95 % of Babati District inhabitants depend primarily on agriculture (crop and livestock production) for their livelihood. Agricultural activities are both crop production and livestock keeping. As a result large numbers of dwellers are farmers and pastoralists; the climate is favourable for farming, especially for maize and they have two up to three seasons of harvest. Vegetable production reaches a total average of 4 723 tons per annum. Babati also has farmers involved in some vegetable interventions and these farmers are closely monitored by the AVRDC project, as they have adopted new technologies from AVRDC. The villages involved in the project are Matufa, Seloto, Bermi, and Galapo.

3.2 Research Design

Research design, is a plan that specifies how data should be collected and analysed. The study employed a panel research design whereby farmers who were once surveyed by AVRDC in previous survey were visited again and data collected from them by the researcher with the aid of structured questionnaires and information obtained was used for comparison of farmers' performances between traditional farming and after the newly AVRDC introduced technologies.

3.3 Sampling Procedure and Sample Size

According to Bailey (1994) total number of 30 is enough for any social science research. For this study data from 77 sample size was collected, purposive sampling was used to select 77 respondents, during follow up survey sample selection was based on previous selection of AVRDC but also in order for data to be useful from respondents, first a farmer was supposed to be one of trained farmers and also availability of respondent's data before intervention. Previously, AVRDC sample was selected through simple

random sampling, from Matufa, Seloto. But it is important to note that, only 45 respondents were used in the analysis (qualified for comparison analysis)

3.4 Methods of Data Collection

Primary data were collected through surveys by using a pre-structured questionnaire and observations. In addition, secondary information (data from previous AVRDC surveys) on vegetable inputs costs collected was used (secondary data for comparison). In addition, before official data collection adesigned questionnaire was also used to conduct a pilot study to a fewer number (about 10) of farmers to measure the data which was collected in Babati District, Manyara Region, Tanzania.

3.5 Data Processing and Analysis

Both objective number one and two, natural transformation were carried out to ensure data are normal distributed as one of the most important criteria for sample paired T-test.

Objective 1:

To examine how newly introduced technology has contributed to vegetable yield production, analysis was done by using sample paired T-test to compare yield under traditional farming practices and after use AVRDC technologies.

Objective 2:

To compare costs and benefits between vegetable interventions based on introduced technologies against the traditional farming system. The objective was intended to assess profitability of newly introduced technologies against traditional farming system, and sample paired T-test was used.

Objective 3

A Likert scale was used to assess farmers' perception on the quality of the vegetables produced under the new technologies compared to those produced under the traditional farming and final data were descriptively analysed.

Study limitation

During the study, one of the major challenges was to find respondents, because the study required the same respondents in order to allow comparison of the performance of farmers before and after intervention (respondents' alteration). The study found other respondents have died, others have moved (shifted) to other places. Hence, less respondent were interviewed compared to a first interview. The solution from the above challenges was solved by analysing only found data.

CHAPTER FOUR

4.0 RESULTS OF THE STUDY

The analysis of this study was based on both, follow up surveys and panel data (collected by AVRDC before intervention) from four villages (Matufa, Seloto, Galapo, and Bermi) from three wards in Babati District. Initially, 120 respondents were surveyed by AVRDC but not all respondents were trained, nevertheless, follow up survey used only 77 respondents.

Trained farmers

Farmers in Babati, received training from AVRDC in different ways, includes, regular training through visiting their farms by AVRDC specialist, sensitization meeting, also in a field day, and preparation of trial plots in their areas. The newly introduced technologies from AVRDC, were introduced to farmers in four above mentioned villages in Babati Tanzania, previously, before newly introduced technologies farmers were using traditional way of cultivation, but AVRDC replaced by introducing new ones.

Basically, this study focused on aspects of profitability of improved technologies (good agricultural practices) including hybrid varieties of vegetable crops from AVRDC. The study assessed the effects of new technologies on household income, which may result in more income earning and finally the income poverty reduction. In addition, the study studied about farmers' opinions/perceptions of a new product after intervention in different vegetable production under AVRDC supervision.

4.1 Social-economic Characteristics of the Respondents

The study starts with socio-economic characteristics which direct or indirect effects on the three main objectives of the study. In this first section, analysisdeals with the gender,

experiences, education, occupation, head of the families also family sizes. The summary of the analysis is shown in Table 1.

Table 1: Socio-economic characteristics of the respondents

	Characteristic	Frequency	Percentage %
Gender of the respondents	Male	39	86.7
	Female	6	13.3
Age of the respondents	<19	2	4.4
	20-40	23	51.1
	40-60	19	42.2
	61>	1	2.2
Education Level	Non-educated	**0**	0.0
	Primary	41	91.1
	Secondary	2	4.4
	Advance	1	2.2
	College	1	2.2
Occupation of respondents	Agriculture	45	100.0
	Non-agriculture	0	0
	Both	0	0
Farmers' experience in vegetable production	1	24	53.3
	2	16	35.6
	3	4	8.9
	Above 3	1	2.2
Household size	1-3	**15**	33.3
	4-6	**17**	37.8
	7-9	**12**	26.7
	10-above	**1**	2.2
Household decision making	Male	30	66.7
	Female	7	15.6
	Both	8	17.6

Source: AVRDC, 2013.

Table 1, presents the socio-economic distribution of the respondents (farmers). The findings in Table 1 show that 86.7% of farmers were males and the remaining 13.3% were females. According to these results, males dominated vegetable production in the villages. These findings comply with that of Stephens (1992) who argued that though

most technologies are considered gender neutral, they are often gender biased during their introduction and use by societies/producers. In addition, based on the results above, men are more employed in vegetable cultivation and at the same time the decision maker of the families, and this is presented by 66.7% decision making of the family are males, this is clear indication that, most of the families depend more on this type of agriculture for their family prosperity by income growth and final reduction of poverty.

Findings in Table 1 also, present education level of the respondents whereby 91.1% of farmers had primary education, 4.4% had secondary education, 2.2% had advance secondary education, and 2.2 % had a college education. These findings indicate that the majority (91.1%) of the vegetable producers have primary education. The findings are in agreement with that of CIMMYT (1993) where it was reported that in Tanzania, most farmers have primary education and rely on traditional farming practices. It must be noted that, the above characteristics of farmers were collected during the first survey, education can be an obstacle on the uses of newly introduced technologies because newly introduced technologies involves some mathematical procedures. So it is possible that, producers in Babati could have produced more, but education level contributed to what they have harvested after introduction of new technologies. Apart from that, at least they have primary education compared with non-educated farmers.

Findings in Table 1 show respondents' occupations whereby 100% were practicing farming as their only occupation; these results indicate that 100% farmers in the villages had no other means of sustaining their livelihoods apart from farming. Not only in agriculture but also, specifically vegetable because AVRDC works with only vegetable producers.

Findings in Table 1 show that most of the families have 4-6 (37.8%) members followed by 1-3 members (33.3%), these findings reveal that, most of the families had more than three members, this enabled farmers to engage more in agricultural production, many times it is farmers with more labour that are able to take advantage of high production in agriculture but with less productivity. Based on the above results, family labour is not very big, so, newly introduced technologies will be so helpful to them. PADEP (2010), argued that, agriculture is the source of food and provides employment opportunities to about 80% of Tanzanians, but there is no logic of employing a huge population with less returns to extent that it takes years to change their lives. So, even if family labour is big or medium as findings shows, but, their labour will be more profitable when they have improved technologies.

