ROLE OF RURAL INITIATIVES FOR PARTICIPATORY AGRICULTURAL TRANSFORMATION (RIPAT) APPROACH IN AGRICULTURAL TECHNOLOGIES DISSEMINATION AND ADOPTION IN IKUNGI DISTRICT, TANZANIA

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A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS IN PROJECT MANAGEMENT AND EVALUATION OF SOKOINE UNIVERSITY OF AGRICULTURE. MOROGORO, TANZANIA.

2020

EXTENDED ABSTRACT

Agricultural technologies are important in increasing crop productivity. However, the rate of adoption of disseminated technologies has remained low among farmers. The study on which this dissertation is based aimed at assessing the role of the Rural Initiatives for Transformation Agricultural Technologies (RIPAT) approach in adoption of disseminated agricultural technologies in Ikungi District, Singida Region, Tanzania. The specific objectives were to: determine association between socio-demographic factors and farmers' adoption of selected agricultural technologies, compare agricultural productivity among the RIPAT approach participants who practise different technologies disseminated by the RIPAT, determine influence of the RIPAT approach factors on agricultural productivity, and determine attitude of farmers towards the RIPAT approach in agricultural knowledge dissemination and adoption. A cross-sectional research design was adopted whereby quantitative and qualitative data were collected from a sample of 120 respondents and five key informants. Qualitative data were collected using key informant interviews. Quantitative data were collected using a structured questionnaire. Qualitative data were analysed using content analysis, and quantitative data were analysed descriptively and inferentially using chi square test, one-way ANOVA and multiple linear regression. Findings from the study showed that, of the four technologies that the RIPAT disseminated, home gardening technology was the most adopted technology, followed by poultry mother unit technology and conservation agriculture technology while rain water harvesting technology was the least adopted. In addition, the findings showed that education of household head was significantly ($p \leq 0.05$) associated with adoption of poultry mother unit, harvesting rainfall and home gardening technologies. The findings also showed that the use of the RIPAT approach had managed to increase contact among farmers and extension agents through sequential training provided to extension agents as well as in provision of working tools among extension agents. The findings also showed that the extent of the RIPAT disseminated technologies was higher at 75% as compared to that of other common technologies which was at 60%, and the extent of overall adoption was 66.67%. The majority of the respondents were engaged in maize production compared to other crops. Moreover, the findings showed that farmers growing maize (68), sorghum (6), millet (29), finger millet (35) and sunflower (25) had adopted for at least three different technologies among conservation agriculture technologies, poultry mother unit technology, harvesting rain water technology and home gardening technology. The findings also showed that farmers' experience on the use of the RIPAT disseminated technologies had a significant $p \leq 0.05$ effect on crop productivity. The findings further showed that 65% of the respondents had favourable attitude towards adoption of conservation agriculture technology, rain water harvesting technology, raised home gardens technology and poultry mother unit technologies disseminated by the RIPAT project. It is concluded that the surveyed farmers in Ikungi District were practising traditional technologies to a large extent but more with the application of the RIPAT approach conservation agriculture, poultry mother unit, harvesting rain water and home gardening agricultural technologies. The farmers had a chance of improving their technologies through increasing their participation in new technologies. Basket of options gives farmers choices in practising the most favourable technologies meeting their needs. It is recommended that RECODA organisation staff should conduct campaigns to promote RIPAT agricultural technologies so that more farmers can have more favourable attitude towards the technologies. This will enhance adoption of the disseminated agricultural technologies. In order to increase farmers' knowledge, adoption and willingness to participate and practise RIPAT disseminated technologies, there is a need for provision of subsidies by projects applying RIPAT approach to farmers and increase collaboration with government extension officers.

DECLARATION

I, Joseph Daniel, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my original work done within the period of registration as a Master of Arts in Project Management and Evaluation student and that it has neither been submitted nor being concurrently submitted in any other institution.

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The above declaration is confirmed by:

Prof. Kim Abel Kayunze **Date**

(Supervisor)

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ACKNOWLEDGEMENTS

This dissertation is a result of a number of people who made their contributions. I wish to express my sincere thanks to my father Daniel Chikolomo and my mother Atuganile Mwakalukwa for their financial and material support.

My sincere thanks go to Prof. Kim Abel Kayunze of the Department of Development Studies, College of Social Sciences and Humanities, Sokoine University of Agriculture, for his assistance, tireless guidance, encouragement and constructive support during the whole period of the study. Special appreciation goes to all lecturers and staff from both the Department of Development Studies and the Department of Policy Planning and Management for their teaching and academic support during my oral presentations of my research concept note, full research proposal and three paper manuscripts. I thank them all. My special thanks go to my father Daniel Chikolomo and my mother Atuganile Mwakalukwa for their support, prayers and patience which encouraged me a lot.

Special appreciation also goes to RIPAT RECODA Organization director Mr. Dominic E. Ringo and his staff for their support, guidance and encouragement during my data collection stage.

DEDICATION

To my beloved parents Mr. and Mrs. Daniel Patrick Chikolomo.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATION

ANOVA	Analysis of Variance
FAO	Food and Agricultural Organisation
FFS	Farmer Field School
FotF	Farms of the Future
GDP	Gross Domestic Product
IDBR	Ikungi District Baseline Report
NGO	Non-Governmental Organisation
PEI	Poverty and Environmental Initiative
PMU	Poultry Mother Unit
RECODA	Research Community and organisational Development Associates
RIPAT	Rural Initiatives for Participatory Agricultural Transformation
T&V	Training and Visits
TASAF	Tanzania Social Action Fund
URT	United Republic of Tanzania
VSLA	Village Savings and Loans Associations

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

In sub-Saharan Africa, use of improved number of technologies in agriculture is increasing but, it is still low compared to Asia and South America. This has led to the need for new approaches to promote dissemination and adoption of new innovations, and the need and opportunity for investigating the effectiveness of agricultural technologies in various parts of the world is increasing (Hellin, 2012). East Africa is among the places with the largest extension system in Africa, but studies show that the agricultural sector in this part of Africa has not improved much in relation to increased productivity thus improvement of people's living standards in rural areas (Kasie *et al*., 2012). In Tanzania, productivity and extent of agriculture intensification is low, and its sustainability is threatened by decline in soil fertility, soil erosion, and reliance on expanding agricultural land in the face of climate change (Mwaseba, 2018). Other practices include use of low yielding crop varieties, less adaptive varieties to changing local environment, continuous extensive farming with low input use, little and poorly planned crop diversification.

Agricultural technology is the process by which inventions are produced, which may involve bringing together new ideas and technologies or finding novel applications of existing technologies, which in general means developing new ways of doing things in a place or by people where they have not been used before (Mudombi, 2013). Nonetheless, agricultural technology uptake is a complicated process and can involve both adoption of a new technology as well as adaptation of existing practices. The decision to adopt agricultural technologies is a mental process consisting of five stages: knowledge, persuasion, decision, implementation and confirmation. According to Rogers (1995) the innovativeness of an individual determines when the individual adopts the technologies and that this follows five recognized successive adopter categories: innovators, early adopters, early majority, late majority and laggards. In addition the adoption process is also affected by the so called receiver variables, such as personality characteristics, social characteristics and perceived need for the innovation.

The Rural Initiatives for Participatory Agricultural Transformation (RIPAT) approach is an agricultural intervention and participatory extension approach that aims at closing the agricultural technology gap as a means of improving livelihoods and self-support among rural small-scale farmers (Vesterager *et al*., 2017). The RIPAT approach is a combination of elements of the 'top-down' and 'bottom-up' approaches which are Training and Visit (T&V) and Farmer Field Schools (FFS). By the RIPAT approach a 'basket' of agricultural technology options are transferred to groups of farmers, including technologies for production of various crops and livestock. Each individual farmer chooses which options to adopt on his or her own farm and agrees to help three other farmers outside the group to do the same (Aben *et al*., 2012). The adoption of agricultural technologies informs farmers' beliefs about the returns and gives them practical knowledge to implement different technologies (Beaman and Dillon, 2018). The study on which this thesis is based aimed to assess how the use of the RIPAT approach enables adoption of selected agricultural technologies which are conservation agriculture, rain water harvesting, raised home gardens and Poultry Mother Unit technologies among villages involved in the RIPAT approach projects in Ikungi District.

In Ikungi District, the RIPAT approach has been employed in dissemination of various agricultural technologies including: conservation agriculture, rain water harvesting, raised home gardens and Poultry Mother Unit technologies, improved maize seeds, animal keeping, preparation and use of organic fertilizer, irrigation using water pumps, applying natural pesticides. These technologies are provided to farmers as a basket of options whereby farmers are convinced to choose technologies which are suitable for them, and which they can easily apply. Through the RIPAT approach, lead farmers from farmers' groups and village extension officers are empowered to ensure technologies reach targeted individuals at the right moment. Nonetheless, farmers in the district use other agricultural technologies apart from those promoted through the RIPAT approach. Other agricultural technologies includes the use of certified seeds, the use of organic and inorganic fertilizers, the use of irrigation and the use of water pumps for irrigation technologies.

The aim of the extension approach employed through the RIPAT approach in targeted villages is to build the farmers' capacity to analyse their production systems, to identify their main constraints, and to test possible solutions, eventually identifying and adopting the practices most suitable to their farming system (Muhamad and Muhamad, 2012). In the RIPAT approach, farmers go through a learning process in which they are presented with new technologies, new ideas, and new situations and ways of responding to problems. The knowledge acquired through this learning process is then used to build on the existing knowledge enabling farmers to adopt the technologies to the best advantage of their own situations (Davis, 2008).

1.2 Problem Statement

Extension approaches are widely applied in a range of contexts, and they are often meant for bridging the gap between the technological and social needs of farmers (Sanga *et al.*, 2016). Such technologies use experiential learning and group approaches to facilitate farmers in making decisions, solving problems, and learning new techniques. A report from a baseline survey in Ikungi District shows that 90% of the population in the district were involved in growing food crops which are sorghum, millet, sunflower, maize and sweet potatoes and livestock keeping on a small scale (IDBR, 2013). In addition, the level of mechanization in agriculture is low with most farmers depending on the hand-hoe and selling honey and chickens as important sources of income (IDBR, 2013).

Traditional farming system is the most practised agricultural activity adopted by a large number of small scale farmers in Ikungi District, like in most other places in the world (Aker and Mbiti, 2010). Traditional farming system might satisfy the needs of smallholder farmers, but, in Ikungi District farmers practising traditional farming systems still have low agricultural productivity.

Traditional farming system in Ikungi District is of small scale, and food produced mostly covers the household needs of small scale farmers (IDBR, 2013). The selection of suitable agricultural innovations and the use of the RIPAT approach can be a proper method to bridge the technological gap between smallholder farmers and the agricultural innovations. Farmers can potentially increase their productivity through adoption of agricultural innovations, practices and new input packages, if appropriate extension services are put in place (Van den Berg, 2004).

Although the RIPAT approach has been used in Ikungi District to disseminate a basket of selected agricultural technologies for increasing agricultural productivity, the extent of adoption of the technologies is not yet optimal. The aim of the study on which this dissertation is based was to assess the role of the RIPAT approach in dissemination and adoption of selected agricultural technologies by smallholder farmers and how the same has subsequently contributed to improved agricultural productivity through conservation agriculture, rain water harvesting, raised home gardens and Poultry Mother Unit technologies among villages involved in practising the RIPAT projects approach in Ikungi District.

1.3 Justification

The agricultural sector plays an important role in the Tanzanian economy and has the potential to advance the country's objectives of growth and poverty reduction. The performance of the overall Tanzanian economy has been driven by the performance of the agricultural sector, due to its large share in the economy. Agriculture in Tanzania provides about 66.9% of employment, accounts for about 23% of GDP, 30% of exports and 65% of inputs to the industrial sector (URT, 2016a).

Over 90.4% of active women in Tanzania are actively involved in the agricultural production and household activities, producing about 70% of the country's food requirements (URT, 2013). According to Agricultural Sector Development Strategy II, transformation of the agricultural sector into a modern, commercial, highly productive and resilient agricultural sector which is competitive in the national and international markets will lead to achieving poverty reduction and hence contributing to realization of Tanzania Development Vision 2025 (URT, 2016).

The findings from the study are of great importance in helping the government and policy makers to re-structure and modify agricultural technologies delivery and in promoting agricultural productivity. Also, the findings is of great importance in formulating strategies to address the situation in the study area and other areas where the RIPAT approach can be applied and to inform various stakeholders on the current status of knowledge and production level in the study area.

1.4 Objectives

1.4.1 Overall objective

The overall objective of the study was to establish the role of the RIPAT approach in dissemination and adoption of selected agricultural technologies to smallholder farmers in Ikungi District.

