FACTORS LIMITING THE ADOPTION OF ANIMAL DRAUGHT TECHNOLOGY PACKAGE IN NKASI DISTRICT, RUKWA REGION. TANZANIA

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ABSTRACT

History shows that Nkasi District farmers had been using oxen to plough for over 50 years but they have never replaced human power in other farm operations of planting, weeding, ridging and transportation. In the study area 70% of ploughed land is done by ox-drawn ploughs enabling farmers to expand area under cultivation. The adoption of the oxen for ploughing only considerably underutilizes the animals' potential and resources leading to merely shifting the labour bottleneck from tillage to weeding. The main objective of the study was to identify factors leading to low adoption of animal draught technology in planting and weeding activities, when ploughing has been highly adopted by the same farmers. The study involved two wards in Nkasi District and two villages from each ward were randomly selected. Data collected were verified, coded and analysed using the SPSS computer programme. It has been identified that extension services given on ADT were inadequate to influence adoption. Extension agents made few ineffective follow ups to farmers who had undergone ADT training. However it was found that groups used as contact farmers had old and related members that resulted in difficulties in groups management. It was further found that women whose principal duties in crop production are planting and weeding are denied the use of oxen by their husbands. The training approach applied in all ADT development projects was passive in which farmers provided land and accepted to use the given implements. Low availability of ox-drawn implements for planting, weeding and ridging as well as their high prices was a major problem that requires a national attention if the nation needs to alleviate rural poverty.

DECLARATION

I, Lameck Mpumbiye Mushiha, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work and has not been submitted for a degree in any other University.

15.11.2010

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The above declaration is confirmed

15.11.10

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DEDICATION

This work is dedicated to my wife Ester Mushiha and my beloved children who encouraged me to pursue studies and were willing to stay by themselves and took care of our homestead for the whole period of study.

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LIST OF ABBREVIATIONS AND ACRONYMS

ADT	-	Animal Draught Technology
ATNESA	-	Animal Traction Network East South Africa
DALDO	-	District Agricultural and Livestock Development Officer
DRC	-	Democratic Republic of Congo
FAO	-	Food and Agriculture Organisation
HIV / AIDS	-	Human Immune-deficiency Virus
IFAD	-	International Fund for Agricultural Development
LITI	-	Livestock Training Institute
MA	-	Master of Arts
MARTI	-	Ministry of Agriculture Research and Training Institute
MKUKUTA	-	*Mpango wa Kukuza Uchumi na Kupunguza Umaskini Tanzania*
NAAS	-	National Agricultural Advisory Service (Uganda)
OTC	-	Oxen Training Centre
SACCOS	-	Savings and Credit Cooperative Society
SHERFSP	-	Southern Highlands Rural Financial Services Programme
SPSS	-	Statistical Package for Social Science
SUA	-	Sokoine University of Agriculture
TARP II	-	Tanzania Agricultural Research Project Phase11
UARI	-	Uyole Agricultural Research Institute

UFI	-	Ubungo Farm Implements
URT-UNFPA.	-	United Republic of Tanzania-United Nations Fund for Population Activities
VAEO	-	Village Agricultural Extension Officer
Z Z K	-	*Zana Za Kilimo*

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Mechanisation of agriculture as experience tells us has the potential to turn idle land into productive land for national economic growth, food self-sufficiency, industrial growth and employment. At present it is estimated that out of the total power potentially available for agriculture operations, only about 10% represent motorized power (tractor), some 20% from draught animals and the agricultural labour force contributes some 70%. This shows that agricultural production is highly dependent on hand tools (Shetto, 2005).

Nkasi District is one of the high potential Districts in Rukwa Region contributing a large share of grain production in the Region. It is endowed with enough arable land; experienced devoted farmers; fertile sand loamy soils easy to till, livestock (cattle and donkeys), enough grazing area and good weather with rainfall ranging from 700-1500mm per annum. The sound production of grain crops in the District depends mainly on the area cultivated and not on good agronomic practices. Ashimogo (1995) points out this situation; "the increased maize production in Ufipa Plateau has been due to the expansion of area under crop attributed to by extensive utilization of animal traction". Crops grown in the District include: maize, beans, cassava, finger millet, paddy, sweet potatoes, round potatoes, sunflower, wheat, groundnuts and bananas on a small scale.

1.2 The current animal traction status

Draught animal power has been in use since 50 years ago in the Region, but has not yet replaced human power. Three quarters of land under cultivation is ploughed by oxen. While 58% of households own pairs of oxen, 6% own donkeys. The District has 1 Ox Training Centre (OTC) where farmers undergo training, demonstration in the use of oxen in farm operations, soil conservation and display of various animal drawn implements to farmers (DALDO, 2008).

There are 20 farmer groups in the District, each having 20 to 26 farmers used as contact farmers established with the purpose of disseminating animal draught technology to farmers. These farmers were trained by Agricultural Field Officers to use cultivators, rippers, ridgers and given the same implements for demonstration in the villages to which they belong. The government has done a lot to encourage farmers to adopt appropriate use of ox-drawn implements in farm operations. In 1995 under IFAD, the Southern Highlands Extension and Rural Financial Services Project (SHERFSP) conducted training programme of 250 contact farmers on use of ox-drawn planters, cultivators, ridgers and ox-carts. These implements were given to farmers at a subsidised price and on loan basis to those who were in social groups.

Sasakawa Global 2000 established three farmer centres in Ntalamila, Kasu and Kantawa villages where farmers were trained by Agricultural Field Officers to use a variety of ox-drawn implements in farm operations. The central government provided funds that facilitated formation of 14 farmer groups having 10-15 farmers

each. These farmers were trained on full use of ADT and given full set of implements (ploughs, rippers, cultivators and ridgers), but currently only ploughs are fully utilized. TARP II under Sokoine University of Agriculture had an animal traction project since 2000 in Nkundi village where a group of farmers was trained on the use of full Animal Draught Technology package in farm operations. The programme took trouble to send farmers to Mbeya where they were shown the source and prices of various farm implements.

Under DADPS the District Council, in financial year 2007/08, established more than 20 contact groups of 20 to 26 farmers. These farmers were given cultivators for use to encourage adoption. All these programmes aimed at promoting adoption rate of animal draught technology to help farmers increase labour productivity, overcoming seasonal bottlenecks and reduce drudgery. The District is estimated to have about 7417 mouldboard ploughs, 29 ridgers, 30 cultivators, 31 harrows, 30 rippers, 359 ox-carts and 5 planters of different types (DALDO, 2008).

1.3 Problem statement

Although Nkasi District farmers have been using animal draught power for the past 50 years and plough three quarters of cultivated area using oxen, they have not yet replaced human power in many farm operations. A number of survey reports show that only 16% of smallholder farmers owning draught animals use them in secondary tillage and planting as pointed out by Kilemwa (1993).

Although maize is a vigorous and tall growing plant, it is susceptible to competition from weeds, with losses greater than 30% commonly reported. However, in regions

where the weed seed bank is frequently very large it has been shown that competition from uncontrolled weeds will result in yield losses of up to 70% (James *et al*, 2000). This is the loss farmers of Nkasi District experience because they always fail to finish weeding on time since their farms are large. Potential production of maize is 3 tones per hectare but current production is only 1.5 tones per hectare (DALDO, 2008).

There have been more than three programmes in the District attempting to promote use of ox-drawn implements. Experience shows that farmers use the given implements and return to hand hoe when the programme ends and when implements are damaged or worn out. Despite all this effort, adoption of ADT in planting and weeding has remained low. This study intends to find out factors contributing to this low adoption of ADT in weeding and planting farm operations.

1 .4 Justification

Nkasi District has a total area of 1 371 949 hectares of which 713 945.6 hectares (54.4%) are suitable for crop production. The land area under crop production currently is estimated to be 88 529.2 hectares only (12.4%), whereas grazing area is 28 304 hectares and water bodies constitute 374 900 hectares. There are more than 150 000 cattle and 1016 donkeys being the source of draught animals (DALDO, 2008).With these potentials farmers can increase production through cultivated area increase and adoption of animal draught power in planting and weeding farm operations to minimize loses as a result of weed infestation and late planting. A number of survey reports show that only 16% of smallholder farmers owning draught animals use them in secondary tillage and planting. According to Kilemwa

(1993) and Mtama (1997), adoption of animal traction technology has increased the area under crops, smallholder farmers had large fields that were not well managed as hand hoes were still relied on for doing secondary tillage, a situation leading to low production as a result of weed infestation. Nkasi farmers rely on the hand hoe to perform secondary tillage and planting. As pointed out by James *et al* (2000), there is an average loss of 30-70% of maize yield due to weeds when weeding is carried out poorly or late. This is the loss farmers of Nkasi District experience because they always fail to complete secondary tillage on time.

Nkasi District being in Rukwa Region which is one of the big four Regions has to use the technology to suit its responsibility of producing food crops. The most threatening situation that forces the District to use oxen in many farm operations is that there is a continuous decrease of labour force resulting from alternative employment opportunities, youth migration from rural areas to urban and impact of HIV/AIDS which is projected to cause a loss of almost 20% of work force by 2020 in our region (Clarke and Bishop, 2002). Households reliant on human power and draught animals to a lesser extent are extremely vulnerable to the loss of their principal power source. The brunt of the pandemic will be felt in the agricultural sector where losses will typically account for at least 10% of the workforce and in five countries more than 20% (Clarke and Bishop, 2002).

Farmers use 60 to 100 hours instead of 3 to 8 hours to weed an acre when animal drawn implements are used (UARI, 2003). This problem affects more than 80% of the population of the District whose livelihood depends on agriculture.

1.5 Research objectives

1.5.1 Overall objective

To determine factors limiting farmers in adopting the full ADT package in Nkasi District.

1.5.2 Specific objectives

(a) To determine extension services provided to farmers on ADT.

(b) To determine the influence of gender division of labour in the adoption of animal draught technology in various farm operations.

(c) To determine the contact farmer groups characteristics and participatory typology of farmers in ADT projects implementation.

(d) To determine economic and operational factors limiting the adoption of animal draught technology in farm operations.

1.5.3 Research questions

(a) What are the extension services provided to farmers on ADT?

(b) To what extent does gender division of labour influence adoption of animal draught technology?

(c) What are the group characteristics and roles farmers played in the ADT improvement projects implementation?

(d) What are the economic and operational factors which limit farmers in adopting animal draught technology in various farm operations?

1.6 The Conceptual Framework

This section describes the adoption process an individual follows to accept or reject an innovation in question. The conceptual framework of this study is based on the adoption process as suggested by Rogers (1983).

According to Rogers, (1983) there are the following five stages of the adoption process:

1. Awareness: At this stage an individual first hears about the innovation. This means that individual is exposed to an idea but lacking detailed information about it. This is somewhat like seeing something without attaching meaning to it.

2. Interest: At this stage an individual is motivated to find out more information about the new idea. An individual wants to know what it is, how it works and what its potential may be.