However, there is a change in the area of cultivation, but still they all depend on agriculture; data show that, the previously average area cultivated was 0.874545 acres, but in this follow up survey the study finds that total average of the area of cultivation was 0.6644064 acres. Interestingly, the producers are still young and energetic; this is well shown in the table 1, whereby more than 51% are of 20-40 age. These findings are similar to those of Adesina and Forson, (1995), ages of the farmers allow them to adopt decisions and quickly use of new techniques of agriculture and this is more appropriate, especially when technologies are cost effective, and therefore more profit generation and finally income growth. If a little more emphasize will be on vegetable, particularly tomatoes, household's life will change dramatically specifically when technologies are cost effective.

4.2 Contribution of Newly Introduced Technologies to Vegetable Yield

To examine how newly introduced technologies have contributed to vegetable productivity, t-test was used to assess the difference in yields between traditional farming and farming using the AVRDC technologies.

The results from the findings show that, mean yield per farmer using traditional farming is 3 122.5 Kg, while the mean yield per framer using the new technology is 4279.2 Kg and the difference in the mean yields between the two types of farming was significant (p-value = 0.006), this suggests that, there is positive change after AVRDC intervention. Generally, the study revealed that there was a significant difference in respect to the use of improved technologies, particularly for tomato production despite a reduction in the area cultivated by farmers. According to Richard *at el*. (1998), technological improvement contributes to a dramatic growth in global agricultural productivity. This indicates that, the traditional farming system was substituted by efficiency of new technologies introduced to farmers in Babati, Tanzania, hence more productivity.

There were some changes in the area cultivated, land which was used previously was 48.1 acres, and during follow up only 28.75 acres were cultivated. Regardless of the difference in area cultivated quantity produced was more than previous quantity, if the same size of land was used productivity could have been even higher than this (4279.2kg), total area cultivated before intervention was 48.1 acres and after new technologies were 28.75 acres, and this is the proof of how new technologies are beneficial to farmers in vegetable production. Basically, the results based on the comparison of the performances of the two production systems (yield), between traditional farming and new introduced technologies and it is clearly indicated that, the new introduced technologies by AVRDC performs better than the traditional farming. Data show that, (only for surveyed farmers) there are significant changes in yields in a short period of time. Regardless of the reduction of area,

farmers by using newly introduced technologies can make the difference of 1156.7 Kg per acre which is more than one tonne per season.

4.3Cost and Benefit of AVRDC Technologies As Compared To Traditional Farming

This objective focused on the profitability of tomato farming, in the real sense, not necessarily increase in productivity may lead to increase in income so the study went beyond productivity and assess profitability in monetary form. Paired sample t-test was used to assess the profitability by taking revenue and costs involved in production (under traditional farming against newly introduced technologies).

The results, show that, mean costs per farmer under traditional farming is 139930 shs, while the mean costs per farmer using the new technology is 180790shs and the difference in the mean costs between the two types of farming was significant (p-value =. 028), this implies that, the cost per acre under traditional farming is less than the cost per acre under the new introduced AVRDC technologies.

Apart from the cost of production, the findings show that, mean revenue per farmer under the traditional farming is 886360 TShs, while the mean revenue per farmer using the new technology is 1212400 TShs and the difference in the mean revenue between the two types of farming was also significant at (p-value =. 028).

The results have shown that, traditional farming has lower cost of production than newly introduced technologies from AVRDC. But also the study has shown farming with new introduced technologies leads to higher revenue than traditional farming, which leads to higher profit of 1031610(1212400 – 180790) compared to profit earned from traditional farming(886360 - 139930) = 746430. Jumo *et al*,.(2013), argued that, in the society where

farmers are using poor traditional cultural practices, high yield and high income can be achieved by adopting modern technologies like use of certified seeds, application of recommended doses of fertilizers, etc. AVRDC technologies can be recommended towards income poverty reduction because the results indicate that, AVRDC technologies could lead to higher revenue.

4.4 Assessment of farmers' perception on the quality of the vegetables produced under the new technologies compared to those produced under the traditional farming

Objective 3 was purposely designed to assess farmers' perception on the quality of the vegetables produced under the new technologies compared to vegetables produced under the traditional farming. Farmers' perceptions on the quality of the vegetables produced under the new technologies were measured using a 5 point Likert scale which had 8 statements. Every respondent was asked to specify if he/she strongly disagrees (1), agree (2), neither agree or disagree (neutral) (3), disagree (4) and Strong agree (5) for each of the 8 statements. Later on in the analysis, the responses were categorized into three categories, strongly agree and agree into agree, neutral remained as it is, and strongly disagree and disagree into disagree. In order to understand the general responses whether respondents had favourable views, unfavourable views or indifferent views the cut-off point were created. The highest likely score was 40 points (i.e. 8×5), the lowest score was 8 (i.e. 1×8) while 24 (i.e. 8×3) was the mid score. In this case, the range of scores for favourable was from 25 to 40; the range of score for unfavourable was from 8 to 23 while 24 signified indifferent (neutral) views.

Table 2: Farmers' perceptions towards newly introduced technologies (n=45)

Statements	Agree		Neutral		Disagree	
	no	%	no	%	no	%
Vegetable size is better for market suitability	40	(89.0)	2	(4.4)	3	(6.6)
Vegetable color is more attractive	42	(93.4)	1	(2.2)	2	(4.4)
Vegetable taste is better than before	38	(84.5)	4	(8.9	3	(6.6
Vegetable Weight differs from of previous productions	40	(88.9)	4	(8.9)	1	(2.2)
For your own experience of AVRDC technologies do you prefer than previous one	38	(84.5)	1	(2.2)	6	(13.3
Other farmers, such as opinion leaders, think AVRDC technologies are good	41	(91.1)	0	(0)	4	(8.9)
It is easy to adopt AVRDC technologies	38	(84.4)	3	(6.7)	4	(8.9)
New seed varieties were available before planting period	5	(11.2)	2	(4.4)	39	(84.4)

Source: field 2014

Table 3: Overall perceptions of farmers towards newly introduced technologies (n=45)

	Frequencies	Percentage (%)
Favourable	42	94
Indifferent	1	2
Unfavourable	2	4

Source: field 2014

Farmers were supposed to provide their opinion on the quality of the vegetables produced under the new technologies. Principally, perceptions of the farmers were very important in order to understand the preference of farmers. Because technologies can be profitable but doesn't give quality vegetable for the better market. Basically opinions such as size, colour, taste and weight of vegetable produced can verify weather technologies are quality or not. Under this objective, quality of vegetable produced was used to prove effectiveness of technologies through farmer's opinions.

Table 2, shows that majority (89.0%) of the farmers, viewed that, vegetable size as better for market suitability; because they are bigger than those of traditional. Based on colour, 93.4 percent of the farmers agreed that, colour of vegetables produced under new

technologies is more attractive. For the taste of vegetables, most farmers, (84.5 percent) viewed it as better compared to vegetables under traditional farming. Similarly, 88.9 percent of the respondents indicated that, weight differs from of previous (for instance 4 tomatoes of newly introduced technologies is equivalent to 7 tomatoes of traditional farming in terms of Kg) productions and this proves that vegetable yield is much better.

Also majority of the respondents indicated that they prefer more new introduced technique, this proved by 84.5 percent of farmers who responded that they prefer more new technologies compared to traditional farming, however the response above on introduced technologies, results show that, technologies were not available or easy accessed by every farmer (probably farmers wanted everything for free). 84.4 percent of the farmers responded that, there was difficult for every farmer to access new improved seed varieties before planting. Additionally, not every farmer received the training directly from AVRDC, because trained farmers were also expected to train others so after harvesting other farmers out of the project asked farmers inside the project why training was only for a few farmers? Possibly, this could be the main reason why many farmers replied that way.

The results in Table 3 show the overall perception of farmers towards newly introduced technologies. Out of all the respondents interviewed, 42 (94%) had favourable perceptions; 1 (2%) had an indifferent perception while 2 (4%) had unfavourable perceptions towards newly introduced technologies. The overall mean score of farmer's perception towards newly introduced technologies was 32.4out of 40 which implies that the perception was positive towards newly introduced technologies, this suggest that technologies are of quality for the better market.