1.4.2 Specific objectives

Specifically the study aimed to:

i. Determine association between socio-demographic factors and farmers' adoption of selected agricultural technologies in the study area,.
ii. Compare agricultural productivity among farmers who have adopted different technologies disseminated through use of the RIPAT in the study area,
iii. Determine influence of the RIPAT approach factors on agricultural productivity, and
iv. Determine attitude of farmers towards the RIPAT approach in agricultural knowledge dissemination and adoption.

1.5 Null hypotheses

i. Socio-demographic factors not associated with adoption of agricultural technologies.
ii. RIPAT participants practising various agricultural technologies disseminated by RIPAT approach have the same agricultural productivity.
iii. RIPAT approach indicators influence agricultural productivity.
iv. Farmers' attitude towards the RIPAT approach in agricultural knowledge dissemination and adoption is the same among farmers who have different socio-demographic characteristics.

1.6 Theoretical Framework

This study adopted the adoption-diffusion theory developed by Rogers (1995) which explains why farmers choose to adopt new ideas. The time needed and the rates of adoption depend on the technology itself and the characteristics of the receivers. The decision to adopt a technology is a mental process consisting of five stages: knowledge, persuasion, decision, implementation and confirmation. The Adoption Diffusion theory is useful as it shows how and at what rate an innovation will be adopted by farmers in a community (Beaman *et al*., 2018). The agricultural technologies disseminated through the use of RIPAT approach enable farmers to adopt suitable agricultural technologies at a given period of time favourable to their environment.

1.7 Gaps in Literature

Previous literature on agricultural adoption has addressed the use of Farmer Field School (FFS) and Training and Visiting (T&V) approaches separately in training farmers to adopt agricultural technologies (Gautam (2000). This study expected to find previous literature addressing the use of combined Farmer Field School (FFS) and Training and Visit (T&V) approaches in transferring agricultural technologies. But, agricultural technologies provided by previous literature studies did not link with traditional agricultural practices of the study population.

The study used the RIPAT approach that combines both bottom-up and top-town approaches for technology transfer. The fundamentals of the Farmer Field School (FFS) and Training and Visit (T&V) programme concepts are applied in the RIPAT project, albeit in a modified form. The RIPAT approach is largely a combination of elements of the ‘top- down’ and ‘bottom-up’ approaches hence there is a gap in the prior studies that are contradictory in the findings (Miles, 2017).

1.8 Conceptual Framework

The study on which this dissertation is based was about adoption of agricultural technologies by smallholder farmers in order to improve agricultural productivity. The role of the Rural Initiatives for Participatory Agricultural Transformation (RIPAT) approach as an agricultural transformation approach is to make sure that adoption of agricultural technologies to farmers made possible by offering a basket of technological options that are context specific. The study adopted a conceptual framework which shows a linear relationship between the background variables (social, economic and institutional), independent variables, and dependent variables (Rogers, 2003). The independent variables are grouped into three categories namely social factors, economic factors and institutional factors. Social factors included: age, level of education, marital status, size of land, and sex of respondent. Economic factors include level of income, access to farm inputs and family labour. Others include institutional factors such as source of information and extension service. The factors influencing adoption of selected agricultural innovations were considered to be the ones indicated in Fig. 1.1

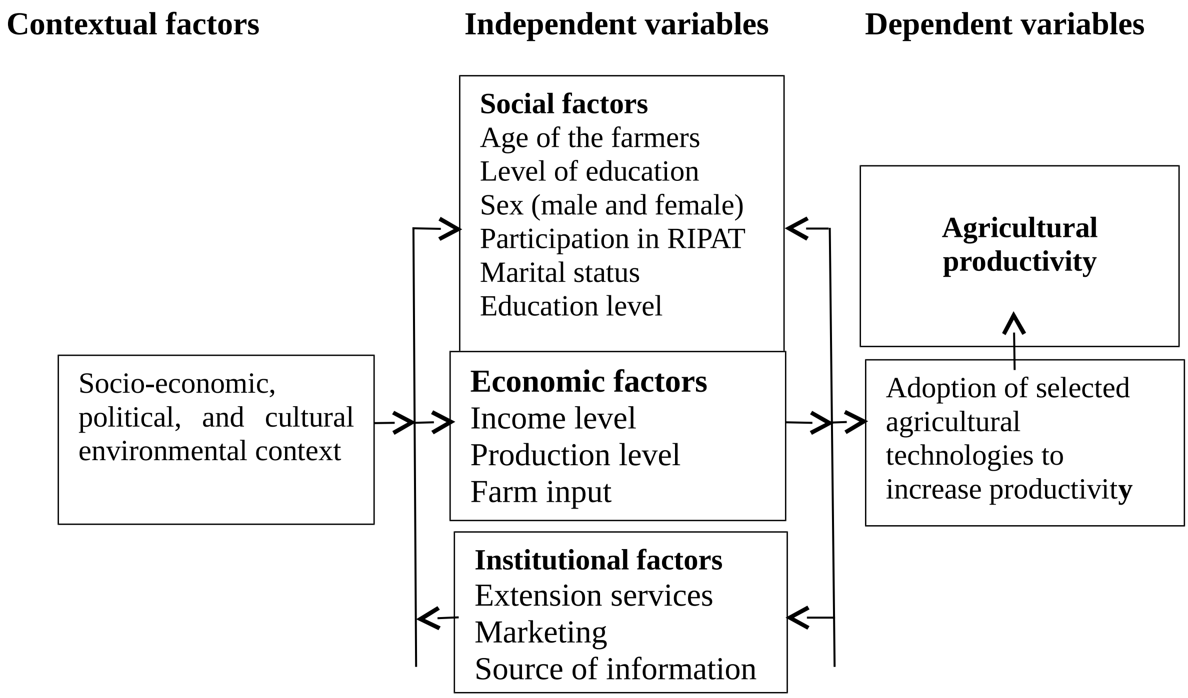

Figure 1.1: Conceptual framework to determine the role the of the RIPAT approach in adoption of selected agricultural technologies

1.8 Limitations of the Study

Respondents did not have good memories of the income accumulated. This was due to the fact that the surveyed farmers lacked proper record keeping about income generation. This shortfall was resolved by probing the respondents through asking different questions to ensure they provided relevant information. The question on amount of crop products harvested in kilograms and income gained per kilogram was asked considering crop products harvested per bag, and then the number of bags harvested per acre were converted into kilogram per hectare.

1.9 General Methodology

1.9.1 Description of the study area

The study was conducted in Ikungi District which is one of the 5 districts of Singida Region which are Singida, Singida municipality, Ikungi, Manyoni, Iramba and Mkalama Districts. It is one of the 20 new districts that were formed in Tanzania since 2010 with 26 wards; it was split off from Singida District. Ikungi District borders with the following districts: to the North Iramba District, Singida Municipality and Singida District. To the East it borders with Manyara Region, and to the South it borders with Manyoni District while to the West it borders with Tabora Region. Its administrative seat is the town of Ikungi. According to the 2012 Tanzania National Census, the population of Ikungi District was 272,959. Singida Region has a total surface area of 49,438 km^2, out of which 95.5 km^2 or 0.19% is covered by water bodies of Lakes Eyasi, Kitangiri, Singidani, Kindai and Balengida. The remaining 49,342.5 km^2 is land area. The reason for choosing Ikungi District is because it is one among the two districts in Singida Region with projects practising the RIPAT approach under the RECODA organisation.

1.9.2 Research Design

The study employed a cross-sectional research design in which data were collected at one point in time from a selected sample of respondents (Kothari, 2004). This approach was relatively cheap, quick and effective since it utilised limited resources in terms of funds, labour, transport and time.

1.9.3 Study population, sample size and sampling procedure

1.9.3.1 Study population

The population practising the RIPAT approach in Ikungi District was 1290 farmers from 43 villages. The study population for the research was farmers practising the RIPAT approach under RECODA organisation in Ikungi District who were 175 from 6 villages namely Taru, Ntewa “A”, Ntewa “B”, Ntuntu, Mungaa and Kinku. However, four villages were selected namely Kinku, Mungaa, Ntuntu and Taru because these had beneficiaries of the RIPAT approach who were easy to reach and appeared to be more active as compared to the remaining villages.

1.9.3.2 Sample size

This study involved 120 respondents. The sample size was determined using Cochran’s (1977) sample size formula for continuous data, which is:

$$n = \frac{(z)^2 \times (s)^2}{(d)^2}$$

Where:

n = the required sample size,

z = Value of standard normal distribution for the selected alpha of 0.25 in each tail = 1.96 which corresponds to 95% confidence interval,

s = an estimated variance in the population from which the sample is drawn, for the population with unknown size as for the case of this study the value is estimated to be 0.5.

d = acceptable margin error (i.e. 0.05) of the mean or proportion (Cochran, 1977, cited by Bartlett *et al*., 2001). The formula is for an infinite population and gives a sample size of 384, i.e. $(1.96)^2 \times (0.5)^2 / (0.25)^2 = 384$.

The population from which the sample was drawn was finite, i.e. 175 households. Therefore, Cochran's (1977) correction formula for adjusting the sample size for smaller populations was further used to adjust the 384 sample, taking into account the population size. The formula is:

$$n = \frac{\text{sample size for any population size, i.e. 384}}{\text{(1+ sample size for any population size)/Population size}}$$

Therefore, the sample size of 120 was obtained as follows:

$$n = \frac{384}{[1 + (384)/175)]}$$

$$n = \frac{384}{(1 + 2.1942857)}$$

$$n = \frac{384}{3.1942857} = 120.2147 = 120$$

1.9.3.3 Sampling Techniques

Multi-stage random sampling approach was used to select a representative sample of technology adopters. Ikungi District was selected purposively because it had a total of 43 villages practising the RIPAT approach. The first stage involved a purposive selection of two wards whereby Mungaa and Ntuntu were selected. The second stage involved a random selection of four villages from the selected wards which were Kinku, Mungaa, Ntuntu and Taru. This method gave no room to biases, and the degree of accuracy obtained allowed making inference applicable to a wider population (Kothari, 2004). Besides the 120 respondents, five key informant interviewees were involved in the study; one member of RECODA organisation and 4 village leaders (one from each of the four selected villages) were purposefully.

1.9.4 Data collection methods

Qualitative data were collected using key informant interviews, and quantitative data were collected using a structured questionnaire from 120 household heads practising the RIPAT approach. The questionnaire, with a combination of open-ended and closed-ended questions, was used to collect data on background information of the respondents, resource allocation towards implementation of project activities, and views of the respondents on achievements of the RIPAT approach project, among other things.

1.9.5 Data analysis

The data collected were analysed qualitatively using content analysis whereby words that were mentioned more frequently by key informant interviewees were coded. The words were then compared and contrasted with information from the questionnaire and with information available in literature. Quantitative data were analysed descriptively and inferentially.

In view of the objectives, different inferential analyses were used to analyse data. Association between socio-demographic factors and farmers' adoption of selected agricultural technologies was analysed using chi-square test. One way ANOVA was used to compare agricultural productivity among households which had adopted different numbers of RIPAT disseminated technologies which they were using as the grouping variable (conservation agriculture, poultry mother unit, harvested rain water and raising home garden) and kilograms harvested per hectare as the test variable.

Multiple linear regression analysis was employed to analyse the association of the RIPAT approach factors (predictor variables) on agricultural productivity (outcome variable). The multiple linear regression model was specified as follows:

$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_5 x_5 + \varepsilon$ ……………………………………………………(1.3)

where:

y = Agricultural productivity

$\beta_1, \beta_2, \ldots, \beta_5$ = Coefficients of the independent variables showing how they influence y

x_1 to x_5 = Independent variables, and

ε = Random error term showing the influence of other factors not explained by the model

x_1 = Farmers experience (1= Experienced, 0 = Not experienced)

x_2 = Number of RIPAT technologies adopted

x_3 = Availability of training methods in teaching RIPAT technologies (1 = Available, 0 = Not available)

x_4 = Farmers' participation in trainings (1 = Participated, 0 = Never participated)

x_5 = Use of mobile phones to talk about RIPAT technologies (1 = Uses, 0 = Does not use).

A five-point Likert scale was employed to measure farmers' attitude towards the RIPAT approach in agricultural knowledge technology transfer. The alternative answers on the scale ranged from strongly disagree (1 point), agree (2 points), undecided (3 points), agree (4 points) and strongly agree (5 points). The respondents were then grouped into three groups of unfavourable attitude (strongly disagree and disagree), neutral attitude (Undecided), and favourable attitude (agree and strongly agree).

1.10 Organisation of the Dissertation

This dissertation consists of three publishable manuscripts which are presented in respective chapters. The whole dissertation is organized in five chapters: the first chapter consists of the extended abstract and introduction of the overall theme studied. In addition, it offers a description of the commonality of concepts presented in the separate manuscripts. Chapter two contains publishable manuscript Number 1 which covers the first objectives and answers for the first hypothesis of the study. Chapter three contains publishable manuscript Number 2 which covers the second and third objectives and answers to the second and third hypothesis of the study. Chapter four contains publishable manuscript Number 3 which covers the fourth objective and provides answers to the fourth hypotheses of the study. Lastly, chapter five presents the study general conclusions and recommendations.

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CHAPTER TWO

2.0 ASSOCIATION BETWEEN SOCIO-DEMOGRAPHIC FACTORS AND FARMERS' ADOPTION OF AGRICULTURAL TECHNOLOGIES IN IKUNGI DISTRICT, TANZANIA

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2.1 Abstract

Socio-demographic variables such as age of household head, household size and level of education are generally known to be associated with adoption of agricultural technologies. However, new agricultural technologies are often adopted slowly, and several aspects of adoption remain poorly understood. Therefore, this manuscript analyses association between socio-demographic factors and farmers' adoption of agricultural technologies in Ikungi District. The specific objectives of the manuscript were to analyse socio-demographic variables of farmers practising the RIPAT approach, identify technologies which were adopted among those that were disseminated by the RECODA project applying the RIPAT approach, and determine associations between socio-demographic variables and adoption of agricultural technologies. A cross-sectional research design was implemented to enable collection of data at one point in time, the design is cheap and less time consuming. Multi-stage random sampling approach was used in selection of 120 household heads, 30 from each of the four study villages. Quantitative and qualitative data were collected and analysed. Secondary data were collected from RECODA documents which are the RIPAT manual and a document on Farmers' Choice. Besides, chi-square analysis was used for inferential analysis to determine whether there was a significant association between farmers' socio-demographic factors and their adoption of of agricultural technologies. The findings showed that respondents' occupations were significantly associated ($p \leq 0.05$) with home gardening adoption, and education was significantly associated with adoption of poultry mother unit, and with harvesting rainfall. Therefore, it is concluded that household heads' occupations and education levels are the main factors that are associated with adoption of the RIPAT disseminated technologies. It is recommended that RECODA officials implementing the RIPAT approach should focus more on these factors for more adoption of the disseminated technologies.

Key words: Socio-demographic factors, Adoption agricultural technologies, RIPAT, RECODA

2.2 Introduction

The agricultural sector plays an important role in the Tanzanian economy and has the potential to advance the country's objectives of growth and poverty reduction. Agriculture in Tanzania provides about 66.9% of employment, accounts for about 23% of GDP, 30% of exports and 65% of inputs to the industrial sector (URT, 2016a). According to the Agricultural Sector Development Strategy (ASDS) II, transformation of the agricultural sector into a modern, commercial, highly productive and resilient agricultural sector which is competitive in the national and international markets will lead to achieving poverty reduction hence, contributing to realization of Tanzania's Development Vision 2025 (URT, 2016).

A report from a baseline survey in Ikungi District shows about 90% of the population in the district people who involve themselves in growing various food crops which are sorghum, maize and sweet potatoes and livestock keeping on a small scale (IDBR, 2013). In addition, the level of mechanisation in agriculture is low with most farmers in the district depending on the hand hoe and selling of honey and chickens as important sources of income (IDBR, 2013). A number of previous studies have reported issues related to adoption of agricultural technologies and have analysed socio-demographic factors and their effects on the decision by farmers to adopt agricultural technologies (Liu *et al.*, 2018). Many factors influence the ability of a farmer to adopt agricultural technologies; some of the factors are within farmers' control abilities while others are beyond their control. However, new agricultural technologies are often adopted slowly, and several aspects of adoption remain poorly understood.

According to Eliya *et al.* (2019), socio-demographic factors such as age of the household head and land size significantly influence farmers' decision to adopt agricultural technologies. In adoption of new agricultural technologies, younger farmers are early adopters and are characterised as being innovative, which enables them to make decision on adoption of new agricultural technologies. Education status has been confirmed to have a positive influence on adoption of technologies. According to Melesse (2018), educated household heads may have enhanced practical awareness and understanding of an erosion problem and apply measures to control it rather than considering erosion as a curse. Sex of the household head is a very important thing in studying factors of adoption; women are mostly a dis-favoured group of the society as they cannot easily access technology information. Findings from other literature sources show that female household headship is negatively associated with technology adoption decisions as compared to male household headed ship. Moreover, male headed households have more access to information about technologies than female-headed households.

The RIPAT approach is a combination of elements of the ‘top-down’ and ‘bottom-up’ approaches which are Training and Visit (T&V) and Farmer Field Schools (FFS) respectively. The T&V approach relies on “top-down” extension of technical information, with specialists and field staff transferring knowledge to lead farmers in villages that in turn are responsible for diffusing knowledge into the local community. As a response to this top-down approach, FFS were developed as a “bottom-up” approach.

Technologies disseminated among farmers in Ikungi District include the raised home gardens, rain harvesting technologies, poultry mother unit, conservation agriculture, improved maize seeds, animal keeping, preparation and use of organic fertilizer, water pumps irrigation and applying natural pesticides. Basket of Options were used to provide agricultural technologies to farmers, technologies that are suitable and easy to apply. Other technologies include the use of certified seeds in production, the use of organic and inorganic fertilizers, irrigation and the use of water pumps in irrigation technologies.

The overall objective of this manuscript was to determine the association between surveyed households’ socio-demographic factors and their adoption of selected agricultural technologies. The specific objectives of the manuscript were to determine socio-demographic variables of the RIPAT project members, identify technologies which were adopted among those that RIPAT project disseminated, and determine association between socio-demographic variables and adoption of agricultural technologies. Also, test of the null hypothesis which states that socio-demographic factors are not associated with adoption of agricultural technologies was tested.

2.3 Methodology

The study was conducted in Ikungi District which is one of the 5 districts of Singida Region which are Singida, Singida municipality, Ikungi, Manyoni, Iramba and Mkalama Districts. It is one of the 20 new districts that were formed in Tanzania since 2010 with 26 wards; it was split off from Singida District. Ikungi District borders with the following districts: to the North Iramba District, Singida Municipality and Singida District. To the East it borders with Manyara Region, and to the South it borders with Manyoni District while to the West of it borders with Tabora Region. Its administrative seat is the town of Ikungi. According to the 2012 Tanzania National Census, the population of Ikungi District was 272,959. Singida Region has a total surface area of 49,438 km^2, out of which 95.5 km^2 or 0.19% is covered by water bodies of Lakes Eyasi, Kitangiri, Singidani, Kindai and Balengida. The remaining 49,342.5 km^2 is land area. The reasons for choosing Ikungi District is because it is one among the two districts in Singida Region with projects practising the RIPAT approach under the RECODA organisation.

Cross-sectional research design was adopted for the study whereby collection of data were done at one point in time from a selected sample of respondents (Kothari, 2004). Multi-stage random sampling approach was used to select a representative sample of technology adopters. Ikungi District was selected purposively because it has a total of 43 villages practising the RIPAT approach. The sample size was 120 respondents, which was determined using Cochran’s (1977) sample size formula for continuous data as follows:

$$n = \frac{(Z)^2 \times (s)^2}{(d)^2}$$

The above formula gives a sample of 384. Because the population from which the sample was drawn which was finite, i.e. 175, Cochran’s (1977), correction formula for adjusting the sample size for smaller populations was further used to adjust the 384 sample, taking into account the population size. The formula is:

$$n = \frac{\text{sample size for any population size, i.e. } 384}{[1+ (\text{sample size for any population size/Population size})]}$$

Using the above formula, the sample size was calculated as follows:

$$n = \frac{384}{[1 + (384)/175)]}$$

$$n = \frac{384}{(1 + 2.1942857)}$$

$$n = \frac{384}{3.1942857} = 120.2147 = 120$$

Qualitative data were collected from five key informant interviewees (KIs) who included one member of the RECODA organisation and four village leaders, one from each of the four study villages. Quantitative data were collected using a structured questionnaire from 120 household heads involved in projects using the RIPAT approach.

2.3.1 Data analysis

Content analysis was employed in analysing qualitative data whereby words that were mentioned more frequently by key informant interviewees were identified. The words were then compared and contrasted with information from the questionnaire and with information available in literature. Associations between socio-demographic factors and farmers' adoption of selected agricultural technologies were analysed descriptively including computation of percentages and frequencies. Inferential analysis was done; it was done using chi-square tests to determine associations between socio-demographic factors of the farmers and the types of the technologies they had adopted.

2.4 Findings and Discussion

2.4.1 Socio-demographic characteristic of the respondents

Household heads' age, sex, marital status, occupation and level of education were considered in order to have a wide view of the respondents as follows. Out of the 120 respondents involved in the study, 81.7% were females while male respondents were 18.3%. The findings in this study, however, contradict findings of a study conducted in Arumeru by Komba *et al.* (2019) which showed that male farmers were less likely perceiving agricultural extension information as compared to female farmers in the study area. The number of female respondents involved in the study was higher because of the *Boresha lishe* project that focused on improving Children health and reducing stunting among under-five children in Ikungi District.

The majority (53.3%) of the household heads were younger than 35 years (Youth household heads), and 46.7% of the household heads were older above 36 years. This means that younger farmers are more likely to adopt agricultural disseminated technologies and considered as an economically active group (URT, 2015). On the other hand, the flexibility and education level of younger farmers is higher compared to older farmers (Melesse, 2018). The findings further showed that 60.8% of the household heads had achieved primary education level, and 6.7% lacked formal education. Generally, educated farmers are more informed of new agricultural technologies as compared to less educated ones. Formal education status increases probability of farmers adopting of new technologies compared to farmers with no formal education (Shiferaw *et al.*, 2009). The majority (63.3%) of the household heads were married, and 8.3% were widows/widowers. The findings also showed that 66.7% of the household heads were depending on farming as their main economic activity.

Table 2.1: Respondents socio-demographic characteristics (n=120)

Variable	Category	Frequency	Per cent
Sex	Male	98	81.7
	Female	22	18.7
Age	Young less than 35 years,	64	53.3
	Older aged above 36 years	56	46.7
Education level	No formal education	8	6.7
	Primary education	73	60.8
	Secondary education	39	32.5
Marital status	Single	18	15.0
	Married	76	63.3
	Separated	16	13.3
	Widow/ Widower	10	8.3
Employment	Salaried employment	7	5.8
	Crop production	80	66.7
	Livestock keeping	14	11.7
	Trade	19	15.8

2.4.2 Adoption of technologies disseminated through the RIPAT Approach

The findings in Table 2.2 show that RIPAT disseminated technologies had been adopted as follows: use of raised home gardens (86.7%), applying poultry mother unit (84.2%), use of conservation agriculture (82.5%) and use of harvested rain water (26.7%). The findings also showed that the adoption of harvested rain water technology was minimal (26.7%).

Table 2.2: Adoption of RIPAT disseminated technologies (n = 120)

Response	Poultry mother unit		Rain water harvesting		Home gardening		Conservation agriculture	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Yes	101	84.2	32	26.7	104	86.7	99	82.5
No	19	15.8	88	73.3	16	13.3	21	17.5
Total	**120**	**100**	**120**	**100**	**120**	**100**	**120**	**100**

The findings in Table 2.2 show a high adoption of agricultural technologies disseminated through the RIPAT approach. Probably, it is because of active participation of farmers in Farmer Field Schools and Training and Visits. According to Nyasimi *et al.* (2017), farmers in Lushoto District increased their crop productivity and adopted varieties of agricultural disseminated technologies after their participation in the Farms of the Future (FotF) approach with the use of improved crop varieties as the main practices. According to Gahanga and Urassa (2019), there was higher maize productivity among farmers involved in Farmer Field Schools in Morogoro district.

2.4.3 Adoption of other pertinent technologies

The findings in Table 2.3 show that other pertinent technologies which had been adopted were as follows: use of certified seeds (87.5%), application of organic fertilizers (82.5%), use of irrigation (80%), use of water pumps (27.5%) and use of inorganic fertilizers (21.7%).