3. Evaluation: At this stage mental trial of new idea takes place. An individual considers the relative advantage of the new idea over other practices/alternatives.

4. Trial: At this stage an individual tests the innovation on a small scale for himself. An individual seeks information about the technique and method of applying the new idea.

5. Adoption: If satisfied with trial an individual will decide to use the innovation on large scale in preference to old methods.

Duration and length of time between any two stages varies with each practice and individual. The rate at which different individuals go through the different stages varies with the personal characteristics of the individual and the nature of the group influences on him (Sign and Mishra, 2007).

1.6.1 Elaboration of conceptual framework

The conceptual framework as shown in Figure 1 on page 14 indicates demographic characteristics of respondents such as age, marital status, education, household size, oxen/donkey ownership, independent variables: extension services, gender, economic and operational services and farmer group characteristics which have an influence on adoption of ADT technologies. Lastly it shows adoption which shows that one is said to adopt ADT Technology package when uses animal drawn implements such as plough, planter, cultivator, ripper, ridger and ox-cart at large scale in preference to hand-tools.

1.6.2 Age

Age is a factor which can influence participation of an individual in development activities. This is because the influence of age on adoption or participation in development programmes can be a reflection of the characteristics of an individual in relation to ownership and control of resources such as land, cash, oxen and labour. The rate of adoption of new technology is likely to be higher among younger members than older ones due to exposure to current changes and education. Maunder (1973) noted that young people are less conservative than their elders and hence more likely to participate in agricultural development programmes. Nanai (1993) observed that there is an increase in the level of adoption with age to an optimum age group. Furthermore the age ranging from 25 to 34 years has proved to be venturesome, active and ready to try out innovations. The age groups above 34 years are pre-occupied with home and community based - obligation. It is thus advisable for extension agents to concentrate on this group while attention is also given to other age groups.

1.6.3 Gender

Gender is one of the factors which can influence participation of farmers in development programmes. Gender is closely related to division of labour in African communities. Women are expected to perform many farm operations in crop production process but they lack access to production services and resources. The problem stems from the fact that women are not perceived as "real farmers" by development agents especially extension workers. A major constraint to increased crop production by women is the lack of labour resources especially during the peak of agricultural season (Lombe *et al,* 1992). According to Nanai (1993), women's workload is one of the major constraints that hinder women participation in development programmes. The author went further by pointing out that, it is difficult for extension agents to hold meetings or address female farmers freely.

1.6.4 Marital status

Marital status has an influence on adoption in that culturally resource ownership and exposure to training programmes is based on gender. Nanai (1993) and Shayo (1991), have mentioned problems and situations that hinder married women participation in development programmes.

Married women are rarely involved in the elaboration of policies or consulted when new technologies are introduced even though these are of direct concern to them. It is further known that, whatever agricultural information that exists in a village is passed on to husbands not to wives who are busy working in fields, household chores and other community obligations. Similarly Shayo (1991) noted that

husbands and neighbours were observed to be the women's source of information rather than extension agents. Rights to productive resources can be affected by technology transfer, including land, forest, water, coastal areas, factories and other productive resources. Successful introduction of new technology or modification of resource use often depends on recognition of the existing forms of resource rights, or on taking steps to create an optimal resource rights regime (Polenske, 2000).

Given proper training and opportunity, women are perfectly able to use draught animals. In some projects such as Mbeya Oxenisation Project, this problem has been addressed by creating credit facilities to allow women groups to purchase oxen (Marshall and Sizya, 1994).

1.6.5 Education

Education tends to broaden horizons beyond habits and traditions of an individual encouraging participation of an individual in development activities. Smallholder farmers are supposed to be put in a position where they can analyse their situations. Nanai (1993) found that the people's level of education has positive relationship with the level of participation. The average farmer is illiterate, which in part explains his reluctance to reject traditional beliefs, attitude and practice that contribute to his resistance to change (Kauzeni, (1989).

Literacy as pointed out by Sylwander (1994) is also linked with utilization of animal traction technology. According to his study, the low utilization of animal traction technology by females is a result of being deprived of opportunity to education.

1.6.6 Household size

The household size determines the rate of technology adoption in that it determines the manpower available for farm activities. A farmer with large number of people capable to carry out farm activities will always need to increase area under crop to maximize the present manpower and will be in position to accomplish farm operations in time. One with few people in his/her household will need extra technology to equate himself /herself to the former in terms of area under crop and production Some technologies require more people hence create limitation to farmers with small households.

1.6.7 Oxen or donkey ownership

Oxen and Donkey ownership has been considered in this study as an important resource. These are draught animals responsible for working. Farmers owning these animals have skill of keeping and working with animals, therefore require buying the implements and training on use and care of the implements. Since oxen and donkeys are valuable resources, farmers owning them can absorb risk that may result in the adoption. It is cheaper for such farmers to adopt the package compared to farmers who don't own animals.

1.6.8 Extension services influence

Literature shows that agricultural extension service is a major institutional factor in influencing the extent to which animal traction technology can be utilized (Starkey 1994). According to Fischer (1994), it is due to the fact that extension services provide knowledge and technical skills to farmers through training and advisory

services. Extension is a non-formal function that applies to an institution that disseminates information and advice with the intension of promoting knowledge, attitude, and skills and aspirations (FAO, 2003). When systematically and effectively provided, extension is known to enhance social and economic development. Technological changes and the knowledge systems that underpin it are critical factor for development. The technology utilization encompasses the users of agricultural technology mainly farmers. User awareness, adaptation and adoption of improved technology from various sources affect farm level productivity and profitability and ultimately economic growth at national level (Peterson, 1997).

1.6.9 Farmers groups characteristics

The current extension approach emphasizes the use of farmer groups such as farmer field schools to ensure that many farmers are attended or served by one extension agent at a time. Characteristics of members in groups have to be known since characteristics have great influence on adoption. These include age, marital status, level of education and constituents. Age, marital status and level of education of group members influence participation in agricultural development programmes and is also related to resource ownership.

1.6.10 Roles of farmers in the existing groups

Farmer roles in sustainable projects implementation have significance in that adoption of an innovation and sustainability mainly depends on type and level of participation farmers practice. According to Carr (1996) there are a lot of

participation examples and types some of them being real successes, others failures. Many times the difference between success and failure is given by the possibility of beneficiary being involved in the moment of deciding the content, the objectives and the methods to use. In other words, the more active the beneficiary is involved in the planning and implementation stages of the project, the more likely he/ she will be attracted to adopt with success.

1.6.11 Economic and operational services

These aspects are very important in technology adoption and diffusion since they involve looking at farmers' incomes, cost of implements, training services, implement availability, supply channels of implements, crops grown, credit facilities, resource ownership and government subsidies which in totality influence affordability and hence adoption or rejection of new technology. Availability of implements and training facilities in an area facilitate adoption of the technology. Crops grown in the area of study also influence use of the technology since some crops like finger millet would not require use of oxen to weed and plant due to its spacing while maize and sunflower need use of oxen to weed due to spacing and large scale farming exercised.

1.6.12 Indicators of adoption

A farmer is said to adopt the ADT package when draught animals are used for ploughing, planting, ridging and transportation at large scale in preference to hand tools.

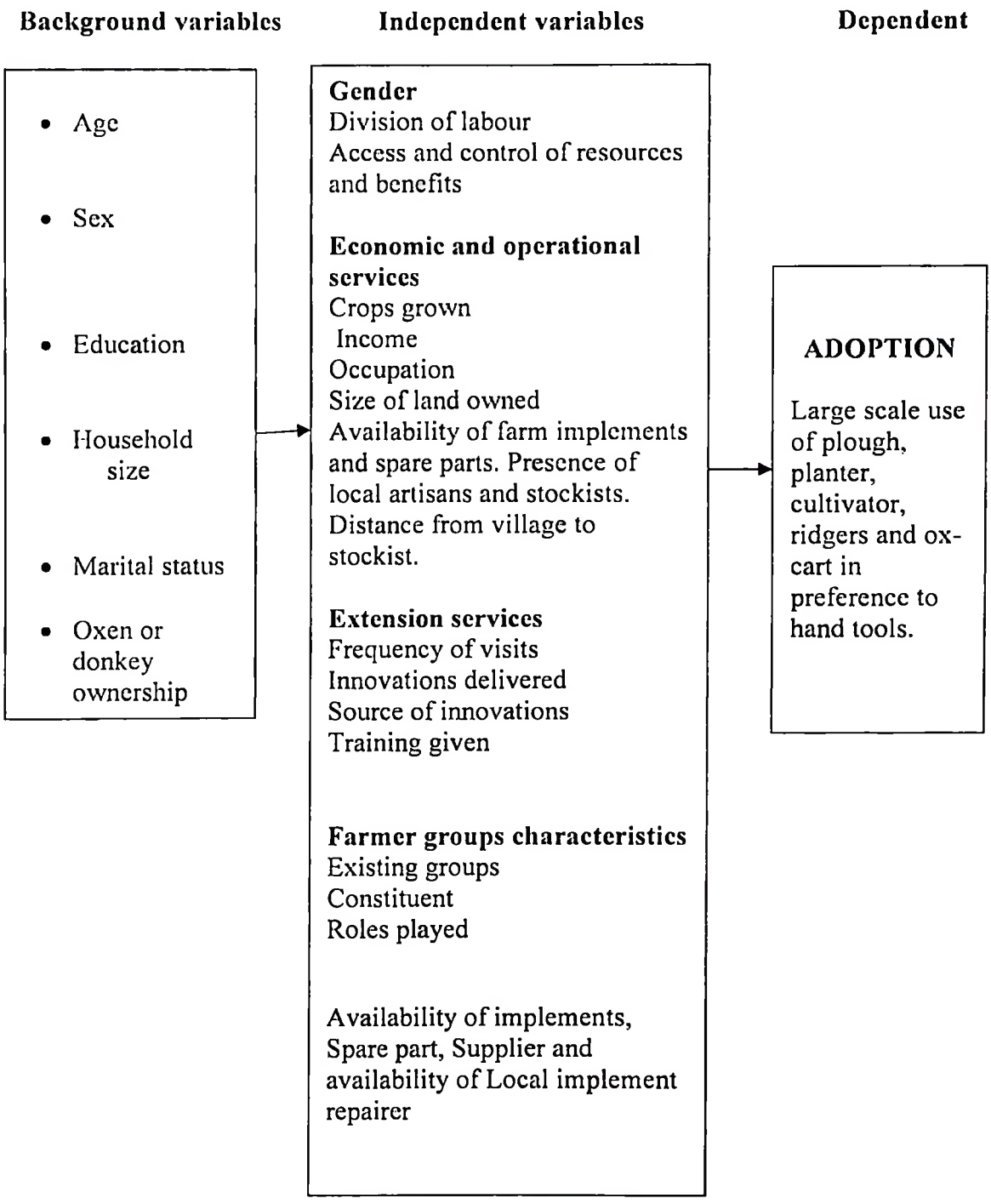

Figure 1: Conceptual framework

CHAPTER TWO

2.0 LITERATURE REVIEW

This Chapter reviews the findings other researchers identified to have influence on adoption or rejection of innovations.