Based on the above results, there is positive agreement on quality of vegetables produced by newly introduced technologies from AVRDC. The statements above proved that vegetables produced under AVRDC are of quality for market suitability and finally income generation. Moustafa, (2007) argued that, vegetable producers can make profit and win the market only when technologies are cost effective and produced vegetables have required quality in the market. By using these technologies introduced by AVRDC farmers are encouraged to use them for more profit.

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

There are multiple, complex pathways linking to real income changes. Agricultural productivity and returns after harvests are among the most important pathways towards income growth. The analysis of the study comes up with some important conclusions; first of all, productivity and cost effectiveness of technologies are the most important components for income poverty reduction and by using the newly introduced technologies there is a strong evidence for direct poverty reduction through more income generation in vegetable cultivation. The study found that there is a significant change between traditional farming and newly introduced technologies, whereby, the newly introduced technologies proved to be more efficient by providing more yield and more income to producers than traditional farming. The available evidence (findings) supports the theories that projects/activity would only be undertaken if accrued benefits exceeded accrued costs.

Although, the area of vegetable cultivation under newly introduced technologies in Babati is small compared to the previous area under traditional farming, but the importance of improved technologies towards more yields cannot be overstated. The study revealed that, there is a huge change of yield compared to previous one; the study suggests that, vegetable farmers can adopt newly introduced technologies for the increase of their yields.

Furthermore, the study shows that, newly introduced technologies are cost effective, although, was expected that, technologies will be very expensive, but the analysis proved

differently by showing a slight difference (Appendix 7) between the two technologies. However, newly introduced technologies are more costfull compared to traditional farming, but also, give higher net revenue than traditional farming system.

Through the quality of vegetable produced under newly introduced technologies, vegetable growers can win the better market and increase their income by using new quality varieties and appropriate technique of vegetable cultivation, which will result in higher yields under affordable costs, and finally this will result in more income earning because of high returns to producers.

5.3 Recommendations

Based on the findings and conclusions the following are the recommendations:

- Farming Technologies should be affordable to farmers based on farmers' scarce resources, so as to enhance income growth, consequently, income poverty reduction.

- It is very important to develop a well accessible, simple means of getting inputs (technologies) to encourage the growers. The effectiveness of newly introduced technologies and promotion of vegetable cultivation toward income poverty reduction is inevitable. Furthermore, through newly introduced technologies vegetable cultivation can be an important instrument to increase the income of small farmers and to generate additional jobs only if market accessibility will be improved.

- The study recommends that, NGOs like AVRDC should work with other institutions, especially health institutions to insure farmers are also provided with

dietary diversity knowledge, not only to assess changes on dietary diversity without knowing if farmers have clear knowledge on that. As we know not necessarily increases in productivity may guarantee the improvement of dietary diversity to farmers until they have enough knowledge about dietary, by doing so the farmer's health will insure a strong future manpower (society with good health)

- Lastly, it should be noted that, in Tanzania the main source of income comes from agricultural sector and 75% of the population is engaged in agricultural activities, and vegetable production as a part of agriculture is potential for income poverty reduction, through the use of newly introduced technologies farmers canshift from the level of low productivity and little income returns. So government, institutions and other stakeholders should motivate and enforce the use of improved technologies in vegetable production in order to reduce farmer's income poverty through vegetable cultivation.

REFERENCES

Adesina, A., Baidu-Forson, J., 1995. Farmers' perception of new agricultural technology-evidence from analysis in Burkina Faso and Guinea, West Africa. *Agricultural Economics* 13, 1-9.

Adofu, I., Shaibu, S. O. and Yakubu, S. (2012). The economic impact of improved agricultural technology on cassava productivity. Kogi State of Nigeria. *International Journal of Food and Agricultural Economics* 1(1): 6 – 74.

Afari-Sefa, S. D., Theresa, E., Abdou, T., Sanjeet, K. and Paul, A. G. (2012). tools and approaches for vegetable cultivar and technology transfer in west africa: A case study of new hot pepper variety dissemination in Mali. *Journal of agriculture Extension and Rural Development* 4(15): 410 – 416.

Afari-Sefa, V., Tenkouano, A., Ojiewo, C. O., Keatinge, J. D. H. and Hughes, J. D. A. (2012). Vegetable breeding in Africa: constraints, complexity and contributions toward achieving food and nutritional security. *Food Security* 4:115-127.

Afari-Sefa, V., Dagnoko, S., Endres, T., Tenkouano, A., Kumar, S. and Gniffke, P. A. (2012). Tools and approaches for vegetable cultivar and technology transfer in West Africa: a case study of new hot pepper variety dissemination in Mali. *Journal of Agriculture Extension Rural Development* 4(15): 3 – 6.

Ahmed, J. U. (2001). A comparative economic study of potato and cauliflower production in a selected area of Comilla district. Dissertaion for Award of MSc Degree at Mymensingh, Bangladesh,

Akhter, F. (2006). Economic of selected winter vegetable production in a selected area of Trishal upazila In Mymensingh district. Dissertaion for Award of MSc Degree at Mymensingh, Bangladesh,

Akter, S., Islam, M. S. and Rahman, M. S. (2011). An economic analysis of winter vegetables production in some selected areas of Narsingdi district. *Journalof Bangladesh Agriculture University* 9(2): 241–246.

Alain de, J. and Elizabeth, S. (2009). *Agricultural Growth and Poverty ReductionAdditional Evidence.* Published by Oxford University Press, Oxford.

Alexander, S., Sara, S. and Luc, C. (2006). *The Role of Agriculture in Reducing Povertyin Tanzania:A Household Perspective From Rural, Kilimanjaro And Ruvuma.* International Association of Agricultural Economists. St Catherine's College, Oxford, England. 36pp.

Ali, M. and Hau, V. T. B. (2001). *Economic and Nutritional Impact of New Varieties and Technologies.* Technical Bulletin No. 25. Asian Vegetable Research and Development Center, 55pp.

Anderson, L. and Gugerty, M. K . (2011). Agricultural productivity and poverty reduction: *Linkages and Pathways. Spring* 1(1): 56 – 74.

Asian Vegetable Research and Development Center (2001). *Vegetables in Bangladesh:* Economics and Nutritional Impact of New Varieties and Technologies, Tainan, Taiwan.

Bailey, K. (1994). *Methods of Social Science Research*. (4th Edition). The Free Press, New York. 345pp.

Barceloux, D. and Potatoes, G. (2009), Tomatoes, and solanine toxicity (Solanum tuberosum L., Solanum lycopersicum L.). *Disease-a-Month* 55(6): 391– 402.

Bayefsky, R. (2014) Dignity as a Value in Agency Cost-Benefit Analysis. Yale Law Journal, Vol. 123 (6) 14-18

Blum, A., Merei, M. and Karem, A. (2006). Effects of tomatoes on the lipid profile. *Clinical Investment Medical* 29: 298 – 300.

Blum, A., Monir, M. and Wirsansky, I. (2005). The beneficial effects of tomatoes. *European Journal International Medicine* 16: 402– 404.

Čechura, L. (2012). Technological change in the Czech food processing industry: *What Did We Experience In The Last Decade? European Association Of Agricultural Economists 131st Seminar,* September 18 - 19, 2012, Prague, Czech Republic.

Cervantes, G. D. and Dewbre, J. (2010). *Economic Importance of Agriculture for Poverty Reduction.* Food, Agriculture and Fisheries Working Papers No. 23. OECD

Chiara Del Bo, Carlo Fiorio, Massimo Florio (2011) Shadow Wages for the EU regions, *journal of fiscal study* vol 32(1) 109-143 Blackwell Publishing Ltd

Chowdhury, S. (1996). Growth and instability of area and production of some selected winter crop in Bangladesh. Dissertation for Award of MSc Degree at Mymensingh, Bangladesh.