Table 2.3: Adoption of other pertinent technologies (n=120)

Response	Certified seeds		Inorganic fertilizers		Organic fertilizers		Irrigation		Water pumps	
	n	**%**	**n**	**%**	**n**	**%**	**N**	**%**	**n**	**%**
Yes	105	87.5	26	21.7	99	82.5	96	80	33	27.5
No	15	12.5	94	78.3	21	17.5	24	20	87	72.5
Total	**120**	**100.0**	**120**	**100.0**	**120**	**100.0**	**120**	**100.0**	**120**	**100.0**

2.4.4 Findings on Associations between Socio-demographic factors and adopted technologies

Gender, age, education, marital status and occupation were cross-tabulated with the four technologies (poultry mother unit, harvesting rainfall, home gardening and conservation agriculture) that were disseminated by the RIPAT project to the respondents. Concomitantly with cross-tabulation, chi-square tests and determination of levels of significance were done. The findings in Table 2.4 show that the only significant association (Chi-square = 12.547, p = 0.006) was between respondents' main occupation and adoption of home gardening. The main occupation of those who mostly adopted home garden technology was crop production; they were 66.7% of the respondents.

Level of education of the respondent was the second factor associated with adoption of RIPAT disseminated technologies. It was associated with adoption of poultry mother unit, harvesting rainfall and home gardening with p-values of 0.093, 0.078 and 0.07 respectively together with the chi-square values seen in Table 2.4. Therefore, from those findings, the null hypothesis that socio-demographic factors are not associated with adoption of agricultural technologies cannot be accepted with respect to occupations of respondents. According to Melesse (2018), agricultural technologies were mostly adopted by educated farmers and it increased the sorghum production in the study area. The findings are in line with findings of a study by Shiferaw *et al.* (2014) who reported that education enhances awareness and decision making thereby increasing of adoption of disseminated agricultural technologies. Educated household heads are more likely to use mobile phones and internet in adoption of agricultural technologies. Education has a power to change knowledge, skills and attitude of farmers towards the use and adoption of disseminated agricultural technology.

Table 2.4: Socio-demographic factors and technologies adoption

Factor	Category	Poultry Mother Unit (%)		Harvested Rain (%)		Home garden (%)		Conservation Agriculture (%)	
		Yes	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
Gender	Male	90.9	9.1	40.9	59.1	90.9	9.1	72.7	27.3
	Female	82.9	17.1	23.5	76.5	85. 7	14.3	84.7	15.3
	X^2		0.919		2.794		0.420		1.782
	P-Value		0.338		0.095		0.517		0.182
Age	Younger	82.2	17.8	26.6	73.4	85.9	14.1	82.8	17.2
	Older	85.7	14.3	26.8	73.3	82.1	17.9	82.1	17.9
	X^2		0.189		0.001		0.063		0.009
	P-Value		0.664		0.978		0.802		0.923
Education	No formal education	62.5	37.5	0.00	100	100	0	100	0.00
	Primary	89.0	11	32.9	67.1	90.4	9.6	84.9	15.1
	Secondary	79.5	20.5	25.0	75	76.9	23.1	74.4	25.6
	X^2		4.761		5.104		5.321		3.786
	P-Value		0.093		0.078		0.07		0.151
Marital status	Single	83.3	16.7	11.1	88.9	94.4	5.6	88.9	11.1
	Married	88.2	11.8	31.6	68.6	85.5	14.5	80.3	19.7
	Separated	75.0	25	25.0	75	87.5	12.5	93.8	6.2
	Widowed	70.0	30	20.0	80.0	80.0	20.0	70.0	30.0
	X^2		3.433		3.415		1.422		2.728
	P-Value		0.33		0.332		0.7		0.435
Main Occupation	Salaried employed	85.7	14.3	28.6	71.4	57.1	42.9	71.4	28.6
	Crop production	83.8	16.2	26.2	73.8	93.8	6.2	86.2	13.8
	Livestock keeping	85.7	14.3	21.4	78.6	71.4	28.6	71.4	28.6
	Trade	84.2	15.8	31.6	68.4	78.9	21.1	78.9	21.1
	X^2		0.048		0.451		12.547		2.728

P-Value	0.997	0.93	0.006	0.435

2.5 Conclusions and Recommendations

This manuscript assessed associations between socio-demographic variables and adoption of agricultural technologies in Ikungi District, Tanzania. Based on the findings, 60.8% of the respondents had primary education; 63.3% of them were married; and 66.7% of them were doing crop production as their main economic activity. Educated farmers and married farmers are more likely to adopt disseminated technologies. Also, the findings showed that household heads involved in crop production are more likely to adopt disseminated technologies. It is recommended that RIPAT officials should equip their beneficiaries with non-formal education in terms of seminars on the technologies they disseminate to them so that they can use them in sustainable ways.

Of the four technologies that RIPAT disseminated, home gardening was the most adopted, being followed by poultry mother unit and conservation agriculture while rain water harvesting was the least adopted. Since rain water harvesting was the least adopted technology it means it had more constraints. It is recommended that RIPAT and local Government authorities should support people in the research area to harvest rain water.

Education, age, gender, marital status and occupation of the respondents were associated with adoption of RIPAT disseminated technologies. Occupations and education levels of the respondents are the main factors that are associated with adoption of the RIPAT disseminated technologies. It is recommended that the RIPAT officials should focus more on occupation (by concentrating more on people whose main occupation is crop production) and giving education to beneficiaries on how to use the technologies in sustainable ways so that more people can adopt the technologies.

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CHAPTER THREE

3.0 ADOPTION OF AGRICULTURAL TECHNOLOGIES DISSEMINATED BY THE RIPAT PROJECT AND AGRICULTURAL PRODUCTIVITY IN IKUNGI DISTRICT, TANZANIA

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3.1 Abstract

Agricultural technology adoption is important in increasing agricultural productivity. In Ikungi District, the RIPAT approach has been used to disseminate a basket of selected agricultural technologies for increasing agricultural productivity. Regardless of the agricultural technologies disseminated through the project applying the RIPAT approach having substantially been adopted in Ikungi District, the linkage between the adoption and agricultural productivity was not empirically known. This manuscript determined linkages between agricultural productivity and adoption of disseminated agricultural technologies by project applying the RIPAT approach in Ikungi District. The specific objectives of the manuscript were to estimate crop produce harvested per unit area, compare agricultural productivity among the beneficiaries who had adopted different technologies disseminated through the RIPAT approach, and determine influence of RIPAT approach on crop productivity. A cross-sectional research design was adopted whereby data were collected at one point in time. A multi-stage random sampling approach was used in the selection of 120 household heads, 30 from each of the four study villages. Quantitative data and qualitative data were collected and analysed. Secondary data were collected from RECODA documents which are the RIPAT manual and from a document on Farmers' Choice. Besides, one-way ANOVA was used to compare crop yields among farmers who had adopted different technologies disseminated by the projects applying the RIPAT approach. Multiple linear regression was used to determine the influence of RIPAT approach factors on crop productivity. Farmers' experience had a significant effect on crop productivity ($\beta = 0.269$, $p = 0.008$). It is concluded that the experience of farmers towards practising technologies disseminated by the RIPAT project is an important tool for adoption to increase crop productivity. Therefore, training offered by the RIPAT approach is needed to further promote farmers' participation and in designing training based on farmers' problems and need.

Key words: crop productivity, farmers' experience**,** agricultural technology, RIPAT approach

3.2 Introduction

Farmers' adoption of agricultural technologies is widely recognised as a key means of addressing most of the causes of low productivity such as pests and diseases, soil infertility and low yielding crop varieties and livestock (Campenhout, 2017). Tanzania records a continuous agricultural sector growth and is considered largely self-sufficient in its main staple foodstuffs, particularly maize and rice. Cassava, paddy, sorghum and bananas are other most widely grown staple crops in Tanzania (FAO, 2018). Nonetheless, low adoption of agricultural technologies is among the main reasons for low farm productivity in Tanzania (Kaliba *et al.*, 2018). In Tanzania productivity and extent of agriculture intensification is low and its sustainability is threatened by decline in soil fertility, soil erosion, and reliance on expanding agricultural land in the face of climate change (Mwaseba, 2018).

The RIPAT (Rural Initiatives for Participatory Agricultural Transformation) is an agricultural intervention and participatory extension approach that aims at closing the agricultural technology gap as a means of improving livelihoods and self-support among rural small-scale farmers (Vesterager *et al*., 2017). The RIPAT approach is a combination of elements of the 'top-down' and 'bottom-up' approaches which are Training and Visit (T&V) and Farmer Field Schools (FFS). The T&V approach relies on "top-down" extension of technical information, with specialists and field staff transferring knowledge to lead farmers in villages that in turn are responsible for diffusing knowledge into the local community.

In Ikungi District, the RIPAT approach has disseminated a basket of selected agricultural technologies for increasing agricultural productivity. Regardless of the agricultural technologies disseminated by the projects applying the RIPAT approach having substantially been adopted in Ikungi District, the linkage between the adoption and agricultural productivity was not empirically known. Probably, it is because of farmers' ambivalence about agricultural technologies; lack of trust in agricultural agents; low levels of agricultural technology knowledge; extension services as the source of information dissemination to farmers; predominance of gender in determining agricultural technology adoption; and gender inequity in agricultural decision-making (Nyairo, 2020). According to FAO (2018), despite on-going agricultural growth in Tanzania, limited access to agricultural inputs exacerbates smallholders 'low productivity. While the majority of farmers rely on traditional farming methods, only 1.4% of smallholder farmers use motorized equipment. In addition, the provision of extension services or other knowledgeable sources is similarly weak. The aim of this paper is to determine crop production (kg/ha) of the beneficiaries of projects applying the RIPAT approach to disseminate agricultural technologies. In addition it compares productivity among the beneficiaries practicing different technologies disseminated through approach and lastly it determines the influence of RIPAT approach on crop productivity.

Crop production is the main agricultural activity of many Tanzanian smallholder farmers with household size of about 5 members with a mean land holding capacity of around 1.2 hectares (FAO, 2018). Tanzania is characterised by low productivity because it is highly dependent on rainfall and has been affected by severe droughts over the last decade. Compared to other East African countries, Tanzanian farmers' application of fertilizers is lower (16% of the households use fertilizers), despite almost a half (42%) of the households having access to improved seeds. In addition, almost 80% of the annual crop production is dedicated to food production, thus, improved agricultural productivity has great potential of reducing poverty of Tanzanian smallholder farmers (FAO, 2018).

According to PEI (2014) mapping Report of (2014), Ikungi District has both fertile sandy soil and black soil suitable for production of various crops. The annual rainfall ranges from 600 mm to 700 mm. This climatic condition favours production of various agricultural crops. The main crops grown in Ikungi District include sorghum, finger millet, sweet potatoes, cassava, sunflower, pigeon peas, cowpeas, cotton, rice, groundnuts and finger millet. Besides, Ikungi District has been facing continuous climatic stress. For example, pressure on forests has progressively escalated, and ecological degradation is evident, including forest destruction, poor management, and environmental degradation. This has led to low agricultural productivity among farmers in the district.

According to Teklewold *et al.* (2013), factors that influence technology adoption can be grouped into the following three broad categories: factors related to the characteristics of producers (farmers), factors related to the characteristics and relative performance of agricultural technologies, and factors related to the programme and institutional factors. The factors related to the characteristics of producers include education level, experience with specific agricultural activities, age, gender, level of wealth, and farm size.

A study by Mwangi and Kariuki (2015) showed that adoption of agricultural technologies can be affected/ influenced by technological factors, economic factors, institutional factors and household-specific factors. This manuscript considered factors such as farmers' experience, several RIPAT technologies adopted, availability of training methods used in teaching RIPAT technologies, farmers' participation in training and use of mobile phones to talk about RIPAT technologies as the programme and institutional factors influencing adoption of agricultural technologies to increase agricultural productivity in Ikungi District.

Farmers can have decisions to adopt or not or to abandon a technology once adopted (Baumüller, 2012). In Ikungi District, project applying the RIPAT approach disseminated various technologies to farmers, including raised home garden, harvested rainwater, poultry mother unit technology, conservation agriculture, improved maize seeds, animal keeping, preparation and use of organic fertilizer, water pumps irrigation and applying natural pesticides.

Generally, through the RIPAT approach technologies are provided to farmers as a Basket of Options from which farmers are to choose technologies that are suitable and which they can easily apply. RIPAT applying projects, with the help of Lead farmers from farmers groups and extension officers, use both bottoms-up and top-down approaches to ensure technologies reach targeted individuals at the right moment. Nonetheless farmers continues to practice other agricultural technologies in addition to those accesed through *boresha lishe* project under RECODA organisation. Other technologies include the use of certified seeds in production, the use of organic and inorganic fertilizers, irrigation and the use of water pumps in irrigation. Therefore, this paper aims to show how the adoption of agricultural technologies subsequently contributes to improving agricultural productivity.

3.3 Methodology

The study on which this manuscript is based was conducted in Ikungi District which is one of the 5 districts of Singida Region which are Singida, Singida municipality, Ikungi, Manyoni, Iramba and Mkalama Districts. It is one of the 20 new districts that were formed in Tanzania since 2010 with 26 wards; it was split off from Singida District. Ikungi District borders the following districts: to the North Iramba District, Singida Municipality and Singida District. To the East it borders with Manyara Region, and to the South it borders with Manyoni District while to the West of it borders with Tabora Region. Its administrative seat is the town of Ikungi. According to the 2012 Tanzania National Census, the population of Ikungi District was 272,959. Singida Region has a total surface area of 49,438 km^2, out of which 95.5 km^2 or 0.19% is covered by water bodies of Lakes Eyasi, Kitangiri, Singidani, Kindai and Balengida. The remaining 49,342.5 km^2 is land area. The reasons for choosing Ikungi District is because it is one among the two districts in Singida Region with projects practising the RIPAT approach under the RECODA organisation.

Cross-sectional research design was used whereby collection of data was done once in time from a selected sample of respondents (Kothari, 2004). This design is relatively cheap, quick and effective since it utilizes limited resources in terms of time, funds, labour, transport and time. According to Bernard (1994), this design provides useful information for statistical description and interpretation. It allows determination of relationships between different variables that are focused to a particular study.

The sample size was 120 respondents, which was determined using Cochran's (1977) sample size formula for continuous data as follows:

$$n = \frac{(Z)^2 \times (s)^2}{(d)^2}$$

The above formula leads to getting a sample size of 384, but because the population from which the sample was drawn was finite, i.e. 175, Cochran's (1977) correction formula for adjusting the sample size for smaller populations was further used to adjust the 384 sample, taking into account the population size. The formula is:

$$n = \frac{\text{sample size for any population size, i.e. 384}}{(1+\text{ sample size for any population size})/\text{Population size}}$$

Using the above formula, the sample size was calculated as follows:

$$n = \frac{384}{[1 + (384)/175)]}$$

$$n = \frac{384}{(1 + 2.1942857)}$$

$$n = \frac{384}{3.1942857} = 120.2147 = 120$$

Multi-stage random sampling approach was used to select a representative sample of technology adopters, because respondents who were to be chosen were ones believed to be a good source of information and had varied experiences in the village to represent farmers in the district (Krysik and Finn, 2007). Ikungi District was selected purposefully because it had a total of 43 villages practising the RIPAT approach. Besides the 120 respondents, five key informant interviewees were selected. They included one member of the RIPAT RECODA organisation team and four village leaders, one from each of the four selected villages.

Qualitative data were collected using key informant interviews, and quantitative data were collected using a structured questionnaire from 120 household heads practising the RIPAT approach. The questionnaire consisted of a combination of open-ended, closed-ended questions and a Likert scale to measure attitude. The questionnaire was used to collect information on background information of the respondents, resource allocation towards implementation of project activities, views of the respondents on achievements of the

RIPAT approach project with respect to training and respondents' attitude towards the RIPAT approach agricultural technologies dissemination and adoption.

Qualitative data were analysed using content analysis whereby words that were mentioned more frequently by key informant interviewees were coded. The words were then compared and contrasted with information from the questionnaire and with information available in literature. Quantitative data were analysed using descriptive statistics to determine frequencies, percentages, averages, standard deviations, and minimum and maximum values of individual variables. Multiple linear regression analysis was used to determine influence of RIPAT approach (predictor variables) on agricultural productivity (outcome variable). The following model was used:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_5 x_5 + \varepsilon$$

where:

y = Agricultural productivity

$\beta_1, \beta_2, ..., \beta_5$ = Coefficients of the independent variables showing how they influence

x_1 to x_5= Independent variables, and

ε = Random error term showing the influence of other factors not explained by the model

In this paper:

x_1 = Farmers' experience (1 = Experienced, 0 = Not experienced),

x_2 = Number of RIPAT technologies adopted,

x_3 = Availability of training methods in teaching RIPAT technologies (1 = Available, 0 = Not available),

x_4 = Farmers' participation in training (1 = Participated, 0 = Never participated), and

x_5 = Use of mobile phones to talk about RIPAT technologies (1 = Uses, 0 = Does not use).

3.4 Results and Discussion

In this section study findings and their discussions are presented based on this manuscript's objectives. The first section discusses the amounts of crop products harvested. The second section presents agricultural productivity and the RIPAT disseminated technologies, and the third section discusses the Institutional factors influencing crop productivity.

3.4.1 Beneficiary households crop productivity

The main crops that were produced using technologies disseminated by the project applying the RIPAT approach were maize (81.6%), finger millet (49.1%), sunflower (35.0%), millet (43.3%) and sorghum (10.8%).

3.4.2 Agricultural productivity and the RIPAT disseminated technologies

One-way ANOVA was used to compare crop yields among households adopted conservation agriculture, poultry mother unit, harvested rain water and raising home garden agricultural technologies. Table 3.1 indicates numbers of farmers who had adopted different agricultural technologies disseminated by the RIPAT approach and mean yields of maize, sorghum, millet, finger millet and sunflower.

Table 3.1: The RIPAT disseminated technologies and Agricultural Productivity

Crop	Number of technologies adopted	n	Mean yield (kg/ha)	F-value	Sig. (p-value)
Maize	1	10	1255.1	2.381	0.074
	2	23	1144.9		
	3	68	794.7		
	4	19	1197.9		
Sorghum	1	2	888.9	0.695	0.578
	2	3	592.6		
	3	6	1338.8		
	4	2	963.0		
Millet	1	4	681.5	1.558	0.212
	2	8	457.2		
	3	29	657.0		
	4	11	865.5		
Finger millet	1	2	790.1	0.189	0.903
	2	14	1202.8		
	3	35	1010.2		
	4	8	1018.5		
Sunflower	1	2	1259.3	2.781	0.054
	2	7	522.0		
	3	25	581.8		
	4	8	980.6		

The findings on agricultural productivity and the RIPAT disseminated technologies show that 68 farmers growing maize, 6 farmers growing sorghum, 29 farmers growing millet (29), 35 farmers growing finger millet and 25 farmers growing sunflower had adopted 3 different technologies among conservation agriculture, poultry mother unit, rain water harvesting and raising home garden agricultural technologies disseminated by the RIPAT approach. Farmers growing sorghum six had higher sorghum yield at 1338.8 kg/ha. This means that the more farmers adopted more agricultural technologies the higher the sorghum yield was.

3.4.3 Influence of the RIPAT approach Factors on Crop productivity

Crop productivity was regressed on experience of farmers, number of technologies adopted by farmers, training methods used to disseminate agricultural technologies, farmers' participation in training and the use of mobile phones to talk about the RIPAT basket of technologies options to determine the influence of those independent variables on crop productivity. The multiple correlation between the RIPAT approach factors and crop productivity, R = +0.309, shows that independent variables were positively correlated with crop productivity. The coefficient of determination which was $R^2 = 0.095$ indicates that the RIPAT approach factors included in the model were able to explain 9.5% of the variation in the variance of the crop productivity.

Table 3.2: Factors influencing crop productivity

Independent variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
Farmers experience	-22.573	8.300	-0.269	-2.720	0.008	0.808	1.237
Number of RIPAT technologies adopted	-136.852	89.439	-0.144	-1.530	0.129	0.895	1.117
Training methods	-210.262	167.141	-0.118	-1.258	0.211	0.900	1.111
Farmers participation in training	11.599	7.631	0.153	1.520	0.131	0.785	1.274
Use of mobile phones	-19.190	165.791	-0.011	-0.116	0.908	0.961	1.040

The findings on the factors influencing crop productivity indicated that participation in training offered by the RIPAT approach had a positive influence (Standardised $\beta = 0.153$) on crop productivity. This means that farmers' participation in training offered by RECODA projects using the RIPAT approach increased crop productivity by 15.3%, if all other predictor variables remained constant. This implies that the participation of farmers in training offered by the projects positively impacts on their agricultural productivity. According findings by Mudombi (2013) on the adoption of agricultural technologies in Zimbabwe, socio-demographic factors were positively correlated with the adoption of innovation through farmer training, participation in on-farm trials; irrigation use; farmer-to-farmer input exchange and extension services.

Findings on the RIPAT approach factors influencing crop productivity also showed that the experience of farmers (measured as the number of years in crop farming) in using the RIPAT disseminated technologies had a significant effect on crop productivity at (p = 0.008), although it was negative (β = -0.269). The null hypothesis that RIPAT-RECODA project factors do not have a significant impact on crop productivity is rejected accepted because of the p-value of < 0.05. Experienced farmers spend substantial time on farming and are more likely to adopt disseminated technologies.

Experience is a very important aspect to farmers in adopting a particular technology, especially if the technology proves to be worthwhile to them (Ntshangase *et al.*, 2018). This is because farmers with accumulated experiences from the production of crops can easily understand the benefits of different technologies disseminated by the RIPAT project. According to Tiamiyu *et al.* (2009) more experienced farmers may have better skills and access to information about improved technologies. Hence, the more the experience of growing new rice, the higher its adoption. According to Miruts (2016), farmers' experience with agricultural extension is expected to increase crop yields.

The study findings are in line with the adoption-diffusion theory developed by Rogers (1995) which explains why farmers choose to adopt new ideas as the agricultural technologies disseminated by the RIPAT approach to farmers ensured increase in yield. The time needed and the rate of adoption of the RIPAT disseminated agricultural technologies depend on the technology itself and the characteristics of farmers who are the receivers of the technology. Since the decision to adopt a technology is a mental process, the RIPAT approach normally advocates for introduction of a basket of options among farmers to ensure farmers' choices are kept in consideration.

3.5 Conclusions and Recommendation

The following are the conclusions made from the findings. The majority of the respondents produce maize as compared to other crops. Therefore, it is concluded that knowledge obtained from the RIPAT approach through conservation agriculture technology has enabled farmers to increase crop productivity, especially maize. Conservation agricultural technologies aimed at improving farmers' awareness in preparing their farms and in the use of organic fertilizers as well as the application of improved maize seeds. Training offered to farmers by RECODA officials should focus more on improving already existing technologies in order to increase farmers' access to new technologies and using them in sustainable ways.

Farmers growing maize (68), sorghum (6), millet (29), finger millet (35) and sunflower (25) had adopted at least 3 different technologies from the basket of technologies options; i.e. conservation agriculture, poultry mother unit, rainwater harvesting and raising home garden agricultural technologies; disseminated by the RIPAT approach. Generally, crop productivity depends on the type of technology being introduced; for example farmers who had adopted three different technologies had higher sorghum productivity at 1338.8 kg/ha. This indicates that training provided to farmers on agricultural technologies was adopted by farmers. It is recommended that, in order to increase crop productivity, RECODA should provide a basket of more technologies to increase farmers' selection of suitable technologies that meet their needs.

Farmers' experience measured as the number of years in crop farming on the use of the RIPAT disseminated technologies had a significant effect on crop productivity at p =

0.008. The experience of farmers towards practicing technologies disseminated by the RIPAT project is an important tool for adoption to occur. Understanding the RIPAT approach factors that influence or hinder crop productivity is essential in planning and executing other technology-related programmes for meeting crop productivity challenges in Tanzania. Therefore, there is a need to further promote farmers' participation in training offered using the RIPAT approach through the Basket of options.

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CHAPTER FOUR

4.0 FARMER'S ATTITUDE TOWARDS ADOPTION OF AGRICULTURAL TECHNOLOGIES DISSEMINATED THROUGH THE RIPAT APPROACH IN A CASE OF IKUNGI DISTRICT, TANZANIA

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4.1 Abstract

The study on which this manuscript is based was carried out to investigate, among other things, attitudes of farmers towards adoption of agricultural technologies in Ikungi District. Attitude of farmers towards adoption of different agricultural technologies disseminated by the RIPAT approach in the district was not known. Therefore, the aim of the manuscript is to determine attitudes of farmers towards agricultural knowledge dissemination and adoption. The specific objectives of the manuscript are to determine attitude of farmers' towards adoption of disseminated agricultural technologies, find the extent of adoption of technologies disseminated through the RIPAT approach, and determine linkages between farmers' attitude towards adoption of agricultural technologies disseminated by the RIPAT approach and their extent of adoption. A cross-sectional research design was adopted by the study in which the manuscript is based. Therefore, data were collected once. Multi-stage random sampling approach was used in selection of 120 household heads, 30 from each of four villages where the research was conducted. Quantitative data and qualitative data were collected and analysed. Secondary data on farmers' attitude towards adoption of technologies were collected from RECODA documents which are the RIPAT manual and from a document on Farmers' Choice. Besides, one-way ANOVA was used to compare the extent of adoption of technologies disseminated using the RIPAT approach attitude as the grouping variable. The findings showed that there was no significant difference in extent of adoption of RIPAT disseminated technologies among farmers with favourable, neutral and unfavourable attitudes ($F = 0.628$, $p = 0.535$). Therefore, it is concluded that there is not much difference in extent of adoption of RIPAT disseminated technologies among farmers with unfavourable, neutral and favourable attitudes. This shows that the respondents in Ikungi District were almost equally involved in the project. It is recommended that RECODA organisation staff should conduct campaigns to promote RIPAT agricultural technologies to allow farmers to have more favourable attitude towards the technologies and to enhance adoption of the disseminated agricultural technologies.