2.1 Extension services

Agricultural extension is defined as a system of informal education which assists farmers to improve farming methods and techniques through the application of scientific knowledge. As a system extension includes research, training, liaison and information dissemination, the purpose of which is to increase production efficiency and income so as to improve the farmers' standard of living (Kauzeni, 1989).

In Tanzania, as is in the case for most developing countries, long term development requires increasing agricultural efficiency by improving the farming systems, livestock management and the management skills and techniques of farmers, rather than by merely increasing the acreage of land under cultivation. Improvement of farming systems, livestock management, management skills and techniques of farmers requires knowledge and technology. Efficient agricultural production means using land, labour, capital and managerial ability to get a marketable product with the least expenditure of productive resources and human effort (Kauzeni, 1989).

To achieve this efficiency, a farmer has to get knowledge on how to manipulate the resources with minimum cost. Literature reveals that agricultural extension service

is a major institutional factor in influencing the extent to which animal traction technology can be utilized (Starkey, 1994).

According to Fischer (1994), this is due to the fact that extension services provide knowledge and technical skills to farmers through training and advisory services. The effective of this depends on the competence of extension staff. According to Carr (1996), "agricultural extension, being a service that involves activities of a large number of persons and being designated for a larger number of beneficiaries must be rationally organised in the way of achieving its objectives in time and with the smallest cost for labour, materials and financial resources". Regardless of the political, social and economical circumstances of the country for which the extension service in designated, the conditions are in a continuous process of change, and because of this the objectives that must be accomplished by agricultural extension are or must be adjusted for solving the requirements in an optimal way.

With importance of extension services to farmers there are a number of challenges which need to be minimised to achieve the intended goal to farmers. Zinnah, *et al* (1998) discovered that initial formal extension programming training in developing countries was usually inadequate (basic post secondary training). In addition where in-service training was provided, it was often ad hoc and not responsive to the changing nature of extension work. Hence most extension personnel lacked the knowledge and skills required to be effective when working in a complex and rapidly changing agricultural environment. Moreover the curricula of agricultural (education) institutions were observed to be mostly theoretical with very little time

being devoted to practical training and the acquisition of off-campus occupational experience.

The Ministry of Agriculture and Cooperatives (1998), pointed out that national extension programme performance in the country was threatened by inadequate skills of front line staff. The report further elaborated that field extension workers trained for six to nine months in agricultural training centres could not cope with the dynamic nature of new technologies.

2.2 Need for technology change

Experience shows that millions of farmers in third world countries haven't been able to move from subsistence to market oriented farming because they lack the appropriate farm power and the right kind of implements. It is only after this transition that they will be capable of feeding not only themselves and their families but also feed rapidly expanding urban populations as well (Kilemwa, 1998).

As substantial increase in agricultural production is much needed now than in the past, Tanzania cannot afford to wait for the slow evolution of agricultural technology if the nation wants to achieve its own development objectives. It must not be forgotten that technical innovations come about as a response to on going social process. Projects attempting to introduce new technology must ensure that they are taking these social factors into account (Starkey, 1994). Too often the development of animal traction technology in southern and eastern African zone/area seems to halt after ploughs and carts have been introduced.

According to Simon (1992) animals are rarely used in weeding in Africa, even in areas where ploughing has been practiced for generations. Planters and weeding implements are used in some areas, but sales of such implements are only a fraction of those of ploughs. Several factors may account for this low interest in planters and weeders. He further pointed out that, perhaps development programmes have given too much emphasis to ploughing. Perhaps it is the men in farming households who generally take major decisions, but they themselves are not very much involved in weeding operations. Perhaps it is too costly to invest in more than one implement. Probably the answer is the combination of such factors. Nevertheless, draught animals do provide a clear opportunity to alleviate the problems of labour shortage for weeding than the hand hoe (Simon, 1992).

The ability of agriculture to meet the needs of an expanding population has for the part of the 20th century, been due to the development and adoption of new technologies (Baethgen, 2000). Weeding with animal traction is much faster than hand weeding and is physically lighter (benefiting all the people including women, children and the elderly). Animal power makes the timely weeding of all fields possible with benefits for labour productivity and production. Animal drawn weeding techniques are more cost effective than herbicides and are more likely to be available to smallholder farmers (Stevens, 1994).

However results from Uyole Agricultural Research Institute (UARI) indicates labour saving of 57% with Jab planters, 60% when animal-drawn rippers are used and 72% with the animal-drawn direct seeder compared to conventional flat

cultivation using the ox- drawn mouldboard plough (UARI, 2003). According to Shetto and Mkomwa (1996), employment of draught animals in weeding and transportation enhances an increase in utilization efficiency, spreads the ownership costs over a longer period of time making animal traction less costly and probably more attractive.

2.3 Economic and operational services

These aspects are very important in technology adoption and diffusion since they involve looking at farmers incomes, cost of implements, training services, availability, supply channels of implements, crops grown, credit facilities, resource ownership and government subsidies which in totality influence affordability and hence adoption.

According to Baethgen (2000), there are many barriers that may be encountered in technology transfer process. Some of the options require more labour and some need more capital investment which may represent the main constraints slowing adoption of the technologies. This will be critical in achieving adoption and wide scale diffusion of alternative technologies in the country. In most cases the transfer of technologies needs to take into account the link between technology adoption and diffusion and enhancing income in technology receiving communities. For farm level adoption the barriers include small farm size, credit constraints, risk aversion, lack of access to information associated with tenure arrangements and unreliable supply of complimentary sources and or inputs.

Vander Ende (1991) writes that, within Tanzania context, the principle of marketing is almost exclusively associated only with the selling of goods. Okoso-Amaa, (1989) states that poor infrastructure, inadequate marketing channels and the poor financial position of the channel members' results in ineffective outlets. In Tanzania centralized marketing infrastructure has tended to place the distribution and equipment services too far away from farmers. According to Jumbe, (1994) poor transport systems make it difficult for some farmers to reach distribution points when the need arises. Mahdavi (1990) commented the same that animal drawn weeding is rare and harvesting implements are non-existent.

Sakala (1992) in Zambia found that some of the limitations of using of animal draught technology were poor availability of implements in rural areas, poor quality of implements, high cost of implements and lack of credit facilities. Shetto and Mkomwa (1996), noted that training of farmers on ADT technologies took place in the rainy season when farmers are busy to meet timely ploughing and planting leading to poor attendance in training programmes.

2.4 Consideration of social aspects in technology transferring process

Technology transfer comprises the processes of learning to understand, utilise and replicate the technology including the capacity to choose it and adapt local conditions and integrate it with indigenous technology. To know why innovations fail to be adopted one has to observe culture, the local environment and the individuals (Rogers and Shoemaker, 1971).

Many change programmes fail because they seek to swim against the tide of the clientele cultural values without steering towards clients' perceived needs. Change agents must have knowledge of their clients' needs, attitude and beliefs, their social norms and leadership structure if programmes of change are to be tailored to fit the clients (Rogers and Shoemaker, 1971).

Rights to production resources can be affected by technology transfer including land, forestry (natural resources) and other productive resources. Successful introduction of new technology or modification of resource use often depends on recognition of the existing forms of resource rights or on taking steps to create an optimal resource regime (Polenske, 2000). It must not be forgotten that technical innovations come about as a response to on going social process. Projects attempting to introduce new technology must ensure that they are taking these social factors into account (Starkey, 1994). Local culture and context in which a new technology is introduced have to be taken into consideration as they have a great bearing on the manner of its adoption. Technological innovation is a social process. It is not merely a matter of providing technically suitable solutions to a given technical problems.

2.5 Need for stakeholders participation

Kajembe, (1994) defines "participation as a social process whereby specific groups with shared needs living in a geographical area actively pursue the identification of their needs, take decisions and establish mechanisms to meet these needs." Deep participation, if not ownership, by beneficiaries is essential at some or all stages of the innovation process. The systems approach captures the critical elements:

multiple sources of innovation; the need for participation of the rural poor as actors and in setting the research agenda according to local conditions; and networks of partnership with governmental and non-governmental organisations, and with commercial players (Poole and Buckley, 2006). Carr (1996) pointed out that participatory approaches have shown to improve the equality, effectiveness and sustainability of development projects and strengthen ownership and commitment of government and stakeholders.

Participation is a process of social change. Different dimensions and levels, degrees or types of participation can be analytically distinguished. The terms are used differently depending as to where in the project cycle participation occurs (planning, implementation, monitoring, and evaluation take over) as to quality, intensity or extent of participation (as passive beneficiaries, informants, cost shares or as colleagues or counterparts with a voice in management, decision making and control and to societal levels. Current inclusive approaches have several stages if they relate to all stages of project cycle. Basically participatory development stands upon a partnership that is built upon the basis of a dialogue among the various stakeholders. Participation of the main stakeholders in the assessment stages can help establish a process that will produce a technology selection better matched to local needs (Klein, 2000).

The current process of technology selection often works against involvement and consultation of local communities. According to Klein (2000) social anthropological enquiry has long stressed the diversity and multiplicity of

knowledge particularly related to the exploration of indigenous concepts and categories as opposed to outsiders perspectives on how things are. This focus has become central to technological development, as it is important to comprehend how people themselves understand whatever technological issues are targeted for assistance.

In many projects participation has taken place during implementation but more seldom in project formulation, management, control over resources and distribution of benefits. Because strategies for new technologies are often imposed from the top-down, implementation fails when local people are not consulted or are treated as labourers only or when local research and extension staff are not sufficiently trained in the specific techniques (Klein, 2000). For sustainability of development projects key stakeholders should participate in all stages of project planning and implementation (URT-UNFPA, 2003).

The participation problem is not a new one regarding the agricultural extension; during the middle of the previous century it was recognised that, both in extension and community development, an efficient instrument for acquiring the relevance and the success was to create programmes in which all who were included, participated to all stages: planning, implementation and evaluation. But the idea is not widely accepted especially by the ones who have the power for different political, cultural or economic reasons (Carr, 1996).

But in many extension services, especially the ones controlled by government, the participation approach is different. The agents start from the premise that

beneficiaries are not competent enough for deciding the objectives and the content of the programme of extension, just because many of them have a poor professional preparation. That is why those agents consider that only experts or scientists can decide on what is best. It is one of the examples of the substitution of the clients' knowledge in a top-down approach. It can not be denied that in some special situations that require extremely special knowledge, this approach obtains good results but in day-by-day activity of agricultural extension it leads inevitably to failure (Carr 1996).

It is easy to recommend participation but it is hard to apply it. The modality of participation is extremely different zone by zone, a function of cultural, economic, social or educational factors. For that reason, there is not a participatory model that can be successfully applied anywhere, the extension agents being the ones, who have the responsibility for finding the most efficient techniques to attract the beneficiaries into the whole process of decision, implementation and evaluation, because this is the only way for continuing the development in the future (Carr 1996).