CIAT (2004). *Increasing the Competitiveness of Market Chains for Smallholder Producers*. Manual No. 3. Territorial Approach to Rural Agro-Enterprise Development Project.

CIMMYT Economic Program, (1993). *The Adoption of Agricultural technology: A*

De la Peña, R. and Hughes, J. (2007). Improving vegetable productivity in a variable and changing climate. *Journal of SAT. Agricultural Research* 4(1): 1 – 22.

Encarta Dictionaries (2008), Encarta World English Dictionary

Enete, A.A.; Amusa, T.A.(2010), Contribution of Men and Women to Farming Decisions in Cocoa Based Agroforestry Households of Ekiti State, Nigeria. *Tropicultura*, vol. 28, p. 77-83.

Freeman, B. B. and Reimers. K (2010). Tomato consumption and health emerging benefits. *American Journal of Lifestyle Medicine* 13: 23 – 25.

Gari, J. A. (2003). *Agrobiodiversity Strategies to Combat Food Insecurity and HIV/AIDS Impact in Rural Africa*. Food and Agriculture Organization, Rome, Italy.154pp.

Genova, C., Schreinemachers, P. and Afari-Sefa, V. (2013). An impact assessment of AVRDC's tomato grafting in Vietnam. *World Vegetable Center* 13: 752 – 773.
guide for survey design. D. F., Mexico. 88pp.

Guyen, V. C. (2010). Does agriculture help poverty and inequality reduction? evidence from Vietnam. *Agricultural Economics Review* 11(1): 44 – 56 .

HODECT (2010). Tanzania Horticultural Development Strategy 2012- 2021.
Horticultural Development Council of Tanzania 2005.

Hossain, M. M. (1997). A comparative economic analysis of some selected high yielding varieties of winter vegetable in an area of Bangladesh. Dissertationfor Award of MSc Degree at Mymensingh, Bangladesh.

Ingold T. (2002). The Perception of the Environment, Essays in livelihood, dwelling and skill. Published by Routledge Taylor & Francis Group, London and New York.. p. 294-322.

Islam, M.R. (2000) an economic analysis of winter vegetable in an area of Mymensgh District. Dissertationfor Award of MSc Degree at Mymensingh, Bangladesh.

Jumo K. B., Khalil A., Muhammad A, Nadeem S, and Muhammad N I., (2013)Economic Analysis "Cost of Production of Major Vegetables" In Balochistan, Pakistan, *Journal of Agriculture and Veterinary Science*, Volume 6(1)12-19

MAFSC (2012). *Tanzania Variety Catalogue.* Ministry of Agriculture, Food Security and Cooperatives,Dar es Salaam, Tanzania.

Makurira, H., Savenije, H. H. G. Uhlenbrook, S. (2010). Modelling field scale water partitioning using on-site observations in sub-Saharan rainfed agriculture. *Hydrology and Earth System Sciences* 14: 627 – 638.

Moustafa, A, 2007, Protected Agriculture: A Different Greenhouse Effect, Coordinator of ICARDA's Arabian Peninsula Regional Program, based in Dubai, UAE. Issue No.24

Mowla, M. G. (1998). An economic analysis of some selected Winter Vegetable in a Selected Area of Narsingdi District. Dissertation for Award of MSc Degree at Mymensingh, Bangladesh,

Muzari, W., Gatsi, W. and Muvhunzi, S. (2012). The impact of technology adoption on small holder agricultural productivity in Sub-Saharan Africa. *Journal of Sustainable Development* 5(8): 69 – 77.

Naher, S. (1998). An economic analysis of vegetables Production in Selected Area of Mymensigh District. Dissertation for Award of MSc Degree at Mymensingh, Bangladesh,

NBS (2013) National Bureau of Statistics- Tanzania.

Ojiewo, C., Tenkouano, A., Oluoch, M. and Yang, R. Y. (2010) The role of AVRDC - The World Vegetable Center in vegetable value chains. *African Journla of Horticulture Science* 3:1 – 23.

Participatory Agricultural Development and Empowerment Project (PADEP) (2010). Environmental and Social Framework Report

Polívková, Z., Šmerák, P., Demová, H. and Houška, M. (2010). Antimutagenic effects of lycopene and tomato purée. *Journal of Medicinal Food* 13 (6): 1443 –1450.

Robert S. G. G. and Geoffrey W., (1974) Investment Decisions and Institutional Constraints on Income Redistribution *journal of public economics* vol 3,171-180.

Rogers, EM 1983. Diffusion of innovations (3rd edition). The Free Press. A Division of Macmillan Publishing Co., Inc. New York. Collier Macmillan Publishers, London.

Shaner,W. W., Philipp, P. F. and Schmehl, W. R. (1982). *Farming Systems Research and Development Guidelines for Developing Countries.* Westview Press, Boulder,Colorado.

Shidfar, F., Froghifar, N., Vafa, M., Rajab, A., Hosseini, S. and Shidfar, S. (2011). The effects of tomato consumption on serum glucose, apolipoprotein B, apolipoprotein A-I, homocysteine and blood pressure in type 2 diabetic patients. *International Journal of Food Science Nutrition* 62(3): 289 – 294.

Srinivasan, R., Shelton, A. M. and Collins, H. L. (2011). *Proceedings of the Sixth International Workshop on Management of the Diamondback Moth and Other Crucifer Insect Pests*, 21-25 March 2011, AVRDC The World Vegetable Center, Taiwan. 321pp.

Stephens, A. (1992). Yes, technology is gender neutral but women in Asia might not Agree, *Ceres Journal* 108: 32 – 35.

Sultana, M. S. (2005). Economic study on commercially Produced Winter Vegetables in some selected Areas of Comilla District. Dissertaion forAward of MSc Degree at Mymensingh, Bangladesh

United Republic of Tanzania (2005). *National Strategy for Growth and Reduction of Poverty*. Government Printer,Dar es Salaam, Tanzania.156pp.

URT (2012b). *National Agriculture Policy Draft*. Government Printer, Dar es Salaam, Tanzania. 49pp.

Weinberger, K. and J. Msuya, (2004). *Indigenous vegetables in Tanzania: Significance and prospects*. Technical Bulletin No. 31. AVRDC-The World Vegetable Center, Shanhua, Taiwan.

Weinberger, K. And Lumpkin, T. A. (2007). Diversification into horticulture and poverty reduction: *Research Agenda World Development*

Weinberger, K. and T. A. Lumpkin. 2005. Horticulture for Poverty Alleviation: The Unfunded Revolution. Taiwan: The World Vegetable Center.

Websites

http://comtrade.un.org/.

Agenda World Development, Elsevier 35: 1464 – 1480.

APPENDICES

Appendix 1: Yield Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	before	3.1501	45	.48748	.07267
	after intervention	3.3743	45	.40241	.05999

Source: panel 2013 and field 2014

Appendix 2: Yield Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Before intervetion - afterintervetion	22421	.51915	.07739	.38018	.06824	2.897	44	.006

Source: panel 2013 and field 2014

Appendix 3: Costs of production Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Costs_before	4.9544	45	.43003	.06411
	Costs_after	5.1170	45	.32415	.04832

Source: panel 2013 and field 2014

Appendix 4: Costs of production Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Costs_before – costs_after	16256	.48081	.07167	30701	01811	-2.268	44	.028

Source: Panel 2013 and field 2014

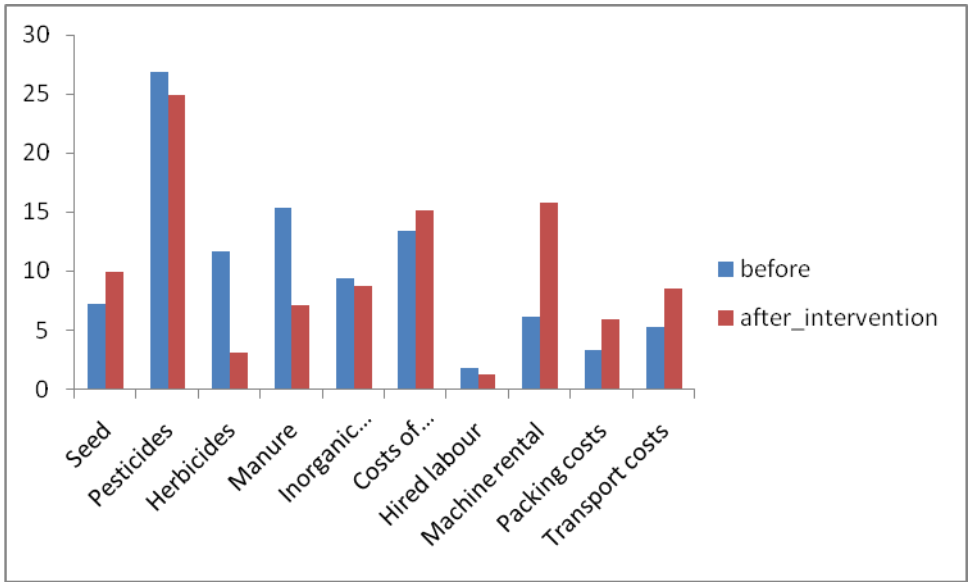
Appendix 5: Revenue Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Incomebefore-	5.6828	45	.50853	.07581
	Incomeafter	5.8980	45	.43080	.06422

Appendix 6: Revenue Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	incomebefore - incomeafter	-.21522	.63392	.09450	-.40567	-.02477	-2.278	44	.028

Appendix 7: Costs in percentage before and after intervention



Farm Household Questionnaire

Survey Starting Time: **Survey End Time:**

Date (dd/mm/yyyy)_____

Type of Sample: Baseline Survey (2013) =1; Follow-up Survey (2014) =2 [_____]

Regional Profile

1. Country: _____ 2. Region: ……..….. 3. District: ……..……4. Ward: …….…… 5. Village: ……

SECTION A: RESPONDENT IDENTIFICATION & HOUSEHOLD SOCIO-ECONOMIC CHARACTERISTICS

A1. The person in the household managing vegetable production

1.1 HH ID. [_____] 1.2 Main Vegetable Crop cultivated_____

1.3 Name of Respondent [_____] 1.4 Cell phone/Mobile No. [_____]

1.5 Name of the Household Head (if not respondent)

[_____]

1.6 Age of Respondent (No. of years) [_____] 1.7 Gender of Respondent (Male-1; Female-2)[____] 1.8 Marital Status (1=Married; 2=Single 3= Widow/Widowed 4=Divorced 5=Separated) [_____] 1.9 Educational level of Respondent (No. of years) [_____] 1.10 Total household size [____] 1.11 Occupation (code) [_____] 1.12 Type of farming? 1 = Contract only; 2 = non-contract only; 3=Both [___] 1.13 No. of Female & Male in the HH (Age group 15-50 yr) (_____ Male _____Female) 1.14 Household Head Farming Experience (No. of Years) [___] 1.15 Decision Making 1=head alone, 2=entire family [ ]

1.16 Categories of Households 1. Male-headed household 2.Female-headed household 3. Female co-head; the primary female decision maker in male-headed household _____

Enumerator Name: _____ Survey checked by: _____

To be read by the enumerator:

Recommendation to policy makers and rural community as to how farmers can gain knowledge on production, markets, consumption and nutritional benefits from African traditional vegetables and also understand adoption and diffusion process in order to improve income of farmers who grow vegetables in Tanzania. The information will not be reported as individual, and thus will be fully anonymous, without identity revealed. Do you wish to continue with the interview?____ 1=Yes 2=No"

Definitions:

Household: A household is a group of people who live together and eattogether. In our survey, a household member is someone who has lived in the household at least 6 months and at least half of the week in each week in those months. Even those persons who are not blood relations (such as servants, lodgers, or agricultural laborers) are members of the household if they have stayed in the household at least 3 months of the past 6 months and take food together. Generally, if one person stays more than 3 months out of the last 6 months outside the household, they are not considered household members. We do not include them even if other household members consider them as household members.

Reference period. The reference period that will be used for the survey is DURING CROP YEAR

Dry season –December, 2013 to May, 2014; **Rainy season** – June, 2013 to November, 2013)

Currency: The type of currency unit might varies from country to country

SECTION B: LAND AND IRRIGATION SOURCES

B1. Description of land holdings and irrigation practices

Description	Land Size (inKeret) (a)	Irrigated (inKeret) (b)	Irrigation Source	Distance of the water source from the field where vegetables are grown (In km)	Type of Irrigation	Rent in Birr perKererт		Remark
			Code (c)	(d)	Code (e)	Birr/ Keret (f)	Share (%) (g)	(h)
1. Own Area (farm and non-farm area)								
2. Own Area (Farm Land)								
3. Own Area (Cultivated Land) from (*2) Own Area (Farm Land)*								
4. Leased-out from (*2) Own Area (Farm Land)*								
5. Leased-in								
6. Net Operated Area=Own Farm Land+(leased in-leased out)								
7. No of plots								

Local unit code: * Source of irrigation code (c)*– (1) Canal (2) pond/tank (3) surface (4) ground water (5) Others*

Type of irrigation code (e): *1=Furrow without ridges, 2=Furrow with ridges, 3=Manual from tube well 4=Manual from tank/lake 5=sprinkler 6= drip 7=pump with siphons, 8=Others (specify)*

SECTION C: CROPPING PATTERN, INPUT, FARM MANAGEMENT AND MARKETING

C1. Cropping (all crops) pattern during LAST SEASON in reference period

Activities	Unit	Crop. Code ____	Crop. Code ____	Crop. Code ____	Crop. Code ____	Crop. Code ____	Crop. Code ____	Crop. Code ____	Crop. Code ____	Crop. Code ____	Crop. Code ____
		Sowing. month: _____	Sowing. month: _____	Sowing month: _____	Sowing month: _____	Sowing. month: _____	Sowing month: _____	Sowing. month: _____	Sowing month: _____	Sowing month: _____	Sowing month: _____
		Harv.month: ____	Harv.month _____	Harv.month _____	Harv.month: _____	Harv.month _____	Harv.month: _____	Harv.month: _____	Harv.month: _____	Harv.month: _____	Harv.month: _____
Cropping pattern	1=mono; 2=intercrop										
Contract Crop	Yes=1; No=2										
Area	Acres										
Variety	Name										

C2.1 Crop (major vegetable crop *(note: it should be a major crop under Seed category)* OUTPUT during LAST SEASON in reference period

SNo	Activities	Unit	Crop. Code
	Output: Seed		
1	Do you produce seeds? (***If yes, go to 2 and C3)***	1=Yes; 2=No	
2	Area	(Keret)	
3	If Yes, Seed Production	Qty	
4	Name of the Unit	Name	
5	Unit Conversion	Gram/Unit	
6	Seed Production	Qty in Gram	
7	Qty (seeds) given as gift (Gram)	Qty in Gram	
8	for seed storage (Gram)	Qty in Gram	
9	Qty by- product (kg)***(Only if by-product is sold)***	Qty in Kg	
10	Value for by- product***(Only if by-product is sold)***	Val in Birr	
11	Loss before Harvest	Qty in Kg	
12	Qty Wastage after harvest (Kg)	Qty in Kg	

C2.2 Crop (major vegetable crop *(note: it should be a major crop under Vegetable category)* OUTPUT during LAST SEASON in reference period

S/No	Activities	Unit	Crop. Code
Output: Vegetable			
1	Do you produce vegetables? (***If yes, go to 2 and C3)***	1=Yes; 2=No	
2	Area	(Acres)	
3	Vegetable Production (Unit)	Qty	
4	Name of the Unit	Name	
5	Unit Conversion	Kg/Unit	
6	Vegetable Production (Kg)	Qty in Kg	
7	Home Consumption (only vegetables)	Qty in Kg	
8	Qty (Vegetable) given as gift (Kg)	Qty in Kg	
9	Qty by- product (kg)***(Only if by-product is sold)***	Qty in Kg	
10	Value for by- product***(Only if by-product is sold)***	Val in Birr	
11	Loss before Harvest	Qty in Kg	
12	Qty Wastage after harvest (Kg)	Qty in Kg	

C3. Crop marketing during LAST SEASON in reference period

Marketing				
SNo	Activities	Unit	Vegetable seeds Crop. Code	Vegetables only Crop.Code
1	Qty Sold (Kg)	Qty in Kg		
2	No. of Transaction	No.		
3	Amount Received	Birr		
4	Source of Buyers	Code		
5	Reasons- buyers	Code		
6	Mode of payment	Code		
7	Time of Payment	Code		
8	Any input advance?	Yes=1; No=2		
9	If yes, how much?	Birr		
10	Sales location	Code		
11	Distance from home to sales location	KM		
12	Time btn. home to sales location	Hrs		
13	Transport mean	Code		
14	Transaction time on the sales location	Hrs		
15	Source of Price info	Code		
16	Packaging Cost	Birr		
17	Transportation Cost	Birr		
18	Loading and Off loading	Birr		
19	Payments at checkpoint or road-block	Birr		
20	Entry license fee at the market	Birr		
21	Weighing fees	Birr		
22	Grading	Birr		
23	Other expens:_____	Birr		

C4. Details on Inputs used for the main crop during LAST SEASON in reference period

Input Details				
SNo	Activities	Unit	Vegetable seeds Crop. Code_____	Vegetables only Crop. Code_____
1	Did you purchase any seeds in last 12 months	1=Yes; 2=No		
2	Total Seeds used– Qty	Grams		
3	Own Seed used – Qty	Grams		
4	If no, why	code		
5	Purchased Seeds– Qty	Grams		
6	Purchased Seeds cost – value	Birr		
7	When did you buy seeds	Months		
8	Source of Seeds	Code		
9	Major reason for choice of this vendor	Code		
10	Distance to vendor	KM		
11	Method of pay	Code		
12	Tagged product	Code		
13	If yes, tagged product price	Birr		
14	Branded	Code		
15	Package	Code		
16	Hybrid	1=Yes; 2=No		
17	Satisfied purchase	1=Yes; 2=No		
18	If No, why?	Code		
19	Manure-quantity	Kgs		
20	manure–value	Birr		
21	Inorganic fertilizer– quantity	Kgs		
22	Inorganic fertilizer– cost	Birr		
23	Inorganic Sellers	Code		
24	Pesticide (fungicides,insect, pactricaletc) - Qty	Kg		
25	No of times applied per season/crop cycle	Numbers		
26	At what growth stage	Code		
27	Pesticide (fungicides,insect, pactricaletc) – cost	Birr		
28	Pesticide (fungicides,insect, pactricaletc) Sellers	Code		
29	Herbicides - Qty	Kg		
30	No of times applied per season	Numbers		
31	At what growth stage	Code		
32	Herbicides – cost	Birr		
33	Herbicides Sellers	Code		
34	Source of info. on pesticides/harbicides	Code		
35	Cost of Irrigation	Birr		
36	Frequency of irrigation	No. of times /season		
37	Hired labor– quantity	Man-days		
38	Hired labor– value	Birr		
39	Family labor– quantity	Man-days		
40	Machine rental – value	Birr		
41	Other input costs – value	Birr		

C5. Pesticide and Insecticides Management for Main Vegetable Crop

5.1. What kind of precaution do you take before/during application of agricultural pesticides or insecticides? *Please circle multiple correct responses.*

a. Wearing all protection gear like gloves, mask, Overall, gumboots =1
b. Wear of few protection gear e.g. only nose/mouth protection =2
c. Protection gear and wind direction =3
d. Washing hand with soap after chemical application =4
e. Milk taking before and after pesticide application =5
f. Milk taking only after chemical application =6
g. Wind direction =7
h. No precaution taken, I just apply =8

5.2.How long do you usually wait after a pesticide or insecticides application on vegetable before harvest?

1. < 1 week 2. 1 – 2 weeks 3. > 2 weeks

5.3. Do you use the same source of water for pesticide mixing on vegetables as for irrigation? *Tick the right response*

1. Yes 2. No Please specify the source(s):_____

5.4. How do you decide when to use the pesticides on vegetables?*Please circle ① one correct response*

a. At regular intervals throughout the season (calendar)
b. When we see pests and /or diseases symptoms in the field (control)
c. After field sampling and finding a certain number of pests or a certain level of damage (thresholds)
d. When told by someone to apply a pesticide
e. Other (please specify)

5.5 If someone told to apply pesticide, who is that? 1. extension agent, 2. trader, 3. Stockist 4. Commission agent, 5.Wife, 6.Husband 7. Others (specify) (multiple answers possible)

C6. Soil testing

6.1. Did you ever get soil of your plots tested? ____ *1=Yes 2=No>>next section*

6.2. When was the last time that you got your soil tested? _____ year

6.3. What was the purpose of soil testing? ____*1=To find out about mocro-nutrients; 2=To find out about pesticides residue; 3=To find out what the soil is good for; 4=Other:_____*

6.4. do you receive soil test? Yes=1; No=2

6.5. if Yes, how long they took time? _____ days

6.6. Who did the soil testing? ____ *1=Government unit; 2=University; 3=NGO; 4=NNARES; 5=International organization; 6=Private company; 7=Other:_____*

6.7. Were you satisfied with the service delivered? _____*1=Yes 2=No*

6.8. If no, what could be improved? _____

C7. Access to market and price information for main vegetable crop

7.1In General, before choosing which crop/varieties to grow, do you seek market information (for example what to grow and where to sell to maximize product price) _____*1=Yes 2=No*

7.2 Source of Information_____

7.3 **Before growing** the main crop, do you seek information on **potential demand**? _____*1=Yes 2=No*

7.4 **Before harvesting**, do you seek information on **market prices** for your main crop? _____*1=Yes 2=No*

7.5 If Yes, what are the most important sources of market prices information for your crops (Circule all that applies)? 1=radio; 2=TV; 3=news paper; 4=government's agricultural marketing information center; 5=any trader at the local market; 6=collector who comes to the farm; 7=other farmers; 8=extension officers; 9=internet; 10=cooperative/farmers' association; 11=contract company; 12=NGOs; 13=mobile; 14=others (specify)_____

7.6 How often do you obtain this information? 1=Daily; 2=once a week; 3=more than once a week; 4=once a month; 5=2-3 times a month; 6=once in 3 months; 7=once in a season

7.7 Are you satisfied with the accuracy of this information?_____*1=Yes 2=No*

7.8 If you no, what is the main reason? 1= info. is not frequently available; 2=info. is inaccurate; 3=info. provided does not meet my interest; 4=info is too complex to understand; 5=others (specify)_____

D. INFORMATION NEEDED

D1. Information Needed

Which information you need most (*(Note: Capture information on major crops FARMERS is occupied with) Use codes (1-29 for filling this table)*

S.n	**Crop**	**Information need (code*)**								
		A	**B**	**C**	**D**	**E**	**F**	**G**		
1										
Code *= A. Pre sowing				**B. Inputs availability**						
1. Soil quality	2. Land Preparation/ farm practices	3. seed variety	4. crop choice	5. Seed	6.Fertiliser	7. Machinery	8 Labour	9 Pesticides	10Weedicides/ herbicides	
C. Inputs prices				**D. Sowing**						
11. Seed prices	12. Fertilizer price	13. Pesticide price	14. Herbicides price	15. Implements price	16. application of inputs	17. irrigation	18. Rainfall forecast	19.Temperature	20. electricity timings	
E. Intermediary										
21. agronomic information			22. Weeds	23. Pest	24. machinery		25. best practices			

F. Harvesting	26.Packaging	27. Storing
G. Marketing	28. more profitable Markets opportunities	29. Prices

E: HOUSEHOLD VEGETABLE CONSUMPTION AND DIETARY DIVERSITY

E1. Food diversity and consumption

Please describe the foods (meals and snacks) that you ate or drank **yesterday** (recall period 24 hours) during the day and night, whether at home or outside the home. Start with the first food or drink of the morning. *Write down all foods and drinks mentioned. When composite dishes are mentioned, ask for the list of ingredients. When the respondent has finished, probe for meals and snacks not mentioned.*

Breakfast	Snack	Lunch	Snack	Dinner	Snack

[Households: include foods eaten by any members of the household, and exclude foods purchased and eaten outside the home

E2. When the respondent recall is complete, fill in the food groups based on the information recorded above: For any food groups not mentioned, ask the respondent if a food item from this group was consumed. Food Frequency – all the different foods that you're household has eaten in the last 30 days.

Qn. No.	Food Group **(mention code from Qn.no)**	Examples	Recall period: 24 hours Yes=1; No=2	Food Frequency Recall period 30 days (Code)
1	Cereals	corn/maize, rice, wheat, sorghum, millet, tef or any other grains or food		
2	White Roots & Tubers	white potatoes, white		

4	Dark Green Leafy Veg	dark green leafy veg, including wild forms +		
5	Other Veg	other veg. (e.g. tomato,		
6	Vitamin A Rich Fruits	ripe mango, cantaloupe, apricot (fresh or dried),		
7	Other Fruits	other fruits, including		
8	Organ Meat	liver, kidney, heart or		
9	Flesh Meats	beef, pork, lamb, goat,		
10	Eggs	eggs from chicken, duck,		
11	Fish & Seafood	fresh or dried fish or		
12	Legumes, Nuts & Seeds	dried beans, dried peas, lentils, nuts, seeds, or		
13	Milk & Milk Product	milk, cheese, yogurt or		
14	Oils & Fats	oil, fats or butter added to		
15	Sweets	sugar, honey, sweetened soda or sweetened juice		
16	Spices, Condiments, Beverages	spices (black pepper, salt), condiments (soy sauce, hot sauce), coffee, tea, alcoholic beverages		
HH level only	Did you or anyone in your HH eat anything (meal or snack) OUTSIDE the home yesterday?			
Individual level	Did you eat anything (meal or snack) OUTSIDE the home yesterday?			

Code for food frequency: *16 to 30 days/months (at least every other day); 2=4-15 days/month (1-2 times/week); 3=1-3 days; 4=Not at all*

F. FOOD SECURITY COPING STRATEGIES

F.1 Please answer the following and encircle the answer

S.No	Activities	Code
1	In the past four weeks, did you worry that your household would not have enough food?	
2	IN the past four weeks, were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources?	
3	In the past four weeks, did you or any household member have to eat **a limited variety** of foods due to a lack of resources?	
4	In the past four weeks, did you or any household member have to eat some foods that you really **did not want to eat** because of a lack of resources to obtain other type of food?	
5	In the past four weeks, did you or any household member have to eat a **smaller meal** than you felt you needed because there was not enough food?	
6	In the past four weeks, did you or any household member have to eat **fewer meals** in a day because there was not enough food?	
7	In the past four weeks, was there ever **no food to eat of any kind** in your household because of lack of resources to get food?	
8.	In the past four weeks, did you or any household member go **to sleep at night hungry** because there was not enough food?	
9	In the past four weeks, did you or any household member go **a whole day and night**	

	without eating anything because there was not enough food?	
10	**In the past 12 months**, were there months in which you did **not have enough** food to meet your family's needs?	
11	If yes, **which were the months** in which you did not have enough food to meet your family's need	

Code: *1=No; 2= Rarely (1-2 times in the past four weeks); 3=Sometimes (3-10 times in the past four weeks); 4=Often (>10 times in the past four weeks)*

G. GENDER DIVISION OF LABOUR IN THE HOUSEHOLD

G1. Labour force for the main vegetable crop cultivation

a. Wage rate for hired labour/day_____ Male _____ Female

b. Crop codes (crop_code) _____	Household Labour (person days)							Hired Labour (person days)						
	Male Adult (1)	Days (2)	hours	Female Adult (3)	Days (4)	hours	Total Hrs (5)	Male (6)	Days (7)	hours	Female (8)	Days (9)	hours	Total Hrs (10)
1.Land preparation														
2.Direct Seeding /transplanting														
3.Mulching														
4.Weed control														
5.Staking														
6.Chemical fertilizer application														
7.Manuring/composting														
8.Pesticide application														
9.Watering/irrigation														
10.Harvesting														
11.Packing/Transportation														
12.Other (specify)														

G2. Gender role

S.No	Activities	Code (Yes=1; No=2)
1	Production & domestic activities done by women	
2	Production done jointly; domestic activities done by women	
3	Production and domestic activities done jointly	
4	Production done by men; domestic activities done by women	
5	Selling of the crop done by women?	
6	Does female at home have access to income from agricultural activities?	
7	If yes, does she have full control of crop income?	
8	Does female at home have access to income from non-farm activities?	
9	If yes, does she can control of non-farm income fully?	
10	Does any of your female family members are member of female association or group?	

G3. Decision making by gender

S/No	Decision	Code (Male=1; Female=2; Both=3)
1	Buy land	
2	Buy food items	
3	Cooking Food	
4	Who collect fuel wood?	
5	who collect water?	
6	who maintain house?	
7	care of children	
8	Education of children	
9	Type of food items	
10	Planting crops	
	a)Stable crops	
	b)Vegetables	
	c)Others	
11	Who to sell crops to?	
	a)Stable crops	
	b)Vegetables	
	c)Others	
12	Receive/or control income from crop sales	
	a)Stable crops	
	b)Vegetables	
	c)Others	
13	Selection of planting site	
14	Buying inputs (seed, tools, fertilizer and pesticides)	
15	When and how to use fertilizer	
16	When and how to use pesticides	
17	Assist in funeral and local ceremonies	
18	Who interact with extension officers	
19	Who participate in community meeting or training program?	
20	Who decide to participate in the community meeting or training program?	
21	Who participate in agricultural training program conducted by NGO/Government etc?	
22	Who participate farming study tour?	
23	Who gets credit?	
24	Who decide spending plan from credit received?	
24	Who save money at home?	
25	Who maintain livestock at home?	
26	Who sells livestock?	
27	Who transport crop produced after harvest?	

H: HOUSEHOLD FOOD & NON_FOOD EXPENDITURE PATTERNS

H1. In the last 30 days, how much did your household spent on food and fuel?

Food_item	Did your household purchase? (1)	If yes, how much did your household spend in the past 30 days? (2)	If yes, number of times purchased in last 30 days? (3)		Did your household purchase?	If yes, how much did your household spend in the past 30 days?	If yes, number of times purchased in last 30 days?
	1=Yes 2=No	Birr	Number		*1=Yes 2=No*	Birr	Number
Wheat (1)				Apples (15)			
Rice (2)				Mangoes (16)			
Maize flour (3)				Banana (17)			
Tef (4)				Orange (18)			
Sorghum (5)				Melon (19)			
Cereal products* (6)				Other fruits (20)			
Other cereals (7)tef				Tubers (21)Enset			
Beans (specify type) (8)				Onion (22)			
Green gram/Mung bean (9)				Tomato (23)			
Sugarcane (10)				Okra (24)			
Meat, chicken, fish (11)				Bell pepper (25)			
Eggs (12)				Radish (26)			
Liquid milk (13)				Cucumber (27)			
Milk products ** (14)				Fresh beans (28)			
Kerosene (31)				Other vegetable (29)			
				Edible oils (30)			

Milk products** e.g. ghee, Yogurt, Cheese, milk powder, ice cream, sweets, etc**Cereal products*** e.g. bread, noodles

H2. How much did your household spent on the following items?

	In the past 30 days				**In last 12 months**		
Item_code	Did your household purchase?	If yes, how much did your household spend in the past 30 days?	If yes, numbers of times purchased in past 30 days?		Did your household purchase?	If yes, how much did your household spend in the past year?	If yes, number of times purchased in last year?
	1=Yes	Birr	Number		*1=Yes;*	Birr	Number

	2=No				*2=No*		
Salt and spices (includes dry spices, powder, oilseeds, etc.) (32)				Medical (in-patient) (47)			
Other food items like tea, coffee, processed food (such as biscuits, cake, pickles, sauce) (33)				School/private tuition, School books & other educational articles (48)			
tobacco, intoxicants (34)				Men's wear (49)			
Nuts (coconut, dates, other dried fruits) (35)				Ladies wear (50)			
Food at restaurants, eating out, etc. (36)				Kids wear (51)			
Fuel and light (LPG, electricity, firewood) (37)				Home linen (52)			
Entertainment (includes cinema, picnic, sports, club fees, DVDs) (38)				Footwear (53)			
Telephone, Cellphone, internet (39)				Furniture and fixtures (including bedstead, suitcase, carpet, paintings, etc.) (54)			
Toilet articles (including toothpaste, hair oil, shaving blades, etc) (40)				Crockery and utensils (includes casseroles, thermos, etc) (55)			
Household items (including electric bulb, tubelight , glassware, bucket, soap,				Personal care (includes spectacles, torch, umbrella, etc) (56)			

insecticides, etc.) (41)							
Conveyance (including railway, bus, taxi, auto, airfares, porter charges, diesel/petrol, school bus, *dada dada*…) (42)				Therapeutic appliances (including hearing aids, glasses, orthopedic equipment) (57)			
House rent and rent other appliances (43)				Repair and maintenance (of residential buildings, bathroom equipment) (58)			
Consumer taxes, fees (including water charges) (44)				Insurance premiums (59)			
Non-agricultural staff (domestic servants and others) (45)				Vacations (60)			
Medical expenses (out-patient services) (46)				Social functions (marriage, funerals, gifts, etc) (61)			

KNOWLEDGE TEST

Code for scale measurement (1=strongly disagree; 2=disagree; 3=neither agree or disagree; 4=agree; 5=strongly agree

S.No	Topics	Indicators	Questions	Scale for survey (5-point likert)
1	Farm Management	Crop Management Skills	vegetable seedling raising and transplanting serves production cost in terms of quantity of seeds required, management of soil borne pests and results into quality of seedlings	
			Crop spacing and isolation distances are critical aspects in vegetables seeds	
			Since fertilizer and manure are routinely applied, so there is a need bother about soil fertility status	
			Root color can be a very good indicator of crop growth and development	
			Vegetables damaged by pests are not safer than undamaged once	
			Water Source can be a critical source of vegetable contamination	
		Farm Management Skills	I keep record about my input and output details	
			I am effective time manager	
			I am effective personal manager	
			I provide proper wages to labours	
			I provide employees and others with a clear work schedule	
			I manage my farm business in compliance with state local and federal regulations	
			My farm has a good safety record.	
			If I rent or lease farmland, I have a good relationship with the owners	
			The general appearance of my farm reflects good management	
			I feel confident about my farm management skills	
2	Market Knowledge	Entrepreneurs skills	I carry necessary crop insurance in sufficient amounts.	
			Seeking for credit opportunities is important for farmers to expand their business	
			My income from farming is increasing annually	
			My farm does business based on fair contracts	
			My farm serves a diversity (good risk management) of markets	
			My farm serves profitable markets	
			I can effectively manage and/or am free from debt	
			I feel confident about my knowledge of market opportunities	
			I have a plan to increase my income from farming	
			I understand the characteristics of vegetables	

			that shoppers are looking for	
			I cooperate with other farmers to improve our incomes	
			I build relationships with the people I buy from and sell to help increase my income	
3	Pre and Postharvest Handling knowledge		Pre-harvest losses largely happen due to pests and diseases	
			Vegetable grading should be done under the shade	
			After harvest, sorting is important to get better prices	
			After harvest, grading is important to get better prices	
			Type of packaging is important for reducing postharvest losses	
			Postharvest losses largely happen during transport	
			After harvest, type of storage facilities plays an important role to maintain perishability	
			After harvest, keeping produce under directly sun light reduces weight of produces	
			After harvest, the way of handling crops much more important to reduces losses	
4	Knowledge on pesticides usage and its impact on health	Pests and Diseases	Aphids and white flies spread virus diseases in vegetables	
			More usage of pesticides affect vegetable cultivation	
			pesticides affect environment	
			Thinks that duration of effect is less 24 hours	
			chose the time of applications (during raining time) is important	
		Health Impact	Pesticides affect human health	
			route of pesticides entry into body by inhalation	
			route of pesticides entry into body by skin	
			route of pesticides entry into body by mouth	

HB. ***Farmers' perception on vegetable quality based on new introduced technologies***

Please use the following scale to indicate your extent of agreement about how well each of the following statements is an accurate description of your vegetable quality characteristics. **Code for scale measurement (1=strongly disagree; 2=disagree; 3=neither agree or disagree; 4=agree; 5=strongly agree**

NO	**Statements about the vegetable quality after AVRDC technologies**	**Scale for survey (**5-point likert)
Perception about vegetables after intervention		
1	Vegetable size is better for market suitability	
2	Vegetable color is more attractive	
3	Vegetable taste is better than before	
4	Vegetable Weight differs from of previous productions	

5	Vegetable yield is much better	
6	For your own experience of AVRDC technologies do you prefer than previous one	
7	Other farmers, such as opinion leaders, think AVRDC technologies are good	
8	It is easy to adopt AVRDC technologies	
9	New seed varieties were available before planting period	
10	I actively seek information from others	
11	I like new ideas	
	Social Norms	
1	Other farmers think I am a progressive farmer	
2	Other farmers ask my opinions about agricultural technologies or farming practices	
3	Other farmers will not object how I produce vegetable on my fields.	
	B**ehavioral Control**	
1	It is easy for me to collect information about the new agricultural technologies and practices	
2	I have good contacts with extension workers	
3	I can adopt new agricultural technologies as long as they are profitable	
About Tengeru 2010		
4	Tengeru 2010 is a very good variety	
5	Other farmers, such as opinion leaders, think Tengeru 2010 as a good variety	
6	It is easy to adopt Tengeru 2010 as compared to other tomato varieties	
7	Tengeru 2010 provides better size as compared to other tomato varieties	
8	Color of Tengeru 2010 is more attractive	
9	Taste of Tengeru 2010 is much better than other tomato varieties	
10	Weight of Tengeru 2010 is much better than other tomato varieties	
11	Tengeru 2010 seeds were available before planting	