Key words, attitude, dissemination, adoption, agricultural technologies, RIPAT

4.2 Introduction

The RIPAT (Rural Initiatives for Participatory Agricultural Transformation) approach is an agricultural intervention and participatory extension approach that aims at closing the agricultural technology gap as a means of improving livelihoods and self-support among rural small-scale farmers (Vesterager *et al*., 2017). The RIPAT approach is a combination of elements of the 'top-down' and 'bottom-up' approaches which are Training and Visit (T&V) and Farmer Field Schools (FFS). The T&V approach relies on "top-down" extension of technical information, with specialists and field staff transferring knowledge to lead farmers in villages that are responsible for diffusing knowledge into the local community. As a response to this top-down approach, FFS were developed as a "bottom-up" approach. FFS is a participatory, experiential, and reflective learning to improve the problem solving capacity of farmers through highly trained facilitators working with farmer groups (Feder *et al*., 2010).

The RIPAT approach normally promotes a 'basket' of agricultural technology options for production of various crops and livestock to farmers' groups. Therefore, allowing for joint, experiential and participatory learning. Each individual farmer chooses which options to adopt on their farms and agrees to help three other farmers outside the group to do the same (Aben *et al*., 2012). The diffusion of agricultural technologies informs farmers' beliefs about the returns and gives them the practical knowledge to implement different technologies they may adopt (Beaman and Dillon, 2018).

Generally, farmer's decision to adopt a new technology is affected by the information gained as well as his or her attitude about the technology (Li *et al.*, 2019). Information on the agricultural technology can be diffused both formally through training and informally through neighbours practising the technology. Regardless of using both Training and Visit (T&V) and Farmer Field Schools (FFS) by project applying RIPAT approach to disseminate agricultural information in Ikungi District, attitude of farmers towards adoption of agricultural technologies is not known. According to Rogers (2003), innovation diffusion theory, attitude is one among the 5-step process by which a farmer adopts a new technology.

A study by Mokotjo and Kalusopa (2010) on challenges to dissemination and adoption of agricultural information found that the agricultural information delivered to farmers was in a print form and written in vernacular languages. Nonetheless, use of local languages enabled the farmers to utilise the information effectively. In another study conducted in Tanzania on sources of agricultural research information for women, farmers in Hai and Kilosa Districts (Isaya, 2015) found that farmers faced challenges such as inadequate knowledge on how to apply the information acquired from extension officers and researchers, and lacked credit to purchase farm inputs, improved seeds and chemical fertilizers. For this manuscript, therefore, information on attitude of farmers towards adoption of agricultural technologies disseminated by RECODA projects gathered and analysed.

The RIPAT approach gives farmers a choice regarding the range of agricultural technologies (basket of options) and a voice regarding how they want to organize themselves. This leads to sustained adoption of the new farming technologies (Larsen and Lilleør 2014). According to Aben *et al*. (2012), the effects of the RIPAT approach in adoption of technology are robust and positive. The study concludes that the RIPAT approach has been relevant project in terms of both the technologies offered and the way in which they were offered, through the use of a basket of options as a pragmatic mix of different extension approaches. There are indications that the RIPAT has succeeded in closing the technology gap experienced by small-scale farmers, as the risk of agricultural failure during drought has been reduced. However, according to Aben *et al*., (2012), a potential weakness of the agricultural technologies adoption may be a lower level of sustainability in the farmer groups compared with the classic Farmer Field School (FFS) set-up.

3.3 Methodology

The study on which this manuscript is based was conducted in Ikungi District which is one of the 5 districts of Singida Region which are Singida, Singida municipality, Ikungi, Manyoni, Iramba and Mkalama Districts. It is one of the 20 new districts that were formed in Tanzania since 2010 with 26 wards; it was split off from Singida District. Ikungi District borders with the following districts: to the North Iramba District, Singida Municipality and Singida District. To the East it borders with Manyara Region, and to the South it borders with Manyoni District while to the West of it borders with Tabora Region. Its administrative seat is the town of Ikungi. According to the 2012 Tanzania National Census, the population of Ikungi District was 272,959. Singida Region has a total surface area of 49,438 km^2, out of which 95.5 km^2 or 0.19% is covered by water bodies of Lakes Eyasi, Kitangiri, Singidani, Kindai and Balengida. The remaining 49,342.5 km^2 is land area. The reasons for choosing Ikungi District is because it is one among the two districts in Singida Region with projects practising the RIPAT approach under the RECODA organisation.

Cross-sectional research design was used whereby collection of data was done at one point in time from a selected sample of respondents (Kothari, 2004). Multi-stage random sampling approach was used to select a representative sample of technology adopters. Ikungi District was selected purposively because it has a total of 43 villages practising the RIPAT approach. The sample size was 120 respondents, which was determined using Cochran's (1977) sample size formula for continuous data as follows:

$$n = \frac{(Z)^2 \times (s)^2}{(d)^2}$$

The above formula gives a sample of 384. Because the population from which the sample was drawn which was finite, i.e. 175, Cochran's (1977) correction formula for adjusting the sample size for smaller populations was further used to adjust the 384 sample, taking into account the population size. The formula is:

$$n = \frac{\text{sample size for any population size, i.e. 384}}{[1+ (\text{sample size for any population size/Population size})]}$$

Using the above formula, the sample size was calculated as follows:

$$n = \frac{384}{[1 + (384)/175)]}$$

$$n = \frac{384}{(1 + 2.1942857)}$$

$$n = \frac{384}{3.1942857} = 120.2147 = 120$$

Qualitative data were collected using key informant interviews in which 5 key informant interviewees were selected. They included one member of RIPAT RECODA organisation team and 4 village leaders, one from each of the four selected villages. Quantitative data were collected using a structured questionnaire from 120 household heads practising the RIPAT approach.

Qualitative data were analysed using content analysis whereby words that were mentioned more frequently by key informant interviewees were identified. The words were then compared and contrasted with information from the questionnaire and with information available in literature. Quantitative data were analysed to determine frequencies, percentages, averages, standard deviations, and minimum and maximum values of individual variables. Inferential statistics were used to find correlation between attitude of farmers towards the RIPAT approach in agricultural knowledge dissemination and adoption and extent of adoption of technologies.

A five-point Likert scale was used in measuring farmers' attitude towards the RIPAT approach in agricultural knowledge technology transfer. According to Bernard (1994), Likert-scale type interview items result in a single score that represents the degree to which a person has favourable or unfavourable views with respect to the questions asked. The alternative answers on the scale ranged from strongly disagree (1 point), disagree (2 points), undecided (3 points), agree (4 points) and strongly agree (5 points). The responses were then grouped into three groups of unfavourable attitude (strongly disagree and disagree), neutral attitude (Undecided), and favourable attitude (agree and strongly agree).

One way-ANOVA was used to compare attitude of farmers towards adoption of agricultural technologies disseminated by the RIPAT approach by extent of adoption of technologies. Content analysis was implemented for analysis of the qualitative information collected using key informant interviews in which themes were developed regarding various issues that were responded to.

4.4 Findings and Discussion

4.4.1 Attitude of farmers towards use of the RIPAT approach in disseminating agricultural knowledge

Attitude towards adoption of disseminated technologies was measured using a Likert scale which comprised of 14 statements a half of which had positive connotations while the others had negative connotations. The respondents were required to show whether they strongly disagreed (1 point), disagreed (2 points), where undecided (3 points), agreed (4 points) or strongly agreed (5 points) with each of the statements. For streamlining presentation of the findings, strongly disagree and disagree were grouped into disagree, undecided was left intact and agree and strongly agree were grouped into agree. The findings are presented in Table 4.1.

The findings in Table 4.1 show that 89.2% of the respondents disagreed with the statement which stated that the RIPAT approach was there to benefit leaders and better-off farmers and not common people and poor farmers. The findings are similar to the findings by Mcharo (2013) which indicates more than a half of the respondents disagreed on the effectiveness of agricultural extension agents in knowledge transfer among farmers in the study area.

On the other hand, 85% of the respondents agreed with the statement which stated that the RIPAT approach increases contact among farmers and extension agents. The findings were also confirmed by a Project Coordinator with the RIPAT organisation who pointed out that:

> *"... we provide training and material support to government extension officers from BORESHA LISHE project that targets villages. Training has increased cooperation between farmers and extension agents, and we have received great*

> *cooperation from extension officers as well*" (Project Coordinator RIPAT RECODA organisation key informant interviewee, 5th December 2019).

Concerning an increase in contact among farmers and extension agents, a village leader from Ntuntu Village also revealed the following:

> "*… before implementation of RIPAT RECODA project in the village, extension officers were facing difficulties in moving from one village to another especially during rainy seasons due to poor roads; the officers were few in number as compared to areas which they were required to serve. Hence, reaching all farmers in terms of farm visits was cumbersome, and there were not enough funds from the government to facilitate their work. Through the RIPAT RECODA project, extension officers are properly trained and provided with adequate material support from the project to ensure their active participation in collaboration with RIPAT RECODA officials in conducting Training and Visit (T&V)*". (Ntuntu Village leader key informant interview, 10th December 2019).

Table 4.1: Attitude of farmers' towards adoption of the RIPAT approach disseminated agricultural knowledge (n = 120)

Attitude	Disagree		Undecided		Agree	
	n	%	n	%	n	%
1. RIPAT approach training helps provide knowledge on agricultural production (+)	35	29.4	32	26.7	53	44.1
2. RIPAT approach increases contact with extension agents (+)	1	8	17	14.2	121	85
3. RIPAT approach increases access to knowledge disseminated on agriculture (+)	1	8	12	10	107	89.2
4. RIPAT approach makes farmers more competent in delivery of knowledge on agricultural production (+)	0	0	11	9.2	109	90.8
5. Knowledge gained through RIPAT approach helps in increasing agricultural productivity (+)	3	2.5	12	10	105	87.5
6. Knowledge gained through RIPAT approach improves farm management (+)	14	11.7	28	23.3	78	65
7. RIPAT beneficiaries teach other farmers on good agricultural practices gained through RIPAT approach (+)	34	28.3	27	22.5	59	49.2
8. RIPAT is there to benefit its employees, not farmers (-)	85	70.8	24	20	11	9.1
9. RIPAT is there to benefit better-off farmers, not poor	97	80	20	16.7	3	2.5

	farmers (-)						
10.	RIPAT is there to benefit leaders, not common people (-)	107	89.2	11	9.2	2	1.7
11.	People expecting RIPAT to help them increase agricultural productivity will remain poor (-)	93	77.5	17	14.2	10	8.3
12.	RIPAT is not as good as TASAF which gives money to the poor (-)	83	69.2	30	25	7	5.9
13.	It takes time to practice technologies provided under RIPAT approach (-)	96	80	15	12.5	9	7.5
14.	The environment is not friendly when it comes to practicing RIPAT technologies (-)	94	78.3	14	11.7	12	10

+ = Positive connotation; - = Negative connotation

The overall lowest and highest points scored on the Likert scale were 33 and 56 respectively out of a possible maximum of 70 points while the average point was 43.9. The minimum possible score was 14 (i.e. 1 times 14 equals 14); the neutral score was 42 (i.e. 3 times 14 equals 42) and the maximum possible score was 70 (i.e. 5 times 14 equals 70). Therefore, 14-41 points denoted unfavourable attitude while 42 points denoted neutral attitude and 43 to 70 points denoted favourable attitude. Those with unfavourable, neutral and favourable, neutral and unfavourable attitude were 65.0%, 10.0% and 25.0% respectively as seen in Table 4.2.

Table 4.2: Overall attitude

Attitude	Frequency	Per cent
Unfavourable	30	25.0
Neutral	12	10.0
Favourable	78	65.0

The proportion of the respondents who had favourable attitude (65%) in Table 4.2 supports the above finding that overall the respondents had favourable attitude towards adoption of conservation agriculture technology, rain water harvesting technology, raised home gardens technology and poultry mother unit technologies disseminated by the RIPAT project.

4.4.2 Extent of Technology Adoption

Extent of technology adoption is the degree to which farmers adopt disseminated technologies. Extent of adoption was determined by calculating percentages of agricultural technologies adopted which were conservation agriculture technology, rain water harvesting technology, raised home gardens technology and Poultry Mother Unit (PMU) technology disseminated by the RIPAT approach.

4.4.2.1 Extent of RIPAT disseminated technologies adoption in farms

The extent of RIPAT disseminated technologies adoption was found as stated in 4.4.2. The average adoption of RIPAT disseminated technologies was 70.0%, which shows the technologies disseminated by the RIPAT approach were generally well adopted.

Table 4.3: Extents of adoption of RIPAT disseminated technologies (n = 120)

Extent of adoption (%)	Frequency	%
25.00	10	8.3
50.00	23	19.2
75.00	68	56.7
100.00	19	15.8

The findings in Table 4.3 show that the extent of adoption of RIPAT disseminated agricultural technologies that had the highest frequency was 75.0% (56.7%), followed by 50.0% which had a frequency of 19.2%. The least extent of adoption was at 25% adoption whose frequency was 8.3%. Then again, the extent of adoption of RIPAT disseminated technologies was higher in Ikungi District since more than half of the respondents (68 respondents) adopted the technologies.

Findings on the extent of adoption of RIPAT disseminated technologies showed that through the use of the RIPAT agricultural technologies there was easily control and management of pests and diseases as well as improved soil fertility after the advent of the RIPAT project.

4.4.2.2 Extent to which other technologies were adopted

Extent of adoption of other pertinent technologies is the degree to which farmers adopt the traditional technologies. The extents were determined by calculating percentages agricultural technologies such as use of certified seeds, use of organic and inorganic fertilizers, use of irrigation and use of water pumps for irrigation technologies practised by farmers in Ikungi District. The average extent of adoption of other pertinent disseminated technologies was 60.0%, which shows that the technologies were generally were adopted. The frequencies of extents of adoption of the technologies are presented in Table 4.4.

Table 4.4: Extent to which other pertinent technologies were adopted

Extent of adoption (%)	Frequency	%
20.00	10	8.3
40.00	23	19.2
60.00	53	44.2
80.00	26	21.7
100.00	8	6.7

The findings in Table 4.4 show that the extent of adoption of other pertinent disseminated agricultural technologies that had the highest frequency was 60.0% (44.2%). The extent of adoption of other pertinent disseminated technologies was higher in Ikungi District since more than half of the respondents (53 respondents) adopted other pertinent disseminated technologies.

3.4.2.3 Overall extent to which technologies (RIPAT, non RIPAT) were adopted

The overall extent to which technologies (RIPAT, non RIPAT) were adopted was found after calculating the percentage of the combination of nine technologies into which four

RIPAT disseminated technologies had been adopted besides other five pertinent technologies which were also adopted. The percentage obtained was the indicator of overall extent to which technologies (RIPAT and non-RIPAT) had been adopted. The highest extent of overall adoption was 66.67%; 42 households (35.0%) attained that extent. The least extent of adoption was at 22.22%; only 1 household (0.8%) had that rate of adoption.

Table 4.5: Overall extent to which technologies (RIPAT and non-RIPAT) were adopted

Extent of adoption (%)	Frequency	Per cent
22.22	1	0.8
33.33	7	5.8
44.44	13	10.8
55.56	24	20.0
66.67	42	35.0
77.78	20	16.7
88.89	9	7.5
100.00	4	3.3
Total	120	100.0

3.4.3 Linkages between farmers' attitude towards adoption of agricultural technologies disseminated by the RIPAT approach and extent of adoption of technologies

Linkages between farmers' attitude towards adoption of agricultural technologies disseminated by the RIPAT approach and extent of adoption of technologies were determined using correlation and one-way ANOVA.

3.4.4 Correlation between attitude of farmers towards the RIPAT approach in agricultural knowledge dissemination and adoption and extent of adoption of technologies

Extent of adoption of RIPAT disseminated technologies, extent of adoption of other pertinent technologies as well as overall extent of adoption of technologies, after being expressed as per cent, became continuous variables. Attitude was also measured as a continuous variable in terms of points scored on the Likert scale that was used to measure it. Therefore, the extent of adoption were correlated with attitude to determine how they were related (positively, negatively, significantly or insignificantly). If the correlation coefficient is closer to zero, the correlation between the variables is weak; if the correlation coefficient is closer to one, the correlation between the variables is strong. According to Bryman and Cramer (1992), a correlation coefficient below 0.20 is considered to be very low, regardless of a positive or negative signs In addition, a positive correlation coefficient shows a direct relationship between the variables while a negative correlation coefficient shows an inverse relationship. These findings are presented in Table 4.6.

Table 4.6: Correlation between attitude of farmers towards the RIPAT approach in agricultural knowledge dissemination and adoption and extent of adoption of technologies (n = 120)

Extents of technology adoption	Overall attitude	
	r	**p**
Extent of adoption of RIPAT disseminated technologies	-0.017	0.856
Extent to which other pertinent technologies were adopted	0.091	0.322
Overall extent to which technologies (RIPAT and non-RIPAT) were adopted	0.055	0.550

Extent of adoption of RIPAT disseminated technologies had negative correlation (-0.017) with overall attitude. Agricultural technologies disseminated under the RIPAT approach were new to farmers; thus it took some time and effort to adopt and practise them as compared to already existing technologies.

Extent to which other pertinent technologies were adopted had positive correlation at r = 0.09, and the overall extent to which technologies (RIPAT and non-RIPAT) were adopted had a positive correlation with overall attitude at r = 0.055. This shows that farmers' adoption of agricultural technologies will vary positively with overall attitude towards the technologies. On the other hand, the RIPAT disseminated technologies are to cover farmers' necessities as well as improving other pertinent traditional technologies. As farmers apply the technologies and observe good findings from the application, their attitude towards adoption of disseminated technologies increases.

4.4.5 Difference in extent of adoption of the RIPAT disseminated technologies by attitude of farmers

One-way ANOVA was used to compare the extent of adoption of the RIPAT disseminated technologies in terms of percentages scored among farmers who had unfavourable, neutral and favourable attitudes towards the RIPAT approach agricultural knowledge dissemination and adoption. The findings are presented in Table 4.7 and show that there was no significant difference (F = 0.628, p = 0.535) in extent of adoption of the RIPAT disseminated technologies among the three groups of respondents.

Table 4.7: Difference between attitude of farmers and Extent of adoption of RIPAT disseminated technologies

Groups of Attitudes	n	Mean score (%)	Sum of squares between and within the group		df	Mean square	F	Sig (p-value)
Unfavourable	30	73.3333	Between groups	512.821	2	256.410	0.628	0.535
Neutral	12	66.6667	Within groups	47737.179	117	408.010		

Favourable	78	69.2308		
Total	**120**	**70.0000**	**48250.000**	**119**

This means there was no big difference in extent of adoption of agricultural technologies disseminated among groups of respondents who had different attitudes towards adoption of those technologies.

4.4.6 Difference between groups of attitudes

Post hoc test was used in looking into differences between groups testing each possible pair of unfavourable and neutral, unfavourable and favourable and favourable and neutral groups of attitudes as indicated in Table 4.8. There was no significant difference in any of the three pairs as indicated by the p-values in Table 4.8, which were 0.336, 0.346 and 0.683 respectively. This means that there was not much relationship between the extent of adoption of RIPAT disseminated technologies and the pairs of unfavourable and neutral attitudes, unfavourable and favourable attitudes and favourable and neutral attitudes.

Table 4.8: Multiple comparisons table

Test	p-value
Unfavourable and neutral attitudes	0.336
Unfavourable and favourable attitudes	0.346
Favourable and neutral attitudes	0.683

4.5 Conclusions and Recommendations

The following conclusions are made from the findings. The RIPAT approach has managed to increase contact among farmers and extension agents through sequential training provided to extension agents as well as in provision of working tools among extension agents. It is recommended that the government, NGOs and other stakeholders should work together with RIPAT RECODA project in provision of training to extension agents and in ensuring sustainability of adopted agricultural technologies among farmers.

The extent of RIPAT disseminated technologies was 75% and the extent of adoption of other pertinent technologies was 60%, and the extent of overall adoption was 66.67%. The RIPAT approach included both training and teaching and hence enabled farmers to be aware of principles and concepts associated with adoption of agricultural technologies. Teaching (top-down) was combined with hands-on practical and adult reflective learning (bottom up). The more farmers adopt new techniques, the more productive they benefit from an increase in their welfare. Therefore, the RIPAT RECODA organisation should implement more techniques in teaching and adult reflective learning that can spur technology uptake by farmers.

There was positive correlation between extent to which other pertinent technologies were adopted and overall extent of adoption, at r = 0.091 and r = 0.055 respectively. There was no significant difference in extent of adoption of the RIPAT disseminated technologies among farmers with unfavourable, neutral and favourable attitudes. Attitude (unfavourable, neutral and favourable) is not much related to adoption of agricultural technologies. The use other pertinent technologies as well as the use of a combination of both RIPAT disseminated technologies and other pertinent technologies should be strengthened. It is recommended that RIPAT RECODA organisation staff should conduct campaigns to promote RIPAT agricultural technologies so that more farmers can have more favourable attitude towards the technologies; this will enhance adoption of the disseminated agricultural technologies. The study also recommends on the distribution of agricultural extension services in rural areas by the Ikungi district council in order to maximize farmers yield hence increase their income.

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CHAPTER FIVE

5.0 SUMMARY OF MAJOR FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of Major Findings

Below is a summary of the study major findings as per presented manuscripts.

5.1.1 Associations between socio-demographic factors and farmers' adoption of agricultural technologies

Objective one aimed at analysing socio-demographic variables of farmers practising the RIPAT approach. Objective two involved identifying technologies that were adopted among those that were disseminated by the RIPAT RECODA project. In addition to the above, objective three aimed at determining associations between socio-demographic variables and the adoption of agricultural technologies. Generally, the study findings show that occupations and education levels of the respondents are the main factors that are associated with the adoption of the RIPAT disseminated technologies. The findings showed that the only significant association (Chi-square = 12.547, p = 0.006) was between respondents' occupation and adoption of home gardening. The occupation of those who mostly adopted home garden technology was crop production; they were 66.7% of the respondents.

The level of education of the respondent was the second factor associated with the adoption of the RIPAT disseminated technologies. It was associated with the adoption of poultry mother unit, harvesting rainfall and home gardening with p-values of p = 0.093, p

= 0.078 and p = 0.07 respectively. Therefore, from those findings, the null hypothesis that socio-demographic factors are not associated with the adoption of agricultural technologies cannot be accepted with respect to occupations of respondents.

5.1.2 Attitude of farmers towards adoption of agricultural technologies disseminated by the RIPAT approach

Objective two aimed at finding the extent of adoption of technologies disseminated by the RIPAT approach. The study findings showed that there was no significant difference ($F = 0.628$, $p = 0.535$) in the extent of adoption of the RIPAT disseminated technologies among the three groups of attitudes (favourable, neutral and unfavourable attitudes).

5.1.3 Adoption of Agricultural Technologies Disseminated by the RIPAT Project and Agricultural Productivity

Objective three aimed at determining the influence of the RIPAT approach factors on crop productivity. The findings of the study showed that the experience of farmers (measured as the number of years in crop farming) in using the RIPAT disseminated technologies had a significant effect on crop productivity at ($p = 0.008$), although it was negative ($\beta = -0.269$). The null hypothesis that RIPAT-RECODA project factors do not have a significant impact on crop productivity cannot be accepted because $p < 0.05$.

5.2 Conclusions

Based on the study's findings, it is concluded that socio-demographic variables (gender, age, education, marital status and occupation) of the respondents are associated with the adoption of the RIPAT disseminated technologies. Occupations and education levels are the main factors that are associated with the adoption of the RIPAT disseminated technologies. It is also concluded that the extent of adoption of the RIPAT disseminated technologies was high at 75% because of training and teaching methods that enabled farmers to better understand the concepts and underlying principles associated with the adoption of technologies. It is further concluded that the experience of farmers is an important tool for adoption to occur and enable farmers to increase crop productivity in Ikungi District. Lastly, it is concluded that understanding the RIPAT approach factors that influence or hinder crop productivity (such as lack of enough knowledge among farmers) is essential in planning and executing other technology-related programmes for meeting crop productivity challenges.

5.3 Recommendations

Therefore, based on the study findings and conclusions, it is recommended that:

i. The RIPAT officials should focus more on occupation (by concentrating more on people whose main occupation is crop production) and giving education to beneficiaries on how to use the technologies in sustainable ways so that more people can adopt the technologies.

ii. Government, NGOs and other stakeholders should work together with the RIPAT RECODA project in the provision of training to extension agents and in ensuring the sustainability of adopted agricultural technologies among farmers.

iii. The RIPAT RECODA organisation staff should conduct campaigns to promote the RIPAT agricultural technologies so that more farmers can have more favourable attitude towards the technologies; this will enhance the adoption of the disseminated agricultural technologies.

iv. Training offered to farmers by the RIPAT RECODA officials should focus more on improving already existing technologies in order to increase farmers' awareness with new technologies. Training offered by the RIPAT approach should focus on the farmers' problem and need to ensure sustainability.

5.4 Suggested Areas for Further Study

It was observed that the extent of adoption of the RIPAT disseminated technologies among farmers practising the RIPAT approach was high. Therefore, there is a need to conduct research to see if there will be more progress and to find a difference in adoption among the RIPAT and non-RIPAT participants. The study only captured basic information of the farmers practising the RIPAT approach only. Moreover, the study picked some of the more practised technologies among many technologies that were implemented and still implemented by the RIPAT RECODA organisation.

APPENDICES

Appendix 1: A copy of questionnaire used for Research

SOKOINE UNIVERSITY OF AGRICULTURE

COLLEGE OF SOCIAL SCIENCE AND HUMANITIES

DEPARTMENT OF POLICY PLANNING AND MANAGEMENT

A Household Questionnaire for Research on

ROLE OF RURAL INITIATIVES FOR PARTICIPATORY AGRICULTURAL TRANSFORMATION (RIPAT) APPROACH IN AGRICULTURAL TECHNOLOGIES DISSEMINATION AND ADOPTION: A CASE STUDY OF IKUNGI DISTRICT, SINGIDA, TANZANIA

BY

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INTRODUCTION

Dear Citizen(s),

I am called Joseph Daniel, a student at Sokoine University of Agriculture (SUA) where I am studying for a Master of Arts Degree in Project Management and Evaluation. I am here to kindly request you to assist me so that my studies can be successful. The assistance that I need from you is that you spare your time and respond to my questions, which I have written in a questionnaire. I have got permission from SUA and from Research

Community and organisational Development Associates (RECODA), NGO Management to conduct interviews with you for my research.

The general objective of the research is to examine the role of Rural Initiatives for Participatory Agricultural Transformation (RIPAT) Approach in agricultural technologies dissemination and adoption. I will ask you about how you and RECODA organisation have been working on the project, how the project has been successful, factors which led to adoption of the technologies disseminated by the RIPAT, agricultural production and productivity among farmers who have adopted the technologies and those who have not, and attitude towards dissemination of the technologies. All the answers and comments you will give me will be kept confidential and used only for my studies. Therefore, please respond to all questions truthfully and sincerely.

Are you willing to participate in the research by responding to the questions I will ask you?

1 = Yes (   ), 2 = No (   )

A. HOUSEHOLD HEAD GENERAL INFORMATION

1. Household head's name: …………………………………………………………..
2. Name of village: ……………………………………………….............................
3. Ward:…………………………………………..
4. District:……………………………………………..
5. Date of interview: …………………………………………………......................

B: SOCIO-DEMOGRAPHIC CHARACTERISTICS

6. Particulars of the household head and his/her household members

Socio-Demographic Characteristics	Person (P) 1 Household head	P2	P3	P4	P5	P6	P7	P8	P9	P10
Sex (1. Male, 2. Female)										
Year of birth										
Marital status*										
Householdhead's education level **										
Main Occupation***										

~~Socio-Demographic Characteristics~~	~~Person (P) 1 Household head~~	~~P2~~	~~P3~~	~~P4~~	~~P5~~	~~P6~~	~~P7~~	~~P8~~	~~P9~~	~~P10~~
~~Sex (1. Male, 2. Female)~~										
~~Year of birth~~										
~~Marital status*~~										
~~Householdhead's education level **~~										
~~Main Occupation***~~										

Key:
Marital status:** 1. Single, 2. Married, 3. Separated, 4.Widow/Widower, 5. Others (Specify)***
**** Household head's education level:** 1 = No formal education, 2 = Primary education, 3 = Sec. education, 4= Post-secondary education
*****Main occupation:** 1. Salaried employment, 2. Crop production, 3. Livestock keeping, 4. Trade, 5. Others (***Specify)***

7. Do you own land

1 = Yes

2 = No

8. What type of land ownership

1 = Inherent

2 = Bought

3 = Rented

9. Do you afford to buy agricultural inputs?

1 = Yes

2 = No

10. If no, where do you get income for buying agricultural inputs?

1 = …………………………………..

2 = ……………………………………

C. THE EXTENT OF TECHNOLOGY ADOPTION

11. Please indicate whether you apply the technologies listed in the following table. Write 1 (Yes) or 0 (No).

Extent of Technology adoption	**Yes (1)**	**No (0)**
RIPAT disseminated technologies		
Applying Poultry Mother Units		
Use of harvested rain water for irrigation		
Use of raised home gardens		
Application of conservation agriculture		
Other pertinent technologies		
Use of certified seeds (Hybrid seeds)		
Use of inorganic fertilizer (Inorganic fertilizers- like D.A.P, C.A.N etc.		
Use of Organic fertilizers – like farmyard manure		
Use of irrigation		
Use of water pumps		

D. AGRICULTURAL PRODUCTIVITY AMONG RIPAT PARTICIPANTS

12. Write the main crops grown, amounts of acreage, costs of production, amounts of harvests, and gross monetary values of the harvests in the table below during from June 2018 to July 2019.

Crops grown	**Acreage assuming mono-cropping (hectares)**	**Costs incurred**	**Amounts of harvests (kg)**	**Gross monetary values of the harvests**
Maize				
Sorghum				
Millet				
Sesame				

~~**Crops grown**~~	~~**Acreage assuming**~~	~~**Costs**~~	~~**Amounts of**~~	~~**Gross monetary**~~

	mono-cropping (hectares)	incurred	harvests (kg)	values of the harvests
Maize				
Sorghum				
Millet				
Sesame				

E. RIPAT FACTORS

13. Whether the household practices the RIPAT-disseminated technologies 1 = Yes, 0 = No

14. Since when (year) have you been doing the main economic activity indicated in Question 6?…………....

15. Since when (year) have you been a beneficiary of RIPAT? …………………

16. (a) Have you attended any training offered by RIPAT? 1 = Yes, 0 = No

(b) If Yes, how many times? ………….

(c) If Yes, on which technologies?

……………………………………………………………………………………

17. What method is mostly used in the dissemination of the agricultural information?

(a) Train & Visit

(b) Farmer Field School

18. (a) Do you own a mobile phone? 1 = Yes, 0 = No

(b) Do you use a mobile to talk about RIPAT technologies? 1 = Yes, 0 = No

19. In your own opinion give two reasons why you think the adoption of agricultural technology has an influence on productivity in farms?

……………………………………………………………………………………

F. FACTORS FACILITATING THE DISSEMINATION OF AGRICULTURAL TECHNOLOGIES UNDER RIPAT APPROACH

20. What constrain hinder to participate in the RIPAT approach?

1 = Lack of time due to socio economic commitments

2 = Learning priorities are sometimes imposed from out sides the group

3 = No observable benefit from RIPAT approach

4 = Inefficient of extension services

21. Indicate the advantages of RIPAT approach as perceived by farmers. Tick (√) Yes

Item	**Yes (1)**	**No (2)**
Farmers are embracing technology in their farms		
Increasing farm management skills of farmers		
Increasing knowledge of farmers on agricultural production		
Helping to solve problems associated with agricultural production		
Changing the attitude of farmers		
Increasing farm-income of farmers		
Increasing agricultural production		

or No (X).

G. FARMERS' ATTITUDE TOWARDS RIPAT APPROACH IN AGRICULTURAL KNOWLEDGE DISSEMINATION FOR INCREASING AGRICULTURAL PRODUCTIVITY

Selected aspects of RIPAT approach	Strongly Disagree (5)	Disagree (4)	Neutral (3)	Agree (2)	Strongly Agree (1)
1. RIPAT approach training helps provide knowledge on agricultural production (+)					
2. RIPAT approach increases contact with extension agents (+)					
3. RIPAT approach increases access to knowledge disseminated on agriculture (+)					
4. RIPAT approach makes farmers more competent in delivery of knowledge on agricultural production (+)					
5. Knowledge gained through RIPAT approach helps in increasing agricultural productivity (+)					
6. Knowledge gained through RIPAT approach improves farm management (+)					
7. RIPAT beneficiaries teach other farmers on good agricultural practices gained through RIPAT approach (+)					
8. RIPAT is there to benefit its employees, not farmers (-)					
9. RIPAT is there to benefit better-off farmers, not poor farmers (-)					
10. RIPAT is there to benefit leaders, not common people better-off farmers, not poor farmers (-)					
11. People expecting RIPAT to help them increase agricultural productivity will remain poor (-)					
12. RIPAT is not as good as TASAF which gives money to the poor (-)					
13. It takes time to practice technologies provided under RIPAT approach (-)					
14. The environment is not friendly when it comes to practicing RIPAT technologies					

Indicate the extent to which you agree or disagree with the following statements (Strongly Disagree =1, Disagree =2, Neutral = 3, Agree= 4, Strongly Agree =5), (4-5 = Agree, 3 = Undecided, 1-2 = Disagree)

Selected aspects of RIPAT approach	Strongly Disagree (5)	Disagree (4)	Neutral (3)	Agree (2)	Strongly Agree (1)
15. RIPAT approach training helps provide knowledge on agricultural production (+)					
16. RIPAT approach increases contact with extension agents (+)					
17. RIPAT approach increases access to knowledge disseminated on agriculture (+)					
18. RIPAT approach makes farmers more competent in delivery of knowledge on agricultural production (+)					
19. Knowledge gained through RIPAT approach helps in increasing agricultural productivity (+)					
20. Knowledge gained through RIPAT approach improves farm management (+)					
21. RIPAT beneficiaries teach other farmers on good agricultural practices gained through RIPAT approach (+)					
22. RIPAT is there to benefit its employees, not farmers (-)					
23. RIPAT is there to benefit better-off farmers, not poor farmers (-)					
24. RIPAT is there to benefit leaders, not common people better-off farmers, not poor farmers (-)					
25. People expecting RIPAT to help them increase agricultural productivity will remain poor (-)					
26. RIPAT is not as good as TASAF which gives money to the poor (-)					
27. It takes time to practice technologies provided under RIPAT approach (-)					
28. The environment is not friendly when it comes to practicing RIPAT technologies					

THANK YOU FOR YOUR COOPERATION

Appendix 2: Interview Guide for Key informants

A Checklist of Items for Discussion with Village leaders

A. Knowledge about RIPAT and the technologies it disseminated

1. For how long RIPAT has been working in the village/ward
2. Technologies which RIPAT has disseminated there, and approximate proportions of the farmers who have adopted them
3. Determinants of and constraints adoption of the technologies in the village/ward
4. Strengths and shortfalls of RIPAT services

B. Agricultural productivity among RIPAT participants
5. The crops that are mostly grown in the village/ward
6. The livestock that are mostly kept in the village

C. How RIPAT–disseminated technologies help improve agricultural productivity
7. Ways in which the technologies disseminated by RIPAT have helped increase crop and livestock production and productivity in the village/ward
8. Any ways in which the technologies disseminated by RIPAT have affected negatively crop and livestock production and productivity/ward
9. Strongly positive and extremely negative views of people of this village/ward about RIPAT assisting in crop and livestock productivity
10. Constraints in sharing agricultural knowledge between farmers practising RIPAT-disseminated technologies and those not practising the technologies
11. Whether levels of agricultural productivity between farmers who have adopted agricultural technologies by RIPAT approach and those who have not differ much
12. Opinions on the use of RIPAT approach in adoption of improved agricultural technologies

A Checklist of Items for Discussion with RIPAT-RECODA organisation team

A. Knowledge about RIPAT and the technologies it disseminated

1. Agricultural technologies disseminated to farmers during sessions and training

2. Agricultural technologies mostly adopted

3. Constraints in sharing agricultural knowledge between farmers practising RIPAT-disseminated technologies
4. Methods used to disseminate agricultural technologies

B. Agricultural productivity among RIPAT participants

1. Is there any change in productivity since farmers stated practicing in RIPAT approach? Give records for at least one year back.
2. Whether you perform Training and Visits (T&V) in farmers' fields
3. Knowledge provided during T&V

C. how RIPAT–disseminated technologies help improve agricultural productivity

5. Ways in which the technologies disseminated by RIPAT have helped increase crop and livestock production and productivity to farmers
6. Any ways in which the technologies disseminated by RIPAT have affected negatively crop and livestock production and productivity
7. Strongly positive and extremely negative views of farmers about RIPAT assisting in crop and livestock productivity
8. Whether levels of agricultural productivity between farmers who have adopted agricultural technologies by RIPAT approach and those who have not differ much
9. Opinions on the use of RIPAT approach in adoption of improved agricultural technologies

THANK YOU FOR YOUR COOPERATION