However, there is evidence that engineers and engineering technology alone can do little to affect the adoption and use of mechanized farm power inputs, as has been highlighted in many of the characteristics discussed (Clarke and Bishop, 2002). Engineers therefore need to create linkages to groups discussing much wider issues, for example the wider farming community, development fora, the manufacturing and commercial sectors and policy issues within their governments. This will

improve our ability to develop and offer the right engineering solutions that are capable of being delivered i.e. technologies that can be manufactured profitably, can be sold profitably and be used profitably (Clarke and Bishop, 2002).

The conventional "transfer of technology" paradigm in which scientists develop technology on research stations and extension workers pass these technologies on to farmers is producing disappointing results. Much that is proposed to smallholder farmers in Africa is not acceptable to them because it is too costly or does not suit their farming conditions or in some other way is unacceptable to them. Attempts to impose a technology through explicit mandates and requirements, as in the top-down scenario, are not likely to be effective. Policies and procedures promoting the technology should grow naturally from its application, and incentives for using it likewise should be tied to its practical use. Adoption and diffusion is more likely to occur where incentives and policies encourage a natural acceptance and use of the new technology (Carr, 1996).

2.6 Gender bias/Gender division of labour

Women carry out the major part of workload on subsistence agriculture; they plant, apply fertilizer, weed, harvest, market and process for consumption. They are also fully involved in the preparation of food for their families. Although women are to perform all these tasks, they lack access to production services and resources. The problem stems from the fact that rural women are not perceived as "real farmers" by development agents especially extension workers (Simon, 1992).

In reality the customary division of labour in agricultural production in a household puts women on a disadvantaged position. Where men employ draught animals in ploughing fields, the women do the planting., weeding and other husbandry chores without mechanical assistance .even though the appropriate kind of technology has been invented and is available (Kilemwa, 1998). The central problem with many African customs and traditions is associated with ownership and decision –making rights. Many household assets are regarded as men's property, and women are seldom involved in decision-making on their use.

Shayo (1991) argues that, in many rural societies the social status of women is inferior to that of men. Due to that, they become a disadvantaged group especially when it comes to the introduction of technology in their area. The author goes further that it is difficult for extension agents to hold meetings or address female farmers freely. Gender differences define how in a specific social and cultural context, men and women interact and what is considered appropriate for each to do.

In the study area men have responsibility of land clearing, firewood collection and primary tillage while women and children are assigned planting, weeding and harvesting activities. Means of production like land, oxen and or farm implements belong to family members but it is men who have control over the resources and have mandate to decide on their use. The selection of technology often has a strong gender impact. As a result of the social position of a woman in a society her needs may be shaped in different ways. Technology transfer may either lead to empowering women by meeting needs of women in their productive, reproductive

and community management roles or it may lead to disempowering women by displacing their roles in the society. Thus technology can be an opportunity for women when it provides them with greater income, reduced health risks and security and autonomy or it can be a threat to the livelihood of women when the transfer of technology leads to process in which men take over the traditional work of women. This may happen if women are not fully involved in the technological innovation processes (Klein, 2000). Furthermore Koda (1994) revealed that, wives remained the implementers of decisions made by husbands due to their limited participation in politics, development programmes and public life.

It is important to note here that the absence of women users of animal traction is a clear gender issue and has nothing to do with women's capacity or capability to handle animals. Marshall and Sizya (1994) pointed out that given proper training and opportunity women are perfectly able to use draught animals. Although it is not possible to review the reverse explanations here it seems reasonable to generalize and say that communities in eastern and southern Africa have the common socio cultural notion that cattle are male property. Cattle, it is felt should be handled by males and their use for traction purposes is a male responsibility and task. Thus it seems that the use of animal traction is an inherently male activity and most communities would identify animal traction as male work according to gender division of labour (Sylwander, 1992).

2.7 Group characteristics and roles farmers play in projects and programme implementation

Group is defined as any self-help organization in rural community. It is further defined as people who come together to mobilize resources, for their own development for increased food crops productivity and for their better living conditions (FAO, 1993). Burkey (1992) points out that majority of the formed groups fail to improve the living conditions of the group members. The groups either disintegrate or become passive recipients of external assistance. This is because of the failure of the organization as well as the members to analyses the factors that pre-condition group success. Garforth (1993) points out the necessary conditions to be voluntary membership, that is members should be free to join and leave at any time, size of the group should be neither too big nor too small. Experience from other parts of the world recommends the size of 10 to 25 members The author further points out that the group should be composed of members with common interests; there should be group autonomy on group affairs; group leaders and decision making should follow democratic procedures.

The group members should be motivated according to objectives and strategies to attain goals, the group should have meetings and joint activities. There should be group objectives and by laws and there should be members contributions in terms of time, labour, financial and others. Moreover an assessment team of National Agricultural Advisory Services (NAAS) in Uganda reports the group conditions and or properties as observed in the existing groups in terms of size, meetings and constitution, in the Mid-Term Review report of the Project.

2.7.1 Size of groups

Membership of big groups tends to be spread over a wider geographical area leading to poor attendance of meetings and they take long to take decisions, thus delaying implementation of group activities. Large groups require a lot of time and resources to mobilize members for action however, with good leadership and clarity of goals and objectives some large groups have demonstrated a reasonable degree of effectiveness. Recommended number of members range from 8 to 20 (NAAS, 2003).

2.7.2 Group meetings

Rotating meeting places among households of the members was found to improve attendance. Also peer pressure encourages members to adopt better farming practices and improves up keep of their households and acquisition of assets in the homes. Besides, other members of the household attend the meeting and their interest in joining and participating in group activities is aroused. Frequency of meeting depends on the maturity of the group and on the matter to be discussed. Groups in their early stages of development require frequent meetings. When farmers are made to join groups which are not of their choice they show little interest in group meetings (NAAS, 2003).

2.7.3 Constitution

The group constitution should be simple, clear with room for amendment. All group members should participate in the formulation of the constitution. Development of the constitution should be in line with the stage of growth of the group.

2.7.4 Members` roles and responsibilities

Members should understand their roles and be prepared to shoulder them. A case was quoted where a chairman of a group paid registration fee for the group after which he tried to treat the group as a personal property. He caused a lot of disharmony in the group until he was thrown out of the group. Members should not have thought that the chairman was just being magnanimous (NAAS, 2003).

2.7.5 Group leadership

Founder members tend to dominate leadership positions in groups making new members feel alienated. Groups which have been in existence for long and which were initiated and nurtured by individuals lack participatory leadership and planning and are therefore, difficult to transform. Such groups have to be encouraged to make a provision in the constitution, which lets every member to participate in a leadership position for a given period of time. The group secretary should be literate enough to be able to take minutes of meetings and keep other group records. Illiterate members have to be encouraged to attend 'Functional Adult Literacy' programmes.

Difficulty in penalising leaders and founder members in case of wrongdoing: by-laws agreed upon by the group members have to be observed by all the members. During training emphasis should be put on upholding group norms and values. Encouraging rotating leadership can help to address the issue. Persistent and regular interaction between a farmer group and the development programmes facilitators improves performance of even those groups which are difficult to deal with (NAAS, 2003).

2.7.6 Group savings and joint economic activity

A joint economic activity boosts group cohesiveness and attendance of meetings. In groups with joint activities such as a crop enterprise or savings and credit arrangements, attendance and participation of members is higher than those without. Groups respond positively to the need to save after gaining better understanding of the importance of saving. Income differences among members make it difficult to fix the amounts to be saved on a regular basis while contributions to social functions (like burial, marriages etc.) disrupt contribution to the group fund. A group can hire out labour and the proceeds realised can be used to kick start a group fund (NAAS, 2003).

CHAPTER THREE

3.0 METHODOLOGY

3.1 Description of a study area

The study was conducted in four selected villages namely: Mtenga, Mashete, Kipande and Nkundi in Nkasi District in Rukwa Region in Southern Highlands of Tanzania mainland. Rukwa Region is divided into three Districts namely Sumbawanga District, Mpanda District and Nkasi District which has an area of 1 371 949 hectares. It is located in the south western part of Tanzania. The District shares common border with Democratic Republic of Congo in the west across Lake Tanganyika, whereas in the southeast with Sumbawanga District and in the north with Mpanda District. In 2002 the District had a population of 208 497 of whom 102 790 are male and 106 707 are female (URT, 2002).

3.2 Research design

The study was conducted using a cross-sectional survey approach in which data were collected at one point in time as recommended by Bernad (1994). The approach is economical in terms of finance and time.

3.4 Sampling procedure and sample size

The study population included Nkasi District farmers living in Ufipa Plateau who own oxen and or donkeys. The area was chosen for research because farmers use oxen for ploughing extensively leading to large areas under crop production (Ashimogo, 1995) and it is an area where ADT development programmes were implemented.

To obtain the desirable sample, simple random sampling technique was employed to obtain two wards out of ten in the area of study. Two villages were randomly selected from each ward. Twenty five respondents were sampled from each selected village using simple random sampling technique making a total sample of 100 respondents both men and women heads of households. However 4 village leaders, 4 Field extension agents and the District ADT Subject Matter Specialist were purposively sampled as key informants by virtue of their positions. A checklist was used to interview key informants who are believed to have important information of the area of study. The choice of this sample size is justified by limitation of financial and time resources at the same time it fulfills the requirements of the study having accuracy, representatively and reliability to ensure meaningful analysis (Bailey, 1994).

3.5 Data collection

3.5.1 Pre-testing

The questionnaires were prepared at SUA and submitted to professionals for content and clarity of questions and checking whether contained questions correspond to the objectives of the study. Thereafter the overall validity of survey instrument was established in the field condition by pre-testing it. Pre-testing of the questionnaire was done in Nkasi District using a random sampling of six smallholder farmers from Nkomolo1 village. Pre-testing was done to ensure common understanding of questions and to avoid ambiguities in the wording of items.

3.5.2 Primary data

Questionnaires were used to collect relevant information. In this survey, questionnaires were used as tools for data collection from respondents within a limited span of time. The respondents were heads of household who own draught animals. Key informants in the study area were identified and interviewed to get primary data as these have experience with the situation.

3.5.3 Secondary data

Secondary data were gathered by consulting different publications in the study area and libraries. These included different reports and other publications that were proved to have relevant information eg Population census, District profile, number of contact groups and ox-drawn implements, Nkasi District annual reports, factory production, other researchers results/reports, Sokoine National Agricultural Library, University of Dar es Salaam Library, Tanzania Library Services and the Internet.

3.5.4 Data analysis

Data from the respondents were verified, coded, summarized and analysed. Statistical Package for Social Sciences (SPSS) computer programme was used to analyse the collected data. Descriptive analysis of quantitative data such as frequencies, percentages and means were generated. Qualitative data were summarized and presented in tables to supplement important information. Inferential model was used in which the obtained factors in the area of research have been used to generalize the causes of low adoption of the technology in question.

3.5.5 Inferential model specification

According to Trochim (2006), inferential statistics tries to reach conclusions that extend beyond the immediate data alone. For instance inferential statistics is used to try to infer from the sample data what the population might think. Or inferential statistics is used to make judgments of the probability that an observed difference between groups is a dependable one or one that might have happened by chance in this study. Thus, inferential statistics is used to make inferences from our data to more general conditions; we use descriptive statistics simply to describe what's going on in the data.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

This Chapter presents the results of the study as observed from the field and from other relevant sources consulted by the researcher. The Chapter includes demographic information of respondents, agricultural information, extent to which ADT is used, factors hindering utilization of ox-drawn implements in planting and weeding farm operations.

4.1 Socio-demographic characteristics of respondents

4.1.1 Sex

Sex of respondents' matters in many aspects of the study because socially ascribed activities are based on sex of an individual and therefore affects the use of oxen in some farm operations. Culturally, resource ownership and division of labour is based on sex of an individual. ADT would be effectively adopted if the great users of draught animals are also those whose socially ascribed duties need the use of animal traction technology. However observation showed that resource ownership and power to decide on resource priotisation depended on sex of the family member. Seventy eight percent of respondents were male and only 22% were female indicating that most of the households are headed by men as it is shown in Table 1 below.

Table 1: Distribution of respondents by sex

Sex	Frequency	Percentage
Male	78	78
Female	22	22
Total	100	100

4.1.2 Age

Age of respondents was also considered because young people are considered to have gone to school and can easily adopt some innovations compared to old people who are more conservative. Most of the respondents ages range from 35 to 50 years and above (72%) as shown in Table 2 below. This implies that their ability to participate in development programmes is limited since they are pre occupied by family and community obligations (Nanai, 1993). Large proportion of aged people involvement in ADT training programmes might have been one of the causes of present unsustainability due to their minimum participation.

Table 2: Distribution of age of respondents in categories

Age category	Frequency	Percent
18 to 24 years	1	1
25 to 34 years	27	27
35 to 50 years	54	54
Above 50 years	18	18
Total	100	100

4.1.3 Marital status

Marital status is considered important in this study because marriage stabilizes the households and gender analysis is easily studied from people in couples. Majority of the respondents 87 % are married and 11% are separated when only 2% are single (Table 3). Simon (1992) pointed out that, inspite of women being key contributors to agricultural production, they have been constantly marginalized by agricultural development programmes facilitators especially extension agents. Married women are rarely involved in the elaboration of policies or consulted when new technologies are introduced even though these are of direct concern to them.

Since many women are married, chances to participate in ADT training programmes was minimum and therefore low adoption of the technology. Married women have no wide chance to attend ADT technology training due to many assigned duties of taking care of the family as pointed out by many authors. In this case where a large number of respondents are married women who can not attend training and do not have autonomy to use animals freely traditionally the adoption is likely to be low.

Table 3: Marital status of respondents

Marital status	Frequency	Percentage
Single	2	2
Married	87	87
Separated	11	11
Total	100	100

4.1.4 Level of Education

Level of education was also considered by the researcher as this would indicate the possibility of the society to change or being reluctant to change. The majority attended primary school education 90% and only 5% got secondary school education while 5% had not attended formal education as shown in Table 4 below. This implies that most of them have average education and can read and write hence capable of keeping some farm records. This implies a good opportunity for technology adoption if other causes of low adoption are minimized. As pointed out by Kauzeni (1989), that the average farmer is illiterate which in part explains his reluctance to reject traditional beliefs, attitude and practice that contribute to his resistance to change.

Table 4: Distribution of level of education of respondents

Educational level	Frequency	Percentage
Non-formal	5	5
Primary education	90	90
Secondary education	5	5
Total	100	100

4.1.5 Household size

The household size is considered to influence adoption of ADT technology in two aspects. A small sized household will require a small amount of food and other necessities compared to large household. Large sized households have more requirements in terms of food and other necessities and have an adequate labour force when members are old enough to work. ADT requires extra labour because an oxen herder has to be among the family members. The average households' size exceeds the national average of 5 people per household indicating that the study area is populated. Forty seven percent of the households have 4-6 members, 42 percent have 7-9 members while 11 percent have 10-15 members. Table 5 below indicates the figures. Although most households have large number of people, majorities are children less than 18 years of age and pupils therefore limited number of people capable to work.

Table 5: Household sizes of respondents

Household size	Frequency	Percentage
4 to 6 people	47	47
7 to 9 people	42	42
10 to 15 people	11	11
Total	100	100

4.1.6 Oxen and or donkey ownership

Farmers who own draught animals have already adopted to take care of animals and ploughing. Adoption of using ADT in planting and weeding will be easy if they understand its importance in drudgery reduction and timing of farm operations. It is less costly to buy implements compared to one who would include procurement of a pair of oxen or donkeys. In the study area 61 percent of the respondents have one pair of oxen and 39 percent own more than one pair of oxen at different numbers as it is shown in Table 6 below. This implies that these farmers are familiar with care and use of animals therefore require only orientation of using the new implements for planting and weeding Farmers in an area have large plots under cultivation as a result of using oxen to plough. This is an opportunity for adoption of ADT for planting and weeding.

Table 6: Ownership of pairs of oxen (n=100)

No of oxen pairs owned	Frequency	Percentage
None	0	0
One pair	61	61
Two pairs	27	27
More than two pairs	12	22
Total	100	100

4.2 Agricultural information

4.2.1 Area of land owned in hectares

Land resource is considered because it has a great influence on use of ox-drawn implements since the area owned by an individual determines land resource allocation and use of ox-drawn implements. Land being a major resource in

farming, its ownership determines ability of a farmer to participate and adopt an innovation. Mechanisation of agriculture as experience tells us has the potential to turn idle land into productive land for national economic growth, food self-sufficiency, industrial growth and employment (Shetto, 2005).

Observation shows that farmers in the study area own larger areas than the national average of 2 hectares per household. Fifty eight percent own more than 5 hectares while 42% own 2 to 5 hectares as shown in Table 7 below. This ownership of large areas has contributed to farmers having large areas under crop since oxen are used for ploughing but hand hoe being relied on for weeding and sowing as pointed out by Kilemwa, (1993), Mtama, (1997) and Ashimogo, (1995)

In 2007/08 farming season the smallest area under crop was 2 hectares while the largest was 20 hectares of different crops among the interviewed respondents. This situation calls need for such farmers adopt use of oxen-drawn planters and weeders to overcome the experienced labour bottleneck, late sowing and weeding that lead to low crop production.

Table 7: Distribution of an area owned by individual respondents (n=100)

Area category	Frequency	Percentage
2 to 5 hectares	42	42
More than 5 hectares	58	58
Total	100	100

4.2.2 Sources and annual incomes of respondents

4.2.2.1 Sources of income of respondents

Reliable sources of income have significance in technology adoption since adoption process and adoption per-se involves cost. Baethgen (2000) pointed out that in most cases the transfer of technologies needs to take into account the link between technology adoption and diffusion and enhancing income in technology receiving communities. Furthermore risk aversion which farmers consider in adoption process can be easily accommodated by a farmer with reliable source of income. Although the community in the area of the study is primarily farmers, it was identified that some of the farmers had additional activities that contributed to additional income. It was found that 72% of respondents were farmers while 28% had additional activities as shown in Table 8 below. This implies that consideration of an improvement has to include even other sectors like business, infrastructures, education and other social services.

Table 8: Sources of income of respondents (n=100)

Activity	Frequency	Percentage
Solely farming	72	72
Salaried work an farming	5	5
Business and farming	17	17
Other activities and farming	6	6
Total	100	100

4.2.2.2 Annual incomes of respondents in categories

Income has great influence on use of ox-drawn implements as it determines the ability of a farmer to buy implements as well as oxen. Care of oxen in terms of herding, treatment and vaccinations is costly therefore requires a farmer with

adequate income. Maintenance of ox-drawn implements like ox-cart, plough, planter, ridger, cultivator and others costs. Risk aversion which every rational farmer considers before making decision of adopting or rejecting an innovation involves having enough income. Another crucial condition for adoption is that farm inputs and implements, plant stock and in some cases, the labour force which are the necessary ingredients of the innovations to be adopted should be physically and financially accessible to farmers (IFAD, 2000). Due to these facts, income of farmers has got great influence in ADT technology adoption even if other factor were favourable.

Farmers in the research area have different levels of income as seen in Table 9 below. Thirty two percent earn Tshs 300 000 to 500 000, 45% of respondents have moderate income ranging from Tshs.500 001 to 1 million, 15% earn 1million to 2 millions, 2% earn income ranging from 2 to 4 million and 6% earn more than 4 million. This indicates that majority of the farmers cannot buy implements if they are not highly subsidised and recognised to be important tools which can increase production.

Table 9: Annual income in categories of respondents (n= 100)

Income category (Tshs)	Frequency	Percentage
Below 300 000	13	13
300 001 to 500 000	19	19
500 001 to 1 000 000	45	45
1 000 001 to 2 000 000	15	15
2,000,001 to 4 000 000	2	2
Above 4 000 000	6	6
Total	100	100

ADT package adoption costs high such that only few farmers can adopt. The overall average cost of full package would involve having a pair of oxen, mouldboard plough, ripper or Magoye planter, ripper, ,ridger, ox or donkey- cart and other costs like chains, yokes and transportation cost estimated to be about Tshs 2 685 000 as it is shown in Table 10 below

Table 10: Estimated cost of ADT package

Items	Estimated cost (Tshs)
Pair of oxen	720 000
Ox-cart	530 000
Mouldboard plough	150 000
Planter	360 000
Cultivator	320 000
Ridger	190 000
Ripper	190 000
costs, chain, yoke, fare	225 000
Total	2 685 000

Based on the income of respondents as shown in Table 9 above and estimated cost of adopting full ADT Package (Table 10), only 6% who earn more than 4 million can afford to adopt the technology if the government do not subsidise the implements in question. Exorbitant prices and limited availability of the implements might be the cause of low adoption as pointed out by Baethgen (2000) that the lack of financial incentives will be a major obstacle of some sort like cost sharing to speed up adoption and diffusion and when subsidies run out, the practice is dropped.

4.2.3 Farm activities and implements used in each activity

Activities carried out and implements used have been considered in this study to show the available opportunities and potentials farmers could obtain to increase production if the full package of ADT technology had been adopted. Development agents and organizations can then use these in convincing farmers to adopt the technology. Moreover this has shown a gap that needs to be filled by adopting full package of ADT technology potential production of the study area. Mechanisation of agriculture as experience tells us has the potential to turn idle land into productive land for national economic growth, food self- sufficiency, industrial growth and employment (Shetto, 2005).

Most farmers (70%) use ox-drawn implements in ploughing but a few in other farm operations like planting (8%), weeding (7%), ridging (5%), harrowing (4%), and transportation (8%). Furthermore very few farmers used a tractor for transportation (4%) (Table11). Although these farmers have been innovative to use oxen in some farm operations, they are lacking appropriate implements for many activities. Probing questions revealed that harrowing mentioned for example meant ploughing twice using mouldboard plough. Planting also involved use of conventional mouldboard plough to open the furrow in which seeds are placed manually. The activity needs additional person who follows the animals behind placing seeds in the opened furrows. The work is even more tedious because some of the oxen used are not well trained and can not open straight furrows for seed placement. Transportation is even more difficult because sledges are used in most cases. Sledges are very detrimental to environment since their use results into soil erosion

and animals get heavily burdened as sledges have no wheels to make them move easily.

Table 11: Farm activities and implements used in each activity

Operation	Frequency for implement			Percentage		
	Oxen	Tractor	Hand hoe	Oxen	Tractor	Hand hoe
Harrowing	4	0	96	4	0	96
Planting	8	0	92	8	0	92
Weeding	7	0	93	7	0	93
Ridging	5	0	95	5	0	95
Transportation	8	4	88	8	4	88

4.2.4 Number of respondents who face labour shortage at different farm operations

Labour shortage at different times of the season in this study has been considered to see whether farmers knew the prevailing problem of not using their oxen adequately. When Uyole Agricultural Research Institute (2000) indicates labour saving of 57% with Jab planters, 60% when animal drawn rippers are used and 72% with animal drawn direct seeder compared to conventional flat cultivation using the ox-drawn mouldboard plough, farmers in the study area were still facing labour shortage in weeding and planting. Most of the farmers face labour shortage at the time of weeding which is very important activity that needs to be done in time for high production (72%). Eighty five percent of respondents face labour shortage and only 15% do not experience labour shortage at any time of the season (Table12). The situation implies that the technology is highly needed to ensure timely planting and weeding to avoid a loss to farmers and to reduce burden to women and children who are responsible for planting and weeding.

Table 12: Distribution of labour shortage at different farm operations (n= 100)

Farm operation	Frequency	Percentage
Ploughing	2	2
Planting	1	1
Weeding	72	72
Weeding and planting	5	5
Weeding and harvesting	5	5
Do not face shortage	15	15
Total	100	100

4.2.5 Extension services provided on ADT.

.Extension services have been considered in this study because many authors pointed out its significance in adoption process. Fischer (1994) considered extension services to be important by pointing out that extension services provide knowledge and technical skills to farmers though training and advisory services. Furthermore, the author said that the effectiveness of extension services depends on the competence of the extension staff. Literature shows that extension services influence utilization of innovations as pointed out by Starkey (1994) that, "extension services are important in ADT technology utilization because it provides the knowledge that facilitates its adoption." All the four villages involved in this study had village Agricultural Extension Officers To determine extension services provided in the study area farmers were asked how frequent they were visited by extension officers and other services providers. Results show that 51% were not visited at all, 14% visited once, and 35% were visited more than once last year as shown in Table 13.

Table 13: Frequency of extension agent visits to respondents (n=100)

Visits	Frequency	Percentage
None	51	51
Once per year	14	14
More than once per year	35	35
Total	100	100

It was further discovered that only 8% of farmers received ADT training from extension agents, 22% from fellow farmers and 70% were taught by their parents as it is shown in Table14 below. This implies that the impact of extension agents on adoption of ADT is insignificant. Extension agents were asked whether they had skill on use of ox-drawn implements like cultivators, ridgers and planters. Most of them showed doubt even on the proper use of ordinary implement (mouldboard plough). It was discovered that training of ADT at nation training institutes was unsatisfactory to make extension agents competent on the skill since the time allocated is little and mostly theoretical. Other authors Shetto and Mkomwa (1998), revealed the same problem by stating that many VAEOs have limited knowledge and practical skills on animal drawn technologies as a result of their background training.

In the training programmes at Certificate and Diploma level much emphasis is placed on tractor and motorized equipment as illustrated below; at Certificate level animal power training is allocated only 58 hours out of 3000 contact hours in three years. In the two years Crop Production Diploma course out of 2000 contact hours animal power is allocated 94 hours while tractors and its equipment has an allocation of 170 hours almost double the time. The situation seem to be a limiting

factor of ADT technologies adoption as pointed out by Klein (2000), that strategies for new technologies fail when local research and extension staff are not sufficiently trained in the specific techniques.

Table 14: Who first trained farmers on use of oxen in various farm operations

Trainer	Frequency	Percentage
Parents	70	70
Extension agents	8	8
Fellow farmers	22	22
Total	100	100

4.2.6 Access of women to oxen use for culturally assigned activities

Accessibility here is defined as an opportunity given to women to use oxen for traction purposes for socially assigned farm activities. It was observed that majority of the women were denied access to oxen for various activities assigned to them. Observed results show that, only 30% of women are given oxen for assigned duties when 70% are denied use of the animals. Further observation revealed that even the women given oxen did not use them to perform the assigned duties like planting, weeding and harvesting. The results imply that women have limited control of some household resources which are means of production. Polenske (2000) points out what is normally done to ensure proper assimilation of a technology in a society; "Successful introduction of new technology or modification of resource use often depends on recognition of the existing forms of resource rights or on taking steps to create an optimal resource rights regime".

Moreover it was found that women were not given opportunity because they had no experience of using draught animals or had no knowledge on how to use the animals. Others were said to be too scared such that they could not harness the animals. Women who had opportunity to use animals used them for haulage in most cases. Through probing questions it was known that majority of the women were using the animals to carry fire wood, a task assigned to men culturally. It is some sort of incentive that tries to assign this task to women.

According to Kilemwa (1998), the central problem with many African customs and traditions is associated with ownership and decision making rights. Many household assets are regarded as men's property and women are seldom involved in decision-making on their use. Sosovele (1994) also pointed out that such tendency was reflected on the low utilization of animal traction technology to traditionally female related activities such as planting and weeding. Such gender bias and the failure to involve women effectively in animal traction technology could be the contributing factor to low utilization of animal traction technology in planting and secondary tillage farm operations among the smallholder farmers in the area of study.

It was further found that in some women headed households, women were not accessing oxen for use despite being the household heads. Out of 22 households headed by women only 6 (27.3%) of the women had access while 16 (72.7%) of the women did not have opportunity to use oxen. Sylwander (1992) said that although it is not possible to review the explanations here, it seems reasonable to generalize that communities in eastern and southern Africa have the common socio-cultural

notion that cattle are male property. Cattle it is felt should be handled by males and their use for traction purposes is a male responsibility and task. Thus it seems that the use of animal traction is an inherently male activity, and most communities would identify animal traction as male work according to gender division of labour.

The author went further and pointed out that in most cases men benefit more than women in terms of knowledge acquisition from extension services, who unfortunately are not in a position to deliver the same to women. It is important to note here that the absence of women users of animal traction is a clear gender issue and has nothing to do with women capacity or capability to handle animals (Marshall and Sizya, 1994). Authors further pointed out that, the utilization of animal traction technology in men-oriented activities such as ploughing was higher than with women-oriented activities (planting and weeding). Table 15 below shows some responses from respondents and activities women performed when given opportunity to use oxen.

Table 15: Women given opportunity to use oxen and activities they perform

Activities	Frequency	Percentage
Haulage	21	21
Weeding	3	3
More activities	6	6
No access	70	70
Total	100	100

4.2.7 Group characteristics, members and roles played by members

Farmer groups are the core institutions for empowering farmers to participate and benefit from development programmes. They enable the farmers to take charge and

control the delivery of advisory services. A random sampling of 34 members from five contact groups showed that members were almost equal in terms of gender balance but some groups had already lost some members. Age of group members was also determined and grouped in Table 16 below. Gender and age have been looked into in this study because of their influence on resource ownership and active and efficient participation of members in development programmes since adoption of an innovation is highly influenced by the two aspects. Other characteristics observed include size of the groups, homogeneity, members' roles and motivation as these influence sustainability of groups.

Table 16: Distribution of members and their average age (n=64)

Group	No of members	Females	Males	No of sample	Average age Years
Mtenga	26	14	12	1	44.0
Kipande	13	6	7	9	50.0
Kantawa	15	8	7	11	49.8
.Nkomolo	8	3	5	9	39.6
.Nkundi	12	3	9	4	44.8
Total	64	34	30	34	45.6

Five groups in the study area were observed to identify the members, their personal relationship and roles they played in implementation of the projects of ADT improvement. Results show that the groups had an average of 13 members. Members included 6 women and 7 men from each group to ensure equality which was the directive of each project.

A challenge was when the attendance was observed, most women did not attend meetings and some training programmes since they were pre-occupied by other responsibilities on meeting or training days. Mtenga group had a special case that the group used had other roles. It was a SACCOS when chosen as a contact group. This led to poor performance of the group since more meetings held were about SACCOS development and consequently became a registered SACCOS. Another interesting feature of these groups is that they included many members who are relatives (59%) as shown in Table 17 below. This implies that implementation of rules and guideline of the groups was difficult since a son could not prevent a father to use group implements for example.

The worst part that has also contributed to poor performance of the groups is unsatisfactory supervision provided. Both District Mechanization Officer and VAEOS of the respective villages had no visiting schedules to ensure continuity of groups and farmers practices of what they had learnt. Shetto and Mkomwa (1996) identified this problem when they noted little and ineffective follow up of farmers who have participated in the training session to assist them further in putting into practice what they have learnt.

It was identified too that roles played by members could not lead to sustainability of the projects in place. The majority enjoyed use of implements and few learnt how to use the given implements. In short farmers provided land and accepted to use the given implements. The situation shows that the projects were imposed in a traditional top down fashion which has been argued to end up with unsustainable

results. Klein (2000) had the same opinion when he pointed out that, "Because strategies for new technologies are often imposed from the top-down, implementation fails when local people are not consulted or are treated as labourers only".

Other features of the observed groups show that meetings were few and normally ad hoc in nature, leadership was permanent that is there was no regular election of leaders for the past five years and some of the leaders had misused contributed money and no action taken. Four groups had no constitution and guidelines but some regulations that would require some members to pay few Tshs in case they fail to attend two consecutive meetings. Their common interest was to use the given implements and to attend the field school plots for those who were bean seed producers. The group sizes were ideal although some of the groups had lost some of the members. Probing questions revealed that some farmers joined the groups with the expectation of obtaining a loan of oxen, failure to which resulted to dropouts.

Table 17: Distribution of group members` relationship (n=34)

Responses	Frequency	Percentage
Related members	20	59
Unrelated members	14	41
Total	34	100

4.2.8 Availability and accessibility of ox-drawn implements

To know the accessibility and availability of farm implements farmers were asked about the implements they owned, their sources and prices. The mentioned prices

were low compared to current prices implying that most farmers had purchased the equipment in previous years and had no recent information of the availability. The situation necessitated to find secondary data of the sold stock from animal drawn implements suppliers.254 mouldboard ploughs and 3 cultivators were sold as shown inTable 18 below indicating that availability of implements like ridgers, cultivators, harrows, and planters was a major problem. Mahdavi (1990) commented the same when stated that animal drawn weeding is rare and harvesting implements are non-existent. Shetto (2005) confirmed this scarcity by explaining difficulties facing the implement producing factories:

UFI had a production capacity of 2. 5 million pieces of hand tools and 30 000 ploughs annually, while ZZK had capacity of 1.5 million pieces of hand tools and 10 000 ploughs annually. Economic difficulties forced the two companies to stop production and were listed for privatization. UFI was sold to Tanzania Steel Pipes Ltd and the factory is under rehabilitation. ZZK has been sold to Simba Steel Pipes who are also rehabilitating the factory. However, the rehabilitation of these two plants needs a lot of funds, as many machines have to be replaced.

Table 18: Type and amount of implements District suppliers sold 2008

Name of suppliers	Mouldboard ploughs	Cultivators
Lazaro hardware	142	0
Zabibu Agrovety	50	0
Johnas duka la madawa	62	3
Total	254	3

SEAZ Agricultural Implements in Mbeya, the chief supplier in Southern Highlands Zone produce few implements such that no ready made implements are found in the

market. The plant's 2008 production included 453 cultivators, 301 ridgers, 78 ox-carts, 117 rippers, 88 rice paddlers and 52 planters. Implements are manufactured by order, which a single farmer can not afford when distance and trust of manufacturer are considered.

The circumstances have increased the difficulties of obtaining weeding and planting implements even when prices are not considered. All equipment suppliers are found in urban areas (Namanyere and Sumbawanga). Farmers in the study area have to cover 32 to 61 kilometers to get to supplliers. Suppliers on the other hand have to go to Mbeya SEAZ or ZZK about 400km and 1200 km in Dar-es-salaam (UFI) to purchase implements for sale. Probing questions revealed that both farmers and suppliers had a common problem of transporting the implements due to their bulkiness. Nkasi District being remote and far from Mbeya and Dar-es-salaam with poor infrastructure, inadequate marketing channels and poor financial position of implement suppliers results in ineffective outlets (Okoso-Amaa,1989).

It was further identified that training of farmers on ADT programmes was conducted during the rainy season when farmers were busy which led to low attendance and participation in the training programmes. Ox-drawn implements are also found in the suppliers shops seasonally normally in June to December. The situation was also noted by Shetto and Mkomwa (1996) when they pointed out that manufacture and trading in ADT implements and spares is not attractive as sale of spares is highly seasonal which creates cash flow problems. Mkomwa *et al* (1994), reported that 62 percent of SEAZ annual implement sales were typically realized in four peak farming months from September to December.

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

The Chapter presents conclusions of the study and recommendations to improve the situation

5.1 Conclusions

Extension services provided were unsatisfactory to make farmers adopt the technologies. District Extension Officer responsible for the project and Village Extension Officers had no visiting schedules to ensure consistent supervision that would help farmers to practice what they learnt. Village Extension Officers had no practical skills on appropriate use of ox-drawn implements given to their farmers. Women whose main farm operations are planting, weeding and harvesting have no access and control of draught animals. Reasons for denial discouraged since majority of the women were found to have no knowledge and /or experience of using animals. Culturally women are not taught to use animals because animal traction is mostly used for primary tillage which is men's duty.

ADT improvement projects were introduced in the study area in a top down fashion in which farmers passively participated and training was done during rainy season when farmers were busy with farm operations to complete on time. Farmers provided land and accepted to use the technologies with no mandate to decide. Contact groups used were not suitable for the projects since most of them had more than one function and included relatives which in most cases made leadership difficult. Low availability of ox-drawn implements is a national problem since

factories used to manufacture them have been privatised and are no longer producing them. SEAZ the chief manufacturing plant for Southern Highlands Zone produces few implements usually on order which individual farmers can not afford. High prices and distant marketing places increased the difficulties of availing them to farmers who need them.

5.2 Recommendations

Scheduled, consistent and effective follow up of farmers who have participated in the training session in any project involving technology adoption should be adhered to, to assist farmers further in putting into practice what they have learnt. All extension agents should undergo special training that will help them to master both theoretical and practical skills on use of all ADT package so that they can influence the adoption. Knowledge of contact groups formation, characteristics and suitability for different uses should be given to extension agents. Training Institutes (MARTIs & LITIs) have to increase contact hours and equip Institutes with ox-drawn implements to ensure that their students understand ADT both theoretically and practically since this is the only source of power most farmers can afford to own.

Adequate effort should be made to educate men on the need for changing attitude so that women whose chief activities in crop production are planting and weeding are trained and given opportunity to use oxen. Alternatively special programme of giving credit of oxen- planters and cultivators to women should be implemented to rescue the situation.

Type of participation used should be changed from passive to partnership and or by subscription which will give ownership and decision making ability to farmers. Time of training programmes has to be convenient to farmers to achieve high attendance and participation. Farmers should form associations like SACCOS so that they can have ability of ordering implements from the factory collectively to absorb exorbitant prices that would not be incurred by an individual farmer. The Council should also identify local artisans who can make ox-carts of cheap prices affordable by many farmers. Nkasi District Council input suppliers have to be encouraged to find suitable sources of cultivators, ridgers and planters for sale in the District.

Subsidies introduced on other agricultural inputs by the central government should apply on ox-drawn implements to help farmers achieve poverty alleviation. Central government has to assist the present factories to increase their capacity to produce more implements to cut down the expenses which have lead to high selling prices and to accommodate the demand of farm implements.

REFERENCES

Ashimogo, G. (1995). *Peasant Grain Storage and Marketing in Tanzania. A Case study of Maize in Sumbawanga* District. Varlag, Berlin. 369 pp.

Baethgen, W. (2000). Farmer innovation in Africa; A source of Inspiration for Agricultural Development In: *Methodological and Technological issues in Technological Transfer.* (Edited by Rev. A and Bayer, A.W.) Earthscan. Publishers Ltd. London Sterling VA. 271 -273 pp.

Bailey, K. D. (1998). *Research Methods of Social Science.* The Free Press, New York 4th edd. 589 pp.

Bernad, H. R. (1994). *Research Methods in Anthropology, Qualitative and Quantitative.* Altamina Press, Walnut Creek. 584 pp

Burkey, S. (1992*) People First. A Guide to Self Reliant Participatory Rural Development.* Zed Books Ltd, London and New Jersey. 244 pp.

Carr, Jr. V. H. (1996). Technology Adoption and Diffusion. [http://tlc.nlm.nih.gov/resources/publications/sourcebook/adoptiondiffusion.html]. Site visited on 07/05/2009.

Clarke, L and Bishop, C. (2002). Farm power, Present and Future Availability in Developing Countries. Agricultural Support System Division, FAO, Rome. Italy. 18 pp.

Nkasi District Agriculture and Livestock Development Officer.(2008). District Agricultural Development Annual Report. Nkasi District. 15 pp.

FAO (2003). Agricultural Extension, Rural Development and the Food Security Challenge. FAO, Rome. Italy. 8 pp.

FAO (1993). *Farmers self help Organisations. Mobilising people's Resources for Development.* FAO Rome, Italy. 20 pp.

Fischer, R. (1994). Transfer of Animal Traction Technology: Lessons from Project Experience in Zimbabwe, Cameroon and Tanzania. *Proceeding of ATNESA* held on 18-23 January 1994 (Edited by Starkey. P, Mwenya. E and Stares.J) Lusaka. Zambia. 296-300 pp.

Garforth, C. (1993). Rural peoples' organization and extension communication in Northern Thailand. *Journal of Extension Systems 9.* (2): 33-64.

Hocking, C. (1994). The impact of mobile ox-ploughing courses for women in the Western province of Zambia: *In Improving Animal Traction Technology ATNESA Publications.(*Edited by Starkey, P, Mwenya, E and Stares, J). 288-291 pp.

IFAD (2000). Agricultural Extension and Support for Farmer Innovation in Western and Central Africa Evaluation Report.[*http: www.ifad.org/gbdocs /eb/ec/ e/28/EC- 2001-28-W-P-2pdf]* site visited in July 2009.

James. T. K, Rahman, A and Mellsop, J. (2000). Weed competition in crop under different timings for post-emergence weed control. 2000 New Zealand Plant Protection Society *[http://.www.nzpps.Org /journal/53/nzpp 53-269 pdf].*site visited on 15 July 2009.

Jumbe, J. Y. (1994). Improving Distribution of Animal Traction Implements: In *Improving Animal Traction Technology* ATNESA Publications. (Edited by Starkey .P, Mwenya, E and Stares J.). 256-259.pp.

Kajembe, G. C. (1994). Indigenous management systems as basis for community forestry in Tanzania. A Case study of Dodoma Urban and Lushoto Districts. Tropical Resource Management Paper no 6. Wageningen. Agricultural University. The Netherlands. 194 pp.

Kauzeni, A. S. (1989). *Effective Extension Service. The Tanzania Experience.* Swala, Dar-es-Salaam. 73.pp

Koda, B. (1991). Women Participation in Politics and Public Life in Tanzania. *Proceeding of women research and documentation project.(*Edited by Njau, A. and Mvuna, T*).* University of Dar-es Salaam. 8-16 pp.

Kilemwa, A. (1993). Animal Traction and Rural Technology Report on Survey of Animal Traction Utilization levels in Rukwa Region Unpublished 26 pp.

Kilemwa, A. (1998). Women's Role in Animal Traction: In Business Times No. 498 24 April 1998. 13-14 pp

Klein, R. J. (2000). Enabling Environment for Technology Transfer; In *Methodological and Technological issues in Technology Transfer* (Edited by Polenske K. R). Cambridge University Press 114-116 pp

Lombe. .M, Sikanyika, C. and Tembo, A. N. (1992) .The importance of women participation in animal traction in Zambia. Lusaka Zambia; *In Proceedings of ATNESA held on 18-23 January 1992.*(Edited by Starkey, P. Mwenya, E. and Stares, J). 284-285 pp.

Mahdiv, G. (1990). Development of animal traction in cotton areas of French speaking African countries: *In Hand book of the Role of Draught Animal Technology in Rural Development. (*Edited by Smith. T and Hertog, .G.) University of Edinburg Centre for Tropical Veterinary Medicine Edinburg, Scotland. 12 pp.

Maunder, A. H. (1973). *Agricultural Extension. A Reference Manual.* FAO, Rome, Italy. 280 pp

Marshall, K. and Sizya, M. (1994). Women and animal traction in Mbeya Region of Tanzania: A gender and development approach: *In Improving Animal Traction Technology.* (Edited by Starkey, P. Mwenya E. and Stares, J). ATNESA Publications 266-271.pp .

Ministry of Agriculture and Cooperatives (1998). National Extension Packages 1997/8 Performance Review Report. Government Printers, Dar es Salaam. Tanzania. 14 pp

Mkomwa, S. S, Shetto R. M. and Mkoga, Z. J. (1994). Animal Draught Technology Business in Tanzania; Experiences and Opportunities for Entrepreneurs. Paper presented at the 1994 Tanzania Society of Agricultural Engineers Conference held on 3-6 October, 1994. Dar es Salaam. 16 pp

Mtama, L. Y. (1997). Factors influencing female-headed households involvement in the Sasakawa Global 2000 Project in Rukwa Region. MSc Unpublished Thesis, Sokoine University of Agriculture, Morogoro Tanzania. 97 pp

Nanai, A. H. (1993). Peasants participation in community development projects. Its Implications in laying a strategy for participatory. Msc Thesis. Sokoine University of Agriculture. Morogoro 138 pp

National Agricultural Advisory Services (2003). Promotion and strengthening of sustainable farmer groups and associations: A Report of the Mid – Term Review of the NAAS Project Undertaken from the29 September to 3 October 2003. Kampala, Uganda. 94. pp

Okoso-Amaa, K. (1989). Creating farmers awareness and preference for new products. (With reference to the Mkombozi plough). Department of Marketing. University of Dar es salaam, Tanzania. 15 pp.

Peterson A. (1997).The context of extension in rural agricultural and rural development: *In Improving Agricultural Extension Reference Manual.* (Edited by Swamson E.B*)* FAO. Rome, Italy. [hhttp// www.fao. org/docrep/w5830E.00.htm]. Site visited on 6/3/2008.

Polenske, R. K. (2000). A special report of intergovernmental panel for climate change, Working Group iii: In *Methodological and Technological Issues in TechnologyTransfer (Edited by Baethgen)*. Cambridge University Press. 280-297 pp.

Poole, N and Buckley, C. P. (2006) Innovation challenges, constraints and opportunities for the rural poor. [http://www.ifad.org/gbdocs/eb/84/e/EB-2005-84-R-2-REV-1.pdf] site visited on16 July 2010.

Rogers, E. M and Shoemaker F. F (1971).*Communication of Innovations*.2nd Edition. The Free Press, New York 548 pp.

Rogers, E. M. (1983). *Diffusion of Innovations*. Collier Macmillan, London. 318 pp.

Sakala, E. A. (1992). A note on improving the supply and distribution of animal drawn implements in Zambia. ATNESA Publications Lusaka 254-255pp.

Shayo, E. (1991). Women in Agricultural Extension (Edited by Mattee A.Z, Lupanga I. J. Mollel,.N .M and Lugeye, S. C.) *Women in Agricultural Extension*: *Proceedings of TSAEE and CSE* Workshop held in Dodoma, Tanzania. 30 pp

Shetto, R. M and Mkomwa, S. S. (1996). Study of Animal Draught Technology in the Southern Highlands of Tanzania. A Survey Report IFAD-SHERFSP Mbeya Tanzania 186 pp.

Shetto, R.M. (2005). Agricultural Mechanization Annual Report, .Ministry of Agriculture and Cooperatives. Dar es-Salaam. Tanzania. 15 pp

Sign, B. B. and Mishra, O. P. (2007). Agricultural extension education. Diffusion and Adoption of agricultural innovations. In: *Journal of communication Studies. 25. (2):16-24*

Simon, C. (1992). Women's access to animal traction technology. Case studies from Darfur, Sudan and Turkana, Kenya: *In Improving Animal Traction Technology.(*Edited by Starkey P, Mwenya, E. and Stares, J*).*ATNESA Publications. Lusaka, Zambia. 280-283 pp.

Sosovele, H. (1995).Transfer of animal traction technology Cultural and social issues in Tarime District. Tanzania. *(*Edited by Starkey P, Mwenya E and Stares, J). ATNESA. Publications. 318-320 pp.

Starkey, P. (1994).The Transfer of Animal Traction Technology, some lessons from Siera-Leone*:* *In Improving Animal Traction Technology.* (Edited by Starkey. P, Mwenya E.and Stares J.*).* ATNESA Publications. Lusaka, Zambia 306-316 pp.

Stevens, P. A. (1994) Improving animal powered tillage systems and weeding technology. *Preceedings of ATNESA workshop held on 18 to 23 January 1994.* (Edited by Starkey P, .Mwenya E and Stares, J.*).*ATNESA Publications. Lusaka, Zambia. 166-181 pp.

Sylwander. L. (1992). Women and animal Traction technology. *A paper presented to the ATNESA workshop held on 18- 23 January 1992.* (Edited by Starkey P. Mwenya E and Stares. J.) ATNESA Publications. Lusaka. Zambia 261-263 pp.

Trochim, M. K. W, (2006). *Social Research Methods. Inferential Statistics.* [http://www.Social research methods, net/ kb/stat: t.php] site visited on 25 May 2009

United Republic of Tanzania (2002). *Integration of Population variable in Development Planning Part 11* Trainee Manual. Demographic Training Unit. University of Dar es- Salaam. 254 pp.

United Republic of Tanzania (2002) .*Tanzania Main Stastical Tables* National Bureau of Statistics. Government Printers. Dar-es Salaam, Tanzania. 503 pp

Uyole Agricultural Research Institute. (2003) Annual Progress Report of 2002/03 Mbeya.18 pp.

Vander Ende, S. (1991). Improving the distribution of animal traction implements in Mbeya. Oxenization Project Survey Report. Mbeya Region, Tanzania 15 pp.

Zinnah D, Samwel, N .D. and Bruening, N. (1998). Assessment of the Sasakawa Africa Fund for Extension Education in Ghana. In: *Journal of International Agricultural and Extension Education.* Vol 15 (1) 93 [http;// www.aiaee org/journal] visited on 24 July 2009.

APPENDICES

Appendix 1: Definition of operational terms

Division of labour-Activities assigned to men or to women as prescribed by the society culturally

Income- Amount one earns per month or per year (Tshs)

Crops grown – Number of crop varieties a farmer grew last season i.e. maize, beans.

Occupation- Socially acceptable activity by which one earns livelihood.

Size of land owned-number of hectares a farmer owns

Frequency of visits - Number of times a farmer has been visited by an extension agent Innovation delivered- Technological message a farmer has received from an extension agent Source of innovation-Any other organization or institution offering technical message to farmers

Training – A training a farmer might have attended.

Existing groups– Groups of farmers in a village who have common interest identified by numbers and group names.

Constituent – Composition of group members identified as male or female and whether relatives or not.

Roles played –Activities which group members did at the time of oxenization programme implementation.

Adoption- Using a plough, cultivator, planter, ox-cart and ridger at large scale in preference to hand tools.

Availability of spare parts – Presence of ox-drawn implements in stockiest shop

Local implement repairer –An artisan who locally make spare parts of some ox-drawn implements

Supplier/ Stockiest availability- Presence of ox-drawn implements supplier within a reasonable accessible distance.

Availability of implements- Situation in which implements are available and easily accessed by farmers.

Appendix 2: Questionnaire

This research aims at finding reasons which has contributed to low adoption of use of ox- drawn implements in secondary tillage. You have been chosen to be one of the resource persons to give important information which will help to accomplish this research. Our conversation is confidential. I highly appreciate your cooperation.

Respondent No.....

VILLAGE name..... **DISTRICT**..... **REGION**.....

A. Demographic information

1. Sex: (a) Male (b) Female

2. What is your age? .....years

3. Marital status; Single ( )

Married ( )

Widowed ( )

Separated ( )

4. What is your level of education?

No formal education ( )

Primary education ( )

Secondary education ( )

Others – (specify).....

5. For how long have you lived in this village.....years

6. What is the size of your family? (1) Under 18 years..... ( )

(2) Between 18-50 years..... ( )

(3) Above 50 years..... ( )

B .General information on agricultural activities

7. What is the total area of your farm? .....hectares

8. What are major crops did you grow last season?

Crops	cultivated area (Ha)
(1).....	.....
(2)	.....
(3).....	.....
(4).....	....

9. How many pairs of oxen/donkeys do you own? ( )

10. Which source of farm power do you use to perform the following farm practices?

Farm practices	Oxen/donkeys	Tractor	Hand tool
1. Land clearing			
2. Ploughing			
3. Harrowing			
4. Planting/Sowing			
5. Weeding			
6. Ridging			
7. Harvesting			
8. Transportation			
9. Threshing			

12. Do you own or hire the farm power sources mentioned above?

(1) = YES (2) = NO

If the farm power is hired, how much money do you pay for each activity?

Farm practices	Charge per hectare
1. Land clearing	
2. Primary tillage	
3. Secondary tillage	
4. Planting	
5. Harrowing	
6. Ridging	
7. Transportation	

13. Do you experience any labour shortage in your household?

(1) =YES (2) = NO

14. If YES when do you experience such a shortage? .....and how do you solve such a problem? (1)..... (2)..... (3)..... (4).....

15. For how long have you been using animal traction technology in farm operations? .....years

16. From whom did you first learn to use animal traction technology?

(1) Extension agent (2) Fellow farmer (3) Parents (4) Others (specify)

17. What farm implements do you own? (1)Ploughs ( ) (2) Cultivators ( )

(3) Planters ( ) (4) Ridgers ( )

18. Do you use animal traction technology in other activities than farming?

(1) = YES (2) = NO

If YES in question 18 what are the activities?

(1) .....

(2) .....

(3) .....

19. What is the price of the farm implements?

Plough Tshs. .....

Ridgers Tshs .....

Rippers Tshs .....

Planter Tshs .....

Harrow Tshs .....

20. Do you have an implement left idle because there is no it's spare part?

(1) =YES (2) = NO

If YES which implement? .....

C. Oxinization programme groups information

21. For those in groups how many women are members and how many men are there?

(I) Women ..... (2) Men.....

22. Are the members relatives (1) = YES (2) = NO (3) = Some are relatives

23. What was the role of group members in group formation?

(1) ..... (2) .....

(3) ..... (4) .....

24. What role did group members play in programme implementation?

(1) ..... (2) .....

(3) ..... (4) .....

D Gender analysis

25. Culturally there is division of labour, what is your system of dividing labour in your household?

(i) Mens duties

(1).....(..2).....(3).....

(4)..... (5).....

(ii) Women duties

(1)..... (2)..... (3).....

(.4)..... (.5).....

26. Are women given opportunity to use oxen?

(1) =YES (2) = NO.

(a) If yes how frequent and for what activities .....

(.b) If NO, Why.....

27. Do you have a formal meeting to discuss about resource priotisation and utilization at household level?

(1) =YES (2) =NO

If YES what normally do you discuss about?

(1).... ..... (2).....

(3).....

28. If no who normally decide on priority and utilization of household resources?

.....

E. Socio- economic information

29. Do you have another source of income aside agricultural activities?

(1) =YES (2) = NO

If YES what are the activities? .....

30. What is your annual income? ....

F. Extension services provided

31. Does your village has an extension agent

(1) = YES (2) = NO

32. How many times have an extension agent visited you in this year?

(1) None, (2) Once (3) Twice (4) Thrice (5) Many times

33. How many times have you attended any agricultural meetings in groups this year?

(1) None, (2) Once (3) Twice (4) Thrice

34. How many times has he/she given animal draught technology training?

(1) None, (2) Once (3) Twice (4) Thrice

35. What are other sources of agricultural innovations do you have

(1)..... (2)..... (3).....