ASSESSMENT OF FACTORS INFLUENCING SMALLHOLDER FARMERS' UTILIZATION OF ANIMAL DRAFT POWER: A CASE STUDY IN BUNDA DISTRICT, MARA REGION

BY

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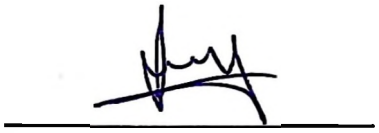
ABSTRACT

The purpose of the study was to investigate factors influencing smallholder farmers' utilization of animal draft power (ADP in Bunda District, Mara region. Six villages were purposively selected, and 17 smallholder farmers from each village were randomly selected, seven of them were using ADP, and ten others were not, making a total of 102 smallholder farmers in the study sample. Structured interview schedules were used to collect primary data on ADP users and non-users. The study reveals that the main source of income is crop production while livestock keeping and off-farm activities are secondary sources. The study reveals further that 66.7% of the ADP users and non-users earn incomes of about Tshs. 364,900/= from the sale of field crops. Observations also show that 52% of the ADP users faced, labour shortages during weeding time, high cost of spare parts and prevalent of cattle diseases. Of the 74 respondents who kept cattle, 42% of them reported that tick borne diseases are common diseases in the area. It was also found that the common diseases that affect oxen during the cropping season were foot rots, Foot and mouth disease, worms and tick-borne diseases. Also, the study reveals that most of the respondents do not control cattle parasites because of the high cattle dipping cost charges and the lack of ALEAs. Of all the ADP users, 54.8% indicated to have had learned ADP technologies from their parents (farther). Of all the ADP users, 62% indicated that ploughing using ADP is done by men, for activities such as land preparation and ploughing, while planting, weeding, harvesting, transportation, and processing of field crops are done manually by women and children. The study found that 50% of ADP users reported that DA worked from 5 am to 9 am ploughig, from 9 am to 6 pm grazing, and there no supplementary feeding.

DECLARATION

I Jane Nyanjiga Mwasiti Ngabo, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work, that it has neither been submitted nor being concurrently submitted in any other University.



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DEDICATION

God is great I dedicate this work to my late farther Ngabo and my late mother Pelusi who laid the foundation of my education and made me what I am. May almighty God rest their souls, amen.

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LIST OF ABBREVIATIONS AND SYMBOLS

ADP	Animal Draft Power
ADPT	Animal Draft Power Technology
DA	Draft Animal
AEA	Agriculture Extension Agent
ALEA	Agriculture and Livestock Extension Agent
ATNESA	Animal Traction Network for Eastern and Southern Africa
ATNET	Animal Traction Network in Tanzania
BOT	Bank of Tanzania
BQ	Black Quarter
FAO	Food and Agriculture Organization
FFS	Farmers Field School
FGD	Farmer Group Discussion
FMD	Foot and Mouth Disease
GDP	Gross Domestic Product
Km	Kilometer
MAC	Ministry of Agriculture and Cooperative
MKUKUTA	Mkakati wa Kukuza na Kuondoa Umasikini Tanzania (Poverty Reduction Strategies)
MOP	Mbeya Oxenization Project
NGO	Non-government Organization
NBS	National Bureau of Statistics
PRS	Poverty Reduction Strategies

SG	Sasakawa Global 2000
TOT	Transfer of Technology
TSAEE	Tanzania Society of Agriculture Education and Extension
UFI	Ubungo Farm Implement
URT	United Republic of Tanzania
ZZK	Zana za Kilimo (Agricultural Farm Implements)

CHAPTER ONE

INTRODUCTION

Economic stagnation, even decline, has characterized most African countries over the last two decades. Poor performance in the main economic sectors, particularly agriculture which in most cases has been growing much slower than has the population has led to a decline of per-capital income (Spencer, 1996: 68). The efforts to bring the countries' economies back to the growth path have led to a renewed interest in the role agriculture sector can play in the economic recovery of African countries. Available evidence shows a close relationship between agricultural development and economic growth. At the current level of development of African economies, it is only agriculture based activities that can bring a broad-based increase in per capital income (Spencer, 1996: 68). This puts the promotion of appropriate technology in agriculture at the centre stage in addressing the challenges facing African countries (Spencer, 1996: 68).

Agriculture is an important sector of the Tanzanian economy. In 1996, Agricultural sector contributed about 50% of the total Gross Domestic Product (GDP) and 68% of the export earnings (Bank of Tanzania, 1997). Agriculture is also the main source of food supply for Tanzanians and a source of raw materials for industrial goods. In this regard, the performance of the agricultural sector is a major indicator of the overall performance of the national economy (Bitegeko, 1997). The agricultural sector in Tanzania is dominated by smallholder farmers who form 80% of the total population

(Kaduma, 1994). Despite its high economic contribution, agricultural sector has not managed to live up to its expectations, that is, among other things, to produce enough food for the growing population in Tanzania. One of the reasons for such a low performance is the smallholder farmers over dependence on the hand hoe (Hassan, 1993).

1.1 Back ground information

The annual population growth is estimated 2.8%, while agricultural production is at 2.5% (URT, 1998a, b). This situation calls for an improvement in agricultural production to exceed the population growth. Besides the productive resources such as land, labor and capital, appropriate technologies are the decisive factors for economic growth, in country such as Tanzania where agricultural sector is predominant (Kauzeni, 1992). Increased food production needs more energy for ploughing to which ADP contributes a share. Due to high cost of tractors, draught animals (DA) are likely to remain essential farm power source for most of smallholder farmers in the African countries.

With regard to the above observations, ADP technology is even more feasible in Tanzania where over 80% of agricultural production is being undertaken by smallholder farmers. Despite being relatively cheap as, Inns (1980) points ADP technology is an attractive alternative to a tractor in augmenting farm energy and agricultural intensification. Apart from this, animal traction is also an appropriate and intermediate technology feasible to replace the hand hoe among the smallholder farmers.

1.1.1 Utilization of ADP Globally

In the early days domestic animals were only used for meat and direct personal transportation, the use of traction was a later development (Sosovele, 1986). Draught animals (DAs) originally involved the use of cattle and usually castrated males (oxen). Donkeys or cross breed of donkeys and horses (mules) came to be used in the third millennium in Mesopotamia for pulling military vehicles with solid wheels. By the second millennium pairs of horses were used to pull specialized, light, spoke-wheeled vehicle (Starkey, 1988). These later uses were a modification of a basic design for a traction system was by the fourth millennium BC, based on paired draught using a draught- pole and a yoke (Pingali et al., 1987). An effective form of paired draught in the form of the chariot was introduced in eastern Asia in the second millennium BC. While the plow and wheel appeared in the fourth millennium BC in Europe (Pingali et al., 1987).

1.1.2 Utilization of ADP in Africa

The recorded history of ADP in Africa started about 6-5000bp in Egypt with the first drawing of oxen and ploughs occurring in 111 dynasty (Ehret, 1979). These, together with the engravings of oxen and plows in early Mesopotamian civilizations, appear to constitute some of the earliest records of ADP in the world. Several ancient Egyptian illustrations clearly show that the animals used for plowing were cows. Cows started to be employed when smallholder farming became intensive, when animals feed resources were limited and when the work operations were light or highly seasonal. In North Africa, the ADP technology has spread from ancient Egypt south wards into Sudan. The technology has also spread around the Mediterranean,

and it was probably widespread along the coast of North Africa for over 500BC. ADP has been an integral part of farming and transportation systems in North Africa for over 2000 years, and there is now a wide range of species and technologies in use. Animals used as DA were Camels but sometimes horses can be used for riding, recreation and pulling carts. Horses can also sometimes assist with cultivation while Mules assist in soil tillage.

Ox-drawn plows appear to have been used in Ethiopia for at least two millennia, and possibly much longer. The *ard* plow was introduced 2600-3000 years ago by Semitic-speaking peoples from South Arabia (Simoons, 1965). Another view is that the plow was already in use at this time, having spread from Cushitic speaking peoples of Nubia in northeast Sudan (Simoons, 1965). Linguistic evidence suggests that the *ard* was in already use several millennia before the South Arabia invasion, and this might make the Ethiopian plow the oldest technology in Africa (Ehret, 1979). The plowing animals are generally oxen, but where oxen are in short supply, horses, donkeys or cows may be used, but the oxen are the work animal of choice. Camels are occasionally used for cultivation but ox-carts do not appear to have been part of Ethiopian traditional systems, and therefore this technology uncommon in this part of the world.

In most of the sub-Sahara African countries, ADP for tillage and wheeled transport was introduced during the colonial period. The process of introduction and adoption is still continuing. Thus, in much of sub-Sahara Africa, the necessary social, environmental and agricultural conditions which favour the use of plows have not

really existed. Hence there are still some parts of Africa where the plow is not really economically justified. The failure of ADP to spread into some semi-humid areas in recent decades is partly explained by the lack of the appropriate preconditions (Starkey, 1986a and 1992; Pingali *et al.*, 1987). Sub-Sahara Africa countries which made some attempts to introduce ADP for cultivation operations include Senegal (1850), Botswana and Angola and Mozambique (1880). Other attempts were made before the First World War in the German colonial farms of Cameroon and Togo. However, it was not until the period between the two world wars, especially the 1930s when other attempts were made in Mali, Senegal, Upper Volta, Ghana, Nigeria, Zambia, Malawi and Zimbabwe (Starkey and Faye, 1990).

In most of the sub-Sahara Africa countries (with exceptional of Senegal), oxen were promoted and used as main work animals. Horses were of high status and expensive and in tropical Africa they only thrive in highland areas. Donkeys were considered too weak to plow and were mainly used for pack transport (Starkey, 1994a).

The use of ADP was first introduced in the coast and river ports in most countries of Africa in the seventeenth, eighteenth or nineteenth centuries (Law, 1980). At the end of nineteenth century, and in the early years of the twentieth century, animal power played a crucial role in the agricultural, mining and transport sectors of the growing economy of South Africa. Animals were used for urban and rural transport, they were used in mines and they ploughed for both large-scale (white) and small scale farmers. For example Madagascar ADP has been long established. One report (van Nhieru, 1982) suggested that ADP was introduced into Mantasoa region during the

regency of Queen Ranavalona 1 in (1828-1861). This is broadly in line with the period of 1850-1880. Guinea was already discussing the idea of using animal power in local farms way back in 1910 Octchere, *et al.* (1988) with the aim of increasing agricultural production. ADP had been established in Sierra Leone in 1928, but its expansion has been slow. Promotional schemes in the 1950s and which gain momentum in the 1980s led to further adoption the technology encouraged by support services such as equipment provision, credit and training (Starkey, 1981; Bangura, 1990 and Starkey, 1994a). Prior to 1955 there was virtually no use of DA for crop cultivation in The Gambia. ADP became a normal part of farming systems in The Gambia in the period of about one Generation ago (Mettrick, 1978; Starkey, 1986b and 1988 and Haswell, 1991).

In Uganda, colonial farmers and British authorities introduced ox-plows for cotton production in the Teso District (east) at the beginning of the twentieth century. The technological uptake was rather rapid, with a favorable combination of training centres, availability of animals and implements and a cash crop production (Kinsey, 1984). In 1903, European farmers and traders started to settle in the Machakos District of Kenya. They used heavy plows that required a team of six animals. There was no formal promotion of ADP at that time, but plows were available from trading stores. Some local Kamba farmers apparently started using ox-plows in 1910 (Tiffen *et al.*, 1994).

1.1.3 Utilization of ADP in Tanzania

In Tanzania, some settler farmers around Arusha used ADP around the beginning of

the twentieth century, but the need for the technology was not considered as great since human labour was readily available. The German colonial authorities attempted to introduce ox plow and harrow ox plow in 1910, with the aim of increasing food production for exports from the colon. In 1920s, missionaries and setters introduced ox-plows in places such as Shinyanga, Mwanza Tarime, and Handeni. By 1945, ox-plows were in use in areas that produced rice, cotton, and maize for commercial purposes (Iliffe, 1979; Kjaerby, 1983; Sosovele, 1991). Through the middle decades of the twentieth century, ADP spread slowly into several parts of Tanzania mainly through informal diffusion rather than active promotion. The initial spread of animal draught power was spontaneous, mainly through farmer to farmer contacts and due to commercial production of cotton, rice, coffee, tea, and wheat (Mkomwa, 1991).

Despite the introduction of cash crops wage labour availability of favorable markets, availability of AD and production facilities (ox implements), and availability of support services such as advisory services, credits and input supply influenced the use of ADP in Tanzania (Fischer *et al.*, 1991). This made it possible for a wide spread utilization of oxen in Mbozi, Kyela, Mufindi and Tarime in the 1950s as well as in Sukuma land where smallholder farmers encouraged with cotton cultivation enhanced the use of ADP technology. In Singida, Dodoma and Rukwa regions, ADP was mainly used in the field for sorghum and finger millet growing. Therefore cattle (oxen) are mainly used for cultivation, but they can also be used for transport. In Tanzania carts are very rare, thus, adoption of ADP appears to be limited due to low availability of carts and (or components), this is apart from the fact that they cost dearly to acquire (Sosovele, 1997).

After independence in 1961, the government paid more attention on the use of tractors than on use of ADP technology (Kjaeby, 1983). For example, in mid- 1960s and early 1970s Tanzania introduced subsidized tractor hire services to modernize agriculture by encouraging farmers to use tractors than oxen in farming. However, these efforts failed because the use of tractors was capital-intensive and most smallholder farmers could not afford (Mtenga, 1991). Policy makers and some agriculture professionals believed that the extensive use of tractors could also pick up in Tanzania, thus ADP technology was not given the deserving attention, and it was almost omitted from the curricula of agricultural institution (Kayumbo, 1991). In this view, graduates left institution with little formal training on the use of ADPT for them to impart the knowledge and skills to farmers. Even credit institutions, have paid much attention on loans for tractors than for ADP in assisting smallholder farmers, a move which has affected utilization of ADP by smallholders farmers (Sosovele, 1995).

The utilization of ADP in Bunda District, might be triggered by a flow of information by migrant farmers from (Bunda District) who had seen ADP in Tarime District, and wanted to try it their own villages. According to Sosovele, 1991 and 1997 and Koponen, (1994), cited by Sosovele (1997 the adoption of ADP was assisted by a widespread of plows which were commercially marketed by traders of Asian origin. Smallholder farmers in the study area have been utilizing DAs for ploughing and some of these smallholder farmers have been using ADs for ploughing and harrowing (second ploughing). Secondary farm operations (planting, weeding and ridging) are done by smallholder farmers using a hand hoe, thus a

longer time is needed to accomplish such operations. In view of this, it was deemed important to carry out a study to investigate factors influencing smallholder farmers' utilization of ADP technology in Bunda District.

1.2 Problem Statement

The extensive utilization of ADP technology in Bunda District has greatly been influenced by the expansion of cotton, maize, sorghum and finger millet production. This has been possible because through the utilization of DAs (oxen) in ploughing, more areas have been put under crops than would have been the case if a hand hoe was used, This rational use of animal power as a technology in agriculture, as pointed by Chirgwin (1996) has the potential of contributing significantly to economic and sustainable development and in particular to improving the living conditions of smallholder farmers.

Smallholder farmers in the study area have been utilizing DAs for ploughing and some of these smallholder farmers have been using DAs for both ploughing and harrowing (second ploughing). Secondary farm operations (planting, weeding and ridging) are done by smallholder farmers using a hand hoe, thus a longer time is needed to accomplish such operations. Kilemwa (1993) and Mbegu (1996) note that the adoption of ADP technology had increased the area under crops production, initially smallholder farmers had large fields that were not well managed as hand hoes were still used for doing secondary farm operations. According to Kwiligwa *et al.* (1992) the use of a hand hoe ultimately contributes to crop losses due to weeds. On the other hand, smallholder farmers are using hand hoes in all farm operations

while plows are laid idle in their households due to high price of spare parts. In order to maximize the utilization of ADP, Shetto and Kwiligwa (1992) point out that oxen have to be utilized in all farm operations throughout the year.

Despite that smallholder farmers had been using ADP for many years in Bunda District, this has been the only district in mainland Tanzania with the highest rate of income poverty according to the 2005 Poverty and Human Development Report. The report indicates that as many as 68 percent of people in Bunda district live below the poverty line. Or with respect to the rate of poverty gap, again Bunda was the worst district in the region for having the highest rate of poverty by 28 percent. This data call for the extensiveness use of animal draft power to increases agricultural production in order to increase food and income rates in the district. Up to 2008, no efforts had been made to determine the factors that influence the utilization of ADP in agriculture farming. The purpose of this study therefore, was to investigate the factors influencing smallholder farmers' utilization of ADP in Bunda District.

1.3 Significance of the Study

Mechanization in agriculture is an important factor in increasing agricultural production. According to Roling (1994) mechanization of agriculture through application of technology is essential for agricultural development. Low utilization of ADP technology as indicated in the previous sections is one of the factors contributing to low crop production per unit area in Bunda District. In view of this, the result of this study would increase the understanding of the social economic aspects, problems and other important issues concerning the utilization of ADP in

agriculture. The study findings would enable policy makers, extension agents and other rural development practitioners to set strategies meant to increase dissemination of knowledge on ADP technology in the rural areas. Also, the study results would assist the government to find solutions to the utilization of ADP in Bunda District and in Tanzania as a whole. Furthermore, the study is in line with the national objectives of reducing poverty as outlined in the Poverty Reduction Strategy (PRS) currently known as MKUKUTA. In view of the aforesaid, this study addressed the following objectives.

1.4 Objective

1.4.1 General objective

The overall objective of this study was to investigate factors influencing smallholder Farmers utilization of animal draft power.

1.4.2 Specific objective

The specific objectives of this study were to:

1. Assess the socio-economic factors that influence the smallholder farmers' utilization of animal draft power.
2. Examine factors that influence the utilization of animal draft power by smallholder farmers.
3. Identify the extent to which smallholder farmers utilize animal draft power in the households.

1.5 Hypothesis

1. Ho: There are no factors that influence smallholder farmers in utilizing animal draft power in agricultural activities ($Ho_1=Ho_2.....=Ho_n$)
2. Ho: There are no socio-economic factors that influence smallholder farmers in utilizing animal draft power in agricultural activities ($Ho_1=Ho_2.....=Ho_n$)

1.6. Operational definition of words used in this study

Age:	Absolute years since one was born.
Gender:	Being a male or female biologically.
Marital status:	Status of marriage of a person (single marriage, Widow, divorced).
Agriculture:	The science and art of raising crops and livestock.
Smallholder farmer:	An individual who engages in raising crops and livestock.
Education level:	Level of literacy (Years of schooling).
Income:	Monetary value of earnings of the household per given period.
Mule:	Non-breeding hybrid animals produced through crossing a female horse with a male donkey.
Bull:	Non-castrated of male cattle of any breed.
Ox:	Castrated bull that is used for draft power.
Draft:	Use of cattle for tillage or transport by including pack transport as well as the "pulling".
Availability of animal-	The physical presence of animal-drawn implements,

drawn implement:	harnesses, spare parts, repair services at the smallholder farmers household.
Non availability of animal drawn- implements:	Animal drawn- implements which are physically not present for animal draft in an area.
Animal draft power users:	Smallholder farmers owning and utilizing animal draf power
Non-animal draft power users	Smallholder farmers not owning animal draft power but use animal draft power by hiring from animal draft power owner
Affordability:	The ability of smallholder farmers to procure ADP own animal-drawn implements, spare parts and services.

1.7 Theoretical framework

The transfer of technology model that emanates from diffusion of innovation theory is basically bureaucratic and hierarchical in nature. Jiggins (1989) postulates that the efforts in modernizing agricultural technology development and dissemination made by most of the developing countries have been the station-based and top-down focused, commonly known as linear or Transfer of Technology model of agricultural innovation, the process in which administrative authority introduces the technology and it is the perceptions, decisions and strategies of the administration authority that drive the adoption and diffusion. According to Rutatora (1994) this model hampers upward communication of problems and clarification of issues and insights from smallholder farmers. This approach was contradictory and inappropriate in the case of dissemination and utilization of ADP technology because it does not seek the

opinions of the end users (smallholder farmers) of the technology (Kjaerby, 1983). Even if researchers such as Mattee (1994), Rutatora and Rutachokozibwa (1995), Arokoyo (1998) assert that utilization of improved agricultural technologies has a tremendous effect on promoting increased agricultural productivity, the approaches have been inappropriate and unsustainable because of their bureaucratic nature (rendering them as non participatory). This situation tends to limit the involvement of smallholder farmers in the technological development and utilization that are compatible with their local situation. Many donor supported agricultural development programmes (and within the framework of assisting smallholder farmers to modernize agricultural production) have missed the strategies for dissemination of these agricultural technologies.

According to Kjaerby (1983) bottom-up approach and the desire for innovation often emanate from the users of the technology. In the case of dissemination and utilization of ADP technology the opinions of the end users (smallholder farmers) ought to be sought. This situation tends to involve smallholder farmers in the technological development and utilization that are compatible with their local situation. This study is in line with the perceived attributes theory. According to this theory, there are five attributes upon which utilization is judged: that it can be tried out (triability), that the results can be observed (observable), that it is not overly complex to learn or use (complexity) that it fits in or is compatible with the circumstances into which it will be utilized (compatibility). Other attributes that affect the rate of utilization/adoption of the technology include socio-economic factors, the extent of efforts of change

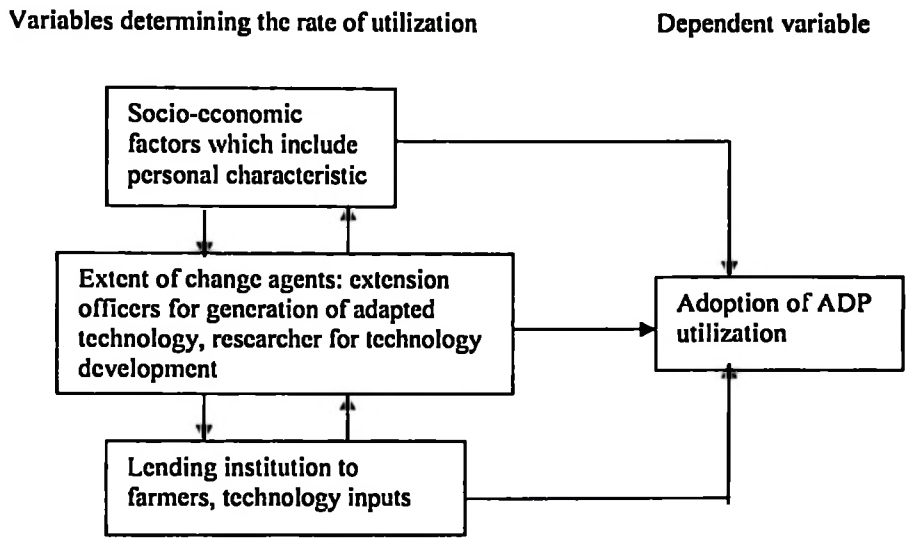

Figure 1: Variables which influence the adoption of the utilization of the technology

agents in diffusing the technology, and the availability of lending institutions. These can lead to either utilization or rejection of the technology innovation (figure 1). The theoretical frame work above indicates some of the variables which can lead to either utilization or rejection of the technology innovation. Also these variables are all integrated in the production system. From the theoretical framework some variables determining the rate of innovation theory of the utilization of the technology was modified to provide the conceptual framework with the independent variables and the dependent variables in order to meet the purpose of the study. The theoretical framework summarizes the attributes that may influence the utilization of technology.

1.8 Conceptual Frame work

A conceptual framework helps to indicate the most useful area (s) in which to concentrate the limited resources and to ensure that the data collected are relevant to

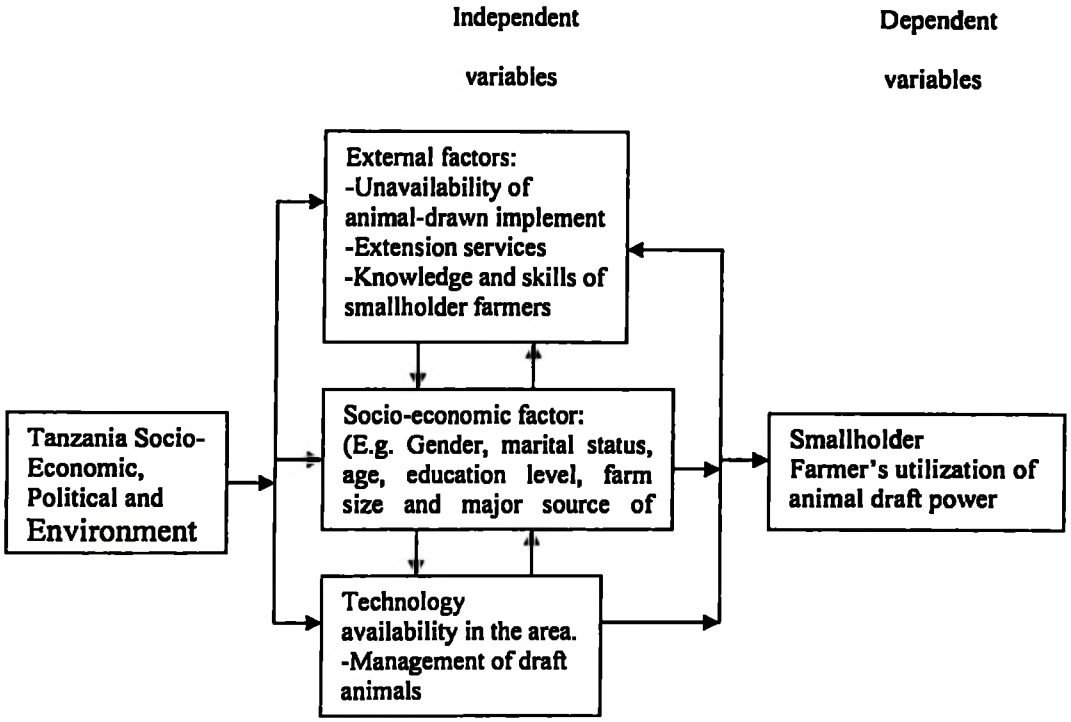

Figure 2: Conceptual framework of assessment of factors influencing smallholder farmers' utilization of animal draft power

the objectives of the research (Scarborough and Kydd, 1992). The framework binds the facts together and provides guidance towards the collection of appropriate data or information (Katani, 1999). The livelihood of communities depends on food security and income. However, food security is influenced by many factors including the efficiency of production system. Animal draft power in agriculture is an important factor that influences production in agriculture. Smallholder farmers' utilization of animal draft power is influenced by socio-economic factors such as gender, marital status, age, education level, land size, and sources of income. Other factors include non availability of animal-drawn implements, ineffective extension services, knowledge and management of draft animals (oxen) in relation with disease control, nutrition status, the age of the animal for castration, the age of the bull for draft, and

the presence of the technology in the area. Figure 2 shows a conceptual framework showing the relationship between factors that influence smallholder farmers' utilization of animal draft power.

1.9 Organization of the study

This study is organized into five chapters. The introduction is presented in Chapter One which describes the general parameters of the research. Chapter Two reviews literature related to the study by presenting the historical overview of ADP development and its utilization in the world, followed with a discussion on ADP in Africa and utilization of ADP in Tanzania and finally factors influencing its utilization. Chapter Three describes the methodology used in this study, while Chapter Four presents the study results. Chapter Five presents conclusion and recommendations of the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter reviews literature related to this study. The first section presents an overview of animal draft power (ADP) utilization in the world, Africa then in Tanzania with a brief description of its development and utilization. The second section presents the extent to which ADP has been utilized in Tanzania. Finally, the chapter describes factors influencing ADP utilization technology in Tanzania.

2.1.1 Overview of ADP Globally

In the early days domestic animals were only for meat and direct personal transportation, the use of traction only followed later. Animal draft power is widely used in the world today, especially because of its importance for food security in smallholder farming system. (Falvey, 1985). ADP is widespread and predominant in Asia and Latin America where it has been expanded and diversified. In the highly urbanized and industrialized countries such as India, Mexico and Brazil large scale farmers use tractors and long-distance transport systems which depend on engine power. At the same time, the many small-scale farms and local transports continue to use animal power (Starkey and Mutagubya, 1992). This pattern of using tractors on large farms and animal powered mechanisms in small farms is common worldwide. Even in highly developed regions such as the European Union, animal power remains as important in areas where there are farms of small size (Spain, Portugal, Greece) (Starkey and Mutagubya, 1992). Many farms in the United States are run

profitably by Amish farmers using only animal power (Starkey and Mutagubya, 1992).

2.1.2 Utilization of ADP in Africa

In sub-Saharan Africa, except Ethiopia, where animals have traditionally been used for draught the attempts to introduce ADP for cultivation operations were made during the colonial era when draught power still played an important role in agricultural production (Ehret, 1979). The earliest attempts in the adoption of the technology were made in the 19th century in Senegal (in 1850) and in Botswana (in 1880) and probably in Angola and in Mozambique (Starkey and Faye, 1990).

A second series of attempts were made before the First World War in the German colonial farms in Tanzania, Cameroon, and Togo. However, it was not until the period between the two world wars, especially the 1930s these efforts gained a serious momentum both in the francophone and Anglophone countries, Madagascar, Guinea, Mali, Senegal and Upper Volta for the former and Kenya, Ghana, Nigeria, Zambia, Malawi, Zimbabwe for the latter (Fischer, 1994). It is Ethiopia and in Botswana, where for totally different reasons animal traction is widely used. As for Ethiopia its agricultural history stand above the rest of sub-Sahara African, being far more a kin to the Middle East where ADP is an ancient tradition Simoons, (1965). In Botswana, where a team of four or six oxen are often used ADP, only 38% of farmers own draught animals but more than 90% of the smallholder farmers use ADP for cropping operation (Starkey, 1986a).

2.1.3 Utilization of ADP in Tanzania

According to Kwiligwa *et al.* (1992) the efforts to promote utilization of ADP technology in Tanzania for the purposes of measuring agricultural production through the use of animals (oxen) started as early as 1920s when missionaries and setters introduced ox-plows in different places like Shinyanga, Mwanza, Tarime, and Handeni. By 1945 ox-plows were in use in areas that produced rice, cotton, and maize for commercial purposes (Iliffe, 1979; Kjaerby, 1983 and Sosovele, 1991). The period between 1961 and 1970s was characterized by stagnation in the adoption of ADP technology in Tanzania. This was due to the fact that after independence the spread of ox-cultivation was interrupted by the government which gave more emphasis on engine powered mechanization especially after subsidized tractor hire service schemes were introduced.

A shift of interest to tractor mechanization that took place, while the use of ADP technology had not developed beyond pulling of plows, slowed the process of technology dissemination and utilization to many smallholder farmers. Moreever, lack of an elaborate institutional mechanization and policy framework to guide systematic development and utilization of ADP technology led to the adoption of oxen for ploughing purposes only (Sosovele, 1993). However, the tractorisation drive was difficult to sustain among smallholder farming system due to high costs and mismanagement as many tractor users had low income, and lacked the necessary skills. Furthermore, the nation economic recession and oil crisis that occurred in the mid 1970s led to the collapse of most tractor programmes that had started in the 1960s (Mtenga, 1991). Gradually, the government began to pay more attention to the

use of ADP and this was done through a combination of measures including Campaigns, Policy formulations, infrastructural support aiming at promoting ADP technology in farming (Mothander *et al.*, (1989).

According to Kwiligwa *et al.* (1992) other government effort regarding the promotion of ADP technology include industrial mass production of ox implements (ploughs) and spare parts at Ubungo Farm Implements (UFI) and Mbeya Farm Implements factory (ZZK). In additional, other measures which also contributed to an increase in the adoption of ADP included donor funded projectsby donors, such as the Iringa Oxenization project, Mbeya Oxenization Project (MOP) and Tanga Animal Traction Technology Project. Later in 1990s other projects supported by the Sasakawa Global 2000. Mensah (1996), however, criticizes the sustainability of externally donor funded programmes by arguing that political commitment is vital and that should be supportive if sustainable agricultural development is to be achieved. According to Mensah (1996) despite much funding from external sources the technology transfer and utilization among smallholder farmers has remained the main obstacle in achieving objectives of most agricultural and rural development programmes. From this point of view most donor driven programmes, with the goal of modernization of agricultural production, have, however failed to come up with best ways of improving the living conditions of rural communities. From a qualitative point of view most of these donor assisted programmes had failed because they were not compatible with the local situation (Mensah, 1996).

2.2 Technology availability in the area

In Tanzania, smallholder cultivation accounts for 80- 85% of the total area under cultivation while the hand hoe being the source of power, and only 15-20% comes from animal traction much of which is by oxen (Simalenga and Hatibu, 1994; MAC, 1997). Studies on utilization of ADP have shown that, the utilization level vary greatly from 80-100% for ploughing and 50-23% for secondary farm operations among smallholder farmers owning oxen (Kilemwa, 1993; Mgaya, 1994; Simalenga and Hatibu, 1994). For example, Mgaya (1994) reveales that of the smallholder farmers owning oxen, in Mbozi District 100% used them for ploughing, 3% for transport (mainly by sledges), 23% for weeding and 10% for ridging. Also, Mgaya *et al.* (1994) study in ten regions in Tanzania mainland reveales that utilization of ADP amounted to 100% for ploughing, 85% for transport, 16% for planting and 5% for weeding.

In the case of Rukwa region (particularly in the Ufipa plateau), a survey of 322 farmers showed that 90% used oxen for ploughing, 78% for transport (by sledges) and 2% for transporting using ox-carts, 16% for planting and weeding. (Kilemwa, 1993).The utilization of ADP in Tanzania is more restricted to energy- intensive activities such as ploughing and transport. For secondary farm operations such as sowing, weeding and ridging because such tasks require more precision, animal power utilization is low. Low utilization of animal power means under-utilizing of ADP and thus negatively affecting crop production (Bordet, 1997).

2.3 Factors Influencing Smallholder Farmers' Utilization of Animal draft power

This section describes the factors influencing smallholder farmers' utilization of animal draft power by sighting socio-economic factors of smallholder farmers, availability of animal-drawn implements, ineffective extension system, knowledge and skills of smallholder farmers and management of draft animals.

2.3.1 Economic factors

Most of the farmers have low income making the technology unaffordable to majority as only a few are able to invest on animal traction technology (Fischer, 1994). The income level of farmers has an impact on the adoption of ADP technologies and on the recommended agricultural practices. Syvret (1991) contends that, the low producers' price and unreliable markets for crops grown by farmers means low capital to invest in technology. Availability of investment capital does influence the adoption of animal draft power technology (Starkey, 1990). Un availability of animal-drawn supplies by subsistence farmers require unconventional interventions to facilitate its introduction or / and adoption (Sosovele, 1995). While credit for farmers is classified as an unconventional intervention in Tanzania, Adesina (1992) argues that, equipment or credits are necessary if both oxen ploughing, planting and weeding are to be adopted. Crees (1992) reports that lack of capital in investing in technologies have been ranked high in Tanzania and in other developing countries. In the same study Adesina (1992) observes that the amount of labour per hectare was lowest for farmers utilizing oxen for both ploughing and weeding than those utilizing oxen for ploughing only, and that the use of this

combination maximizes ADP technology use. Substantial income gain was realized when the complete oxen tillage was utilized than when it was used for single operation.

According to Starkey (1996) ADP is appropriate and affordable technology as opposed to tractor, and requires low initial capital for purchasing implements and animals. Most of the North America households and business cannot function without credit (Jaega, 1984). Government-control banks, aid agencies and more recently, private banks are all very wary of credit schemes because of the failure of earlier intervention. Experience from elsewhere in Africa including Mali, Togo, Benin, Cameroon and Cote d' Ivoire have shown that the provision of credit by crop marketing organizations and financial institutions has lead to widespread adoption of animal traction (Starkey and Faye, 1990). It is becoming more obvious that the agricultural sector is not given adequate attention as Tanzania's key economic sector (Sosovele, 1991). This is reflected in the current government's shift of policy emphasis to issues such as trade liberalization and privatization. The government reduced its commitments to agriculture-related activities and the development of animal power was left in the hands of farmers and some donors who may not be able to address all the pertinent issues (Sosovele, 1991). This situation raises concern, on the manner these changes impinge on the development of animal traction and on the manner in which agriculture would be put at the centre of development policies in Tanzania.

2.3.2 Availability of Animal-drawn Implements

Availability of animal -drawn implements and spares has a fundamental influence on whether or not a farmer adopts animal power technology because it is impossible for farmers who cannot get implements to oxenize. Availability of animal –drawn implement is defined as the timely physical presence at the farmers' place of residence of animal-drawn implements, harnesses, spares, repair services and technical know how. Animal drawn- implements, which are physically present in the area could still be perceived to be unavailable if farmers are not aware of their existence- a problem of education and promotion. According to Jumbe (1994), the availability and prices of implements influence the utilization of ADP technology. Jumbe (1994) further points out that low availability and poor distribution of ox-implements in Southern parts of Tanzania restrict a wider utilization of ADP technology.

2.3.3 Extension system

The evolution of public agricultural extension reached its worldwide turning point in the 1980s. Such changes suggest a refocusing of paradigms for delivery of public sector extension in developing countries. In developed industrialized countries, which often provide models for extension service delivery elsewhere, the declining relative importance of agriculture for economic growth, the increasing education and influence of smaller populations of rural producers, and the increasing use of externally purchased inputs have changed the nature of extension services (Starkey, 1994). In developing countries, where publicly funded extension services are often

more important, there has been a considerable questioning of the structure and form of extension delivery.

Extension service is a major institutional factor in influencing the extent to which ADP technology can be utilized (Starkey, 1994; Fischer, 1994 and Kayumbo, 1991). In Tanzania, agricultural and livestock field extension officer have been found to be ill trained on ADP technology and hence could not transfer such knowledge and skills to farmers (Kayumbo, 1991). As Fischer (1994) points out in areas where ADP technology had been introduced, most farmers learned how to use it from fellow farmers rather than through extension officers. According to Starkey (1994) the national extension services have generally provided relatively formal, top-down training. This has effectively taught farmers to start to use work animals in areas where ADP was unknown. The farmer- led innovations and significant impact for more successful ADP extension programmes have been in areas of introduction than in areas where the draft animals are widely used (Starkey, 1994).

2.3.4 Knowledge and skills

It cannot be assumed that a smallholder farmer in Tanzania may adopt a technology which he/she does not know. In this view, the adoption of ADP technology would be difficult because many smallholder farmers were not trained on the use of the technology and its advantages. As Starkey (1996) points out, the successful utilization of ADP technology depends on the manner in which the oxen are trained and on the farmer's technical knowledge. According to Mgaya (1994) the levels of farmers' education have an influence on utilization of oxen. The accuracy and quality

of work performed by AD is greatly influenced by ease and effectiveness of control (Inns, 1980). Un trained ADP users would not know what to do with the oxen while ploughing or carting. Knowledge and experience is vital for efficient use of ADP technology.

2.3.5 Management of draught animals

2.3.5.1 Livestock diseases and parasites

Many areas of Tanzania experience relative humidity and high temperatures which are favorable for growth and reproduction of diseases causing organisms, biting flies, intestinal worms, ticks and tsetse flies all of which have an influence on the extent to which ADP can be utilized (Mwasha,1989). The heavy work load of draft animals predisposes them more to diseases and traumas than they do to any other animals (Lefevre and Lhoste, 1993). Fatigue, owning to physical stress can stimulate latent diseases or aggravate symptoms for diseases such as trypanosomiasis. Draught animal (oxen) and other cattle must be vaccinated against prevalent diseases (e.g. lumpy skin diseases, foot rot, black quarter, and foot and mouth diseases). Regularly dipping to control tick-borne diseases is important (Payne 1990), more ever it is worth noting that when draft cattle are stall-fed, special attention should be given to the control of worms and mange. Lefevre and Lhoste (1993) have made a detailed review of main diseases affecting draught cattle which are mainly linked to working conditions, and these include contusion, wounds and fractures which are linked directly to traction. Diseases of economic importance in draft animals include dermotophilosis, lumpy skin diseases, empizootic lymphangitis and external

parasites (Lefevre and Lhoste, 1993). According to Mwasha (1989), in areas with highly infested with tsetse flies, livestock is restricted due to high incidence of trypanosomiasis and this has implications on the extent to which ADP can be utilized.

2.3.5.2 Nutrition status

A working animal derives its nutrients from intake and digestion of forage. Other nutrients are mobilized from the body reserves for muscle contraction and for the function of other organs. Under low intensity of work, muscles can draw energy from circulating nutrients supplied by the diet as this prolonged work and then free fatty acids and glycogen from the body stores are mobilized to sustain muscle contraction (Pearson and Fall, 1993). In many parts of sub-Sahara Africa, during the growing season grazing alone is unable to meet even maintenance requirements of the animal. This is because digestible energy and nitrogen content of natural forages reach a maximum level during the growing season, but fall during the dry season. Draft animals deprived of energy will lose weight and become weak, reaching a poor physical condition for work during plowing time (Crees, 1992). Soller *et al.* (1986 and 1991) found that feed intake is high during pre- work period and lowest during the post work periods. This implies that oxen are not able to meet the highest requirements for work by increasing feed intake hence there is a need to feed the animal well before the ploughing season begins. This can be achieved by Multipurpose growing of fodder species and giving supplementary ration which are often unaffordable by small-scale farmers.

In Tanzania the use of preservation of multipurpose fodder like maize Stover, rice husks, and beans strews may be more appropriate to fed animals during the dry season before the ploughing season begins. Generally, animals should be in good body condition prior to working season if animals are to perform efficiently (Goe, 1983; Abbiye *et al.* 1986; Octchere *et al.* 1988 and Mohamed-Saleem and Kafman, 1989).

2.3.5.3 Age of castration

Male animals that have to be chosen for work are often castrated to reduce aggressive behavior. The age of castration varies from 0.5 to 5.5 years (Payne, 1990) and it is recommended that castration be done between the ages of 1.5 years (Octchere *et al.*, 1988). Early castration before one year cause less stress, but suppress muscular development of the animal's fore and hind quarter, especially the shoulder, neck and thigh areas which are important for traction. In Tanzania, however, no information has been made to substantiate the effect of the age of castration on work performance. It has been recommended that castration should be done shortly before the onset of the rainy season (Octchere *et al.*, 1988). This is to minimize insect infestation and ensure ample feed supplies.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter describes the methodology used in this study. It covers the description of the study area, research design, description of the sample and sampling procedure, pre-testing of the questionnaire, as well as data collection, processing and analysis procedures.

3.2 Description of the study area

The study was conducted in Bunda District, which is one of the five districts in Mara region. Other districts include Tarime, Serengeti, Musoma rural and Serengeti. The district is located at the southern end of Mara region, about 65 kilometers from the regional headquarters (Musoma). It lies adjacent to the south east shores of lake Victoria, from which it is separated by wide plains which stretch into the lower and flatter lands of Serengeti district on the eastern side, Musoma Rural district on the north, Magu district in Mwanza region and Bariadi district in Shinyanga region on the south, while Ukerewe district of Mwanza region is located on the western side of the district. The district was purposively selected as the area of study due to the fact that the district has the highest rate of income poverty in the mainland. Six villages were involved in this study; two of them are from the same Ward and Division. These villages, Wards and Divisions include Mariwanda and Kihumbu in Hunyari Ward of Chamriho Division, Tairo and Kinyambwiga in Guta Ward of Serengeti

Division, Buzimbwe and Kabainja in Butimba Ward of Kenkombyo Division. In terms of International identification the district lies between $01^{0}30'$ and $2^{0}45'$ south of the equator and between $33^{0}39'$ and $34^{0}05'$ East of Greenwich.

Bunda district lies in the lowlands of Mara region. The rainfall pattern is closely related to that of the other districts of Mara region with the exception of the short rains which are relatively unreliable. The district is characterized with a dry tropical type of climate with rainfall ranging between 700 and 1250mm. The area receives a binomial type of rainfall which includes long rains between March and May, and short rain between October and December (Cleovoulou, 2001). Temperature ranges between 20 degree centigrade in June and October, and 35 degree centigrade between January and March. The area is flat to hilly and whose soils are vertisol clay with imperfect drainage (Matekere, 1999).

Bunda District is primarily an agricultural and livestock keeping area. The chief cash crop is cotton and which is mostly grown by smallholder farmers; other crops grown include maize, sorghum, cassava, sweat potatoes and paddy (URT, 2005a). Cattle are kept for the provision of milk, meat, dowry payment. Cattle are also used for ploughing while goats and sheep are used for meat and for supplementing dowry payment. Livestock and livestock products are sold to meat social needs such as school uniforms and medical care. In other areas donkeys are kept for the transportation of domestic goods (URT, 2003a). There are two ginning factories in the district which along with the local government are the largest employers. However, most people are self- employed working either in the agriculture and

fishing sectors or in self operated micro- enterprises such as small shops and marketing stalls.

The 2002 National Census indicates that the district has a population of 258,930 people. This census also indicates the annual growth rate of 1.8 % which is below the regional growth rate of 2.6% and the national average growth rate of 2.4%. However, the projections for 2007 put the district population at 311,087. Out of which, are males 160,521 and are 150,566 females with an average population density of 93 persons per square kilometer. This is considered to be a moderate densely populated district compared to other rural districts of Mara region. The Population density of Bunda District which is slightly above the regional average of 70 persons per sq. km is the third largest of the rural districts in the region. The relatively large population density of Bunda District is attributed to both its relative small land area and the number of residents (NBS, 2007).

3.3 Research Design

The design of this study was a cross-sectional survey method, which allowed the collection of data at one point in time. The design is quick, appropriate for simple statistical descriptive purpose and interpretation and it also makes it possible to determine relationship between variables (Babbie, 1990). The nature of the study objectives and limited resources in terms of time and finances convinced the researcher that the design would be appropriate for the current study.

3.4 Sampling Procedures and Sample Size

The population of the study included all villagers in six selected villages. Systematic sampling technique was used to select the sample population. The sampling technique was under two stages. The first stage involved a purposive selection of Division, Wards and Villages based on high population of cattle in the District. Three Divisions were purposively identified; one Ward was selected from each Division and two Villages from each selected Ward. The second stage involved the selection of 17 community members from each selected Village. The names of farm household head who deal with animal draft power /ox cart or both and non users were obtained from respective Village Executive Office. Each of the selected Village had seven users and ten non users of animal draft power. Hence a sample of 102 was considered as reasonable for statistical analysis (Hair *et al., 2006*).

3.5 Pre-testing of the Instrument

The interview schedule (survey instrument) was pre-tested before being subjected to the field for actual data collection in order to ensure their reliability and validity. Pre-testing of the interview schedule was done under similar field conditions where nine farmers were randomly selected, these were later not included in the study. The pre-testing was done to check for any discrepancies and ambiguities in the wording of items (that is, for clarity, meaningfulness and comprehensiveness), so as to obtain the views of the respondents with respect to certain items of the questionnaire. After the pre- testing the interview schedule, was revised accordingly. No major changes in the context were made and a few items which were not clear to respondents were either changed or modified.

3.6 Data Collection Procedure

Primary data were collected through structured interview schedule administrated to the selected users and non-users of animal draft power to get quantitative data. The structured interview schedule consisted of both closed and open-ended questions. The researcher also carried out direct observations to verify some of the information given during the interviews. Secondary data was obtained through a review of documentary information from SUA library, websites, official reports from the district, Wards and Village files using researchers diary.

3.7 Data Analysis

The data gathered from household heads of users and non users of animal draft power was summarized, coded, compiled, analyzed and verified so as to make reasonable conclusion based on the study sample. The Statistical Package for Social Science (SPSS) computer software programme was used in coding and data analysis. In this, study descriptive statistics namely frequencies and percentages were used to summarize the information in order to meet the study objectives. A cross- tab program was used to establish whether or not the variables were statistically independent. In the analysis of data, Chi-square (bivariate analysis) was employed to determine associations between factors influencing utilization of animal draft power and the identified factors as being of interest in this study. The relationship was significant at 95 percent level, and the qualitative data was analyzed by general discussion.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the results of the study and some observations made of inline with the study objectives. The first section describes the socio-economic factors of the respondents. The second section describes factors influencing smallholder farmers' utilization of ADPT. Section three describes the extent of utilization ADPT in the households. The last section describes the respondents' views on the utilization of ADPT in farming.

4.2 Socio-economic data

This section examines the respondents' socio-economic characteristics that influenced smallholder farmers' utilization of ADPT; these include gender, age, marital status, education level, farm size, and major sources of incomes.

4.2.1 Gender

Table 1 shows that of the 102 respondents, 82 (80.4%) were males and 20 (19.6%) were females. Furthermore, Table 1 shows that of the 42 ADP users, 34 (81%) were males and 8 (19%) were females, these results show a low of utilization of ADP among females and this trend was attributed to the reason that women did not own oxen. This trend therefore reduces females' participation in the utilization of the technology, especially in primary tillage (ploughing).

Sylwander (1994) found that cultural norms were the factors in determining who did what and with what technology in farming, in most cases males benefited more than females. The Mbeya Oxenization Project (MOP) found males to be benefiting than females in ADP (Marshall and Sizya, 1994) because the former are better equipped than the latter in the use of the technology. Thus according to Moshi (1999) if females were equipped with resources they could increase productivity through utilizing of ADP and ensure greater return on their labour. Chie-square shows a statistical significant difference of the mean between the two sexes in the utilization of ADP at $p< 0.01$.

4.2.2 Age

The study reveals that there is little involvement of young people in farm activities as in 2007/08 season, only 18 (17.6%) was involved in farm activities. Of the 102 respondents, 42 (41.2%), 34 (33.3%), and 8(7.8%) were aged between 46 and 65, 31-45, and over 66 years old, respectively. Of the 42 respondents who were ADP owners, 22 (52.4%) were older people aged 55 years and over. The participation of older farmers in ADP was attributed to the fact that these farmers had long experience in cultivation; they also owned adequate agricultural resources that enabled them to utilize the technology.

These findings are similar to those of Adesina and Baidu-foison (1995) in Guinea and Burkina Faso, West Africa, who report that older farmers were more involved in ADP because they had more experience in cultivation and were able to assess the characteristics of modern technology than young farmers. Observations of the study

Table 1: Distribution of Respondents According to Sex and Age (N= 102)

Gender	ADP owners n= 42		Non- ADP owners n= 60		Total n= 102		Chie-square value	P-value
	n	%	n	%	n	%		
Male	34	81.0	48	80.0	82	80.4		
Female	8	19.0	12	20.0	20	19.6	37.686**	0.000
Age	n	%	n	%	n	%		
18- 30 years	5	11.9	13	21.7	18	17.6	27.725**	0.000
31- 45 years	11	26.2	23	38.3	34	33.3		
46- 65 years	22	52.4	20	33.3	42	41.2		
Above 66	4	9.5	4	6.7	8	7.8		

**= Significant at P< 0.01

findings show that young people do not constitute a stable labour force in rural areas because most of them migrate to urban areas or get engaged in off-farm generating activities. The chie-square shows a statistical significant difference in the means between ADP users and non-ADP users implying that age influences the utilization of the technology.

4.2.3 Marital status

Table 2 shows that 91 (89.2%) of all the respondents were married, implying that the study sample belonged to a stable society which concentrate more on agricultural production because of the available labour force. The study results show that five (4.9%), five (4.9%) and only one (1%) of the respondents were single, widowed and divorced, respectively.

Table 2: Distribution of Respondents According to Marital Status (N= 102)

Marital status	ADP owners n= 42		Non- ADP owners n= 60		Total n = 102	
	n	%	n	%	n	%
Single	-	-	5	8.3	5	4.9
Marriage	39	92.9	52	86.7	91	89.2
Divorce	-	-	1	1.7	1	1.0
Widowed	3	7.1	2	3.3	5	4.9
Total	42	100.0	60	100	102	100.0

4.2.4 Education level

Education is perceived as one of the factors that influence individual's perceptions of an innovation before deciding on whether or not to adopt it (Rogers, 1995). Education is also linked with the utilization of animal traction technology. As Sylwander (1994) points out that education either makes farmers more open- minded to the advice from extension agents or makes farmers able to deal with technical innovations. Furthermore, Sylwander (1994) points out further that, low utilization of animal traction technology by females is a result of women being deprived of opportunity to education. The respondent's level of education in relation to gender is presented in Table 3. Of the 102 respondents, 18 (17.6%) had no formal education, 66 (64.7%) were primary education levers 16 (15.7%) had adult education and two

Table 3: Distribution of Respondents' Level of Education by Gender (N= 102)

Education level	Gender		Total	%
	Male	Female		
Adult education	14	2	16	15.7
Adult education	57	9	66	64.7
Secondary education	2	0	2	1.9
No formal education	9	9	18	17.6
Total	82	20	102	100.0

(1.9%) had secondary education. Illiterate farmers are unable to write and read which implies that they cannot easily adopt the technologies from agriculture and livestock extension officers and from news papers, booklets, and brochures. A population which has low level of education tends to resist change and would also tend to lack initiatives (Mcfalls, 2003).

4.2.5 Farm size

Table 4 shows that of the 102 respondents, 51 (50.0%) had farm sizes of more than 3 hectares, which was above "the national average of 2 hectares" (MAC, 1997). This was probably due to the utilization of ADPT in farm cultivation. Also the utilization of ADP could be the need to increase cotton and food crops such as maize, cassava and sorghum grown in the study area. As Starkey (1996) observed one of the factors associated with the utilization of ADPT in many places of sub- Sahara Africa has been the need to increase food crop production and farm size influenced by ADPT

Table 4: Distribution of Respondents According to Farm size (N= 102)

Farm size	n	%
Less than 1 ha	7	6.9
1- 2 ha	14	13.7
2- 3 ha	30	29.4
Above 3 ha	51	50.0
Total	**102**	**100.0**

utilization. According to Ashimogo (1995) and Mbegu (1996) the increased in maize production in Sumbawanga in the Ufipa plateau was due to the expansion of areas under crop production and which was attributed to extensive utilization of ADPT.

4.2.6 Source of incomes in 2007/08 season

The level of incomes of households to a large extent determined the adoption of certain technological innovation. Of the 102 respondents, 84 (50%) indicated to have incomes mainly coming from cotton and maize, and of all, 68 (41%) reported to have been earning less than Tshs.364, 900, 12 (7%) said to have been earning Tsh. 364,901- 729,800 and four (2%) reported to have been earning above Tshs.729, 801 per year. Incomes from off-farm activities came mainly from fishing, (Table 5). Table 5 shows that of the 102 respondents, 14 (8%) earned above Tshs. 729,801; 13 (8%) earned less than Tshs. 364, 900; and 11 (7%) earned between Tshs. 364,901- 729,800 per year. Also, of the 102 respondents, 20 (12%) reported to have been earning Tshs. 364,901- 729,800; six (4%) earned above Tshs. 729, 801; and three (2%) earned less than Tshs. 364, 900 from selling cattle. Furthermore, of the 102 respondents, nine (5%) reported to have been earning less than Tshs. 364, 900 from causal labour and one respondents earned Tshs. 364,901- 729,800.

From salary and on farm activities two (1%) of the respondents earned above Tshs. 729, 801 (Table 5). The study observations show that most of the respondents had low incomes below Tshs. 364,900 which is equivalent to less than Tshs. 1,000 per day per farmer. These findings are in line with those of Fischer (1994), who found that, only a few of smallholder farmers invested in ADP because most of them had low incomes. Availability of capital as pointed out by Starkey (1990) influence the adoption of ADPT. As Syvret (1991) contends low producer price and unreliable markets for crops also contributed to farmers having low investment in ADPT. The current study found that, few respondents earned incomes above Tshs. 729,801 due to mixed off-farm income generating activities and farming followed by livestock

Table 5: Distribution of Respondents According to Source of Income and Percent Contribution in 2007/08 season (N= 102)

Source of income	n	%
Income from field crops		
Less than 364,900/= Tshs	68	41
364,901/=- 729,800/= Tshs	12	7
Above 729,801/= Tshs	4	2
Income from off-farm income activities		
Less than 364,900/= Tshs	13	8
364,901/=- 729,800/= Tshs	11	7
Above 729,801/= Tshs	14	8
Income from livestock		
Less than 364,900/= Tshs	3	2
364,901/=- 729,800/= Tshs	20	12
Above 729,801/=. Tshs	6	4
Causal labour		
Less than 364,900/= Tshs	9	5
364,901/=- 729,800/= Tshs	1	1
Remittance		
Less than 364,900/= Tshs	3	2
Paid employment and on farm activities		
Above 729,801/= Tshs	2	1
Total	**166**	**100**

The frequency of respondents exceed 102 because respondents mentioned more than one source of incomes thus leading to multiple responses

sales. Off-farm income generating activities included fishing, operating small shops, selling locally brewed beer and carpentry. The study results show that livestock was among the high income generating activity besides off-farm income activities.

4.2.6.1 Types of crops grown

Respondents in the study area grew a number of crops in intercropping and or pure stands. The major cash crop grown was cotton, while food crops included maize, sorghum, cassava, finger millet, sweet potatoes and paddy rice. Cotton and paddy rice were grown in pure stand while other crops were intercropped (Table 6). Of the 102 respondents, 95 (93.1%) indicated to have been growing more than one crop with cassava being dominant. Intercropping in the area enhanced the expansion of farms making the utilization of ADPT possible, as 51 (50%) of the respondents grew cassava together with maize and cotton (Table 6). The results also show that, majority of the respondents grow food crops to meet food requirements for their families.

Table 6: Distribution of Respondents According to Major Type of Crops grown (N= 102)

Types of crops	n	%
Cassava	7	6.9
Cassava, maize and cotton	51	50.0
Cassava, , maize cotton, sweet potatoes, sorghum	8	7.8
Cassava, cotton, maize, sweet potatoes, sorghum, paddy rice	15	14.7
Cassava, cotton, maize, sweet potatoes, sorghum, finger millet, paddy rice	11	10.8
Cassava, cotton, maize, sweet potatoes, sorghum, finger millet,	10	9.8
Total	102	100.0

4.2.6.2 Livestock kept in 2007/08 season

Table 7 shows that of the102 respondents, 74 (72.6%) indicated to have been keeping cattle. According to the respondents' livestock keeping was done for various purposes such as food, source of income, for ADP utilization, for dowry, for manure, and dried manure used as fuel for cooking purposes. In terms of the size of the cattle kept, 27 (26.5%) reported to have kept 21 to 30 cattle, and 17 (16.7%) said to have

Table 7: Number of Livestock that Respondents Kept in the Wards (N= 102)

Types of Livestock Kept by Wards	Name of the Ward				
	Guta	Butimba	Hunyari	Total	%
Less than 10 cattle	5	7	5	17	16.0
11-20 cattle	6	3	5	14	13.7
21-30 cattle	10	6	11	27	26.5
31-40 cattle	1	0	0		1.0
41-50 cattle	2	1	5	8	7.8
Above 51 cattle	0	2	5	7	6.8
Don't have cattle	10	12	6	28	27.4
Total	**34**	**31**	**37**	**102**	**100.0**

kept less than 10 cattle. Other types of livestock kept in the study area include goats, sheep, donkeys, ducts, rabbits, and local chicken.

4.2.6.3 Land fertility

The respondents were asked if they had used any organic fertilizers in the 2007/08 season in their fields. Of the 102 respondents, 82 (80.4%) reported not to have been using any organic fertilizers, and 20 (19.6%) reported to have been using organic (manure) fertilizer. This non use of inorganic fertilizer or low use of manure was

attributed to lack of credit for inputs among the respondent due to the high costs involved in acquiring such inputs. These study findings however indicated that the respondents knew the importance of using manure in their field in increasing crop production.

Of the 102 respondents, 82 (80.4%) who indicated that they did not use any kind of fertilizer, 38 (46.3%) indicated that the use of organic fertilizer was a tedious work, 28 (34.1%) said that they had no money to buy manure, and 16 (19.5%) reported that the land is fertile and does not need any inorganic fertilizers or manure. The results from FGDs show that using manure encourages the growth of star grasses which makes weeding operation difficult. Also FGDs indicated that manure is too bulk to transport to the fields easily as the ADP users do not own ox-carts, they opted not to use it.

4.3 Period stayed in the village

The number of years one has been a resident and the age of the respondents are presented in Table 8. Accordingly, the results show that of the 102 respondents, 74 (73%) reported to have resided in the area for over 21 years, and 19 (20%) indicated15 to 20 years. The longer the period one had stayed in a given area, the wider the indigenous knowledge one had accumulated and which is necessary for coping with the environment crises. According to Makwaia (2003), age and experience of an individual play an important role in adopting innovations. Table 8 also indicates that two (4%) respondents had stayed for a period between 11 to 14 years, two (2%) stayed between 7 to 10 years and one (1%) stayed between 3 to 6

.Table 8: Distribution of Respondents According to Years of Stay in Village by Age (N= 102)

Years of stay in village	Age group in years				n	%
	18-30	31-45	46-65	Above 66		
3-6 years	0	1	0	0	1	1.0
7-10 years	1	0	1	0	2	2.0
11-14 years	0	1	1	2	4	4.0
15-20 years	7	6	6	2	21	20.0
Above 21 years	10	26	34	4	74	73.0
Total	**18**	**34**	**42**	**8**	**102**	**100.0**

χ^{*2}= 19.870, Df= 12, Significance = 0.07

years. The Chie-square result reveals lack of any significant difference between the age and the number of years of stay in the village at $p< 0.05$.

4.4 Factors influencing utilization of ADPT

This section describes the factors influencing smallholder farmers' utilization of ADPT. According to the results of the102 respondents, 60 (58.8%) were non-ADP owners of this number. 36 (60%) indicated that, they were not involved in ADP technology because they were not in possession of cattle and that they were unable to buy oxen, 12 (20%) said that they not have cattle, 9 (15%) said they were not able to buy oxen and were not able to buy ox-plough and three (5%) said that they were not able to buy oxen. The results from observation show that the presence or absence of draft animals and poverty plays a major role in influencing utilization of ADP by

Table 9: Reason for not Utilizing Animal Draft Power in Farming (N= 60)

Reasons	n	%
Do not have cattle	12	20
Do not able to buy oxen	3	5
Do not have cattle and not able to buy oxen	36	60
Do not able to buy oxen and do not able to buy ox-plow	9	15
Total	**60**	**100.0**

smallholder farmers. These findings conform to Marshall and Sizya (1994) observation that the major factors that influence utilization of animal traction technology in most parts of Tanzania is the availability of draught animals.

4.4.1 Problems facing ADP users due to utilization of ADP in their households

The results from Table 10 show that 22 (52%) of the respondents pointed out that labour shortage during weeding, high costs of spare parts and problems on animal diseases were the limiting factors in the utilization of ADP technology in agricultural production. About 13 (31%) of the respondents pointed out that labour availability in weeding and planting was a limiting factor in the utilization of ADP technology. Other problems facing ADP users are indicated in Table 10.

Table 10: Problems facing ADP Users due to Utilization of ADP (N= 42)

ADP users' problems facing	n	%
Spare parts are expensive	3	7
Labour shortage during weeding and planting	13	31
Animal diseases	4	10
Labour shortage during weeding, spare parts are expensive and animal diseases	22	52
Total	**42**	**100.0**

Furthermore, ADP owners pointed out that they have been cultivating large areas and weeding operations done manually this led excessive labour demand for weeding and increases work drudgery. Moreover, the respondents pointed that some of their ploughs are idle due to high cost of spare parts. They added that some farmers who earlier were utilizing ADP technology now days were out of the technology due to unable of buying spare parts and death of their working cattle (oxen) due to diseases problem (mostly tick borne diseases). Labour availability has been pointed as one of the factors influencing the adoption of animal traction technology (Starkey, 1996). Although the adoption of traction animals as noted by Kilemwa (1993) and Mbegu (1996) had increased the area under crop production, smallholder farmers had large fields that were not well managed as farmers still being relied on hand hoes for doing secondary farm operations.

4.4.2 Diseases of cattle in the area

It can be noted in Table 11 that 31 (30.4%) of the respondents reported to have their cattle mostly infected by tick borne diseases, 29 (28.4%) of the respondents indicated tick borne diseases, worms, BQ, FMD as being the most common diseases of cattle in the area, 28 (27.5%) reported not to have known the common diseases of cattle

Table 11: Common Diseases of Cattle in the Area (N= 74)

Diseases of cattle in the area	n	%
Tick borne diseases	31	30.4
Tick borne diseases, worms	14	13.7
Tick borne diseases worms, BQ, FMD	29	28.4
I don't know	28	27.5
Total	74	100.0

in the area, and 14 (13.7%) indicated tick borne diseases and worms as being the most common diseases in the area. Animal diseases and parasite do influence ADP technology utilization as they affect animal health. According to Mwasha (1989) in the areas highly infested with tsetse flies, livestock keeping is restricted due to high incidence of trypanosomiasis and which has some consequences on the extent to which animal traction can be utilized. This observations conform to that of Akarro and Maro (1992), Shetto and Kwiligwa, (1992), Mwakitwange and Beifer (1992), who indicated tick borne diseases as the main constraints for cattle production in Southern Highlands.

4.4.3 Diseases affecting draught animal during working season

Table 12 shows that of the 42 respondents, 18 (42.9%) claimed that working animals were mostly affected by foot rots, tick borne diseases, worms and foot and mouth diseases (FMD). This trend can be attributed to the stress involved in draught work coupled with inadequate feeding and insufficient resting period the animals are subjected into. Tables 12 also show that of the 42 of the ADP owners, 15 (35.7%)

Table 12: Diseases Affecting Draught Animals during Working Season (N=42)

Common diseases affecting DAs during cropping season	n	%
Foot rot and foot and mouth diseases	15	35.7
Foot rots, tick borne diseases, worms and foot and mouth diseases	18	42.9
Foot rot, tick borne diseases	9	21.4
Total	**42**	**100.0**

indicated that foot rots and FMD as the most common diseases affecting draught animals during the cropping season, nine (21.4%) indicated foot rots and tick borne diseases as serious. Disease may lower the work performance of the DAs due to physical impairment and can cause losses due to treatment costs.

4.4.4 Factors influencing the utilization of ADPT

This section discusses the factors that influenced the utilization of ADPT including the respondents' incomes, gender, education level, type of livestock and type of crop. Others are the use of fertilizer, period of stay in the village, common diseases in the area, readiness of ALEAs and the land cultivated. Still, other factors include non-ADP owners, problems of hindering utilization of ADP, ADP owners' problems facing due to utilization of ADPT, and animal diseases affecting DAs during the working

Table 13: Association between utilization of ADPT with respondents' income (N= 102)

Factors influencing utilization of ADPT	n	X^2	P-value
Gender	2	0.655	0.72 Ns
Education level	8	8.418	0.394 Ns
Type of livestock	6	14.614	0.023**
Type of crops	8	7.439	0.490 Ns
Fertilizers use	2	0.655	0.721 Ns
Common diseases in the area	8	8.378	0.0397**
Readiness of ALEAs	4	0.763	0.943 Ns
Land cultivated in 2007/08	4	10.945	0.205 Ns
Non-ADP users' problems of not using ADP	8	21.396	0.006**
ADP users' problems facing due to utilization of ADP	8	13.870	0.085 Ns
Common diseases affecting AD during the cropping season	8	17.438	0.02**

Ns= Non Significance p>0.05, **Significance at p<0.05

season. The Chie-square statistics was carried out to test the association between the identified factors and the utilization of ADPT. Table 13 shows that there was a statistical significant association between the type of livestock kept, common diseases in the area, non-ADP users' problems of hindering utilization of ADPT and common diseases affecting DA during the working season. However, the results show no statistical significant associations between sex, education level, the types of crop, the size of land cultivated in 2007/08, the period of stay in the village, readiness of AEAs, and ADP users problems facing due to utilization of ADPT does not mean that, these are not important factors to be considered, but it lack definitive association between incomes of respondents and utilization of ADPT. The study results show that most of the respondents were not taking ecto-parasite control measures. O f the 74 respondents, 43 (58%) reported that they not to have being dipping their animals whereas 31 (42%) reported to have being doing so.

Of the 74 respondents, 43 (58%) who reported not to have being dipping their animals said that dip charge was high. According to Payne (1990) regular dipping/spraying to control tick-born diseases is important; therefore attention should be given to the control of ticks and worm. Of the 74 respondents, 17 (23%) reported that dips were far away, while 14 (19%) reported that acaricides were not available in their areas. Tick borne diseases are the main constraints to cattle production in Southern Highlands (Akarro and Marro, 1992; Shetto and Kwiligwa, 1992; Mwakitwange and Beifer, (1992). Sosovele (1986) found that in some villages in Iringa the problems of dipping were due to lack of water and to the fact that acaricide and dips being far away.

Extension is known to catalyze awareness, organization, and information exchange among smallholder farmers. Literature reveals that agricultural extension services influence the utilization of ADPT (Starkey, 1994; Fischer, 1994 and Kayumbo, 1991). Of the 102 of respondents, 64 (63%) indicated that agriculture extension agents were not readily available in their areas and 38 (37%) indicated that the agriculture extension agents were readily available. And of the 38 respondents, 35 (92%) said they were receiving inadequate advice from AEAs on ADPT while only three (8%) said that they were receiving adequate advice from AEAs on ADPT. FGDs showed that there was only one AEA in the Ward.

4.5 Utilization of ADPT

This section describes the extent to which the ADPT was utilized in the study area.

4.5.1 Number of year's respondents utilized ADPT

Table 14 shows that of the 42 respondents, 27 (64.3%) indicated that they had been using ADP (oxen) for over 8 years. This implies that the utilization of ADPT was not new in the study area. According to Bordet (1996) the longer the period one has been using a technology the more the knowledge and skills gained. Starkey (1994) points out further that in areas where the technology is new, basic knowledge of how to employ ADPT to agricultural production is one of the limiting factors for its utilization. Chie-square test reveals that the relationship between age and the period of using ADP was not significant at $P< 0.05$. The common animal used for draft

Table 14: Respondents' Use of ADPT by Age (N=42)

Period of utilizing ADPT	Age of respondents				Total	%
	18-30 years	31-45 years	46- 65 years	above 65		
4-8 years	1	4	8	2	15	35.7
Above 8 years	4	7	14	2	27	64.3
Total	**5**	**11**	**22**	**4**	**42**	**100.0**

$\chi^2 = 19.870$, Df = 12, Significance at $p < 0.05$

power is cattle, this was reported by 26 (62%) of the ADP users. Also of the 42 respondents, 16 (38%) reported that the common draft animals in the area were cattle and donkeys. The respondents' use of cattle (oxen) as draft animals was attributed to the fact that these animals are easy to train for work, they are very strong, and they are easily available.

Of the 42 ADPT users, 23 (54.8%) reported that they got knowledge and skills about ADPT from their parents (father) and 19 (45.2%) said that they got knowledge and skills from fellow farmers (Table 15). The study findings show that in the household parents (farther) taught other family members about the ADPT. Observations from the study reveal that there was an element of biasness between males and females in terms of the use of ADP, in that the former use ADP for doing the work (that is

Table 15: Respondents' Source of Knowledge about Use of ADPT (N= 42)

Source of Knowledge	n	%
Fellow farmer	19	45.2
Extension officer	0	0.0
Parents	23	54.8
Total	**42**	**100.0**

ploughing), the latter use hands for doing their work (that is weeding). Sosovele (1994) also pointed that such tendency was reflected on the low utilization of ADP technology to traditionally female related activities such as planting and weeding.

Of the 102 respondents, 66 (64.7%) said they were not hiring farm power, while 13 (12.7%) of non-ADP owners said they were hiring ADP, and 17 (40.5) of ADP owners said were hiring causal labour (hand hoe) (Table 16). This trend may be due to high demand of labour during weeding operation as ADP users had no animal-drawn implements for secondary farm operations. One (1%) of the non-ADP users indicated to have hired a tractor in the 2007/08 season. These findings conform to Starkey (1996) observation that labour availability was one of the factors influencing animal traction.

It was further reported that ADP users earned substantial incomes from hiring out ADP (oxen) to non- ADP users for farm activities. The study found

Table 16: Distribution of Respondents According to Farm Power Hired in 2007/08 Season (N= 102)

Farm power hired	ADP users n= 42		Non- ADP users n= 60		Total n= 102	
	n	%	n	%	n	%
Causal labour	17	40.5	5	8.0	22	21.6
ADP	0	0.0	13	22.7	13	12.7
Tractor	0	0.0	1	1.0	1	1.0
Not hired farm power	25	59.5	41	68.3	66	64.7
Total	**42**	**100.0**	**60**	**100.0**	**102**	**100.0**

That charges of hiring ADP for ploughing one hectare were Tshs. 50,000, 60,000 and 75,000 as reported by eight (61.5%), four (30.8%) and one (7.7%) of the ADP users, respectively. The charges of hiring ADP for the second ploughing of one hectare cost Tshs 30,000, 40,000 and 50,000 as reported by eight (61.5%), four (30.8%) and one (7.7%) of the ADP users respectively. These findings imply that ADP was used as an income generating activity in the study area. Through FGDs most of the ADP users pointed out that the incomes obtained from hiring ADP to non-ADP owners were used to hire causal labour to weed their fields.

Working animal in a team of more than one is common in the study area as 42 of the ADP owners, 19 (45%), 14 (33%) and nine (22%) indicated that they used 3 pairs, 2 pairs and 1pair of working animals, respectively, (Table 17).

Table 17: Respondents' Use of Pair of Oxen (N=42)

Pair of oxen owned	n	%
2 pair	14	33.0
3 pair	19	45.0
1 pair	9	22.0
Total	**42**	**100.0**

4.5.2 Price of oxen, donkeys and implements in 2007/08 season

Of the 42 of ADP owners, 25 (59%), 13 (31%) and four (10%) reported that the price of one ox ranged from Tshs. 200,000 to 250,000, Tshs. 250,000 to 280,000 and Tshs. 260,000 to 300,000, respectively. The study observations reveal that these prices were high as most respondents' incomes were low, attaining Tshs. 364,900 per year, which was equal to less than Tshs. 1,000 a farmer spent per day implying that few

could afford to buy draught animals. This was one of the factors that contributed to low ADPT utilization and sustainability in the study area.

Of the 42 ADP owners, 21 (50%) reported that the price of a donkey was Tshs. 70,000 to 80,000, 16 (38.1%) implying that they did not know its price and 5 (11.9%) reported that it ranged from Tsh. 90,000 to 100,000 in 2007/08 season (Table 18). In this case, farmers could be advised to use donkeys in farming operations as the price of donkeys was lower than that of cattle (oxen). But most of the respondents reported to have been lacking the knowledge on using donkeys as draught animals.

Table 18: Respondents' Views on the Price of Donkeys (N= 42)

Price of donkey in 2007/08 season	n	%
Tshs. 70,000 to 80,000	21	50.0
Tshs. 90,000 to 100,000	5	11.9
I don't know	16	38.1
Total	**42**	**100.0**

Table 19 shows that of the 42 ADP owners, 19 (45.2%) reported that the price of a plough and ox- cart in the 2007/08 season were Tshs.150, 000 and Tshs.700, 000, respectively. Further, 11 (26.2%) respondents reported that the price of a plough was Tshs.140, 000 and that of an ox-cart was Tshs.680, 000, seven (16.7%) said it was Tshs.150, 000 for a plough and Tshs.750, 000 for an ox- cart, and five (11.9%) indicated that, the price of a plough was Tshs.150, 000 and that of an ox- cart was Tshs.650, 000. These study findings show that the price of ox- cart was too high making the technology unaffordable to most respondents.

Table 19: Respondents' Views on Price of Animal-drawn Implement in 2007/08 Season (N=42)

Price of animal-drawn implement in 2007/08 season	n	%
140,000/= Tshs- plough and 680,000/= Tshs-ox-cart	11	26.2
150,000/= Tshs- plough and 700,000/= Tshs- ox- cart	19	45.2
150,000/= Tshs- plough and 750,000/= Tshs- ox-cart	7	16.7
150,000/= Tshs- plough and 650,000/= Tshs- ox-cart	5	11.9
Total	**42**	**100.0**

4.5.3 Distances to sources of animal- drawn implements

Of the 42 of the respondents, 17 (40.5%) indicated that they traveled 15 to 18 km to the source of implements, 10 (23.8%) said they traveled 18 to 24km, eight (19%) traveled 10 to 13km and seven (16.7%) traveled 6 to 8km. The ADP owners indicated that there were no shops around that sold animal-drawn implements and

Table 20: Respondents' Views on Distance to Sources of Animal-drawn Implements (N= 42)

Distance to sources of animal-drawn implements	n	%
6- 8 km	7	16.7
10- 13 km	8	19.0
15- 18 km	17	40.5
18- 24 km	10	23.8
Total	**42**	**100.0**

spare parts for ADP technology. Further, they indicated that there were no blacksmiths for providing maintenance and even making of ox- carts. The respondents said that when they required maintenance or even to buy a nut they had to walk long distances for the services. The ADP users added that the situation was

equally bad as the non availability of animal- drawn implements were not found in their localities. This hindered the utilization of ADP in the study area.

4.5.4 Activities those DAs did in households

Of the 42 ADP owners, 26 (62%) indicated that DAs were utilized for plowing and harrowing. Further, 16 (38%) reported that DAs were utilized in primary tillage (plowing). The study observations show that ADP was not used for transportation and for secondary farm operations (ridging, planting, weeding, harvesting). This might be a source of low crop yields that ADP users got due to weed out infestation. Since secondary tillage operations were done using hand hoes, long time was needed to complete the operations. According to Kwiligwa *et al.* (1994) the weeds ultimately contribute to crop losses Kilemwa (1992) also notes that the extensive use of oxen for ploughing in Ufipa Plateau had increased labour bottlenecks for secondary farm operations, these were done using the hand hoe and they were not timely and efficiently done. Low utilization of ADP means under- utilizing of ADP and which had negative effect on crop production (Bordet, 1997). As Adesina (1992) argues equipment or credits are necessary if oxen plowing, planting, and weeding are to be adopted.

Of the 42 ADP owners, 21 (50%) reported that land preparation was done manually by men, and ploughing (cultivation) was done by DA also by men, while 17 (40.5%) indicated that planting, weeding and harvesting were done by women and some times with the company of children. But four (9.5%) of the respondents said that land preparation, ploughing, planting, weeding and harvesting were done by all members

Table 21: Respondents' Views on Household Work with AD and Manual (N=42)

The one in household work manually and with AD	n	%
Land preparation -manually, ploughing and harrowing AD- men and boys	21	50.0
Land preparation, planting, weeding and harvesting- manually ploughing and harrowing AD - men, boys, women and girls	4	9.5
Planting, weeding and harvesting manually- women and children	17	40.5
Total	**42**	**100.0**

in the household (men, women, boys, girls) (Table 21). From these study findings, one can note that men did the initial farm activities of land clearing (removal of trees, stumps). But secondary tillage operations (planting, weeding and harvesting) were usually done by women. Since utilization of ADP technology in the study area was done only for ploughing (cultivation), there was a shift of farm workload of secondary tillage operations to women. Due to these observations, it is true that utilization of ADP technology in the study area has led to more workload to women for secondary farm operations. According to Hoeper (1991) and Kilemwa (1993) the extension of area under crop production in the Ufipa Plateau using oxen for cultivation had increased labour bottlenecks for secondary farm operations resulting into an increased burden work to women. According to these findings, it can be noted that women were not helped by ADP technology as DAs were used only for plowing, activities which were done by men.

4.5.5 Schedule of DAs.

Of the 42 ADP owners, 21 (50%) mentioned that DAs time and activities stretched from 5.30am to 10.30am for ploughing, 10.30am to 6.30pm for grazing and at

6.30pm the animals went to rest in the kraal. Yet others 12 (28.6%) mentioned that DAs time and activities were from 6am to 10am for ploughing 10am to 6pm for grazing and at 6pm the animals rested in the kraal. Table 22 shows that of the 42 ADP owners, 21 (50%) and 9 (28.6%) reported the same time and duration that was 5 hours per day for grazing. Usually, 6 hours per day is allowed for DAs to graze, which was not the case in the study areas. ADP users indicated that DAs worked in 1 hectare for 5 days with a working duration of 5 hours per day.

Table 22: Respondents' Views on Schedule of DAs Working Time (N= 42)

Schedule of DAs working time	n	%
6 am to 10 am ploughing, 10 am to 6 pm grazing, 6 pm kraaling	9	21.4
5 am to 10 am ploughing, 10 am to 6 pm grazing, 6 pm kraaling	21	50.0
5.30 am to 10.30 am ploughing, 10.30 am to 6.30 pm grazing, 6.30 pm kraaling	12	28.6
Total	42	100.0

4.5.6 Strategies for feeding DAs

All 42 ADP users reported that there were no strategies for feeding DAs; cattle depended on natural pastures. This is despite that maize, beans, paddy rice, ground nuts were grown in the area and their residues could be utilized for animal feed.

This implies that the respondents had no knowledge about the importance of supplementary feeding/ providing extra feeds to their DAs. The study found that there were no grazing areas nearby the villages because most of the land was under crop production. Thus, the animals tracked for long distances (4 to 5km) in search of pastures. This was true for ADP users who spent 6 hours, in search of pastures, meaning that DAs received little feed. These findings conform to Shetto and

Kwiligwa (1992) observation that animals' nutrition was a major constraint to the use of animal traction. Utilization of crop residues for animal feed is important, but crop residues are bulk and thus expensive to transport and requires storage facilities. There is thus a great need to train farmers on handling and storage of crop residues.

It needs to be pointed out that DAs should start working during the beginning of rains, during this time (November) DAs suffer from shortages of pastures, water , fall of digestible energy and nitrogen content of pastures leading to seasonal change in their body weight. DAs deprived of energy become weak leading to low ploughing time. In additional, DAs with poor body conditions may lose the body immunity to resist diseases and fail to work efficiently. These findings conform to Goe, (1983); Abbiye *et al.* (1986); Octchere *et al.* (1988) and Mohamed-Saleem and Kafman, (1989) observation that DAs should be in good body condition prior to working season if they are to perform efficiently.

4.5.7 Several aspects of DAs

Of the 42 respondents, 38 (90.5%) pointed out that DAs should be 2-3 years old before they start draught activities, while four (9.5%) said that the animals should be 3-4 years old for the job (Table 23). Most of the ADP users reported that cattle with more than 3 years of age were difficulty to train. These findings show that the respondents knew the advantage of utilizing DAs while young. These findings, however, are in contrast with those of Payne (1990) who reported that animals should not be put to work until they reach 4 years. As for the castration Octchere *et al.* (1988) recommends that this should be done between the ages of 1.5 years to

Table 23: Distribution of Respondents According to Age of Cattle Intended for Working (N= 42)

Age of Cattle Intended for Working	n	%
1- 2 years	0	0.0
2-3 years	38	90.5
3-4 years	4	9.5
Total	**42**	**100.0**

avoid stressing the animal. Contrary to this observation, Table 24 shows that the age of castration for cattle was recommended to be 2-3 years by 30 (71.4%) of the respondents and 1.5- 2 years by eight (19%) respondents and 3-4 years by four (9.5%) respondents. The respondents pointed out that early castration of cattle reduces stress for the cattle but suppressed muscular development of the animal's shoulder and neck areas, which are important in providing horse power/energy for pulling implements. Further, the respondents indicated that castration was usually done along side training of the animals for work. The training is done in the field where untrained

Table 24: Respondents' Views about Castration (N=42)

Variable	n	%
1.5- 2 years	8	19.0
2- 3 years	30	71.4
3 – 4 years	4	9.5
Total	**42**	**100.0**

oxen are fitted to trained oxen. Moreover, the respondents indicated that castration is usually performed by the Ward agriculture extension officer using burdizzo (closed

method). They added that the operation is usually done after the long rains between May and June when pastures are in plenty and also to avoid secondary infection. As for record keeping all the respondents, 42 (100%) indicated that they did not keep record of their DAs implying that the respondents were not aware of record keeping. Record keeping assists in the day to day management decision and in the selection of cattle for draught purposes within the herd. As Kifaro (1995) and Kiago (1996) observe record keeping is an important tool for breeding.

All the 42 ADP owners reported not to have received any kind of formal training on ADPT. According to Mgaya (1994) the level of farmers' education had an influence on the utilization of ADPT. A trained farmer adopts the technology more early than does the untrained one. FDGs reveal that the respondents needed training on ADPT. Table 25 shows that of the 42 of ADP owners, 26 (62%) reported that their incomes were not affected by using ADPT, while nine (21%) reported that their incomes had increased and seven (17%) said they had decreased. The ADP users claimed that they ploughed larger areas and cropped them but there were loses of crops due to drought and dependence on hand hoe during weeding. Further, they indicated that the change

Table 25: Respondents' Views on Incomes due to Use ADP by Sex (N= 42)

Since started utilizing ADP has income	Gender		n	%
	Male	Female		
Increased,	8	1	9	21
Decreased	7	0	7	17
Remain unaffected	19	7	26	62
Total	34	8	42	100.0

$X^2 = 3.061$, Df= 2, Significance= 0.216

of weather would usually affect the time of starting the cropping season as the rains would start earlier or later than would have been expected. Also, there were prolonged drought spell leading to crop loses. Chie- square results revealed that there was statistical significant difference between gender and incomes since started utilizing ADP.

The respondents were asked to give their views on the use of ADP in their area. Of the 42 respondents, 31 (23%) mentioned that there should be an improvement of extension services (Table 26). According to Fischer (1994) extension services provide advisory services. Also 28 (21%) of the respondents mentioned that the provision of credit services is a key factor to enable the uptake of the use of ADP technology, especially in acquiring ploughs, planters, weeders, and ox-carts.

Table 26: Respondents' Views' on Use of ADP (N= 42)

Utilization of ADP in the area	n	%
Improve crop pricing	17	12
Availability of implements	25	18
The government subsidies of animal-drawn implements	13	10
Training of smallholder farmers on the technology	21	16
Provision of credit	28	21
Improved extension services	31	23
Total	**135**	**100.0**

The *frequency of respondents exceed 42 because the respondents mentioned more than one views on utilization of ADP in the area

As Greif (1992) observes credit was an important element in modernizing of agriculture because it allowed the use of other factors of production such as improved seeds and fertilizers. Of the 42 ADP owners 25 (18%) reported that there

was non availability of animal -drawn implements such as planters and weeders, while 21 (16%) said that the training of farmers was necessary.

CHAPTETR FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter provides a conclusion and recommendations of the study based on the objectives of the study and areas for further research on ADPT utilization. The overall objective of this study was to investigate factors influencing smallholder farmers' utilization of ADPT. The recommendations are expected to enhance changes in utilization of ADPT in the study area. The specific objectives of this study were to (i) assess the socio-economic factors that influence the smallholder farmers' utilization of animal draft power, (ii) examine factors that influence the utilization of animal draft power by smallholder farmers, and (iii) identify the extent to which smallholder farmers utilize animal draft power in the households.

5.2 Conclusion

The study revealed that males had greater representation than females in ADPT utilization, but females did more households chores than males. The study shows that older farmers are the main users of ADPT due to their experience in farming and ownership of agricultural resources. Also the study reveals that most of the respondents with formal education easily adopted ADPT than those without. Further, the study reveals that the respondents' average farm sizes were more than 3 hectares, and common the crops cultivated include cotton, maize, cassava, and sorghum. The main sources of incomes for most respondents include cotton, maize, off-farm income activities and livestock. Based on the findings of this study socio-economic

factors that influenced respondents' utilization of ADPT includes low incomes. Most of the respondents in the 2007/08 season earned less than Tshs. 364,900 per year, which was equal to less than Tshs. 1,000 per farmer in Bunda District per day. The study reveals that ADP owners earned substantial incomes from hiring of ADP (oxen) to non-ADP owner. The charge of hiring out ADP (oxen) for ploughing one hectare in the 2007/08 season was Tshs. 50,000 to 60,000 and the charge of hiring out of ADP for second ploughing (harrowing) of one hectare was Tshs. 30,000 to 40,000.

The factors that influenced non-utilization of ADPT for the non-ADP owners were lack of money to buy oxen. ADP owners faced higher price of spare parts, shortages of labour, especially during weeding. The study reveals further that utilization of ADPT was only in ploughing, which makes the respondents rely on the hand hoe for other secondary farm operations such as planting, ridging and weeding. Non availability of animal-drawn implements for the secondary farm operations also increases the respondents' workloads, and loss of crops dues to weeds. Other influencing factors include poor weather, that is, long drought spells which lead to loss of crops. The study findings reveal further that there are no agriculture and livestock extension agents (ALEAs) in the study area at villages' levels, meaning that respondents do not receive regular advice on utilization of ADPT. Also, the study revels that even the one ALEA available at the Ward level is not trained on ADPT, which makes ADP users to say that they were not trained on the ADP technology.

The study findings show that ADP owners' knowledge and skills on ADPT, were obtained from their parents (farther), other respondents obtained from the fellow farmers. Further the study found that the price of one ox ranged from Tshs. 200,000 to 250,000, while that of a donkey was Tshs. 70,000 to 80,000. The price of one ox-plough in the 2007/08 season was Tshs. 150,000 and Tshs. 700,000 for one ox-cart. Also, it was revealed from the study that there are no shops in the villages that sell animal-drawn implements and spare parts related to ADPT instead the respondents have to travel 15 to 18 km to get such services. It was further revealed that there are no technicians or "artisan" for providing maintenance or making ox-carts in the respondents' locality. Moreover, the study reveals that the cattle start draught activities at the age of 2-3 years old and castration is done along side the training of animals (oxen) for work.

Most of the respondents do not dip their oxen because of the high dipping costs. The study reveals tick-born diseases, foot rot, foot and mouth disease, black quarter, and worms are the common animal ailments in the area. Further, the study reveals that the time taken by a pair (three pairs) of DAs per day for ploughing was 5 hours, and 8 hours for grazing. A pair of ADs worked one hectare for 5 days with a working duration of 5 hours per day. Also, the study reveals that there are no strategies for feeding DAs supplementary feeds because farmers have no knowledge on the importance of providing supplementary feeds like use of field crop residues.

5.3. Recommendations

The following recommendations are aimed at addressing issues raised in the discussion and conclusions:

1. The government should help farmers to get credit so that they can buy oxen and ADP implements and equipments.

2. The government should encourage NGOs for establishment of credit facilities to assist ADPT users with soft loans to purchase farm inputs.

3. The government should team up with the public sector and start making animal-drawn implements such as ploughs, planters, ridgers, weeders and spare parts.

4. The government should avail ALEAs in the study areas with knowledge and skills in ADPT who in turn will train ADP owners.

5. ALEAs should emphasis ADP owners on proper management of DAs (good feeding, adequate water, daily inspection, good handling, and prevention of diseases (regular dipping/spraying, vaccination and regular control of internal parasite).

6. ALEAs should train ADP owners about handling and storage of field crop residues, growing of leguminous plants and grasses such as Guatemala, elephant grass around their homesteads for feeding DAs prior to the cropping season.

5.4 Suggestion for Further Research

1. Examine problems facing ADP in the secondary farm operations (e.g. sowing, weeding)

2. Determine the usefulness of using donkeys in tillage operations (donkeys are cheap compared to cattle as smallholder farmers with low income can buy them.

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APPENDIX

Appendix 1: Questionnaire on assessment of factors influencing smallholder farmer' utilization of animal draft power: A case study of Bunda District, Mara region

Dear, Sir/Madam

You have been selected to give information on utilization of animal draft power. The main objective of this study is to investigate factors influencing smallholder farmers' utilization of animal draft power. The findings of the study will help policy makers and rural development actors to design mechanisms for enhancing the use of animal draft power. All information obtained from you will be treated with strict confidence.

Section A: Information on farmers' socio-economic characteristics

Respondent's name/ No.....

Date of interview.....year.....

Name of village

.....Ward.....Division.....

1. Sex (Tick)

a). Male [ ] b). Female [ ]

2. What is your age? (Tick)

a). 18-30 [ ] (b). 31-45 [ ]

(c). 46-65 [ ] (d). Above 65 [ ]

3. Marital status? (tick)

a). Single [ ] b). Marriage [ ]

c). Divorced [ ] e). Widowed [ ]

4. What is your level of education? (Tick)

a). Adult education [ ]

b). Primary education [ ]

c). Secondary education [ ]

d) No formal education [ ]

e) Others specify.....

5. What was your source of income earned in your household in 2007/08 season? (Probe)

.....

6. What type of livestock did you keep in 2007/08 season? (Mention and write number of each)

S/N	Type of livestock	Tick
1	Cattle	
2	Goats	
3	Sheep	
4	Chicken	
5	Donkeys	
6	Ducks	
7	Rabbits	
8	Others specify	
	.....	

7. Which crops did you cultivated 2007/08 season? (Tick)

S/N	Crops
1	Cassava
2	Maize
3	Sorghum
4	Millet
5	Leguminous crops
6	vegetables
7	Cotton
8	Rice
9	Tomatoes
10	Sweet potatoes
11	Banana
12	Oil crops
13	Others (specify)

8. What is the size of land owned? (Tick)

a) Less than 2 ha [ ]

b) 2-3 ha [ ]

c) 3-4 ha [ ]

d) Above 4 ha [ ]

9. In 2007/08 season, did you use fertilizers on your farm? (Tick)

a). Used organic fertilizer

b). used inorganic fertilizer

10. If the answer in Q 9 above is not used, what reason (s) for not using fertilizers? (Explain).....

11. How long have you lived in this village? (Mention)..... years

Section B. Factors influencing utilization of animal draft power

12. Do you use animal draft power in your farm? (Tick) Yes..... No.....

13. If you do not use draft animal as a source of power in your household, what are the hindering problem (s)? (Tick)

a) Do not have cattle [ ]

b) Not able to buying oxen [ ]

c) All the above [ ]

d) Others specify.....

14. If you use animal draft power, what problem (s) do you face (Tick)

a) Spare parts are not available [ ]

b) Spare parts are expensive [ ]

c) Labour shortage during weeding [ ]

d) Labour shortage during harvesting [ ]

e) The soil is heavy for animal draught power [ ]

f) Problem of cattle diseases [ ]

g) Others specify.....

15. What is the common disease that affects draft animals? (Tick)

a) Tick borne diseases [ ]

b) Worms [ ]

c) All above [ ]

d) Diarrhoea and Pneumonia .. [ ]

e) Others specify .....

16. What are the common problem (s) affecting draft animals during the cropping season? (List

17. Do you dip (spray) your cattle? Yes.....No.....

18. If answered No above, what is the problem (s)?

a) Unavailability of drugs [ ]

b) Dipping charge is high [ ]

c) Others (specify) .....

19. Are the agriculture extension agents (AEAs) readily available? (Tick)

a) Not readily available

b) Readily available

c) Very available

20. When AEAs visits you, does he/she give advice on animal draft power?

(Tick) Yes..... No.....

21. If the answer in Q 23 above is Yes, is the advice provided by the AEAs on animal draft power adequate or inadequate? (Tick)

a) Adequate [ ]

b) Not adequate [ ]

Section C. Extent of utilization of animal draft power in the area

22. How long have you been using animal draft power? (Tick)

a) Less than 2 years

b) 2 to 3 years

c) 3 to 4

d) Above 4 years

23. Which are the common draft animals in this area? (Tick)

(a) Cattle [ ]

(b) Donkeys [ ]

(c) Others specify.....

24. From whom did you first learn how to use animal draft power technology? (Tick)

a) Fellow farmer

b) Extension officer

c) Others specify.....

25. In 2007/08 season, did you hire farm power for your agricultural activities?

Yes.....No.....

26. If answered Yes in Q 34 above, which one did you hire? (Tick)

a) Animal draft power [ ]

b) Hand hoe [ ]

c) Animal draft power and hand hoe [ ]

27. If you hired oxen in 2007/2008 season, what was the charge (Tshs) per farm operation per hectare? (Mention)

S/N	Farm operation	charge per hectare (Tshs)
1	Land clearing	
2	Ploughing	
3	Harrowing	
4	Planting	
5	Weeding	
6	Harvesting	
7	Ridging	
8	Transport	
9	Packing	
10	Others specify	

28. How many pairs of oxen do you have?... .....pairs

29. What is the price of an ox? .... Tshs

30. What is the price of a donkey? .... