THE RELATIONSHIP BETWEEN SPECIFIC RESEARCH-EXTENSION-FARMER LINKAGE FACTORS AND ADOPTION OF TECHNOLOGIES OF ON-FARM TRIALS: A CASE OF KARI-KISII REGIONAL RESEARCH CENTRE

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DECLARATION

I hereby declare that this is my original work and that has not been presented for the award of any degree or diploma in this University or any other University.

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APPROVAL

This thesis has been presented with our approval as University supervisors.

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DEDICATION

To my late father and mother, Philemon Ochola Onyona and Philgona Atieno Ochola respectively for their sacrifice in educating me and for teaching me the way of the Lord.

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ABSTRACT

On-farm research trial approach, as used by the regional research centres in Kenya has not achieved much in terms of adoption and improving agricultural productivity. This may be attributed to lack of a comprehensive approach for disseminating findings, arising from weak research-extension-farmer linkages. The study examined the relationship between specific linkage factors and adoption of agricultural technologies of on-farm trials conducted in KARI-Kisii mandate area. The linkage factors examined include: Level of participation of the groups in the on-farm trials; relevance of the technologies being disseminated to the farmers; roles played by each group in the on-farm trials; the presence of pre-formed attitudes, and level of satisfaction of farmers, researchers, and extension agents with their respective institutions. The study used an *Ex-post facto* research design with a survey methodology. It was designed to collect data from the researchers, farmers, and government extension agents in the KARI-Kisii mandate area. Stratified random sampling technique was used to identify 42 farmers out of all the farmers in the mandate region, 45 extension agents out of all the extension agents working within the mandate region and all the 17 technical research scientists working in KARI-Kisii, making a total of 104 respondents. Collection of data was done using three sets of questionnaires directly administered to farmers, extension agents and researchers respectively. Data analysis was carried out using both inferential statistics to test the hypotheses, and descriptive statistics to describe and summarise the results. The study found out that, level of participation, presence of preformed attitudes, level of satisfaction, knowledge of the roles in on-farm trials as well as relevance of technologies were significantly related to the level of adoption of technologies of on-farm research trials. It was concluded that linkage factors affect the level of adoption of technologies of on-farm trials. It was recommended that the barriers impeding farmer-extension-research interaction should be eliminated to make the on-farm research trials more effective. The study is expected to be significant to the policy makers, research, extension and farmers in improving sustainable agriculture and rural development. The study emphasises the need to improve farmers-research-extension linkage so as to improve adoption of technologies developed through on-farm research trials hence improving agricultural productivity.

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LIST OF ABBREVIATIONS AND ACRONYMS

AEZ	Agro-Ecological Zones
CEA	Conventional Extension Approach
FASA	Focal Area Shifting Approach
FPR	Farmer Participatory Research
FSR	Farming Systems Research
GDP	Gross Domestic Product
IFAP	International Federation of Agricultural Process
IRRI	International Rice Research Institute
LH	Lower Highland
LM	Lower Midland
MoALD	Ministry of Agriculture and Livestock Development
NARS	National Agricultural Research Stations
NGO	Non Governmental Organization
PLA	Participatory Learning and Action
SPSS	Statistical Package for Social Sciences
T&V	Training and Visit
UM	Upper Midland

CHAPTER ONE

INTRODUCTION

1.1 Background Information

On-farm research trial approach to technology transfer, apart from suiting the agricultural technologies to the farmers' socio-economic conditions and agro-ecological zones (AEZs), emphasises the importance of research-extension-farmer linkage. This approach involves a multidisciplinary group of persons, and requires a strong working link between the farmers, extension agents, and researchers. The concept of linkage implies the communication and working interrelationship established between two or more organizations pursuing commonly shared goals and objectives. Although agricultural research, agricultural extension and farmers obviously have a common ultimate objective, their collaboration needs to be adequately addressed. In the new and more market oriented environment, farmers need to have constant access to agricultural research and extension services as without such services farmers will not be able to diversify rapidly and effectively. They will not be able to develop the kind o f quality and quantity of products required of them. The study looked at the relationship between specific linkage factors and adoption of on-farm research trials carried out by KARI-Kisii.

The agricultural sector accounts for over 25% of the Gross Domestic Product (GDP), 60% - 70% of export earnings and over 75% of the country's employment (Republic of Kenya, 2002). Over 70% of the Kenyan farmers are small-scale, majority of who practice subsistence agriculture. However, the sector's contribution to the GDP has progressively declined from the 37% of the GDP in 1970s to about 23.9% at the end of 2002 (Republic of Kenya, 2003). The decline has been attributed to the decreasing farm sizes, inadequate use of technologies, unreliable rainfall, poor marketing infrastructure, limited access to credit and high cost of inputs (Republic of Kenya, 2004).

Agricultural extension contributes greatly to agricultural development and that is why extension provision is one of the major roles of the Ministry of Agriculture (MoARD, 2002). Without extension guidance, farmers are unable to fully exploit the opportunities available to them and to improve their productivity. The main function of agricultural extension is to facilitate agricultural development by identifying farmers' problems, discussing with them

and jointly arriving at feasible technical and socio-economic solutions (MOARD, 2002). Without farmer participation at the initial stages of priority setting, adoption of technologies is difficult (Ewell, 1990). For the technologies to be relevant to the farmers' needs, researchers, extension agents and farmers must play a joint role in identifying the farmers' problems and modifying the technologies to suit the farming conditions (Agbamu, 2000). These collaborative efforts are likely to improve adoption levels and increase productivity.

Research and extension personnel in Kenya have used a number of approaches to transfer technologies to the farmers. Some of these technology transfer approaches are Conventional Extension Approach (CEA), and Training and Visit system (T&V). These approaches however did not achieve much in delivering the technologies to the farmers, because they used the Top-Down approach and did not emphasize inter-group linkages (MOARD, 2002). This partly contributed to the low performance of agricultural extension in the last decade. The low performance of agricultural extension forced the Ministry to change strategies of delivering technologies to the farmers (MOARD, 2002).

Multidisciplinary approaches that recognise the importance of strong working linkages between extension agents, farmers and researchers were then introduced. Some of these approaches include: Participatory Learning and Action (PLA), Focal Area Shifting Approach (FASA), Farmer Participatory Research (FPR), Farmer Field Schools (FFS) and On-farm research. These approaches to technology transfer understand the farm as an entire system thus being able to closely examine the components of the farming systems, and their interactions. Through these approaches, constraints to farmers and opportunities for increased productivity can be identified. The multidisciplinary approaches therefore have the capability of producing high adoption levels thereby increasing agricultural productivity.

These approaches may complicate technology transfer even further, if the linkages between extension agents, researchers and farmers are not well managed (Ewell, 1990; Merrill- Sands *et al.,* 1990). Reasons for poor linkages were more complicated than what the approaches purport to solve. The underlying technical, institutional, sociological, and economic implications of building up such linkages was not always handled well, analysed in detail and translated into action programmes. That was why the weak linkages between the farmers, extension and research persist as a critical constraint on the promotion of agricultural development. According to Ewell (1990) linkages are often affected by factors such as

relevance of the technology to be disseminated to the farmers, disagreements among the participants, which stem from long held stereotypes, level of participation, conflicting roles in the research and dissemination process, and differences in institutional programmes and reward systems.

Kenya Agricultural Research Institute in Kisii (KARI – Kisii) is one of the regional research centres mandated to carry out research in southern Kenya. Its mandate area covers 10 districts, namely; Kisii, Gucha, Nyamira, Homa-Bay, Migori, Rachuonyo, Suba, Kuria, Nyando, and Transmara districts. The area lies under varied Agro-Ecological Zones (AEZ) ranging from Upper highland (UH) to lower midland (LM). The Regional Research Centre has been using On-farm research trials since 1994 to transfer technologies to the farmers (KARI-Kisii, 2002). This was aimed at achieving high adoption levels, so as to improve food productivity in the region. The station develops technologies such as improved bean variety, improved fodder, soil and water conservation measures and indigenous local poultry improvement and management. According to the MoALD annual report of 2001, adoption levels of these technologies in the region were still low despite using on-farm research trial approach. Specifically, improved fodder production was adopted at 40% instead of 80% as targeted, bean variety production adopted at 10% instead of targeted 50%, similarly local poultry improvement and management was adopted at 20% instead of the targeted 50%, and soil and water conservation was adopted at 40% instead of the targeted 70%.

An on-farm research trial involves the interaction of farmers, extension agents, and researchers and therefore the strength of linkages between the groups determines its effectiveness. The low adoption levels may therefore be attributed to weak linkages in the group. According to Ewell (1990), Merrill-Sands *et al.* (1990), Russel (1991), managing the Farmer-Extension-Research linkages is problematic and often affects adoption levels. To achieve the adoption levels required, using the on-farm approach, linkages between researchers, extension agents and farmers must be strengthened. This can only be achieved by eliminating barriers to the linkages.

The study examined the linkage factors and their relationship with the level of adoption of technologies of on-farm research trials carried out by KARI-Kisii in its mandate area. Research-extension-farmer linkage factors affecting adoption of technologies of on-farm research trials examined in the study include: levels of participation of researchers, extension

agents and farmers in on-farm trials; presence of pre-formed attitudes due to differences in socio-economic status among the extension agents, researchers and farmers; the roles of farmers, extension agents, and researchers in on-farm trials; the relevance of the technologies transferred to the farming conditions, and level of satisfaction with institutional programmes and reward systems in farmer organisations, agricultural research and extension.

1.2 Statement of the Problem

Despite KARI-Kisii's substantial agricultural research capacity, the impact of its research and technological breakthrough on agricultural productivity has been limited by lack of a comprehensive approach for disseminating their findings, partly arising from weak research-extension-farmer linkages. Despite using on-farm research trials approach, KARI-Kisii regional research centre is still achieving low levels of adoption as indicated earlier. This is an indication that the on-farm trials carried out in the region have not been effective and farmers were still using inappropriate agricultural technologies. Use of poor agricultural technologies is one of the factors contributing to low food productivity. No studies have been carried out related to the relationship between farmer-extension-research linkages and adoption of on-farm research trial technologies with regard to maize and beans production in KARI-Kisii mandate area. This study was designed to understand the relationship between the farmer-extension-research linkage factors and adoption of technologies developed through on-farm trials with regard to maize and bean production.

1.3 Purpose of the Study

The research was designed to determine the relationship between farmer, extension, and research linkage factors and adoption of recommended technologies developed through on-farm research trials. This was to highlight the barriers to the linkages for consideration in designing the most appropriate way to transfer technologies to the farmers.

1.4 Objectives

The following objectives were used to examine the relationship between the research-extension-farmer linkage factors and adoption of technologies developed through on-farm research trials carried out by KARI-Kisii.

1. To determine the level of participation of researchers, extension agents and farmers in on-farm trial activities and its relationship with the level of adoption of technologies developed through on-farm research trial.

2. To describe the farmers, extension agents, and researchers knowledge of their respective roles in disseminating technologies through on-farm research trial and its relationship with adoption of technologies developed through on-farm research trial.

3. To find out the level of satisfaction of farmers, researchers and extension agents with their institutions and its relationship with adoption level of technologies developed through on-farm trials.

4. To investigate the presence of pre-formed attitudes, due to differences in socio-economic status among the extension agents, researchers and its relationship with levels of adoption of technologies developed through on-farm research trials.

5. To determine the relevance of the technologies disseminated to the farmers and its relationship with the level of adoption of recommended technologies developed through on-farm research trial.

1.5 Hypotheses

Ho_1: There is no statistically significant relationship between the level of participation of researchers, extension agents, and farmers and level of adoption of technologies using on-farm trials.

Ho_2: There is no statistically significant relationship between farmers', extension agents', and researchers' roles in on-farm trials and level of adoption of technologies developed through on-farm research trial.

Ho_3: There is no statistically significant relationship between level of satisfaction and level of adoption of recommended technologies developed through on-farm research trials.

Ho_4: There is no statistically significant relationship between the presence of pre-formed attitudes, among extension agents, researchers and farmers, and level of adoption of technologies generated through on-farm trials.

Ho_5: There is no statistically significant relationship between the relevance of technologies disseminated to the farmers and the level of adoption of the technologies developed through on-farm research trials.

1.6 Significance of the Study

Constraints to research-extension-farmer linkage potentially affect agricultural output, whereas effective linkages improve adoption of technologies. This study was designed to find out the relationship between linkage factors and adoption level of technologies generated through on-farm research trials. This may contribute to improving the implementation of farmer-extension-research collaboration for improved and sustainable agricultural and rural development. Barriers to linkages may be addressed, so as to come up with the appropriate technology transfer approaches with stronger linkages. The study may also be used by policy makers in designing the appropriate approach to technology transfer; an approach that considers the relevant linkage factors and recognises the need for strong working relationships between research, extension and farmers.

The linkage between the farmers, extension and research is beneficial for all parties concerned. Research and extension benefit from the farmer feedback and guidance in their work, at all levels, ensuring that the results of their work are useful and easily accessible to the farmers. They also benefit from the financial and "political" support of farmers at all levels, ensuring the sustainability of quality of research and extension as well as for the continuity of the collaborating partners. The farmers benefit from regular and useful technical support given by research and extension, which serves as the basis of sustainable agriculture. Further research can be organised on each farmer-research-extension linkage factor for an in depth study.

1.7 Limitation of the Study

The study was limited to studying the relationship between the linkage factors and level of adoption in KARI-Kisii mandate area. During the period of data collection process, the

researcher was faced with communication barrier in some regions. Employing an interpreter who was trained on the research methodology solved this problem.

The study used a survey methodology, which has limitation since it collects data from a point at a given time. This poses a problem of generalisation. Taking a large random sample of 104 respondents reduced the magnitude of the problem.

1.8 Assumptions

The study made the following assumptions:

- The low adoption levels of agricultural practices, lead to low productivity.
- The availability of technologies is a direct indicator of the existence and intensity of the linkage between the researchers, extension agents and the farmers.

1.9 Scope of the Study

The study was limited to the five linkage factors including;

(i) Levels of participation of researchers, extension agents and farmers in on-farm trials

(ii) Presence of pre-formed attitudes due to differences in level of education and income among the extension agents, researchers and farmers.

(iii) The roles of farmers, extension agents, and researchers in on-farm trials.

(iv) The relevance of the technologies transferred to the farming conditions.

(v) Farmers, extension agents and researchers level of satisfaction to with their organisations.

The factors were examined based on the farmers', extension agents' and researchers' interaction and participation in the on-farm research trials carried out by KARI-Kisii whose mandate area includes 10 districts from Nyanza Rift Valley provinces of Kenya.

1.10 Definition of Terms

The following provide the definitions of terms as used in the study.

Adoption: This is when the farmers put into practice technologies disseminated to them that would improve their production levels. According to the study, adoption was when farmers used maize and beans production technologies disseminated through on-farm research trial.

Adoption level: This is the extent to which the farmers are using the technologies disseminated to them. According to the study, adoption level was defined as the extent to which the farmers used maize and beans production technologies disseminated to them through on-farm research trials.

Extension: The availing technologies that would help farmers improve their productivity at the lowest possible cost. According to the study, it was defined as the process of availing maize and beans production technologies to the farmers through participatory approaches such as on-farm research trials.

FSR Team: This is an interdisciplinary group of researchers including farmers, technical scientists, and extension agents all working to achieve one objective of improving the farmers productivity by developing technologies that are adaptable to the farmers conditions.

Linkages: It is holistic interaction between farmers, extension agents and researchers with an aim of improving agricultural productivity. According to the study, it was considered as the formal and informal collaboration between the farmers, extension agents, and researchers to help farmers improve their production levels by using the most appropriate technologies.

On-farm research trials: This is adaptive research done by FSR team in the farmers' fields to generate technologies that suit the farmers' ecological and socio-economic environment. According to the study, it was defined as the adaptive research done by KARI-Kisii scientists, extension agents and farmers at various sites in KARI-Kisii mandate area.

Recommended technologies: These are technologies that have been ratified and modified to suit the farmers' AEZs and socio-economic conditions. According to the study, it was defined as maize and beans production technologies developed and disseminated to the farmers through on-farm research trials carried out by KARI-Kisii.

Research-extension-farmer linkage factors: These are factors affecting the frequency of interaction, interpersonal and working relationship between the researchers, extension agents, and farmers. According to the study, these were specific factors including,

(i) Levels of participation of researchers, extension agents and farmers in on-farm trials.

(ii) Presence of pre-formed attitudes due to differences in level of education and income among the extension agents, researchers and farmers.

(iii) The roles of farmers, extension agents, and researchers in on-farm trials.

(iv) The relevance of the technologies transferred to the farming conditions

(v) Levels of satisfaction of the farmers, extension agents and researchers with their organisations and causes of dissatisfaction that affect interaction between the farmers, researchers and extension agents such as level of funding, availability of fund, reward systems, transport systems.

Technology transfer agents: These were extension agents, from Ministry of Agriculture, NGOs, or individual farmers who exploit all the possible means to ensure that the farmers improve their productivity at the lowest possible cost.

Thematic research: These were researches done by scientists on particular disciples under controlled conditions with the aim of generating some knowledge. Which were usually on-station and carried out under controlled environments

Uptake: This was the integration of the new technology being adopted by the farmer and eventual utilization of the same.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter examines the existing literature about the relationships between linkage factors and level of adoption of technologies. It gives the theoretical background of on-farm research trial as a Farming System Research (FSR) technology dissemination approach. Specific linkage factors and how they affect adoption levels are also presented. The chapter also reviews dissemination of technologies as a communication process. It ends with the premise upon which the conceptual framework of the study is based as away of identifying knowledge gaps the study sought to investigate.

2.2 Theoretical Background on On-Farm Research Trial as FSR Approach

On-farm research trails are adaptive researches carried out by FSR team with the main aim of understanding the farmers' problems, generating and disseminating technologies that are appropriate to the farmers' conditions. Hildebrand and Waugh (1983) identified the basic factors of FSR as being:

(i) Concern oriented to the disadvantaged rural sectors,

(ii) Recognition of the farmers' situation as a critical factor in any bid to increase the farmer's productivity and improving their welfare,

(iii) The need for a multidisciplinary approach in order to understand the farm as an entire system rather than the isolation of the components within the system.

FSR therefore require researchers to closely examine the components of the farming system and their interactions, to identify constraints to, and opportunities for increased productivity, and to design, test and evaluate technical innovations under actual farming conditions. According to Norman (1989) there are differences between thematic research and farming system research. He described thematic research as a technical research of either a particular discipline or different disciplines, which are primarily geared to generating knowledge. Thematic researchers usually do research in experimental stations and mainly carry out priority setting, management and implementation under ideal situations. In thematic research, social implications and farmers' opinions are not always considered. This makes course-effect relationship very easy to establish.

FSR, on the other hand, is usually done on-farm involving several technical and social scientists of different disciplines with emphasis laid on adaptive research. Researchers, farmers and extension agents usually do priority setting. Implementation of research output is left to the farmers with continued supervision from research and extension in research-managed or extension-managed trials. In FSR technical feasibility, social acceptability and farmers' opinion is often given priority therefore establishing cause-effect relationship is rather difficult as compared to thematic research.

It therefore implies that on-farm research is a modification of thematic research to suit the farming conditions. On the other hand, not all trials done on the farmers fields appeal to all FSR clients. There are three types of on-farm trials on the basis of who manages and who implements them: The three types of trials include, Researcher Managed and Researcher Implemented (RMRI), Researcher Managed and Farmer Implemented (RMFI) and Farmer Managed and Farmer Implemented (FMFI) (Norman, 1989). This grouping evidently excludes the Extension agents' participation in the trials, which may introduce conflict of roles between Extension and Research.

RMRI trials are the equivalent of those conducted on experiment station by thematic researchers. Therefore the level of testing meets the standards demanded by experiment station based researchers. Due to management and resource constraints, farmers' yields or returns will diminish when moving from the RMRI to FMFI level. Thematic researches are not subject to conflict of roles between the extension and research and other exogenous factors affecting the research output. Apart from experimental site differences and decline in yield which is due to differences in farming conditions, other factors affecting technology generation and transfer are, how easily the research output is acceptable to farmers, and how conveniently they can be passed over by extension agents to farmers for eventual uptake and utilisation (Agbamu, 2000).

According to Merrill-Sands *et al.* (1990) several types of activities can be useful in building compliments between thematic and FSR researchers such as: Organising station based research programmes around commodities and subject areas that involve all the interested parties; Having some form of National co-ordination of FSR activities and having all teams use similar methodologies. Tanzania and Zambia both have national co-ordinating units, and Botswana has made strenuous efforts to develop a common methodology for use by all FSR

teams (Worman *et al.*, 1990); Organising field days on farms, and making visits to trials both at the experimental station and in farmers' fields. These activities can provide a very useful fora for informal interaction between farmers, extension and, thematic and FSR researchers and potential planners. There is also need for thematic researchers to develop an understanding and appreciation of the methodologies used by FSR teams.

The reviewed literature on the on-farm research trial as a FSR evidently assumes that, the interaction of the participants involved in on-farm research trial will take place without problems. On that basis then, the on-farm research as FSR is expected to produce good results in terms of adoption of technologies and improved agricultural productivity. This however has not been the case. On-farm research trial as multidisciplinary approach is faced with problems arising from the levels of interaction between the interacting groups. A review of literature on some of the linkage problems facing the on-farm research trials is presented below.

2.3 Specific Linkage Factors Affecting Adoption Level

Some of the factors reviewed are roles of extension agents, level of satisfaction with institutional background and reward systems, levels of participation of the farmers, researchers and extension agents, presence of preformed negative attitude and relevance of technologies to the farmers' conditions.

2.3.1 Roles of Extension Agents

Extension education is generally the main agent for farmer education in the developing countries. It is an educational service for advising, training and informing farmers and growers concerning practical and scientific matters relating to their business, and influencing them to use improved techniques in their farming operations. For this purpose, the task of the extension agents is two-fold, to advice and to influence (Andersen, 1964). Duties of field extension staff as stipulated by Management Manual of Department of Agriculture, Kenya (1980) include technical matters of extension such as, transfer of innovation to farmers, co-ordination and control of all agricultural extension activities, developing and improving management based on the work plans, liaising with all institutions at the area of operation involved in agriculture and rural development, and performance of any other duty that may be assigned by the immediate supervisor.

Extension agents therefore should not only concern themselves with communicating appropriate technical information to the farmers, but also to understand the culture, values, and attitudes of the farmer. They should also select and use the most appropriate extension methods, plan, implement, and evaluate their work programmes. The extension agent can also be described as a community worker, who knows much about the farming conditions, and a change agent, who should diligently effect the dearly needed changes in the community. The most effective extension agent is one who knows and understands his duty as community development agent and a change agent (Ewell, 1990).

A study carried out by Ndung'u *et al.* (2000) on Agricultural Knowledge and Information Systems (AKIS) in Trans Nzoia and West Pokot districts of the North Rift, Kenya revealed that for the developed technologies to be adopted by a larger farming community a strong institutional multi and inter-disciplinary linkage is critical. The linkage involved more than one stakeholder including, individual farmers, research scientists, extension, non-governmental organization (NGOs), private institutions, government institutions and donor agencies. The study also indicates that, the role of various stakeholders needs to be clearly defined to avoid duplication of effort to save on resources.

2.3.2 Differences in Institutional Background

Linkages and interaction between agricultural research and technology transfer institutions and or processes can lead to the identification of barriers to effective technology transfer and uptake (Stoop, 1988; Merril – Sands *et al.*, 1990; Seagers & Kaimowits, 1990). These barriers include institutional, human (cultural) and management constraints (Garforth & Usher, 1997). Institutional barriers, such as the common public sector phenomenon of separate ministries being responsible for agricultural research and extension, limit the possibility of collaboration (Stoop, 1988; Almy *et al.*, 1991). Differences in background status, education levels between research and technology transfer workers have caused human/cultural barriers in research – technology transfer (Stoop, 1988; Seagers & Kaimowitz, 1990). The powers bestowed / associated with certain individuals in an organisation can effectively prevent communication between levels. People are known to communicate most frequently and effectively with those who are most similar to themselves (Roling, 1988). The problem of divisive status, and relationship between individuals and

departments is exacerbated by the hierarchical nature of the institutions involved (Chambers, 1993). The existence of such barriers in the FSR team can lower the output of the team since so much time is often spent in trying to bring the teams together.

Institutional factors strengthen farmer-extension-research linkage and the general level of productivity of a nation. For instance, the changing face of Philippines extension delivery system illustrates the true picture of the effect of institutional factors on agricultural linkage and productivity. According to Faylon and Acoba (2002) the Philippines faced a lot of problems after the decentralization of the management of extension from the centralized Department of Agriculture to the Local Government Units (LGU). The problems include: limited number of extension workers; low budgetary allocation to the extension; low farmer-extension interaction due to reduced funding and limitation of funds; reduced mobility; bureaucracies and lack of incentives to the extension personnel. These problems affected the extension participation and linkages with the Rural Development. The performance of the extension was highly dependent on the existence of local resource-both financial and manpower which largely came from the Local Government Units (LGU). The extension agents had developed credibility problems due to low pay, lack of training except those associated with the national programmes; lack of leadership, institutional and organizational skills necessary to perform effectively. The weak link between the Rural Development and Extension was as a result of Structural/Organizational set up in the country that prevented both extension and researchers from delivering the expected results. The public also developed a lukewarm attitude towards the Rural Development and Extension team. The local NGOs who tried to build back the linkages became impatient with the LGU bureaucratic process.

2.3.3 Participation in Agricultural Activities

Effective linkages to technology transfer involving users in the process, seeking coordination and synergy, and finding partners for technology development activities can increase the potential for programme success (Eponou, 1994). Maximum participation of extension agents, farmers and researchers in the FSR may improve linkages especially if their contributions are sought from the beginning of the program through to the end. For instance, involving the extension in the FSR priority setting may improve linkages during the implementation stages. This will neutralize the impression the extension agents harbour of

being used as the supervisors of the farmers –who are being used as cheap labour by the FSR teams. Participation therefore may give the feeling of being part of the new approach, thereby boosting the morale of the extension agents (Ewell, 1990). Similarly if farmers are excluded from the main frame of decision-making they may disown the project and regard it as the foreigners' initiative to do their own things that do not concern them. The farmers will also think that they are only involved because their land is being used as an experimental ground. Such kind of on-farm research may be categorised as RMRI. Farmers would then act within their limited rights to reject the improved technology that did not involve them from the beginning.

The other constraint to participation was the interpersonal relationship of which the researchers' negative attitude stands out prominently. Often non-scientists are not always trusted enough to be involved in the identification of research or practical problems (Ewell, 1990). This kind of attitude was especially enhanced when mutual expectations were based on long held stereotypes. In an effective participation, researchers are understanding and interested in technology transfer. In such situations, diagnosis, programme formulation, and priority setting could be carried out jointly by research, technology transfer agents and the farmers (Eponou, 1994). Though participation of all the groups is of equal importance, it is advisable to be very clear on the degree of participation from each group. Participants need to understand early in advance just what is offered, otherwise if they are led to expect that their contribution will have a major impact or that they will be seen as partners when this is not the case, their participation may be counter productive (Garforth & Usher, 1997).

A survey by Wanyonyi *et al.* (2000) of Farmer Participatory Research (FPR) approaches reveals that On-farm trials as was used before 1997 emphasized a lot of the Researcher Managed Researcher Implemented (RMRI) approach. This overwhelming research participation overshadowed farmer and extension participation in technology generation and development, thereby leading to poor adoption rates. The low adoption levels led to the improvement of the on-farm trial to involve the participation of researchers, extension, and farmers in problem diagnosis, intervention and technology development process. This improved farmer participation as opposed to the former FPR approach that considered farmers as recipient of research ideas. The study reveals that the empowered farmers' productivity improved with a great margin.

Another study by Kamidi *et al.* (2000) aimed at involving farmers in all stages of technology development in order to enhance adoption at NARC-Kitale between 1994-2000, revealed that farmer participation in the various stages of technology development varied with community they came from, ethnic groups, frontline extension staff working with the farmers and the researcher team dynamics and the farmer research committees. The study also revealed that the more time researchers spent with the farmers the better the understanding, sharing of ideas and the more the confidence to confide in each other as partners in technology development.

A study carried out by Okoko *et al.* (2000) conducted in KARI – Kisii mandate area reveals that farmers' participation may be active in diagnostic stages, their participation in the subsequent stages beyond diagnosis stage was crucial and affected adoption of the technology of on-farm trial. The study also indicated that farmers' participation was crucial in all stages of research process since it allows farmers to take lead in diagnosing problems, and generating feasible solutions. Most of the adaptive research activities were conducted on-farm, with varying degrees of researchers, extension and farmer participation in design, and management of on-farm trials. Farmer involvement should be as equal partners in the diagnosis of the constraints, designing of intervention, monitoring and evaluation, dissemination, assessing adoption and impact, and providing feedback (Okoko *et al,* 2000). Use of farmer participation in all the stages of technology development improves the probability of adoption of technology since it creates the sense of ownership and credibility of the process among the farmers and other partners (Murithi, 2000). The study however, revealed that farmer participation was affected by many factors such as gender, age, resources, culture, and other extraneous factors.

On the potentiality of on-farm trial activities a study carried out by Achuodho *et al.* (2000) to determine the effect on On-farm research trial using soil conservation technologies carried between 1995-2000 indicated that although the general adoption of technologies were low, technologies disseminated through on-farm trial performed relatively higher than other participatory research approaches.

Pre-formed Attitude due to Socio-Economic Status

The participation of technology transfer agents in priority setting is influenced by the relationships established between the farmers and the researchers. In fact establishing good personal and inter-group relationships can overcome many of the difficulties, but it is best to be aware of the potential causes of tension. The generation and transfer of technology is a social process involving actors with different personal attributes, status, attitudes, behaviours, motivation, interests and goals. Individual actors occupy specific positions both at work and in a profession. Organisations differ with respect to prestige, status, incentive systems, authority and resources. Individuals naturally identify with their own work groups and professions. Such differences in personal attributes, professional groups and organisational characteristics have been identified as factors contributing to poor linkages between research and technology transfer because they create tensions and conflict among the actors of the system (Bennel, 1989; Bennel & Zuidema, 1989; Kaimowitz *et al.*, 1989).

In most systems researchers had a higher status than technology transfer agents. There was a sort of pecking order of occupation reinforced by a general perception that researchers are to some extent the "white collar" workers of the technology systems, capable of identifying, analysing and solving farmers' problems. This suggests that technology transfer agents are "blue collar" workers, in charge of rather mechanically delivering the research output to farmers. Researchers seem to enjoy this situation, but technology transfer agents resent it. Often researchers would like to maintain the status quo and were therefore critical of attempts by technology transfer agents to become involved in research (Kung'u *et al.,* 2000). Disagreements may lead to setting up of parallel trials by each group of which researchers would call the extension agents trials as technological adjustments and not research (Wuyts – Fuvawo, 1992). This situation can easily lead to conflicts regarding what must be done to understand farmers' views. Technology transfer agents may assert that they have already incorporated the farmers' viewpoints in their policies and strategies. An FSR team will generally prefer to make their own assessments. Where tension and conflicts were high, effective participation of technology transfer in priority setting was problematic.

In a sudy by Kung'u *et al.* (2000) carried out in North Rift Kenya, the effects of weak linkages on adoption and sociological aspects that weaken the sociological linkage were illustrated. The study illustrates how the Farmer Participatory Research (FPR) approach was introduced after the conventional methods had failed to generate further acceptable

technologies. The initial stage of problem diagnosis was successful, but farmers' participation declined thereafter, during the first three years. Further modification of the FPR approach was done to sustain substantial farmer involvement and a multi-disciplinary research – extension team. However, the research team dynamics were weak and utility of farmers in technology evaluation beyond the biophysical feasibility inadequate. Experience in the phase I of the project showed that there were sociological influences, which affected the performance of the FPR endeavour.

The study illustrated that the success of OFR was dependent on the multi-disciplinary team dynamics and community's willingness to participate. Since the objective of research intervention was to enhance agricultural productivity under culture or traditional-bound communities, the onus was upon the research teams to reach out to those people by applying suitable communication methods. However, the efforts of the biophysical scientists to obtain necessary feed back from the farmers was hampered not only by the absence of a sociologist to articulate socio-metric principles and procedures, but also by their attitude.

The study also illustrated that the scientists had acquired some "professional personalities" that made them to be biased towards their own specialized disciplines. Such acquired personalities often lead to an inclination to traditional and conventional ways of conducting research where biological data especially yield, were used as the chief-evaluation criteria. These complexities jeopardized the interdisciplinary team spirit (Kung'u *et al.*, 2000).

Some of the human characteristic factors that can exist in a functional community as noted by Ashley (1969) and Kung'u *et al.* (2000) include: -

(i) Frustration - This is a situation where individuals can be frustrated and demoralized as a result of constant criticism, low income, low family status, poor performance, low education status and unhappy marital status and other social problems.

(ii) Antisocial behaviour – This is when individuals fail to adjust to the community demands by being selfish, greedy or wanting to have their ways always.

(iii) Loneliness – This is when individuals cannot develop successfully either because of their rigid parental orientation or religious/cultural affiliation.

(iv) Isolation - This is when individuals in a group suffer from inferiority complex. Such individuals isolate themselves and exude a lot of criticism to others.

(v) Ambition – This is when an individual in the team tries to outshine the rest of the team members due to having a higher dream or aspiration than the rest.

(vi) Slow performance – There are individuals who would otherwise take a lot of time to perform an easy task. The same individuals would also decline to make simple decisions.

However the above grouping of human characters might portray personalities negatively. It provides a basis for identifying the weaknesses to be rectified and strengths to build upon. Any on-farm research team that doesn't recognize these characters and fails to address them would be dragged with them. The team leaders should therefore recognize the social aspects that encourage the characters in order to ensure the team works for the common good.

The social aspects affecting inter-disciplinary team are also pronounced when the participants are from different organizations or institutions. A study by Kamidi *et al.* (2000) confirms that if there are conflicts of interests, conducive environment for participatory research cannot exist. The study also revealed that in order to ensure success, the team needs constant meetings among themselves for planning and sharing responsibilities. The roles of different institutions need to be clearly spelt out and the scientists should appreciate the holistic approach in FPR without necessarily over emphasizing their disciplines. Institutional factors can also encourage the groupings of negative human characteristics as in the Philippines after and decentralization of the Department of Agriculture and Extension System. The performance of the Rural Development and Extension declined due to personality problems (Faylon & Acoba, 2002) and there were little incentives for personnel.

2.3.5 Relevance of the Technologies Transferred to the Farmers

Technologies viewed by the farmers as too complex and too costly, such that it is not within their ability to implement, are often poorly adopted. Farmers also do not readily adopt technologies that are not culturally acceptable. It is therefore important to involve farmers in decision-making. Farmers are known to accept technologies that involved them in the initial technology generation, modification and during the implementation stages. These technologies also tend to be very relevant to their needs. Some of the related studies on relevance of technologies being disseminated to the farmers also point out the effect of

farmer attributes and technology attributes on adoption of technologies disseminated through on-farm research trials.

A study carried out by Odera and Okalebo (2000) in Ileho division of Kakamega district on the significance of relevance of technology to adoption level indicated that some of the technology attributes affect adoption. Some of the technology attributes found to affect level of adoption in the Farmer Managed Researcher Supervised technology disseminated through on-farm research trials include, influence of the technology on yield, labour requirement associated with the use of the technology and influence of technology on the crops' growth and vigour. The study found out that the technology-specific attributes under study were positively related to the probability of adoption except the labour requirements.

Other factors also found to be relevant to adoption of technology are farmer-specific characteristics (Wanyama *et al.,* 2000), which include years of farming, off-farm income, farmer participation in trials implementations, education level of the farmers, farm size, and the age of the farmer. The combination of the farmer-specific characteristics and technology-specific attributes determine the relevance of technologies to the farming households, which affect the level of adoption of technologies of on-farm research trials.

2.4 Extension Communication

Technology transfer is a communication process. Extension agents encounter a diversity of clients in terms of education level, socio-economic status and cultural orientation (Zinnah, 1992). It is therefore imperative for extension agents to have an array of communication methods to disseminate the technologies to the end users effectively. To achieve high adoption level, the communication channels must be without impediments. The means and methods of communicating agricultural information, knowledge and skill are almost the same everywhere.

The communication methods differ in their effectiveness and applicability to different people and situations. A particular method of communication may be effective under a given set of conditions with a given set of people. It may be ineffective with a different set of people under the same conditions or with the same people under a different situation. The effectiveness of communication methods therefore depend on the structure of the society or community, the patterns of behaviour of individuals forming the society, religious sentiments,

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traditional customs, the degree of cohesiveness of the society members, socio-economic development, mental soundness or consciousness of the people, utility or relevance of the information being communicated, age composition of the community, level of literacy, size of farm house-hold, economic status and the integrity of the person disseminating the information. The factors, which affect the effectiveness and applicability of the different methods of communication, change continuously with changes in the society (Lopez & Bruening, 2002). Cultural, religious, socio- economic scientific and technological forces effect the changes. No single method of communication can be said to be effective for all people and in all situations. Often one method of communication is complementary or supplementary to the other. Each method of communication has a distinctive appeal or approach, which the others may not have. This calls for a combination of various methods of communication, depending on the resource availability (FAO, 2002).

Extension employs various communication methods with the aim of teaching farmers how to raise their living standards, using their own efforts and resources of manpower and materials with minimum assistance. It also has a responsibility of encouraging local leadership and a spirit of self-help. The FSR team therefore tries to arouse the farmers to recognize, and take interest in their problems. This is to help the farmers overcome their problems. To ensure the effectiveness and broader dissemination of agricultural technologies to the resource poor farmers, the FRS teams encourage strong working linkages between the farming society, extension agents and the researchers. Linkages are needed for effective exchange of information and resources (Ndung'u *et al.,* 2000). The linkages also encourage sharing of responsibilities and agreement on the priority areas for co-ordination and allocation of resources.

Low adoption of agricultural technologies is a major constraint to increased food self-sufficiency and income generation from smallholder farms in Kenya. This problem can be partly due to poor technology transfer centered on three main stakeholders (Ndung'u *et al.,* 2000). According to Ndung'u *et al.* technology transfer or information flow was one way and there was little feedback to extension and research (Figure 1).

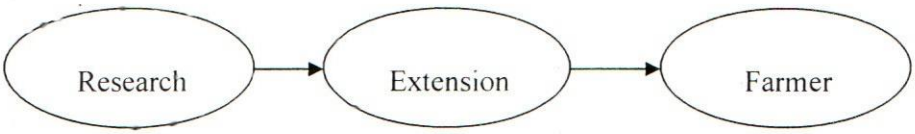


Figure 1: Conventional information flow

Adopted from Ndungu *et al.* (2000) in KARI (2003).

The farmers were treated as uniform in the way they received and made use of agricultural information and this resulted in many technologies being rejected by the farmers. Another aspect of information flow also illustrated by the study by Ndung'u *et al.* (2000) was an improvement of the above one way information flow, the Farming Systems Approach to Research-Extension and Training of farmers (FSA-RET). This approach is also criticized for having neglected other stakeholders and only concentrating on information flow among the farmers the researcher and the extension agent (Figure 2).

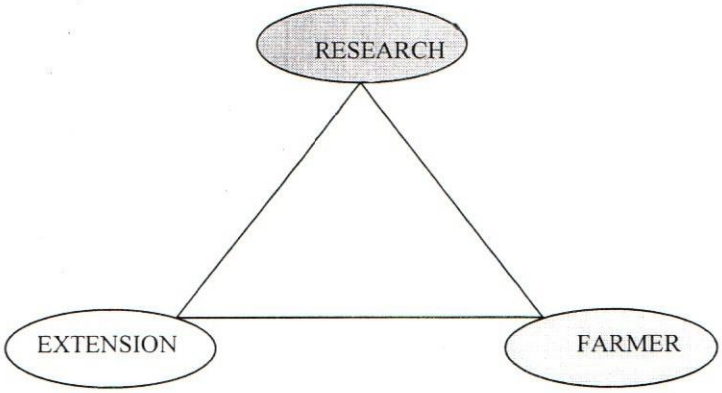


Figure 2: Extension Research farmer triangle

Adopted from Ndungu *et al,* 2000 in KARI 2003

The information flow among the farmers, research and extension and neglecting other actors who are also active in agricultural activities, limit improvement of agricultural productivity to the three. Without information to the actors such as NGOs, private institutions that produce inputs etc, Government institutions and donor agencies, the information flow would not improve the agricultural productivity (Ndung'u *et al.*, 2000).

These limitations lead to development of another model of information flow that includes the participation of other actors to enhance performance of agricultural productivity. Ndung'u *et al.* illustrates the AKIS paradigm (Figure 3) involving all the actors in agricultural activities.

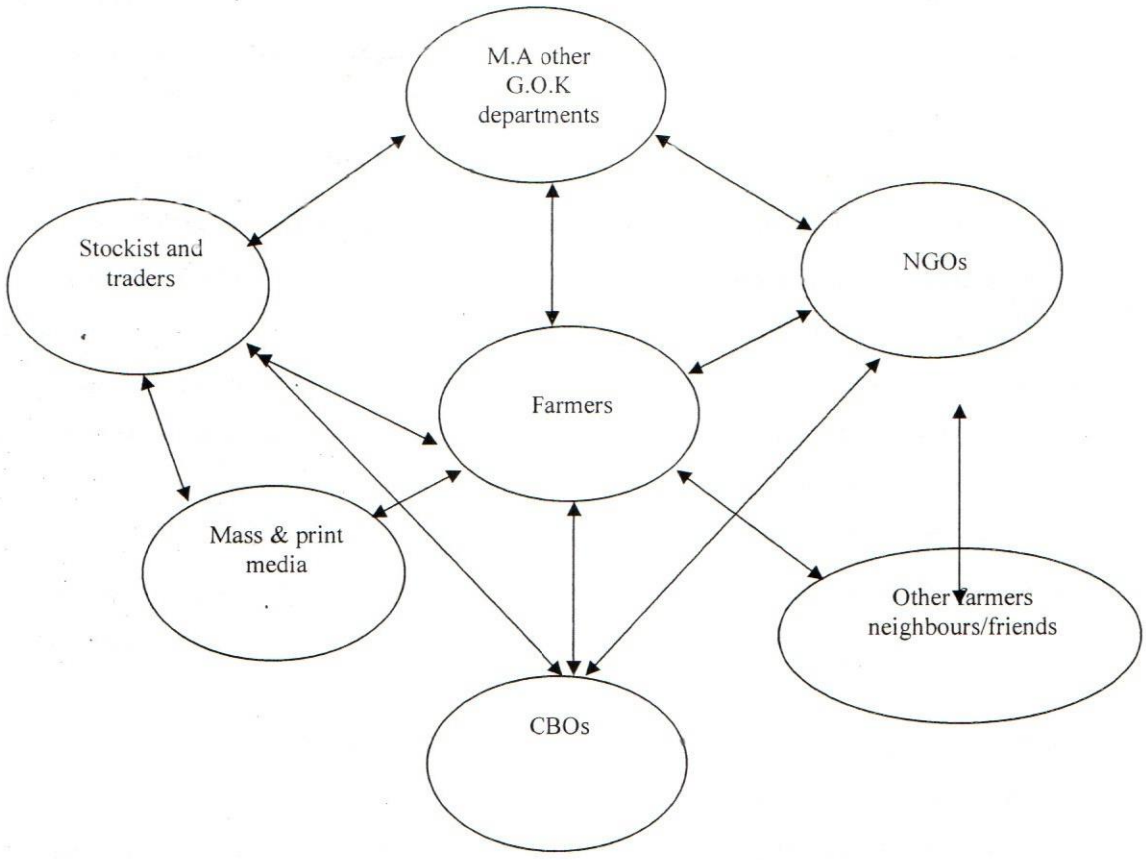


Figure 3: The AKIS paradigm

Adopted from Ndungu *et al.* (2000)

The study also found out that not all actors are able to link with each other and this complicates communication. For instance, too much information, which may be conflicting in nature, may only confuse the farmers even further. The flow of the information in the system is also affected by certain socio-economic factors such as gender, age, income, education level, culture and religion.

Wanyama *et al.* (2000) illustrates that in rural areas, the challenge is to increase the quality and accessibility of information, to ensure it is exchanged in appropriate ways and to elicit more information from rural people themselves in order to guide the planning of sustainable development programmes. Communication is therefore central to the task of empowering people and stakeholders to get into the management and protection of agricultural resources (Lopez & Bruening, 2002). It enables planners when identifying and formulating

development programmes, to consult with people in order to take into account their needs, attitudes and traditional knowledge (FAO, 2002).

2.5 Conceptual Framework

The conceptual framework developed for this study was based on the theory of the triangular schema (IFAP, 1995). The theory of the triangular schema works on the perspective that links between the farmers, research and extension is a prerequisite for a healthy agriculture. That is, farmers, extension and research are closely inter-linked through a multiplicity of formal and informal contacts and working institutions. The triangular interrelationship between the researchers, extension agents and farmers was used to point out where the link cracks. The study therefore looked at the two-way link between; farmers and researchers, farmers and extension agents, and extension agents and researchers. In each link the study examined the specific linkage factors as the independent variables.

The study also operationalized the two premises of communication and adoption. Communication is the dissemination processes that involve a multidisciplinary group of participants hence it is affected by the interrelationship existing among the groups. On-farm research trials as a Farming System Research approach involve a multidisciplinary group of persons with different attitudes, tastes and preferences. On-farm research trials therefore operate as a group activity and are faced with the problems any other group activity may face. Institutional, human/cultural and management problems facing such groups break down communication among the group members. On-farm research trial being a technology transfer approach, pegs its success mainly on effective communication. This implies that, on-farm research trials cannot be an effective technology transfer if there is no proper communication among the farmers, extension agents and the researchers. Without proper communication channels adoption is affected. Before the adoption level is affected by the interaction problems, participation of the researchers, extension agents and the farmers would be affected. The effect on the participation therefore would compound its effects on adoption.

The study examined the specific linkage as the independent variables. Level of adoption was the dependent variable. The intervening variables were the farmers characteristic including, age, land sizes, Agro-Ecological Zones, gender and level of education. The intervening variables were studied and used to describe the population. Figure 4 shows an illustration of

the conceptual framework. It indicates how linkage factors affect adoption of on-farm research trial technologies.

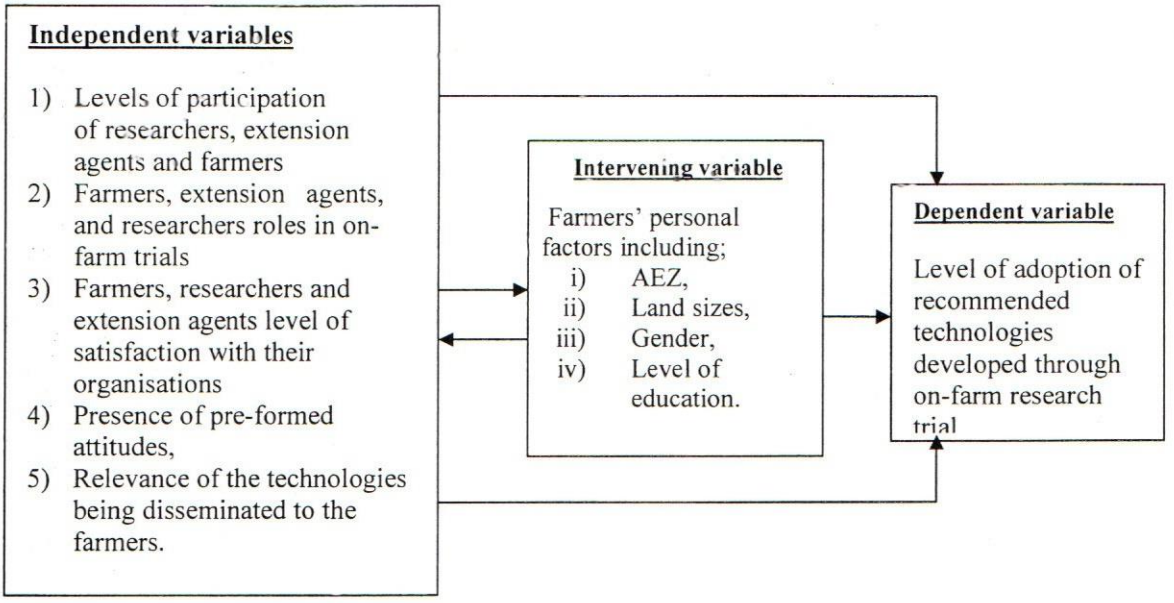


Figure 4: The conceptual framework showing linkage factors affecting adoption of on-farm technologies

The availability of technologies was an indication that there was an interaction between the farmers, researchers and extension agents. The intervening variables affect the level of participation, roles played during an on-farm trial process, institutional factor affecting farmer, research, extension interaction. The relationship of independent and intervening variable with the dependant variable was measured. The strength of the interaction (linkage) among the farmers, researchers and extension agents was assumed to be dependent on the linkage factors, which are used as the independent variable.

The following indicators were used in the study.

Independent variables

(i) Levels of participation of researchers, extension agents and farmers in on-farm research trials.

(a) The number of times participated in on-farm research trial activities.

(b) Stage each group is involved in the technology generation and dissemination.

(ii) Farmers', extension agents', and researchers' roles in on-farm trials.

(a) Activities carried out by the participants in the on farm trials

(b) Presence of conflicting roles.

(c) Knowledge of the roles

(iii) Level of satisfaction of the farmers, extension agents and researcher with their organisations respectively.

(a) Courses of dissatisfaction.

(b) Availability of management problems impeding interaction.

(c) Differences in institutional reward systems.

(iv) Presence of pre-formed attitudes, due to differences in socio-economic status among the extension agents, researchers and farmers.

(a) Level of income

(b) Attitudes

(c) Education level

(v) The relevance of the technologies being disseminated to the farmers.

(a) Technical feasibility

(b) Cultural acceptance

(c) Cost

(d) The benefits

Intervening variables

3 Farmers personal factors

(a) Farmers age

(b) Farmers level of education

(c) Gender distribution of the farmers

(d) Size of land used for agriculture

Dependent variables

Level of adoption of technologies developed through on-farm research trial in relation to beans and maize production technologies.

(a) Planting materials.

(b) Farm management practices

(c) Maize and beans production levels.

(d) Post harvest technologies.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter summarises the main procedures and techniques adopted for the study including the research design, target population and sampling technique as well as data collection and analysis procedures. The various procedures and techniques selected for the study have been justified and explained to show how they enabled the researcher achieve the research objectives.

3.2 Research Design

Ex-post facto research design was used to establish the effect of linkage factors on adoption of technologies generated through on-farm trials that have been conducted by the KARI-Kisii. An *ex-post facto* design involves a study of phenomena as related to a naturalistically occurring treatment after its occurrence (Kathuri & Pals, 1993). The study took the *ex-post facto* design, as it involved studying the linkage factors and adoption level of on-farm trial technologies that had been carried out without introducing any treatment to the study subjects. The on-farm trials had been carried without the researcher taking part in their introduction as research treatments.

A survey methodology was employed to examine the farmer-research-extension linkage factors in the KARI-Kisii mandate area. Survey explores and describes a situation using questionnaires and interviews to determine the opinions, attitudes, preferences and perception of the study population at one point in time (status study) (Kathuri & Pals, 1993). The study was a survey, since it used questionnaires to gather data at one point in time relating to the opinions, attitudes, and perception and adoption levels from farmers, researchers, and extension agents.

3.3 Location of the Study Area

The study was carried out in KARI-Kisii Regional Research Centre's mandate area. This is an agriculturally productive area located in Southwest Kenya. The mandate area covers 10 districts, namely; Kisii, Gucha, Nyamira, Homa-Bay, Migori, Rachuonyo, Suba, Kuria,

Nyando, and Transmara districts. This area lies in varied AEZs, calling for specificity in farming systems in the different ecological zones. Some of the zones include UM, LH, LM. Appendix D presents the map of KARI-Kisii mandate area.

3.4 Population

The population of the study consisted of all the farmers in the region, all the government extension workers, and all the 17 technical research scientists working in KARI-Kisii Regional Agricultural Research Centre mandate area.

3.5 Sample and Sampling Procedures

Equal proportion stratified random sampling technique was used to identify the respondents. Out of the total population of the farmers in the mandate area, six on-farm research sites were randomly identified from a list of 14 sites in the study region. The on-farm sites were distributed equally in all the 3 ecological zones. Each ecological zone was represented by 2 sites. From each of the on-farm sites, seven (7) farm household heads were randomly selected and interviewed. This made a total of 42 farm household heads interviewed. The same sampling technique was used to randomly identify a sample of extension agents from all the extension agents working in the mandate region. In each of the 3 ecological zones 15 extension agents were randomly identified. This brought a total of 45 government extension agents interviewed. All the 17 technical scientists working in KARI-Kisii Regional Research Centre were interviewed. This made the total number of people interviewed to be 104 respondents. This is within the sample size requirement for each sub group as suggested by Kathuri and Pals (1993).

3.6 Instrumentation

3.6.1 Types of instruments

Structured questionnaires with both closed and open-ended statements and questions were used as data collection instruments to collect relevant information needed to address the objectives of the study. The questionnaires were designed to capture interval, ordinal and nominal data as per the study objectives, for both descriptive and inferential statistical analysis. Three sets of the questionnaires were used to interview farmers, and collect data from extension agents and researchers respectively.

3.6.2 Validity and Reliability of the Instruments

3.6.2.1 Validity

To ensure content validity, attempts were made to develop items to measure the objectives of the study. Content validity refers to the representativeness of the items in the instruments as they relate to the entire domain or the content being measured. Attempts were also made to ensure that the instruments had the best appeal and appearance. This ensured face validity of the instruments, so that it does not illicit biased or incorrect responses from the respondents. Face validity refers to appeal and appearance of the instruments. The instruments were validated through discussions with two supervisors, four peers, and three faculty experts. All useful comments and suggestions were incorporated to further improve the instruments. The useful comments and suggestions were incorporated. Addition of more items to measure objectives one, two, four and five and reframing certain statements to remove ambiguity and to make them clear was done. Items that were not relevant to the objectives were also removed. This was done before the pilot-test.

3.6.2.2 Reliability

A pilot study was carried out in KARI-Kitale to determine the range of answers, sequence of questions, question phrasing, respondents' interpretation of the meaning of questions, respondents' reaction and length of questions. The area chosen is out of the station's mandate area but with similar agro-ecological attributes. Ten questionnaires were taken to the researchers in KARI-Kitale but only 6 were recovered. Ten extension agents were interviewed at random. Ten farmers were visited at random and the items in the questionnaire read to them. After interviewing two farmers it was realised that reading the questionnaire affected the response the farmers were giving. The other 8 farmers were then interviewed informally following the organisation of the questionnaires. This made a total of 24 respondents interviewed properly. According to Mugenda and Mugenda (1999), the pilot-test sample is between 1% and 10% of the calculated sample, depending on the sample size. The calculated sample size for the study was 104 respondents, hence the pilot-test sample fell within the acceptable range. The results of reliability test of the pilot-test indicated a reliability coefficient of 0.7030 for the whole instrument using Cronbach's alpha coefficient. The reliability coefficient for farmers', researchers' and extension agents' questionnaires were computed separately using the Cronbach's alpha coefficient. The reliability coefficients for these instruments were 0.7040, 0.7160 and 0.6850 respectively. More items were added

into the extension agents' questionnaire to improve its reliability. The researcher set the minimum acceptable reliability coefficient at 0.7. Bryman and Cramer (1997) and Santos & Reynaldo (1999) indicated that the level of acceptance of an instrument for social research is set at 0.7

3.7 Data Collection Procedures

A letter to carryout the study was obtained from the Graduate School, Egerton University. This letter was used to obtain a research permit, indicated in the appendix C to conduct an educational research from the Ministry of Education Science and Technology. The two documents were used as an introductory note to the Director KARI-Kisii and the extension agents in the sites visited. The researcher was introduced to the farmers by the extension agents in the sites visited.

Secondary data was obtained from KARI-Kisii station offices in Kisii on the location of the on-farm sites and how to locate the farmers. More secondary data was obtained from the Divisional extension offices, where the majority of the government extension workers were found and interviewed. The sites were first grouped into the three agro-ecological zones. Sites in each zone were randomly selected to obtain at least 2 sites per zone. The names of the farmers in the selected sites were obtained from the socio-economic officer in KARI-Kisii. These names were randomly selected to obtain seven farmers per an on-farm site. The divisional extension coordinator introduced the researcher to the farmers.

A table of random numbers was used to select farmers, extension agents and the on-farm sites. The researcher administered the structured questionnaire to the farmers orally. The researchers and the extension agents were allowed to fill the questionnaire within the shortest time possible. Most of the questionnaires to the extension agents were filled on the same day they were issued to them. Researchers were allowed more time to fill the questionnaires due to bureaucracies that was involved in obtaining information from them. The questionnaires were to be left with the personnel manager who identified the respondents. The researcher was then allowed to interview the researchers (respondents).

3.8 Data Analysis

Responses to each category of items in the instrument were coded and scored for purposes of data entry. Data was analysed using the computer based statistical package for Social Sciences (SPSS) version 10.0 for windows based on the study objectives and hypotheses at 5% level of significance ($\alpha = 0.05$). The items in the questionnaire and knowledge tests were scored in conformity with the hypotheses. Data was first subjected to descriptive statistics in order to describe the characteristics of the farmers, researchers and extension agents. The descriptive statistics that were generated included frequencies, percentages, means and standard deviations. These statistics were used to describe the results of data analysis for independent variables in all the five objectives.

Inferential statistical tests were used to test the five hypotheses formulated for the study. Inferential statistical tests used include chi-square, Pearson product moment correlation coefficient, f-test and t-test were used. Chi-square values were used to determine relationships between the level of adoption and education level of on farm research participants; approximate level of gross monthly income for the researchers and extension agents; Participation level of farmers, extension agents and researchers; role of extension agents, researchers and farmers in on-farm research trials; existence of the preformed attitude among the researchers, extension agents and farmers; satisfaction level of farmers, researcher and extension agents and relevance of the technologies to the farming conditions. The t-test was used to test the mean difference of adoption level of farmers belonging to farmers' organizations and those not belonging to the farmers' organizations for significant differences at the 0.05 alpha level. The t-test was appropriate because it allows a researcher to compare means of two independent samples to determine that the difference between the means is a real difference rather than a difference due to chance. F-test was used to compare the mean level of participation of the farmers, researchers and extension agents. Pearson product moment correlation coefficient was used determine the strength and direction of the relationship between the level of participation and adoption level. Table 1 summarises the data analysis procedures as per the study.

Table 1: Summary of Data Analysis procedures

Hypotheses	The study Variables	Dependent Variable	Statistical analysis
Ho_1: There is no statistically significant relationship between levels of participation of researchers, extension agents, and farmers and level of adoption of technologies generated through on-farm trials.	Levels of participation of researchers, extension agents, and farmers.	Level of adoption of technologies generated through on-farm trials.	Frequency distribution Pearson's correlation coefficient. and F-test
Ho_2: There is no statistically significant relationship between farmers', extension agents', researchers' roles in on-farm trials and level of adoption of technologies generated through on-farm research trial.	Farmers', extension agents', researchers' roles in on-farm trials.	Level of adoption of technologies generated through on-farm trials.	Descriptive statistics and Chi-square.
Ho_3: There is no statistically significant relationship between the level of satisfaction of researchers, extension agents and farmers and level adoption of technologies of on-farm research trials.	Level of satisfaction of farmers, researchers and extension agents.	Level of adoption of technologies generated through on-farm trials.	Descriptive statistics, frequency distribution Chi-square, t-test*
Ho_4: There is no statistically significant relationship between the presence of pre-formed attitudes, due to differences in socio-economic status among extension agents, researchers and farmers, and level of adoption of technologies developed through on-farm trials	Presence of pre-formed attitudes.	Level of adoption of technologies generated through on-farm trials.	Mean, Frequency distributions Chi-square
Ho_5: There is no statistically significant relationship between the relevance of technologies disseminated to the farmers and the level of adoption of the technologies	Relevance of technologies disseminated to the farmers.	Level of adoption of technologies generated through on-farm trials.	Mean, Frequency distributions Chi-square

*t-test. This was used to test the difference between the mean adoption level of farmers belonging to farmers' organisation and farmers not belonging to farmer organisations

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the results of the study in relation to each objective and hypothesis. The chapter begins with a presentation of the general characteristics of the respondents followed by adoption level of maize and beans production technologies, then the objectives and hypotheses, and finally a summery of the results. The results on each objective are discussed first and then immediately followed by the related hypothesis.

4.2 General Characteristics of Farmers, Extension Agents and Researchers

The farmers', researchers' and extension agents' characteristics that have influence on adoption of technologies of the production of maize and beans developed through on-farm research trial were studied. The characteristics include age of the farmers, the estimated size of farm-land in acres used for agriculture, gender distribution among the farmers, level of education of the farmers, researchers and extension agents, approximate level of gross monthly income for the extension agents and researchers. The general characteristics are discussed in relation with how they influence level of adoption of technologies developed through on-farm research trials.

4.2.1 Age Distribution of the Farmers

Table 2 indicates seventeen out of the forty-two farmers (40.5%) interviewed indicated that they were between the age of 31-40 years. This is a prime age when the farmers are very active and ready to take risk by adopting technologies delivered to them. Farmers who are within the age group 18-43 years tend to be more active in practicals, 'hands-on' activities as compared to older farmers. Burkey (1996) indicates that groups with majority of members within similar age groups are expected to be more effective. This is because members of same or similar age groups tend to have similar interests.

Table 2: Age range of the farmers in the study

Age group	Frequency	Percentage
Below 20yrs	01	02.4
21-30	09	21.4
31-40	17	40.5
41-50	12	28.6
Above 50yrs	03	07.1
Total	**42**	**100.0**

N= 42

4.2.2 The Estimated Size of Land Used for Agriculture

Table 3 presents the size of farmland in acres used by farmers for agriculture. On the size of farmland, twenty-six out of the forty-two farmers (61.9%) in this region own small pieces of land (2 acres). The small pieces of land are fully used for agricultural activities due to the high population pressure. The largest piece of land recorded was 7.5 acres found in the Lower Midland (LM), which is of a lower potentiality compared to the LH and UM. The mean farmland size was 2 acres. The smallest piece of land recorded was 1 acres owned by up to 23.8% of the farmers. With the small pieces of land the farmers are only able to engage in subsistence agriculture. Subsistence agriculture does not provide enough motivation to try innovations. This therefore means that the adoption of new technologies may be affected by the land sizes used by farmers for agriculture.

Table 3: Estimated size of farm-land owned by farmers in the study

Size of land in acres	1	2	3	4 <	Total
f	10.0	26.0	05.0	01.0	42
%	23.8	61.9	11.9	02.4	100

4.2.3 Gender Distribution of the Farmers

Table 4 presents the gender distribution of the farmers interviewed by ecological zones. More than half of the farmers interviewed (59.5%) were female compared to 40.5% male. This is an indication that women handle most of the farm activities. Women also form most of the groups or farmer organizations. Culturally, majority of women do not own land therefore they make very little decision concerning what the land should be used for. This may affect the adoption of technologies since majority of farm activities are carried out by women, who are not land owners and are not able to make decisions concerning the land and it utilisation.

Table 4: Gender distribution of farmers by agro-ecological zones in the study

		Ecological zones			TOTAL
		LH	UM	LM	
Female	f	10.0	09.0	06.0	25.0
	%	23.8	21.4	14.3	59.5
Male	f	04.0	05.0	08.0	17.0
	%	09.5	11.9	19.0	40.5
TOTALS	f	**14.0**	**14.0**	**14.0**	**42.0**
	%	**33.3**	**33.3**	**33.3**	**100.0**

N= 42

4.2.4 Level of Education of the Farmers

Table 5 presents the frequencies and percentages of the levels of education of the farmers. On the level of education, the farmers were asked to indicate the highest level of education they had attained. Eighteen out of the forty-two farmers interviewed (42.8%) had at least higher primary level of education and another 18 farmers (42.8%) had secondary school level of education. Those with secondary school level of education and above were 47.6%. With this high level of education the farmers' intellectual capacity is also expected to be high. This high level of education enhances the understanding of instructions given and should also improve the farmers' level of participation in agricultural activities.

Table 5: Level of education of farmers in the study

Level of education	F	%
None	01	02.4
Lower primary	03	07.2
Higher primary	18	42.8
Secondary school	18	42.8
Tertiary	02	04.8
Total	**42**	**100.0**

N= 42

4.2.5 Level of Education of the Researchers and Extension Agents

Table 6 presents the level of education of the researchers and the extension agents by occupation. The extension agents and the researchers were asked to indicate the highest education level they had attained. Twelve out of the seventeen researchers interviewed (70.6%) had received masters' degree level of education and above. Twenty-five out of the

forty-five extension agents (55.6%) had a bachelors' degree level of education. The lowest level of education among the researchers was a bachelors' degree while among the extension agents the lowest level of education was a certificate. The difference in education levels between the extension agents and researchers was partly due the availability of programmes that support higher education in the research institutions but lacking in the extension. High education level in the research section is also due to influence from colleagues that had attained a higher level of education.

Table 6: Level of education of extension agents and researchers in the study

		Level of education				
		Certificate	**Diploma**	**Bachelors**	**Masters and above**	**Total**
Extension	F	02.0	15.0	25.0	03.0	045
agents	%	04.4	33.3	55.6	06.7	100
Researchers	F	00.0	00.0	05.0	12.0	017
	%	00.0	00.0	29.4	70.6	100

N=62

4.2.6 Approximate Level of Gross Monthly Income of the Researchers and Extension Agents

The analysed data indicate that gross monthly income for the researchers was higher than that of the extension agents. More than half of the researchers (64.7%) indicated that they get more than Ksh.60,000 as gross monthly income. Twenty-six out of the forty-five Extension agents (57.8%) indicated that their gross monthly income were between Ksh.30,001 and Ksh.60,000. Table 7 presents the level of gross monthly income of extension agents and researchers by occupation. The researchers earned more than the extension agents may be because; the researchers were more educated than the extension agents; it was an employment policy requiring that people of higher educational qualification be employed in research organisation. The two institutions also had different reward systems such as differences in allowances tied to the nature of their work.

Table 7: Approximate level of gross monthly income of extension agents and researchers by occupation

Income level	Frequency		Percentage	
	Extension	Research	Extension	Research
Below 10,000	01	00	02.2	00.0
10,001-30,000	16	02	35.6	11.8
30,001-60,000	26	04	57.8	23.5
60,001 & above	02	11	04.4	64.7
Total	**45**	**17**	**100.0**	**100.0**

N= 62

4.3 Adoption of Maize and Beans Production Technologies

Adoption of both maize and beans production techniques were used as the dependent variable. Beans were chosen, as it was the cheapest main source of plant protein in the area and its ability to yield after a short duration of time. Maize was picked because it was the main stable food crop in the area. Farmers were asked to respond to questions on how they produced the crops. The questions were based on the production technologies including, planting materials used, farm management practices such as weed control, pest and disease control, fertilizer application and harvesting procedures, the approximate yield in 90kg bags and the post harvest technologies used to preserve the yields. The answers of the questions were then scored to determine how well the farmers applied the agricultural practices in the production of the two crops. The scores were then converted to percentage and grouped into four categories: Less than 25% was very low; 26%-50% was low; 51%-75% was high and 76% and above was very high.

4.3.1 Adoption of Maize Production Techniques

Table 8 presents the frequencies and percentages on how the farmers responded to the questions on maize production technologies. Farmers were asked to respond to a set of 8 questions on the technique of maize production. The questions were based on the planting materials used, farm management practices such as weed control, pest and disease control, fertilizer application and harvesting procedures, the approximate yield in 90kg bags and the post harvest technologies used to preserve the yields. The results obtained indicated that out of the 42 farmers 23 (54.8%) used certified hybrid maize seeds from local shops. Others got

seeds from other sources such as, friends (14.3%), family members (16.7%), and from the previous crop (14.3%). Farmers were then asked to indicate whether they used fertilizers during planting, 66.7% responded in affirmative. Twenty-eight farmers indicated that they used these fertilizers: DAP (42.9%), Farm Yard Manure (28.6%), mixture of different types of artificial fertilisers (14.3%), others (14.3%). Five farmers (11.9%) indicated that they top-dressed their crops. Thirty-nine farmers (92.9%) indicated that they did weeding two or more times. Thirty-two farmers (76.2%) indicated that they do not control pests or diseases at all. The other group of farmers (16.7%) argued that they uprooted the infected crops while three farmers (7.1%) indicated that they bought insecticides. Thirty-five farmers (83.3%) indicated that they sold most of the crop immediately without storing for long. This means that they did not use any of the long storage methods apart from the use of sacks.

Table 8: Farmers' utilization of maize production technologies

Maize production technologies	F	%
Use of certified seeds	23	54.8
Other sources of seeds		
• Friends	6	14.3
• Family members	7	16.7
• Previous crop	6	14.3
Use of fertilizers during planting	28	66.7
• DAP	12	42.9
• FYM	8	28.6
• Mix	4	14.3
• Others	4	14.3
Use of top-dressing fertilizers	5	11.9
Proper weed control	39	92.9
Disease and pest control	10	23.8
• Cultural practice e.g. rogueing	7	16.7
• Chemical	3	7.1
Harvesting technologies	34	80.1
Post harvest technologies; Sold after harvest	35	83.3
Yield in percentage of maximum average yields		69.2

4.3.2 Adoption of Beans Production Technologies

Table 9 presents farmers responses on how they produced beans. Farmers responded to a set of five simple questions on the production of beans. All the farmers indicated that they did not use certified seeds. On further investigation of the marketing of bean seeds, it was realised that almost all the shops visited did not stock certified bean seeds. The same farmers were asked to indicate the source of bean seeds they used for planting. They indicated the

following sources, fellow farmers (31%), family members (28.6%), previous crop (26.2%), and local market (14.3%). Thirty-five farmers (83.3%) indicated that they planted beans as mix crop with the maize but not as a pure stand. Thirty-two farmers (76.2%) indicated that they never planted using any fertilizers since they had used fertilizers when planting maize. Forty farmers (95.2%) accepted that there was a lot of pest attack on the beans. The farmers indicated that they control the pests, which they indicated that are mainly aphids and bean fly. They indicated the following methods: indigenous methods (ash), artificial chemical methods while others indicated that a lot of rain suffocates the aphids. On the harvesting methods, the farmers indicated that they uproot the whole plant, which they dry and thresh, while three farmers (7.1%) indicated that they pick only the pods.

Table 9: Farmers utilization of bean production technologies

Bean production technologies	F	%
Use of certified seeds	00	0.0
Source seeds		
• Fellow farmers	13	31
• Family members	12	28.6
• Previous crop	11	26.2
• Local market	6	14.3
Farming methods		
• Mix cropping	35	83.3
• Single stand crop	7	16.7
Use of fertilizers during planting / seed inoculation	10	23.8
Proper weed control	37	88.1
Disease and pest control	40	95.2
• Cultural practice e.g. rogueing	29	69.0
• Chemical	11	26.2
Harvesting technologies		
• Picking only the pods	3	7.1
• Uprooting the whole plants	39	92.9
Post harvest technologies. Sold after harvesting	32	76.9
Mean yield compared to the expected		15.6

N= 42

The farmers characteristics such as the high levels of education, farmers belonging to the same age groups and the farmers being young and youthful, are known to improve adoption level of agricultural technologies (Burkey, 1996). The adoption level is relatively low despite the favourable farmer characteristics. This therefore means that the adoption level was affected by other factors other than the farmer characteristics. The study also investigated the effect of selected linkage factors such as the level of participation of farmers, researchers and

extension agents in on-farm research trials, knowledge of roles in on-farm research trial, differences in institutional background, presence of preformed attitude among the farmers, researchers and extension agents and relevance of technologies disseminated to the farmers to their socio-economic background on adoption of maize and beans technologies developed through on-farm research trial.

4.4 Level of Participation of Researchers, Extension Agents and Farmers in On-farm Trials and its Relationship with Level of Adoption of Technologies

Apart from the farmer characteristics, level of participation of farmers, researchers and extension agents in on-farm research trials was studied to determine its relationship with the adoption level of technologies developed through on-farm research trials. This determined how active the researchers, extension agents and farmers ware in participating in these agricultural activities. The study put more emphasis on the activities that bring together the farmers, researchers and extension agents such as, number of visits made to the farmers' fields, visits made to the extension agents offices by the researchers and the farmers, demonstrations made on-farm and on-station, and attendance of the Barazaas, ASK shows, and workshops.

4.4.1 Description of Findings of Level of Participation of Researchers, Extension Agents and Farmers in On-farm Trials

The responses from the researchers, extension agents and the farmers on the number of times they participated in joint activities are summarised in Table 10. The objective of "determining the level of participation of researchers, extension agents and farmers in on-farm trials and their relationship with level of adoption of technologies" was described using descriptive statistics such as the percentages and frequencies. Extension agents, researchers and the farmers were asked to respond to a set of 8 statements on the various activities bringing together the researchers, extension agents and farmers.

Table 10: Responses on participation by farmers, extension agents and researchers in joint agricultural activities in the past one year

		Number of times participated in the activities in the last one year							
		0	1	2	3	4	5	>5	Total
Visits by extension	Farmers f	12.0	27.0	03.0	00.0	00.0	00.0	00.0	042
	%	28.6	64.3	7.1	00.0	00.0	00.0	00.0	100
	Research f	02.0	07.0	06.0	01.0	01.0	00.0	00.0	017
	%	11.8	41.2	35.3	05.9	05.9	00.0	00.0	100
Group visit by extension	Farmers f	12.0	19.0	11.0	00.0	00.0	00.0	00.0	042
	%	28.6	45.2	26.2	00.0	00.0	00.0	00.0	100
	Research f	08.0	05.0	03.0	01.0	00.0	00.0	00.0	017
	%	47.1	29.4	17.6	05.9	00.0	00.0	00.0	100
Visit to extension offices	Farmers f	19.0	14.0	09.0	00.0	00.0	00.0	00.0	042
	%	45.2	33.3	21.4	00.0	00.0	00.0	00.0	100
	Research f	04.0	06.0	04.0	02.0	01.0	00.0	00.0	017
	%	23.5	35.3	23.5	11.8	05.9	00.0	00.0	100
Demonstration on-farm	Farmers f	06.0	21.0	09.0	06.0	00.0	00.0	00.0	042
	%	14.3	50.0	21.4	14.3	00.0	00.0	00.0	100
	Extension f	05.0	04.0	05.0	17.0	13.0	01.0	00.0	045
	%	11.1	08.9	11.1	37.8	28.9	02.2	00.0	100
	Research f	01.0	02.0	04.0	06.0	03.0	01.0	00.0	017
	%	05.9	11.8	23.5	35.3	17.6	05.9	00.0	100
Demonstration on-station	Farmers f	29.0	11.0	02.0	00.0	00.0	00.0	00.0	042
	%	69.0	26.2	14.8	00.0	00.0	00.0	00.0	100
	Extension f	32.0	06.0	04.0	03.0	00.0	00.0	00.0	045
	%	71.1	13.3	08.9	06.7	00.0	00.0	00.0	100
	Research f	00.0	01.0	03.0	05.0	04.0	03.0	01.0	017
	%	00.0	05.9	17.6	29.4	23.5	17.6	05.9	100
Barazaas	Farmers f	02.0	02.0	03.0	03.0	07.0	10.0	15.0	042
	%	04.8	04.8	07.1	07.1	16.7	23.8	35.7	100
	Extension f	01.0	00.0	00.0	04.0	14.0	20.0	06.0	045
	%	02.2	00.0	00.0	08.9	31.1	44.4	13.3	100
	Research f	10.0	05.0	01.0	01.0	00.0	00.0	00.0	017
	%	58.8	29.4	05.9	05.9	00.0	00.0	00.0	100
Shows	Farmers f	15.0	27.0	00.0	00.0	00.0	00.0	00.0	042
	%	35.7	64.3	00.0	00.0	00.0	00.0	00.0	100
	Extension f	04.0	29.0	10.0	02.0	00.0	00.0	00.0	045
	%	08.9	64.4	22.2	04.4	00.0	00.0	00.0	100
	Research f	00.0	10.0	05.0	02.0	00.0	00.0	00.0	017
	%	00.0	58.8	29.4	11.8	00.0	00.0	00.0	100
Workshops	Farmers f	08.0	25.0	07.0	02.0	00.0	00.0	00.0	042
	%	19.0	59.5	16.7	04.8	00.0	00.0	00.0	100
	Extension f	00.0	03.0	15.0	24.0	03.0	00.0	00.0	045
	%	00.0	06.7	33.3	53.3	06.7	00.0	00.0	100
	Research f	00.0	03.0	04.0	07.0	03.0	01.0	00.0	017
	%	00.0	17.6	23.5	41.2	17.6	05.9	00.0	100

f - Frequency N-104

4.4.1.1 Frequency of Interaction

This looked at how often the farmers, researchers, and extension agents participated in the activities such as visits by individual extension agents to farmers and researchers, visits by a group of extension agents to farmers and researchers, visits made to extension offices by researchers and farmers, on-farm and on-station trials, and attending ASK Shows, Barazaas, Workshops and Seminars.

Visits made by individual extension agents to the farmers and researchers

The analysed data indicate that more than half of the farmers (64.3%) were visited by individual extension officers only once in the past year while 28.6% were not visited. A few researchers (11.8%) were not visited by extension agents (Table 10 above). The researchers explain that most of the meetings (66.7%) they had were facilitated by the organizations sponsoring their research projects. The other visits were not formal. It was also learnt from the extension agents that it was easier to visit the researchers due to the near proximity of the research stations to the main road as compared to the farmers' fields.

Visits made by a group of extension agents to farmers and researchers

Eight out of the seventeen researchers interviewed (47.1%) were not visited by a group of extension agents in the past year. Twelve out of the forty-two farmers interviewed (28.6%) were not visited by a group of extension agents (Table 10). The researchers interviewed explained that most group visits by extension staff required proper organization and coordination.

Visits made to extension offices by researchers and farmers

Nineteen out of the forty-two farmers interviewed (45.2%) indicated that they had not visited the extension offices in the past year. Four out of the seventeen researchers interviewed (23.5%) had not visited the extension agents' offices in the past year (Table 10). The researchers indicated that they visited the extension offices to collect data on the farms. Some of the extension agents explain that they had joint projects with the researcher sponsored by donors other than the government. Researchers with joint projects with the extension visited the extension agents several times in the past year.

On-farm and on-station trials

Thirty-six out of the 42 farmers interviewed (85.7%), 89.9% of extension agents and 84.1% of researchers interviewed had attended an on-farm trial once or more times. On the contrary, twenty-nine farmers (69%), and 32 extension agents (71.1%) had not attended any on-station research, while every researcher interviewed (100%) had participated in the on-station research once or more times.

Attendance of ASK Shows, Barazaas, Workshops and Seminars

Fifteen farmers (35.7%) had not attended any agricultural shows in the past year. They explain that most shows are organized far a way from their homes. Ten researchers (58.8%) had not attended the Barazaas in the past year (Table 10). They explain that, the Barazaas are organised at the village levels and that they were rarely invited. Every extension agent and the researcher interviewed indicated that they had attended workshops and seminars. Eight farmers (19%) had not attended trainings organized by extension agents and researchers (Table 8).

4.4.1.2 Level of Participation

The following Table 11 indicate how extension agents and researchers responded to the statements on the level of participation. Extension agents and researchers were asked to indicate their level of agreement to a set of statements. The statements were based on participation in; technology generation stage; on-farm trial process; frequency of attendance of the on-farm research trial; priority setting stage; modification of technologies and dissemination process. Each response from positive statements were awarded the following marks; strongly agree = 5, agree = 4, undecided = 3, disagree = 2 and strongly disagree = 1. Each response from negative statement were awarded the following marks; strongly agree = 1, agree = 2, undecided = 3, disagree = 4 and strongly disagree = 5.

Table 11: Extension Agents and Researchers response to statements relating to the level of participation in on-farm trials

Statements			SA	A	U	D	SD	Total
Extension participation in technology generation	Extension	f	30.0	10.0	00.0	02.0	03.0	045
		%	66.7	22.2	00.0	04.4	06.7	100
	Research	f	11.0	05.0	01.0	00.0	00.0	017
		%	64.7	29.4	05.9	00.0	00.0	100
Extension must participate in on-farm research trials	Extension	f	04.0	29.0	00.0	05.0	07.0	045
		%	08.9	64.4	00.0	11.1	15.6	100
	Research	f	02.0	03.0	00.0	10.0	010	017
		%	11.8	17.6	00.0	58.9	05.9	100
Extension agents can conduct on farm trials without the research	Extension	f	11.0	23.0	03.0	03.0	05.0	045
		%	24.4	51.1	06.7	06.7	11.1	100
	Research	f	02.0	04.0	01.0	05.0	05.0	017
		%	11.8	23.5	05.9	29.4	29.4	100
Researchers are often busy to go to the field more frequently	Extension	f	09.0	15.0	01.0	07.0	13.0	045
		%	20.0	33.3	02.2	15.6	28.9	100
	Research	f	04.0	04.0	01.0	06.0	02.0	017
		%	23.5	23.5	05.9	35.3	11.8	100
Farmers must participate in the in priority setting stage	Extension	f	38.0	07.0	00.0	00.0	00.0	045
		%	84.4	15.6	00.0	00.0	00.0	100
	Research	f	15.0	02.0	00.0	00.0	00.0	017
		%	88.2	11.8	00.0	00.0	00.0	100
Modification of technologies involve the farmers, extension and research	Extension	f	37.0	07.0	00.0	00.0	00.0	045
		%	82.2	15.6	00.0	00.0	00.0	100
	Research	f	15.0	02.0	00.0	00.0	00.0	017
		%	88.2	11.8	00.0	00.0	00.0	100
Farmers must not understand the technology prior to implementing them	Extension	f	00.0	03.0	01.0	23.0	18.0	045
		%	00.0	06.7	02.2	51.1	40.0	100
	Research	f	00.0	00.0	00.0	02.0	15.0	017
		%	00.0	00.0	00.0	11.8	88.2	100
Involving extension agents in priority setting is very necessary	Extension	f	29.0	09.0	00.0	06.0	00.0	045
		%	64.4	20.0	00.0	13.3	00.0	100
	Research	f	11.0	02.0	01.0	03.0	00.0	017
		%	64.7	11.8	05.9	17.6	00.0	100

N-62

SA -Strongly Agree, A- Agree, U -Undecided, D -Disagree, SD -Strongly Disagree

%-Percentage, f-frequency

Thirty out of the forty-five extension agents interviewed (66.7%) and 64.7% of researchers interviewed agreed with the statement that, extension agents must participate in the initial stages of technology generation (Table 11). According to Agbamu (2000) participation of extension at the initial stages of technology improves uptake and utilization of agricultural technologies. Extension agents (64.4%) agreed with the statement that Farming System On-farm Research cannot be carried out without the participation of an extension agent while the researchers (58.9%) disagreed. This introduces a conflict of opinion among the research and

extension, which can even lead to setting up of parallel on-farm trials (Ewell, 1990). The conflict was confirmed when the extension agents interviewed (51.1%) agreed with the statement that, extension agents can conduct on-farm research trials without the participation of the researchers and a total of 58.8% of researchers either disagreed or strongly disagreed with the statement (Table 11). Such conflicts of ideas when reflected to the farmers would do more harm than good to the farmers, as both parties would be competing to take the farmers attention. Kaimowitz *et al.*, (1989) indicated that such a conflict can lead to extension agents setting up trials parallel to that of the researchers

Six out of the 17 researchers (35.3%) disagreed with the statement that researchers are often too busy to go to the field more frequently. On the contrary, 33.3% of the extension agents felt that the researchers were often too busy to go to the field (Table 11). This might explain the researchers' low participation on extension-organised activities such as, visits to extension offices (Table 8). The researchers who agreed with the statement indicated that researcher would only go to the farmers' field if their on-station schedule permitted. While others pointed out that, they had a socio-economic Department to link them with farmers. Fifteen out of the 17 researchers (88.2%) and 84.4% of extension agents strongly agreed with the statement that farmers must participate in priority setting stage of technology generation (Table 11). This improves uptake and utilization of the generated technology. According to Agbamu (2000) farmers organisations should be involved in the main stream decision making right from the National level to the Divisional level. He explained that decisions affecting the farmers are made at the national level and implemented by the village extension officers based at the divisional headquarters. The extension agents (51.1%) disagreed with the statement that researchers must not understand technologies prior to implementing them at the same time 88.2% of the researchers strongly disagreed with the statement. The first step in adoption according to Ramkumar & Rolls (1995) is internalisation of the technologies by the farmers before they even start the testing and trial stages. Rolls *et al.*, (1995) also observed that ideas imposed on individuals are never viewed as important even if they are indeed very important.

4.4.2 Relationship between Participation and Adoption of On-farm Research Trials

In order to determine existence of any significant relationship between level of participation and adoption of on-farm trials technologies, the hypothesis that "*There is no significant relationship between the level of participation of researchers, extension agents, and farmers and level of adoption of technologies developed through on-farm trials*" was tested. To establish any significant differences in participation by the three groups, one-way ANOVA was used. The Pearson's Product Moment Correlation Coefficient and Chi-square tests were used to establish any significant relations between this participation and the level of adoption. The level of participation of researchers and the extension agents were computed by adding the researchers' and extension agents' scores from level of participation and number of times they participated in joint agricultural activities for each farmer. The scores were then converted to percentage and grouped into four categories: Less than 25% was very low; 26%-50% was low; 51%-75% was high and 76% and above was very high.

Differences in participation levels by occupation

Statistical analysis to determine the level of statistical differences in the number of times extension agents, researchers, and farmers participated in the on-farm trial activities indicated that there was a significant difference between the level of participation of the respondents ($F< 0.05$). The results are presented in Table 12. This would probably mean that the researchers and extension agents who were asked to indicate the probable adoption levels were not right. They indicated different adoption levels compared to what was collected from the field. This was used to verify their contribution in terms of participation in the on-farm trials activities.

Table 12: F-test results showing the differences in the number of times farmers, researchers and extension agents participated in on-farm trial activities

Occupation	N	Mean	SD	df	F-ratio
Extension	45	2.93	1.01	06	0.000
Researchers	17	1.53	0.87		
Farmers	42	2.67	1.05		
Total	**104**	**2.60**	**1.11**		

$p< 0.05$ N= 104

Relationship between the level of participation and occupation

Data analysis by cross-tabulation using Chi-square test, revealed a significant relationship between occupation of respondents and how they scored on level of participation of researchers and extension agents (Chi-square value = 27.692, df=6, P< 0.05). The Chi-square results are presented in Table 13. This finding requires that researchers should find the best way to improve their participation in on-farm trial activities that bring them together with farmers and extension agents. The mean participation of the extension agents was relatively high compared to the researchers and farmers (Table 13 below). Extension agents' participation was higher than that of researchers in most of the activities. Researchers recorded a higher score in attending ASK shows, seminars and on-station activities, while extension agents scored highly in activities such as field visits, attending Barazaas, on-farm trials it self, and making visits to the farmers and researchers (Table 8 above).

Table 13: Chi-Square Results showing relationship between level of participation in on-farm trial activities and occupation

	Occupation			
Participation	**Farmers**	**Extension agents**	**Researchers**	**Totals**
Very low	08	04	11	23
Low	08	12	04	23
High	16	12	01	29
Very high	10	17	01	28
Total	**42**	**45**	**17**	**62**

* P <0.05 Chi-square value =27.692*, df = 6, P = 0.000, N= 62

It is important for the researcher to attend several activities involving the farmers and extension agents so that they can enhance the understanding and adoption of the technologies developed. These findings support the observations by Banu and Bode (2002), and Van den Berg *et at.* (2002) that attending several agricultural activities sets in motion the development of local initiatives and programmes that progress with time, which will eventually ensure the groups remain intact. Ghallagher (2003) also indicates that attending several agricultural activities together tends to strengthen existing groups. The finding is also supported by Nyambati *et at.,* (2003) reported that the FSR approach enhanced cohesiveness among community members in North-Western Kenya. Regular on-farm research trials enable the

participants to get acquainted with each other, which enable them to get along smoothly without conflicts. The more these groups are made to work together the better the adoption levels.

Relationships between the agro-ecological zones and farmers' level of participation

The farmers were asked to indicate the numbers of times they participated in various agricultural activities in the past one-year. The results from all the activities were added and the totals used to examine the relationship between the levels of participation of farmers and the ecological zones they come from. Chi-square test as shown in Table14, revealed a significant relationship between ecological zones and level of participation of farmers (Chi-square value = 26.025, df = 6, $P < 0.05$).

Table 14: Chi-Square Results showing the respective relationship between the total number of times farmers participated in joint agricultural and agro-ecological zones

Participation	Lower highland	Upper midland	Lower midland	Totals
Very low	02	00	06	08
Low	00	03	05	08
High	04	09	03	16
Very high	08	02	00	10
Total	**14**	**14**	**14**	**42**

* $P < 0.05$ Chi-square value = 26.025*, df = 6, $P = 0.000$, N=42

The findings indicate that farmers at higher agro-ecological zones had higher participation levels compared to the farmers at the lower agro-ecological zones. Farmers in the higher ecological zones are therefore likely to adopt technologies developed through on farm research trial better than the farmers in the lower ecological zones. This may be so because the prevailing conditions in these areas support agricultural activities. The farmers in these areas are therefore motivated to work hard compared to the farmers in the lower ecological zones, who are discouraged whenever their crops fail due low rainfall. This also implies that the farmers in the low altitude regions should get more motivation compared to the farmers at the higher ecological zones to attend more of the agricultural activities to boost their skills of practicing agriculture in these areas.

Relationships between the agro-ecological zones and level of adoption

Table 15 presents the chi-square results showing the relationships between the Agro-Ecological Zones and level of adoption. To determine the level of adoption farmers were asked to respond to a set of questions. Their responses were then scored and grouped into 'very high', 'high', 'low' and 'very low'. Analysis by cross tabulation using chi-square test, revealed a significant relationship between the level of adoption and agro-ecological zones (Chi-square value = 12.867, df = 6, $P < 0.05$).

Table 15: Chi-Square Results showing the relationship between levels of adoption in the respective agro-ecological zones

	Agro ecological zones			
Level of adoption	**Lower highland**	**Upper midland**	**Lower midland**	**Totals**
Very low	02	02	06	10
Low	01	03	05	09
High	05	06	03	14
Very high	06	03	00	09
Total	**14**	**14**	**14**	**42**

* $P < 0.05$ Chi-square value = 12.867*, df = 6, $P = 0.045$, N= 42

The results indicate that the farmers at high ecological zones adopted the agricultural technologies developed through on-farm research trials better than the farmers at the lower zones. This may be so because their levels of participation in the agricultural activities were also very high compared to the farmers at the lower ecological zones. Since their level of participation was also comparatively higher, it would also mean that these farmers had a lot of interest in improving their productivity. This finding is in line with the findings of Agbamu (2000).

Relationships between the level of participation and level of adoption

A chi-square test revealed a significant relationship between the level of participation and level of adoption (Chi-square value = 75.057, df = 9, $P < 0.05$). The results (Table 16) indicate that, the higher the level of participation of farmers the higher the adoption levels of on-farm trial technologies.

	Level of adoption				
Times participated	**Very low**	**Low**	**High**	**Very high**	**Totals**
Very low	10	12	01	00	23
Low	04	16	04	00	24
High	00	05	21	03	29
Very high	01	01	18	08	28
Total	**15**	**34**	**44**	**11**	**104**

* P <0.05 Chi-square value = 75.057*, df = 9, P = 0.000, N=104

Further analysis using Pearson's correlation coefficient (r) two-tailed test indicated that there was a significant positive relationship between adoption of on-farm trial technologies and the number of times the farmers participated in the on-farm trial activities (r =0.782). From the results in Table 17 it can therefore be concluded that there was a strong positive relationship between participation of extension agents and researchers and the level of adoption of on-farm trial technologies.

Table 17: Means, Standard Deviations and r-test Analysis for the relationship between the level of adoption and level of participation

	N	Mean	SD	r value	p value
Adoption level	42	55.0476	6.0766	0.782	0.000
Participation level	42	11.5952	4.9191		

r > 0.7, p< 0.05, N= 42

The null hypothesis (there is no significant relationship between the level of participation and level of adoption of technologies of on-farm trials) was therefore rejected. That is, the higher the level of participation of farmers, extension agents and researchers the higher the adoption level of technologies of on-farm trials. The farmer, extension and research linkage should be strengthened by enhanced farmer participation at each stage of on-farm research trials. That is, enhancing farmer, extension and research participation at the technology generation stage, priority setting stage, technology trial stage, technology modification stage, dissemination and implementation stage, and technology monitoring and evaluation stage.

4.5 Roles of Farmers, Extension Agents, and Researchers in On-Farm Trials and its Relationship with Adoption of Technologies

The study investigated the farmers', researchers', and extension agents' knowledge of their roles in an on-farm research trial process. This was used test the effect of the knowledge of the roles on adoption of technologies developed through on-farm research trial. Farmers, researchers and extension agents were asked to respond to a set of ten statements on the roles of extension agents, researchers and farmers. The areas the farmers, researchers and extension agents were tested on include, technology generation stage, priority setting stage, technology trial stage, technology modification stage, dissemination and implementation stage, and technology monitoring and evaluation stage. The totals from each item per respondent were computed. The scores were then converted to percentages and grouped into four categories: Less than 25% was very low; 26%-50% was low; 51%-75% was high and 76% and above was very high.

4.5.1 Description of the Roles

The responses of extension agents and researchers to their roles in on-farm trial activities are summarized in Table 18. Farmers, researchers and extension agents were asked to respond to a set of closed ended statements on the possible roles of extension agents, researchers and farmers in on-farm research trial related activities. Each response from positive statements was awarded the following marks; strongly agree = 5, agree = 4, undecided = 3, disagree = 2 and strongly disagree = 1 except the farmers who were awarded yes =2 or no =1. Each response from negative statements was awarded the following marks; strongly agree = 1, agree = 2, undecided = 3, disagree = 4 and strongly disagree = 5 except the farmers who were awarded yes =1 or no =2. Farmers' marks were then multiplied by 5. Their responses to the statements were recorded, computed and used to determine the possible roles of extension agents, researchers and farmers in on-farm research trials as perceived by extension agents and researchers.

Table 18: Responses by extension agents and researchers on their roles in joint agricultural activities

Statements			SA	A	UD	D	SD	TOTAL
Farmers are free to interact with researchers without involving the extension agents	**Extension**	F	24.00	14.00	01.00	00.00	06.00	045
		%	53.28	31.11	02.22	00.00	13.32	100
	Research	F	09.00	05.00	01.0	02.00	00.00	017
		%	52.92	29.40	5.88	11.76	00.00	100
Researchers are free to modify the technologies being disseminated not the extension agents	**Extension**	F	01.00	00.00	01.00	08.00	35.00	045
		%	02.22	00.00	02.22	17.76	77.70	100
	Research	F	06.00	05.00	01.00	04.00	01.00	017
		%	35.28	29.40	05.88	23.52	05.88	100
Researchers pass down their finding to the farmers through the extension agents.	**Extension**	F	16.00	10.00	02.00	11.00	06.00	045
		%	35.52	22.20	04.44	24.42	13.32	100
	Research	F	05.00	05.00	01.00	03.00	03.00	017
		%	29.40	29.40	05.88	17.64	17.64	100
Farmers, extension agents and researchers must be involved in technology generation process.	**Extension**	F	36.00	09.00	00.00	00.00	00.00	045
		%	76.92	19.98	00.00	00.00	00.00	100
	Research	F	07.00	10.00	00.00	00.00	00.00	017
		%	41.16	58.82	00.00	00.00	00.00	100
Priority setting must involve farmers	**Extension**	F	41.00	04.00	00.00	00.00	00.00	045
		%	91.02	08.88	00.00	00.00	00.00	100
	Research	F	14.00	03.00	00.00	00.00	00.00	017
		%	82.32	17.64	00.00	00.00	00.00	100
Researcher can carry out on-farm trial without the extension agents	**Extension**	F	04.00	06.00	00.00	11.00	24.00	045
		%	08.88	13.32	00.00	24.42	53.28	100
	Research	F	04.00	06.00	01.00	03.00	03.00	017
		%	23.52	35.28	05.88	17.64	17.64	100
Extension agents are community development workers	**Extension**	F	11.00	27.00	00.00	00.00	07.00	045
		%	24.42	59.94	00.00	00.00	15.54	100
	Research	F	07.00	07.00	01.00	02.00	00.00	017
		%	41.16	41.16	05.88	11.76	00.00	100
Researchers provide the necessary guidance in the on-farm trials.	**Extension**	F	27.00	07.00	01.00	08.00	02.00	045
		%	59.94	15.54	02.22	17.76	04.44	100
	Research	F	09.00	08.00	00.00	00.00	00.00	017
		%	52.92	47.04	00.00	00.00	00.00	100
Farmers must the demonstration only under the supervision of the researchers and extension agents	**Extension**	F	05.00	09.00	00.00	18.00	13.00	045
		%	11.10	19.98	00.00	39.96	28.86	100
	Research	F	04.00	06.00	01.00	04.00	02.00	017
		%	23.52	25.28	05.88	23.52	11.76	100
Modification of technologies should not involve the farmers	**Extension**	F	00.00	00.00	00.00	16.00	29.00	045
		%	00.00	00.00	00.00	35.52	64.38	100
	Research	F	00.00	00.00	00.00	05.00	12.00	017
		%	00.00	00.00	00.00	29.41	70.59	100

Roles of extension agents, and researcher in on-farm research trials are discussed in the following subsections in relation to: how they would maintain an interaction between the farmers, researchers and extension agents; modification of technologies; dissemination of technologies; technology generation; team leadership; community development work;

participation in on-farm research trial process. Farmers' roles in technology generation and adoption are also discussed.

Interaction between the farmers, researchers and extension agents

The results indicated that more than half of both extension agents (53.28%) and researchers (52.92%) interviewed strongly agreed with the statement that, farmers are free to interact with researchers without involving the extension agents (Table 18). According to Agbamu (2000) farmers should be very free to interact with both the extension agents and research personnel so that they are able to get exposed to a variety of information. Researchers would also benefit from such interactions by getting the necessary feed back to the developed and disseminated technologies. On the other hand extension agents may also benefit from such interactions by getting the vital information concerning the farmers' socio- economic status and the farmers' general problems. This information can enable them modify the technologies to suit the farmers' conditions.

Modification of technologies

Thirty-five out of the 45 extension agents interviewed (77.7%) disagreed with the statement that researchers are free to modify the technologies being disseminated. On the other hand 35.3% of the researchers strongly agreed and another 29.4% agreed with the statement (Table 18). All the extension agents and researchers either disagreed or strongly disagreed with the statement that modification of technologies should not involve the farmers (Table 18). When the extension agents were interviewed further they explained that certain technologies should be moulded to suit the farmers' socio-cultural and economic background. They further explained that most of the technologies are developed under unrealistic on-station conditions in the research stations thus moulding them is very necessary. The researchers (35.3%) who strongly agreed with the statement argued that some of the technologies are just a modification of the existing technologies and if everybody was allowed to modify them further then the technologies would be reversed to their old status that would not help the farmers improve their status. However, according to Norman and Modiakgotla (1990) all the parties, including the farmers, researchers and extension agents should be involved when any modification is being done. According to Russell et al. (1993) all extension agents should be trained in particular disciplines such as crop production, and agronomy as well as extension

technologies. Such extension officers are able to sort out farmers production problems and to present them to researchers in away that the researchers appreciate and understand.

Dissemination of technologies

Sixteen extension agents (35.5%) strongly agreed with the statement that researchers must always pass technologies to the farmers through the extension agents. On the same note, 29.4% of the researchers strongly agreed, and another 29.4% also agreed with the statement. The extension agents who strongly agreed with the statement explain that extension agents know the farmers better than the researchers. This makes them the best persons to disseminate the generated technologies. The extension agents further explained that it is the role of extension agents in research institutions, NGOs or even government extension workers to disseminate technologies to the farmers. The extension agents are therefore more equipped with the methodologies to successfully disseminate research results. The proportion of the researchers (29.4%) who agreed with the statements argued that allowing researchers to disseminate technologies would introduce a serious conflict in roles that can render the extension agents jobless. They added that majority of the researchers are ill equipped with methodologies to disseminate technologies and they would not have as much effect as the extension agents. According to Wuyts-Fuvawo (1992) extension, research and farmers should work together to ensure that the developed technologies remain relevant and useful to the farmers. To avoid conflict in roles each group of persons should have their roles well defined at any particular situation.

Participation in technology generation

Both researchers (58.8%) and extension agents (76.9%) strongly agreed with the statement that farmers, extension agents and researchers must be involved in technology generation process. The researchers (82.3%) and extension agents (91.0%) strongly agreed with the statement that priority setting must involve the farmers (Table 16). Participation of the three parties improves relevance of the technologies being developed. The participation of the three groups also improves ownership of the technology being developed (Eponou, 1994). When researchers are not involved in the technology development stage they may disown the technologies as the foreigners' experiments on their farms. When the farmers have such feelings it becomes very difficult to disseminate such technologies. Extension agents also have the capability of jeopardizing the dissemination of any technology that did not involve

them in the developmental stages (Kaimowitz *et al.*, 1989). They may have the feeling that they are being used as the blue-collar workers who are only responsible for mechanically disseminating technologies. With such feelings group harmony is very difficult to achieve and the trial may end up solving more internal problems instead of the intended dissemination.

Extension agents as community development workers

The extension agents (84.4%) and researchers (82.3%) either agreed or strongly agreed with the statement that extension agents are community development workers.

Team leadership

More than half of extension agents (59.9%) agreed with the statement that the researchers should provide the necessary guidance during the on-farm research trial process. The researchers interviewed (100%) either strongly agreed or agreed with the statement (Table 18). The researchers further explained that they know the technical aspects of technologies and that they should explain them to the extension agents and to the farmers. On the same note, 68.8% of the extension agents interviewed and 35.3% of the researchers interviewed either strongly disagreed or disagreed with the statement that farmers must carry out demonstrations only under the supervision of the researchers and extension agents.

Participation in the on-farm trial

More than half of extension agents interviewed (53.3%) disagreed with the statement that, researchers can carry out on-farm research trials without involving the extension agents. On the other hand, 35.3% of the researchers agreed with the statement. Collaboration between extension agents and researcher as team members improve the effectiveness of the on-farm trial exercise.

Farmers' response on the knowledge of roles

The farmers (69%) indicated that researchers or the extension agents are the likely leaders of on-farm research trials. Thirty-six out of the 42 farmers interviewed (85.7%) admitted that the researchers or the extension agents have more technical agricultural knowledge. When they were asked whether they were able to develop more superior technologies such as the

composites seeds, 90.5% of the farmers denied. The farmers explain that they used the composites because they could not afford to buy the certified seeds. More than half of the farmers (64.3%) indicated that when appointed they can help the extension agents train fellow farmers on the newly developed technologies. Thirty-nine farmers (92.9%) indicated that they have helped their friends in the past with certain information on how to handle particular situations such as, what to do when aphids are destroying their crop of beans and when a crop of maize is infested with *striga*. The farmers did not consider this as part of technology dissemination. The farmers' responses were scored out of ten then categorised into five as very low, low, average, high and very high.

4.5.2 Relationship between Roles and Adoption

In order to determine existence of any significant relationship between the roles and adoption of on-farm trials technologies the hypothesis that "*There is no significant relationship between farmers', extension agents', and researchers' knowledge of roles in on-farm trials and adoption level of technologies developed through on-farm research trial.*" was tested using Chi-square test. The responses to the knowledge of roles test were quantified by adding up the total per respondent. The scores were then converted to percentage and grouped into four categories: Less than 20% was very low; 21%-40% was low; 41%-60% was average; 61%-80% was high and 81% and above was very high. Chi-square was used to test the relationship between the farmers', researchers' and extension agents' scores on the knowledge of roles and the level of adoption of technologies developed through on-farm research trials.

4.5.2.1 Relationship between the Knowledge of Roles and Occupation

Table 19 shows the relationship between the knowledge of roles and occupation. Analysis by cross tabulation using chi-square test, revealed a significant relationship between knowledge of roles played by extension agents, farmers and researchers and occupation (Chi-square value = 26.865, df = 8, $P< 0.05$). The results indicate that the extension agents are more knowledgeable on how the three parties should relate during on-farm research trials. This may be because extension agents had attended more of the on-farm trials or had attended a lot of trainings on the Farming System Research dissemination methodologies. Knowledge of the roles in the dissemination process helps eliminate conflicts and duplication of duty (Agbamu, 2000). By eliminating conflicts the on-farm research trial would be able to run

smoothly and achieve its aim, and not much time would be wasted solving problems due to conflicting ideas. Duplication of duty also results in time wasting and confusion.

Table 19: Chi-Square Result showing the relationship between knowledge of roles and occupation

	Occupation			
Knowledge of roles	**Extension agents**	**Researchers**	**Farmers**	**Totals**
Very low	05	04	00	09
Low	08	10	10	28
Medium	08	03	09	20
High	09	00	12	21
Very high	15	00	11	26
Total	**45**	**17**	**42**	**104**

* P <0.05 Chi-square value = 26.865*, df = 8, P = 0.001, N=104

4.5.2.2 Relationship between the Knowledge of Roles and Adoption Levels

Analysis by cross tabulation using chi-square test, revealed a significant relationship between scores in the knowledge of roles test played by extension agents, farmers and researchers and adoption levels (Chi-square value = 36.964, df=12, P< 0.05). Table 20 present the results of the analysis by cross tabulation by chi-square on the knowledge of roles by adoption level technologies developed through on-farm research trial. The results mean that there is a significant relationship between the knowledge of roles and adoption levels. That is the more knowledge the respondents had on the roles to be played during an on-farm research trial process the higher the adoption level of technologies developed through on-farm research trial.

Table 20: Chi-Square Result showing the relationship between knowledge of roles and adoption levels

	Adoption levels				
Knowledge of roles	**Very low**	**Low**	**High**	**Very high**	**Total**
Very low	01	07	01	00	9
Low	09	11	06	02	28
Average	03	08	07	02	20
High	01	03	16	01	21
Very high	01	05	14	06	26
Total	**15**	**34**	**44**	**11**	**104**

* P <0.05 Chi-square value = 36.964*, df = 12, P = 0.000, N=104.

From this premise the null hypothesis (There is no significant relationship between farmers, extension agents, and researchers' knowledge of roles in on-farm trials and adoption level of technologies developed through on-farm research trial) was rejected. That is, there is a statistically significant relationship between the farmers', extension agents' and researchers' knowledge of their roles in on-farm research trials and adoption of technologies developed through on-farm research trial. Knowledge of roles played in on-farm research trial process influences adoption of technologies developed through on-farm research trial. Earlier studies such as Eponou (1994), Agbamu (2000), Merrill-Sands *et al.* (1990), Worman *et al.,* (1990) also noted that lack of knowledge on the roles to be played during Farming System Research trial introduces conflicts that may result into disagreements among the research team members. Such disagreements may affect the technology dissemination process thereby leading to low adoption levels.

4.6 Satisfaction Levels and how they are Related to Adoption of Technologies

Farmers, extension agents and researchers belong to certain organisations. These organisations differ in several ways. Certain aspects of these organisations can affect the quality and even the frequency of interaction between researchers, extensions agents and the end users (farmers). The study examined some of the institutional factors that may affect the farmer, extension, research interaction. Farmers, researchers and extension agents were asked to indicate their level of satisfaction with the services offered by the organisations they belong to.

4.6.1 Level of Satisfaction of Researchers, Extension Agents, and Farmers with their Organisations and its Relationship with Level of Adoption of Technologies Developed through On-farm Research Trials

The description of the findings were organized into levels of satisfaction within the institutions, institutional factors limiting farmers, researchers and extension agents interaction, and whether the institutional programmes were being followed. Description of finding for this objective was done using percentages and frequencies. Farmers, extension agents and researchers were asked to respond to a set of closed and open ended questions relating the institutions programmes, reward systems and on their level of satisfaction. The results are presented in the following sub sections.

4.6.1.1 Level of Satisfaction

Researchers, farmers and extension agents were asked to indicate whether they were satisfied with their jobs. The results presented in Table 21 indicate that more than half of the extension agents (55.6%), and 45.2% of the farmers interviewed derived satisfaction from what they were doing. On the other hand, a few researchers (29.4%) indicated that they were satisfied. A few extension agents (28.9%) and 23.8% of the farmers were not sure whether they were satisfied or not, while eleven out of the 17 researchers (64.7%) indicated that they were neither satisfied nor dissatisfied with their work (Table 21). Thirteen farmers (31.0%) interviewed were dissatisfied with what they were doing for a living. Out of the 42 farmers interviewed 33 (78.6%) indicated that they belonged to farmers' organization (Table 24 below). When they were asked whether they would take up other jobs when offered, almost all of them accepted. They further explained that farming alone was not adequate enough to cater for their needs.

Table 21: Level of satisfaction expressed by farmers, researchers and extension agents

Level of satisfaction		Occupation			
		Extension agents	Farmers	Researchers	Totals
Satisfied	F	25.0	19.0	05.0	49.0
	%	55.6	45.2	29.4	47.1
Undecided	f	13.0	10.0	11.0	34.0
	%	28.9	23.8	64.7	32.7
Dissatisfied	f	07.0	13.0	01.0	21.0
	%	15.6	31.0	05.9	20.2
Total	**F**	**45**	**42**	**17**	**104**
	%	**100**	**100**	**100**	**100**

N= 104

Institutional factors limiting researchers, extension agents and farmers interaction

Table 22 present institutional factors limiting farmers, researchers', and extension agents' interaction. Cognisant of the fact that the research and extension systems function within unique contextual factors, researchers and extension agents were asked to indicate, based on their professional experience, the most critical factors limiting their interaction with the farmers. Both groups of respondents were unanimous in citing the following: Low level of funding to the institutions, lack of means of transport, erratic funding to the projects, poor road network and poor remunerations.

The researchers and the extension agents interviewed explained that the level of funding to the institutions were not sufficient to cover the whole year. They explained that this made their work very difficult. The extension agents and researchers indicated that most of the vehicles used for field work were broken down. They explained further that the major courses of the breakages of the vehicles and the motorbikes were mainly the dilapidated roads and lack of proper maintenance and repair. Extension agents complained of poor terms of service compared to their counterparts in research. The extension agents also complained of understaffing of the field extension offices.

Table 22: Factors limiting interaction between researchers and extension agents

		Occupation	
Institutional factors limiting interaction		**Extension agents**	**Researchers**
Low level of funding	F	36.0	15.0
	%	80.0	88.2
Lack of means of transport.	f	43.0	16.0
	%	95.5	94.1
Erratic funding to the projects	f	40.0	14.0
	%	88.9	82.4
Poor road network	f	38.0	11.0
	%	84.4	64.7
Poor renumerations	f	43.0	16.0
	%	95.5	94.1

Following the institutional programmes

The extension agents and the researchers were asked to indicate whether they follow the institutions programmes. The results presented in Table 23 indicate that seven extension agents (15.6%) managed to follow the institutions' programme. More than half (58.8%) of the researchers indicated that they followed the programmes. Thirty-two extension agents (71.1%) indicated that they did not follow the program but made their own programmes with others stake holders such as NGOs working with government and the farmers within their division. A few researchers (29.4%) indicated that they modified the institution's programmes. Six extension agents (13.3%) and 11.8% of the researchers neither modified nor followed the institutions programmes (Table 23). The extension agents indicated that they worked depending on the directive given by their boss or on the urgency of the work. When extension agents were asked why they found it difficult following the institutions programme they indicated that the programme was more theoretical and not realistic citing problems as the ones listed in Table 22 above (institutional problems limiting interaction of researchers' extension agents and farmers).

Table 23: Extension Agents and Researchers indication of how they followed Research programmes

		Occupation		
		Extension agents	**Researchers**	**Totals**
Followed the program	F	07.0	10.0	17.0
	%	15.6	58.8	27.4
Modified the program	f	32.0	05.0	37.0
	%	71.1	29.4	59.8
Did not follow any program	f	06.0	02.0	08.0
	%	13.3	11.8	12.9
Total	**F**	**45**	**17**	**62**
	%	**100**	**100**	**100**

N=62

4.6.2 Relationship between Level of Satisfaction and Adoption

In order to determine existence of any significant relationship between level of satisfaction and adoption of on-farm trials technologies the hypothesis that "*there is no significant relationship between level satisfactions and adoption of technologies developed through on-farm trials*" was tested using chi-square and t-test. Chi-square was used to test the relationship between the adoption level and the level of satisfaction, and the relationship between the farmers belonging to farmers' organizations and farmers not belonging to farmers' organization, and level of adoption. The t-test was used to test the real difference in the level of adoption of farmers belonging to farmers' organizations and farmers not belonging to farmers' organizations. The level of satisfaction was used to establish the relationship between the institutional factors affecting the interaction between the researchers, extension agents and the farmers. The study also compared the differences between the mean score of adoption levels of farmers belonging to farmers' organisations and farmers not belonging to the any farmers' organization.

4.6.2.1 Relationships between the Farmers belonging to the Farmers' Organisations and Adoption Levels

Farmers were asked to indicate whether they belong to any farmers' organisation or not. The farmers' organisations they indicated include farmers' groups, merry-go-round groupings or

women groups etc. Data analysis by cross-tabulation using Chi-square test, revealed a significant relationship between level of adoption and farmers belonging to a farmers' organisation (Chi-square value = 18.968, df=3, P< 0.05). Table 24 presents the result of analysis by cross tabulation using chi-square on the relationship between the farmers belonging to farmers' organizations and farmers not belonging to the farmers' organization and level of adoption of technologies developed through on farm research trials.

Table 24: Chi-Square Results showing the relationship between level of adoption and membership of farmers' organisations

Farmers' organisation	Very low	Low	High	Very high	Totals
Yes	3	8	14	8	**33**
No	7	1	00	1	**09**
Total	10	9	14	9	42

* P <0.05 Chi-square value = 18.968*, df = 3, P = 0.000, N=42

The results indicate that, 33 farmers who indicated they belong to farmers' organisations adopted the on-farm research trials technologies better than the ones who indicated that they did not belong to any farmers' organisation. This has also been confirmed by the group extension approach, and multiple dissemination approach in which the farmers aid in dissemination of technologies to their fellow farmers. This may be because the farmers who belong to the farmers' organisations are able to access inputs at slightly lower rates. The groups also encourage the farmers to work very hard. For instance, farmers might be granted some loans which they are expected to pay back after a certain period of time. This might compel the farmers to work hard on their farms to repay the loans in time.

Further analysis indicated a significance difference between the adoption level of farmers belonging to the farmers' organisations and the farmers not belonging to the farmers' organisation. Mean, standard deviation and t-test value for the difference between adoption level of farmers belonging to farmers' organisations and adoption level of farmers not belonging to any farmers' organizations are presented in Table 25.

Table 25: Mean, standard deviation and t-test value for the difference between adoption level of farmers belonging to farmers' organization and adoption level of farmers not belonging to farmers' organization

Farmers belonging to farmers' organisation	N	Mean	SD	t-value	Significance
Yes	33	57.4836	4.83	4.012	0.000
No	9	46.1156	6.43		

* P <0.05 N=42

The results of the analysis indicate that the farmers belonging to the farmers' organisations adopted the technologies developed through on-farm trials better than the farmers not belonging to any farmers' organisation. The results suggests that to improve adoption levels farmers are encouraged to work in groups or from farmer organizations that would enable share ideas or access inputs at reduced rates.

4.6.2.2 Level of Satisfaction and the Adoption of On- farm Research Trials

Data analysis by cross-tabulation using Chi-square test revealed a significant relationship between level of adoption and level of satisfaction of the researchers, extension agents and the farmers (Chi-square value = 89.350, df = 6, P< 0.05). The results of Table 26 indicate that when the level of satisfaction was used to determine the relationship between satisfaction level and level of adoption, there was a relationship between the level of satisfaction and adoption of on-farm research trials. Institutional factors that affect the level of satisfaction also affect the work productivity. Therefore, when the ability to be productive is affected then the rate at which the extension, research and farmers meet is also affected thus affecting adoption levels of on-farm research trials.

Table 26: Chi-Square Results showing the relationship between level of adoption and level of satisfaction of the respondents

Adoption level	Satisfaction	Undecided	Dissatisfied	Total
Very low	00	03	12	15
Low	03	22	09	34
High	35	09	00	44
Very high	11	00	00	11
Total	**49**	**34**	**21**	**104**

* P <0.05 Chi-square value = 89.350*, df = 6, P = 0.000, N=42

The null hypothesis (there is no significant relationship between level of satisfaction and level of adoption of technologies developed through on-farm research trials) was rejected. That is, the study found out that there was a significant relationship between institutional factors contributing to the feeling of satisfaction and level of adoption of technologies of on-farm research trials. It also found out that there was a significant difference between the level of adoption of the farmers belonging to farmers' organizations and the farmers not belonging to any farmers' organization. Level of satisfaction was also found to have a significant relationship with the level of adoption. Institutional background influences the level of satisfaction. This therefore means that the differences in institutional background that affect level of satisfaction, affect the level of adoption of technologies developed through on-farm research trials.

4.7 Presence of Pre-formed Attitudes, among the Extension Agents, Researchers and Farmers and its Relationship with Adoption Levels of Technologies

Farmers were asked to answer a set of questions that was used to determine their attitude toward extension agents and the researchers. Extension agents and the researchers were also asked to respond to a set of statements that was scored to determine their attitudes toward each other and the farmers. The participants were asked to respond to statements based on their relationship with each other during technology generation, priority setting stage, technology trial stage, technology modification stage, dissemination and implementation stage, technology monitoring and evaluation stage. Each response from positive statements was awarded the following marks; strongly agree = 5, agree = 4, undecided = 3, disagree = 2

and strongly disagree = 1 except the farmers who were awarded yes =2 or no =1. Each response from negative statements was awarded the following marks; strongly agree = 1, agree = 2, undecided = 3, disagree = 4 and strongly disagree = 5 except the farmers who were awarded yes =1 or no =2. Farmers' marks were then multiplied by 5.

4.7.1 Presence of Pre-formed Attitudes, among the Extension Agents, Researchers and Farmers

The description of the findings was done using frequencies and percentages. The scores were then computed by adding all the responses from each respondent. The total score from each respondent as converted to percentage then categorised into five groups. This was as follows; 20% and below was very poor, 21%-40% was poor, 41%-60% was fair, 61%-80% was good, and 81% and above was very good. The categorised responses on the set of questions and statements were used for the analysis. Table 27 presents the results of the attitude test for the researchers and the extension agents.

Table 27: Response on pre-formed attitudes by extension agents and researchers towards one another's performance

Statements	Occupation		SA	A	UD	D	SD	Total
Extension agents lack the methodology of setting on-farm trials.	**Extension**	**F**	09.0	06.0	01.0	14.0	15.0	045
		%	20.0	13.3	02.2	31.1	33.3	100
	Research	**F**	06.0	06.0	00.0	02.0	03.0	017
		%	35.3	35.3	00.0	11.8	17.6	100
Scientific Researchers on-farm research trials must guide extension agents.	**Extension**	**F**	08.0	06.0	01.0	19.0	11.0	045
		%	17.7	13.3	02.2	42.2	24.4	100
	Research	**F**	10.0	07.0	00.0	00.0	00.0	017
		%	58.8	41.2	00.0	00.0	00.0	100
Education level affect interpersonal relationship	**Extension**	**F**	06.0	03.0	01.0	21.0	14.0	045
		%	13.3	06.7	02.2	46.7	31.1	100
	Research	**F**	04.0	05.0	02.0	02.0	04.0	017
		%	23.5	29.4	11.8	11.8	23.5	100
Extension agents are adult educators.	**Extension**	**F**	14.0	24.0	01.0	05.0	01.0	045
		%	31.1	53.3	02.2	11.1	02.2	100
	Research	**F**	05.0	07.0	01.0	03.0	01.0	017
		%	29.4	41.2	05.9	17.6	05.9	100
Meeting involving farmers, extension agents and researchers take long to end.	**Extension**	**F**	03.0	09.0	04.0	14.0	15.0	045
		%	06.7	20.0	08.9	31.1	33.3	100
	Research	**F**	01.0	04.0	01.0	06.0	05.0	017
		%	05.9	23.5	05.9	35.3	29.4	100
Social economic status makes communication between the stakeholders difficult.	**Extension**	**F**	07.0	18.0	00.0	14.0	06.0	045
		%	15.6	40.0	00.0	31.1	13.3	100
	Research	**F**	01.0	05.0	03.0	05.0	03.0	017
		%	05.9	29.4	17.6	29.4	17.6	100
Researchers are likely the team leaders in most on-farm trials	**Extension**	**F**	15.0	11.0	04.0	12.0	03.0	045
		%	33.3	24.4	08.9	26.7	06.7	100
	Research	**F**	06.0	11.0	00.0	00.0	00.0	017
		%	35.3	64.7	00.0	00.0	00.0	100
Farmers' opinion must always be sort before generating any technology.	**Extension**	**F**	12.0	23.0	01.0	07.0	02.0	045
		%	26.7	51.1	02.2	15.6	04.4	100
	Research	**F**	09.0	08.0	00.0	00.0	00.0	017
		%	52.9	47.1	00.0	00.0	00.0	100
Farmers must always be supervised while implementing new technologies.	**Extension**	**F**	04.0	03.0	00.0	24.0	14.0	045
		%	08.9	06.7	00.0	53.3	31.1	100
	Research	**F**	03.0	11.0	01.0	02.0	00.0	017
		%	17.6	64.7	05.9	11.8	00.0	100
Farmers need some incentives such as input to adopt technology.	**Extension**	**F**	14.0	13.0	00.0	15.0	03.0	045
		%	31.1	28.9	00.0	33.3	06.7	100
	Research	**F**	04.0	06.0	01.0	03.0	03.0	017
		%	23.5	35.3	05.9	17.6	17.6	100

N= 62

Fifteen out of the forty-five extension agents interviewed (33.3%) strongly disagreed with the statement that extension agents lack methodologies of setting up on-farm trials. On the other

hand, 35.3% of the researchers strongly agreed with the statement (Table 27). This would probably mean that, the researchers think that the extension agents are not knowledgeable enough to set up on-farm trials. On-farm trial is a Farming System Research methodology of technology generation and dissemination. The method being an effective dissemination method should be known by almost every extension agent especially practicing extension agents. The attitude therefore is that most extension agents are not knowledgeable. It is also very interesting to note that, up to a total of 33.3% of the extension agents themselves claim that extension agents do not know how to conduct an on- farm trial research. This indicates that some of the extension agents think that some of their colleagues are not skilled enough.

More than half of the researchers interviewed (58.8%) indicated that scientific researchers must guide extension agents during on-farm research trials. On the other hand, 24.4% of the extension agents strongly disagreed and another 42.2% disagreed with the statement (Table 27). This statement only confirmed the feeling tested by the above statement that the Extension agents lack the methodology of setting up on-farm research trials. That is the extension agents were guided through the on-farm process because they were less knowledgeable.

Twenty-one extension agents (46.7%) disagreed with the statement that relationship with other stakeholders is always difficult due to differences in education levels, while 29.4% of the researchers agreed with the statement (Table 27). This would mean that, extension agents are more able to accommodate all cadres of people regardless of their educational backgrounds as compared to the researchers. This may be because extension agents deal with different kind of personalities. Some of the farmers the extension agents deal with are highly educated while others are not. The same extension agents are also required to understand all the scientific researches and communicate with the researchers in away that they can understand. Some researchers due to the nature of their work can only be able to communicate effectively with their fellow scientists, but are too technical for the less literate farmers (Zinnah, 1992).

Both extension agents and researchers indicated that extension agents are adult educators. More than half (53.3%) of Extension agents and 41.2% of researchers agree with the statement that extension agents are adult educators (Table 27). Extension agents are not only adult educators but also community development workers (Ewell, 1990).

Fifteen extension agents (33.3%) strongly disagreed with the statement that meetings involving farmers, extension agents and researchers take long to end. Six out of the 17 researchers interviewed (35.3%) also, disagreed with the statement. This statement assumes that meetings involving different personalities are difficult to handle.

The other results as presented in Table 27 include, researchers interviewed either strongly agreed (35.3%) or agreed (64.7%) with the statement that researchers are likely the team leaders in most on-farm research trials while 33.3% of the extension agents strongly agreed with the statement (Table 27). More than half of the researchers interviewed (52.9%) strongly agreed and 51.1% of extension agents agreed with the statement that Farmers' opinion must always be sort before generating any technology. On the other hand, researchers (64.7%) agreed with the statement that farmers must always be supervised while implementing new technologies. More than half of the extension agents (53.3%) disagreed with the statement. Farmers are only supervised in the research managed or the extension managed trials but not in the farmer managed trials.

A third of the extension agents (33.3%) disagreed with the statement that farmers' need some incentives such as input to adopt technologies and 35.3% of the researchers also agreed with the statement (Table 27). This statement scored highly with the extension agents on either side. A total of 60% of the extension agents interviewed agreed with the statement. Those who agreed with the statement argued that one of the factors limiting agricultural productivity is lack of inputs such as fertilizers. Extension agents who disagreed with the statement argued that not all technologies required commercially prepared inputs. They added that some technologies are the farmers' initiative so it would be needless to provide incentives but acknowledge their efforts in being so innovative. Farmers are innovative enough to come up with technologies that suit their needs (Zinnah, 1992). It is also acceptable that lack of credit facilities affect adoption and agricultural productivity (Kaimowitz, 1992).

The farmers were asked to respond to a set of 10 questions that was used to determine their attitudes toward the extension agents or the researchers. The answers provided by the farmers were used to group them into five categories. More than half of the farmers (54.7%) indicated that the researchers are not committed to their work since they are rarely seen. More than half also indicated that the extension agents only earn without working. Some of these statements

demean the extension work and at the same time challenge them to visit the farmers' fields regularly. They, however, indicated that the technologies brought by the researchers or the extension agents are very useful to them.

4.7.2 Relationship between Presence of Preformed Attitude and Adoption

In order to determine existence of any significant relationship between presence of preformed attitude and adoption of on-farm trials technologies the hypothesis that *"There is no significant relationship between the presence of pre-formed attitudes, among the extension agents, researchers and farmers and levels of adoption of technologies developed through on- farm research trials"* was tested using chi-square. The chi-square was used to test the relationship between the preformed attitude and, occupation, level of education, level of gross monthly income, and level of adoption of technologies developed through on-farm trials.

4.7.2.1 Relationship between the Preformed Negative Attitude and Occupation

The extension agents' and researchers were grouped into five groups depending on how they responded to the set of statements on the attitudes. Analysis done by cross tabulation using chi-square test (Table 28), revealed a significant relationship between the attitude test scores and occupation (Chi-square value = 10.333, df = 4, $P< 0.05$). Table 26 present the results of cross tabulation using chi-square of the relationship between the preformed negative attitude and occupation.

Table 28: Chi-Square Results showing the relationship between preformed attitude and occupation

Test scores	Extension	Researchers	Totals
Very poor	04	07	11
Poor	06	03	09
Fair	10	01	11
Good	11	03	14
Very good	14	03	17
Total	**45**	**17**	**62**

* P <0.05 Chi-square value = 10.333*, df = 4, P = 0.035, N=62

The results indicate that, extension agents scored very well in the attitude test compared to the researchers. This would mean that extension agents' preformed attitude towards extension agents, researchers, and farmers was not bad compared to the researchers'. Relationships between extension agents, farmers and researchers are made very difficult with the presence of preformed negative attitudes and this eventually affects linkages (Kaimowitz, 1992).

4.7.2.2 The Relationship between the Test Scores and the Level of Education

Analysis done by cross tabulation using chi-square test revealed a significant relationship between the preformed attitude and level of education (Chi-square value = 31.385, df = 12, P< 0.05). Table 29 present the result of the cross tabulation using chi-square of the relationship between the preformed attitude and level of education.

Table 29: Chi-Square Results showing the relationship between the preformed attitudes and level of education

Test scores	Certificate	Diploma	Degree	Masters and above	Totals
Very poor	00	00	03	08	11
Poor	00	02	04	03	09
Fair	02	02	07	00	11
Good	00	04	08	02	14
Very good	00	07	08	02	17
Total	**02**	**15**	**30**	**14**	**62**

* P <0.05 Chi-square value = 31.385*, df = 12, P = 0.002, N= 62

The results indicated that people with only one degree were more positive in their attitude towards the extension agents, farmers and researchers. The respondents who had masters and above had a negative attitude compared to those with bachelors and below. This indicates that they had preformed negative attitude towards the participants in the on-farm research trial. Presence of preformed negative attitudes between the on-farm research trial participants affects the research and eventual adoption of the technologies (Epenou, 1994). Higher education level improves the socio-economic status of individuals. Individuals easily interact with others they are similar to or belong to the same socio-economic class. This confirms that the interaction between the researchers, extension agents and farmers was affected by their level of education that introduced preformed negative attitudes among the participants of on-farm research trials.

4.7.2.3 Relationship between Level of Gross Income per Month and Preformed Attitude

Table 30 shows that the analysis done by cross tabulation using chi-square test, revealed a significant relationship between the attitude test scores and level of gross income per month of the researchers and extension agents (Chi-square value = 30.463, df=12, P< 0.05).

Table 30: Chi-Square Results showing the relationship between attitude and income levels

Test scores	Below 10,000	10,001 - 30,000	30,001 to 60,000	Above 60,001	Totals
Very poor	00	01	02	08	11
Poor	00	02	04	03	09
Fair	01	03	06	01	11
Good	00	05	08	01	14
Very good	00	07	10	00	17
Total	**01**	**18**	**30**	**13**	**62**

* P <0.05 Chi-square value = 30.463*, df = 12, P = 0.002, N=62

The result indicated that the respondents who earn more than Ksh 60, 000 performed poorly in the attitude test. Those earning average to high income performed relatively better in the test. That is the respondents getting between Ksh 10,001 to Ksh 60,000 performed better than those earning more Ksh 60,000. Level of income improves socio- economic status of every

individual. This would therefore mean that people in the higher in the socio- economic status develop negative attitudes towards those in lower socio-economic ladder. Ewell (1990) also pointed out that people are always free to interact with the people they are similar to. That is, the low class would not interact with the people in the higher classes very freely.

4.7.2.4 The Relationship between the Attitude Test Scores and the Estimated Adoption Level

Analysis done by cross tabulation using chi-square test, revealed a significant relationship between the test scores and adoption levels (Chi-square value = 27.465, df = 12, P< 0.05). Table 31 presents the result of cross tabulation using chi-square of the relationship between the preformed attitude and the level of adoption of technologies generated through on-farm research trial.

Table 31: Chi-Square Results showing the relationship between attitude and adoption levels

	Adoption levels				
Attitude	**Very low**	**Low**	**High**	**Very high**	**Totals**
Very poor	05	10	04	00	19
Poor	06	05	05	02	18
Fair	00	08	10	01	19
Good	01	07	13	02	23
Very good	03	04	12	06	25
Total	**15**	**34**	**44**	**11**	**104**

* P <0.05 Chi-square value = 27.465*, df = 12, P = 0.0035, N=104.

The results indicate that there is a relationship between the attitude test scores and adoption of technologies developed through on-farm research trials. This means that the null hypothesis (There is no significant relationship between the Presence of pre-formed negative attitudes, among the extension agents, researchers and farmers and levels of adoption of on-farm research trial technologies) is rejected. A conclusion can therefore be drawn that there is a statistically significant relationship between the presence of preformed negative attitudes of the participants of on-farm research trials and the adoption of the on-farm research trial technologies. The preformed negative attitudes also affect the interaction between the

farmers, researchers and extension agents. With a feeling of superiority or inferiority among the members of the on-farm research trial group the quality of interaction between the farmers, researchers and the extension agents is affected (Ewell, 1990).

4.8 The Relevance of the Technologies being Disseminated to the Farmers and its Relationship with Adoption

The study also investigated the relevance of the technologies disseminated to the farmers. The relevance of the technologies was then tested to determine their relationship with the level of adoption of technologies developed through on-farm research trials. The farmers' extension agents and researchers were asked to respond to a set of questions relating to the relevance of technologies to the farming conditions. The researchers and the extension agents were asked a set of similar questions while those for the farmers were slightly different but on the same areas. Areas affecting relevance that were covered include technical feasibility, cultural acceptability, cost and ecological feasibility.

4.8.1 The Relevance of Technologies Disseminated to the Farmers

The findings of the study were described using percentages and frequencies. The main area that the study emphasized on include; major source of research ideas, the value of the farmers indigenous ideas. Farmer', extension agents and the researchers were asked questions on, technical feasibility, cultural acceptance, cost and affordability of the technologies being disseminated to the farmers and the benefits the technology would provide to the farmers. The findings are discussed below.

Major sources of ideas used by researchers and extension agents for setting their priorities

Researchers and extension agents were asked to indicate the sources they used in setting up their work priorities. Majority of the researchers reported that a major proportion of their research ideas came from the research community itself. They cited areas such as the research staff members (35.3%), objectives of the research institution (47.1%) and three out of the 17 researchers interviewed (17.6%) indicated farmers as a source of ideas for setting up their research priorities. The extension agents were more balanced in the source of their ideas; programme objectives (26.7%), fellow extension staff members (31.1%), farmers' opinion (31.1%) and other sources (11.1%).

Farmers knowledge

When the researchers and extension agents were asked whether they aware of the local maize composites all of them unanimously agreed. They were then asked to indicate whether the composites were superior in any form to the hybrid seeds available in the market. Twelve out of the 17 researchers interviewed (70.6%) denied their superiority while more than a half of the extension agents (57.8%) agreed that they were superior in one way or another to the hybrid available in the market. The extension agents indicated the following strong points of the local composites, the composites can do well with low soil fertility, they mature faster, example is the *nyamula* taking less than four months, they can tolerate water stress, and are also sweeter than the hybrid when roasted.

Farmers' opinion on the relevance of technologies from the extension agents and researchers

Farmers were asked to respond to a set of statement on the relevance of the technologies they receive from the extension agents and the researchers. The responses of the farmers were the scored and then weighted to determine the relevance of the technologies.

On the technical feasibility of the technologies, farmers were asked to indicate whether the technologies required a lot of supervision and skilled labour. Twenty-seven farmers (64.3%) indicated that some of the technologies required supervision. More than half of the farmers (59.5%) indicated that skills were required to carry on with the technologies. On the cultural acceptance of the technologies the farmers were asked to indicate how marketable their products were. Thirty-six farmers (85.7%) indicated that there was a ready market for the products (maize and beans). They also noted that due to over production such products fetch very little money. The farmers mostly in Rikenye, Kenyenya and Marani sites that engaged in production of French beans indicated that marketing the product was not very easy and they had to take the products to major market centres. On the cost of carrying on with the technologies the farmers were asked to indicate whether they required inputs and credit facilities. Twenty-six farmers (61.9%) indicated that they required inputs. On the credit facility almost all the farmer except two (4.8%) indicated that the credit facility was very vital.

The farmers interviewed indicated that the technologies were useful in improving their productivity but when they were asked to indicate whether they were using the technologies

only 61.9% agreed. The farmers were then asked to list the factors inhibiting the use of the technologies. The major factors listed include, lack of credit facilities, shortage of labour especially when some of the family members are sick, unavailability of inputs in the shops, unpredictability of rainfall. However the 42 farmers interviewed had a different opinion regarding the source of technologies they were using. The most common source of technologies they indicated include fellow farmers (64.3%), family members (23.8%) and 5 farmers (11.9%) indicating researchers and extension agents.

4.8.2 Relationship between Relevance of Technologies and Adoption

In order to determine existence of any significant relationship between the relevance of technologies and adoption of on-farm trials technologies, the hypothesis that "*there is no statistically significant relationship between the relevance of technologies disseminated to the farmers and the level of adoption of the technologies developed through on-farm research trials*" was tested using chi-square. Chi-square was used to test the relationship between the relevance of technologies disseminated to the farmers and level of adoption of technologies developed through on-farm research trials.

4.8.2.1 Relationship between Level of Adoption and the Relevance of Technologies Disseminated to the Farmers

Farmers, researchers and extension agents were asked to respond to statements on the relevance of the technologies they get from the extension agents. The responses on the relevance of technologies were then categorized into very high, high, medium low, very low. Analysis done by cross tabulation using chi-square test, revealed a statistically significant relationship between the relevance of technologies and level of adoption of on-farm research technologies (Chi-square value = 87.670, df = 12, $P< 0.05$). Table 32 presents the results of cross tabulation using chi-square of the relationship between the relevance of technologies and adoption of technologies developed through on-farm research trial.

Table 32: Chi-Square Results showing the relationship between relevance of technologies and level of adoption

Relevance scores	Very low	Low	High	Very high	Totals
Very low	09	08	01	00	18
Low	02	18	04	01	25
Medium	01	07	18	02	28
High	03	01	15	01	20
Very high	00	00	06	07	13
Total	**15**	**34**	**44**	**11**	**104**

* $P < 0.05$ Chi-square value = 87.670*, df = 12, P = 0.000, N=104

The results indicate that the farmers adopt more relevant technologies more. The analysis to test the null hypothesis that there is no statistically significant relationship between the relevance of technologies disseminated to the farmers and the level of adoption of the technologies was rejected. It was therefore concluded that there was a statistically significant relationship between the relevance of technologies disseminated to the farmers and the level of adoption of the technologies. This also conforms to the results of other studies on the same area (Epenou, 1994; Kaimowitz, 1992; Zinnah, 1991).

4.9 Summary of Results

Data was collected from a sample of 42 farmers in different agro-ecological zones in the study area. The places visited included, Rikenye, Marani, Suneka, Kanyaluo, and Kobodo. Results of data analysis indicate that, more than half (59.9%) of the respondents were female. Seventeen farmers (40.5%) were in the ages between 31-40 years. Twenty-six out of the 42 farmers interviewed (61.9%) practiced agriculture in about 2 acres of land. On education level, 42.8% of the farmers had upper primary while 42.8% also had secondary level of education. Twelve researchers (70.6%) had masters degrees and above while only 6.7% of extension agents had the same level of education. More than half of extension agents (55.6%) had bachelors' level of education. More than half of the researchers (64.7%) received a gross level of monthly income of more than Ksh.60,000 while Extension agents received a gross monthly income of between Ksh.31,000 - 60,000.

Adoption of maize production technologies was better than the bean production technologies though the adoption levels of both crops remained low. Extension agents participated more in the activities bringing them together with the researchers and farmers compared to the researchers and the farmers respectively. Farmers, extension agents and researcher interactions were minimal. The agro-ecological zones the farmers came from affected their participation in agricultural activities. Level of participation affected adoption of technologies. The research also confirmed that institutional factors such as low level of funding to the institutions, lack of means of transport, erratic funding to the institutions, poor road network, lack of enough labour, all affect the interaction of farmers, researchers and extension agents. Extension agents were more knowledgeable on the roles played in on-farm trials compared to researchers, and the knowledge of roles played in on-farm research trials affected adoption level. Farmers belonging to farmers' organisations adopted technologies better than the farmers who are not in any farmers' organisation. The research confirmed that perceived negative attitudes are due to differences in socio-economic status. Presence of the perceived negative attitude affected participation and adoption. Farmers who scored the technologies to be very relevant also adopted more. This confirmed that relevance of technologies to the farmers' conditions affect adoption levels of technologies of on-farm research trials.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter summarises the study by highlighting the methodology used in the study, location, sample population and research findings. Conclusions and recommendations are also discussed.

5.2 Summary

This study was set to investigate the effect of farmer-research-linkage factors on adoption of on-farm research trial technologies in KARI-Kisii mandate area. The study was necessary because the performance of agriculture has remained low even after using multidisciplinary approaches such as on-farm research trials to disseminate the technologies to the farmers. The low adoption levels of the technologies affected the overall production of beans and maize in the area. The study used an Ex-post facto research design with a survey methodology. Data was collected from a sample of 42 farmers from different agro-ecological zones, 45 extension agents, and 17 researchers in the mandate area.

Results of data analysis indicated that more than half of the farmers interviewed were female. This is an indication that more women practice agriculture on a day-to-day basis compared to the men. There were younger farmers in the ages between 31-40 years. The farmers in the study area practiced agriculture in about 2 acres of land. The highest acreage was found to be about 7.5acres. On education level, farmers were found to be literate but less educated compared to the researchers and extension agents. The researchers had a higher level of income than the extension agents. Level of income and level of education affected the perceived negative attitude of the participants in on-farm research trial research. Adoptions of maize production technologies were better than the bean production technologies though the adoption levels of both crops remained low at an average of 55.0476%.

The study revealed that the extension agents participated more in the activities bringing them together with the researchers and farmers compared to the researchers and the farmers respectively. Farmers, extension agents and researcher interaction were minimal. The agro-

ecological zones farmers came from affected their participation in agricultural activities. Extension agents were generally more knowledgeable on the roles each group of participants should play during an on- farm research trial process. The knowledge of roles played by each group of participants affected adoption of technologies of on-farm research trial. The study confirmed that institution factors such as, low level of funding to the institutions, lack of means of transport, erratic funding to the institutions, poor road network, lack of enough labour, all affected the farmer-researcher-extension interaction. Farmers belonging to farmers' organization were found to adopt technologies of on-farm research trial better than the farmers who are not in any organisation. Perceived negative attitudes were found to be due to differences in socio-economic status. Presence of the perceived negative attitude affected participation in joint agricultural activities. The study found out that the farmers who scored the technologies to be very relevant also adopted more.

5.3 Conclusions

In view of the data analysis and results presented and discussed in chapter four, it can be concluded as follows:

(1) There was low level of interaction between the researchers, extension agents and farmers. This was due to low participation in joint agricultural activities bringing together the researchers, extension agents and farmers. Level of participation in joint agricultural activities affects adoption of technologies. That is, the higher the level of participation the higher the adoption levels of technologies of on-farm research trials.

(2) Institutional factors such as, low level of funding to the institutions, lack of means of transport, erratic funding to the institutions, poor road network, and lack of enough labour, was found to affect the level of interaction between the researchers, extension agents and farmers. Farmers' belonging to a farmers organisation adopt technologies better than those not in any farmers' organisation.

(3) The preformed negative attitudes affecting the interacting between the farmers, extension agents and researchers are due to differences in socio-economic status. Presence of the preformed negative attitudes affects the level of adoption of technologies of on-farm research trials.

(4) Relevance of technologies to the farmers' socio-economic and ecological conditions affects the level of adoption of technologies of on-farm research trials.

5.4 Recommendations

The following recommendations have been suggested from the findings and conclusions of the study.

(1) Extension agents and researchers should consider improving their level of participation in joint activities. They should also consider improving the number of visits to the farmers' field to understand the farmers' conditions better.

(2) The policy makers should consider improving the institutional factors such as, low level of funding to the institutions, lack of means of transport, erratic funding to the institutions, and lack of enough labour that inhibit the interaction between the farmers, extension agents and researchers. This is to create a conducive condition for the linkages to thrive.

(3) The extension and research institutions should consider involving farmers' organisations in the decision-making. That is, farmers should be involved in priority setting, generation of technologies and dissemination process. This is to develop technologies relevant to the farmers' needs.

(4) Extension agents should adopt the farmers managed adoptive research instead of the researcher or extension managed adaptive researches. The farmers' indigenous technologies should be encouraged, as they are economically friendly to the farmers.

5.5 Recommendation for Further Studies

A study should be carried out on the effect of farmers' organizations in improving the production level and marketing of agricultural products such as, maize, beans and milk. Low productivity of the mentioned products affects the farmers nutritional level on the other hand, over production of the products leads to low prices of the products.

An in-depth study on each of the linkage factors affecting farmer-research-extension interaction should be carried out. This may give more suggestions on how to solve the problems of linkages.

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APPENDICES

APPENDIX A: QUESTIONNAIRES FOR FARMERS

You have been randomly selected to take part in a study on the effects of farmer, extension, and research linkage factors on adoption of technologies of on-farm research trials. Please respond to the questions as honestly and completely as possible. Your responses will be treated with utmost confidentiality and will only be used for this study.

SECTION A

On-farm research site _____

1). Gender ☐ Male

☐ Female

2) What is your approximate age?

☐ Below 20 yrs. ☐ 21-30 ☐ 31-40 ☐ 41-50 ☐ Above 50 yrs

SECTION B

3). State your highest level of education?

☐ None

☐ Lower primary

☐ Higher primary

☐ Secondary school

☐ Tertiary Education

4). What is the estimated size of your land in acres? _____

5). What is your approximate income level per year in shillings (Kshs)?

☐ Below 10,000

☐ 10,001-30,000

☐ 30,001- 60,000

☐ 60,001-90,000

☐ Above 90,000

SECTION C: ADOPTION OF MAIZE PRODUCTION TECHNOLOGIES

Adoption of maize production technologies

6) What type of seeds do you use during planting?

- ☐ Local composites
- ☐ Hybrid seeds
- ☐ Both types

7). What is the source of the seeds?

- ☐ Local shop
- ☐ From the neighbors
- ☐ From family members
- ☐ From the previous crop
- ☐ Others (specify) _____

8). Did you use any fertilizers during planting?

- ☐ Yes
- ☐ No

9). What type of fertilizers did you use?

- ☐ DAP
- ☐ FYM
- ☐ Mixture of different types of fertilizers
- ☐ Others

10) Did you top-dress your crop?

- ☐ Yes
- ☐ No

11) Do you ever control pests and diseases?

- ☐ Yes
- ☐ No

SECTION C: ADOPTION OF MAIZE PRODUCTION TECHNOLOGIES

Adoption of maize production technologies

6) What type of seeds do you use during planting?

- ☐ Local composites
- ☐ Hybrid seeds
- ☐ Both types

7). What is the source of the seeds?

- ☐ Local shop
- ☐ From the neighbors
- ☐ From family members
- ☐ From the previous crop
- ☐ Others (specify) _____

8). Did you use any fertilizers during planting?

- ☐ Yes
- ☐ No

9). What type of fertilizers did you use?

- ☐ DAP
- ☐ FYM
- ☐ Mixture of different types of fertilizers
- ☐ Others

10) Did you top-dress your crop?

- ☐ Yes
- ☐ No

11) Do you ever control pests and diseases?

- ☐ Yes
- ☐ No

12) What control methods do you use in controlling the pest and diseases?

- ☐ Indigenous technologies
- ☐ Chemical methods
- ☐ Cultural practices

13) How long do you store your crop?

---

14) If you store for more than one season, then what storage methods do you use?

Adoption of beans production technologies

15) What type of seeds do you use during planting?

- ☐ Local composites
- ☐ Hybrid seeds

16) What is the source of the seeds?

- ☐ Local shop
- ☐ From the neighbors
- ☐ From family members
- ☐ From the previous crop

17) Did you use any fertilizers during planting?

- ☐ Yes
- ☐ No

18) What type of fertilizers did you use?

- ☐ DAP
- ☐ FYM
- ☐ Mixture of different type of fertilizers
- ☐ Others

19) Did you top-dress your crop?

- ☐ Yes
- ☐ No

20) Do you ever control pest and diseases?

- ☐ Yes
- ☐ No

21) What control methods do you use in controlling the pest and diseases?

- ☐ Indigenous technologies
- ☐ Chemical method
- ☐ Cultural practices

22) How long do you store your crop?

---

23) If you store for more than one season, then what storage methods do you use?

SECTION D

24) In the past one-year, how many times have you participated in the following activities?

Contact with extension	None	1 once	2 twice	3 times	4 times	5 times	More than 5 times
1. Individual visits by extension staff							
2. Group visit by extension staff							
3. Visit to extension office by farmers							
4. Demonstrations on-farm							
5. Demonstrations on-station							
6. Farmers' own demonstrations							
7. Barazaas							
8. Shows							
9. Workshops							

SECTION E: KNOWLEDGE OF ROLE PLAYED BY THE FARMERS

25) The following statements relate to the roles played by extension agents, farmers and researchers in an on-farm research trial. Please indicate by use of a tick (✓), yes or no appropriately on the Table to indicate the level of your agreement to the statements.

	Statement	Yes	No
(a)	Do you think the farmers are free to interact with the research without involving the extension agents?		
(b)	Do you think you are free to modify the technologies.		
(c)	Do you think that the technologies farmers' use are from the extension agents.		
(d)	Farmers, extension agents and researchers must be involved in technology generation process.		
(e)	Must priority setting involve farmers?		
(f)	Farmers can carry out on-farm research without the extension agents		
(g)	Can farmers be the leaders in on-farm trials?		
(h)	Have you ever helped extension agents setup on farm trials?		
(i)	Do you think the local maize composites are better than hybrid?		
(j)	Have you ever advised your neighbour on any agricultural practice.		

SECTION E: INSTITUTIONAL BACKGROUND

26) Do you belong to any farmers' organization?

☐Yes ☐ No

27) Are there rewards such as input or any other incentive given by the organization?

☐Yes ☐ No

28) Are these rewards adequate?

☐Yes ☐No

29) Are the activities of the organization following a definite calendar of activities

☐Yes ☐No

30) Are you aware of any extension programme of activities in the area?

☐Yes ☐No

31) Do the extension agents or researchers follow this programme?

☐Yes ☐No

32) Are you satisfied with farming as an income generating activity

☐ Not satisfied

☐ Undecided

☐ Satisfied

SECTION F: ATTITUDES

33) Indicate how you rate the extension or the researchers' level of performance of their duty.

☐ Very good

☐ Good

☐ Fair

☐ Poor

☐ Very poor

34) Do you think the extension agents or the researchers are working hard enough?

☐ Yes ☐ No

35) How do you rate the effect of their work to your life as farmers?

☐ Very high

☐ High

☐ Fair

☐ Low

☐ Very low

SECTION E. RELEVANCE OF THE TECHNOLOGIES

36) What are the sources of the technologies you use?

- ☐ From the neighbours
- ☐ From extension agents
- ☐ From family members
- ☐ Others

37) The following statements relate to the relevance of the technology you have been introduced to. Please indicate by use of a tick (✓) appropriately on the Table to indicate the level of your agreement to the statements.

Key:

SA Strongly Agree

A Agree

U Undecided

D Disagree

SD Strongly Disagree

STATEMENTS	SA	A	U	D	SD
(a) The technology required a lot of inputs					
(b) The technology required a lot of labour					
(c) There is no market for the products					
(d) The technology improved my productivity					
(e) Farmers need some credit system to use the technology					
(f) The technology is not acceptable to the society					
(g) The technology takes long before the yield can be realized.					
(h) The technology need a lot of supervision					
(i) Other factors such as poor health affected adoption of the technology					

APPENDIX B:

QUESTIONNAIRES FOR EXTENSION AGENTS AND RESEARCHERSFARMERS

You have been randomly selected to take part in a study on the effect of farmer, extension, and research linkage factors on adoption of On-farm research trials. Please respond to the questions honestly and completely. Your responses will be treated with utmost confidentiality.

SECTION A

1) Occupation. ☐ Extension Agent, ☐ Researcher

2) Gender. ☐ Male ☐ Female

3) Highest level of education.

- ☐ Primary
- ☐ Secondary
- ☐ A level
- ☐ Diploma
- ☐ Degree
- ☐ Masters and above

4) What is your approximate level of income per month in shillings (Ksh)

- ☐ Below 10,000
- ☐ 10,001-30,000
- ☐ 30,001- 60,000
- ☐ 60,001 and above

SECTION B

5) From your professional point of view what is the;

a) Adoption level of maize production techniques?

- ☐ Very high
- ☐ High
- ☐ Medium
- ☐ Low
- ☐ Very low

b) Adoption level of bean production techniques?

- ☐ Very high
- ☐ High
- ☐ Medium
- ☐ Low
- ☐ Very low

SECTION C

Are the activities of your organization arranged onto a definite programme of activities with a calendar of activities? ☐Yes ☐No

6) Is the institutional programme followed?

- ☐ Yes
- ☐ No

7) If so, do you discuss the institutional programme with other stakeholders?

- ☐ Yes
- ☐ No

8) Do you find any difficulty in following the institutional progeramme?

- ☐ Yes
- ☐ No

9) If yes, what are the difficulties?

---

10) Please tick on the blank spaces to express your level of satisfaction with the institutional reward systems.

- ☐ Dissatisfied
- ☐ Undecided
- ☐ Satisfied

11) Do you think extension organizations have better reward systems?

- ☐ Yes
- ☐ No

SECTION D

12) What factors limit your interaction with both the farmers and extension agents?

_____

_____

13) The following statements relate to the level of participation of researchers and extension agents. Please indicate by use of a tick (✓) appropriately on the Table to indicate the level of your agreement to the following statements.

Key: AS Strongly Agree, A Agree, U Undecided, D Disagree, SD Strongly Disagree.

	Statements	SA	A	U	D	SD
(a)	Extension agents must participate in the initial stages of on-research trials					
(b)	Farming system research on-farm cannot be done without Extension agents.					
(c)	Extension agents can conduct their own on-farm trials with the farmers					
(d)	Researchers are often busy to go to the field more frequently.					
(e)	Farmers must participate in priority setting stage					
(f)	Modification to the technology must involve farmer, extension and researchers.					
(g)	Socioeconomic data is not very important before a dissemination process					
(h)	Without extension participation adoption is not possible					
(i)	On-farm trials is more easier without researcher					
(j)	Farmers must understand the technology prior to implementation stage					
(k)	Involving Extension agents in priority setting is very necessary.					

14) In the past one-year, how many times have you participated in the following activities? Please tick the appropriate number of times on the Table below.

Contact with extension	None	Once	Twice	3 Times	4 Times	5 Times	> 5 Times
(a) Individual visits by extension staff.							
(b) Group visit by extension staff							
(c) Visit to extension office by farmers							
(d) Demonstrations on-farm							
(e) Demonstrations on-station							
(f) Farmers' own demonstrations							
(g) Barazaas							
(h) Shows							
(i) Seminars							
(j) Field trips							
(k) Workshops							

SECTION E

15) The following are statements relate to the roles played by extension agents, farmers and researchers in an on-farm research trial. Please indicate by use of a tick (✓) appropriately on the Table to indicate the level of your agreement to the following statements.

Key: AS Strongly Agree, A Agree, U Undecided, D Disagree, SD Strongly Disagree

Statement	SA	A	UD	D	SD
1). Farmers are free to interact with Researchers directly without involving extension agents.					
2). Researchers and not Extension agents are free to modify the technology being disseminated					
3). Researchers must pass their findings down to the farmers through the extension agents.					
4). Farmers, extension agents and researchers must be involved in technology generation process.					
5). Priority setting must involve farmers.					
6) Researchers can carry out on-farm research without the extension agents					
7) Extension agents are community workers					
8) Researchers provide the necessary guidance in on-farm trials.					
9). Farmers must do the demonstrations as either extension agent or researchers supervise.					
10). Modification of technologies done in consultation with either the researchers or the extension agents not the farmer					

SECTION F

16) The following are statements that relate to pre-formed attitudes held by extension agents, researchers and farmers. Please indicate by use of a tick (✓) appropriately on the Table to indicate the level of your agreement to the following statements.

Key: AS Strongly Agree, A Agree, U Undecided, D Disagree, SD Strongly Disagree.

Statements	SA	A	UD	D	SD
(a) Extension agents lack the methodology of setting on-farm research trials					
(b) Scientific researcher in on-farm research trials must guide extension agents					
(c) Relationship with other stakeholders always is difficult due differences in education levels.					
(d) Extension agents are adult educators.					
(e) Meeting involving farmers, Extension, Researcher takes long to end?					
(f) Differences in socioeconomic status make communication between the stake holders difficult					
(g) Researchers are likely the team leaders in most trials					
(h) Farmers opinion must always be sort before generating any technology.					
(i) Farmers must always be supervised while implementing new technologies.					
(j) Farmers need some incentive such as inputs to adopt technologies					

SECTION G: RELEVANCE OF TECHNOLOGIES

17) What is the source of your research ideas?

- ☐ Research community
- ☐ Staff members
- ☐ Objectives of the institution
- ☐ Farmers

18) Do you think there still exist the local composites?

- ☐ Yes
- ☐ No

19) Do you think the local composites are superior to the hybrid varieties in any way?

- ☐ Yes
- ☐ No

20) What are the strong points of these composites?

_____

_____

_____

RESEARCH PERMIT

MINISTRY OF SCIENCE & TECHNOLOGY

Telegrams: "SCIENCE TEC", Nairobi

Fax No.
Telephone No: 318581
When replying please quote
MOEST 13/001/36C 204/2

REPUBLIC OF KENYA

JOGOO HOUSE "B"
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P.O. Box 60209-00200
NAIROBI
KENYA

4th April 2005

Ochola Washington Adede
Egerton University
P.O. Box 536
NJORO

Dear Sir

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on *'Effects of specific research extension farmer linkage factors on adoption of recommended technologies of on-farm trials: A case of Kari-Kisii Regional Research Centre'*

I am pleased to inform you that you have been authorized to carry out research in Nyanza Province for a duration of three months ending 30th June 2005.

You are advised to report to the Provincial Commissioner Nyanza, the Provincial Director of Education Nyanza and the Provincial Agricultural Officer Nyanza Province before commencing your research project.

On completion of your research, you are expected to submit two copies of your research report to this office.

Yours faithfully

B. O. ADEWA
FOR: PERMANENT SECRETARY

Copy to:
The Provincial Commissioner –**Nyanza Province**
The Provincial Director of Education – **Nyanza Province**
The Provincial Agricultural Officer – **Nyanza Province**

APPENDIX D

KARI-KISII MANDATE REGION SHOWING AGRO-ECOLOGICAL ZONES AND TRIAL SITES



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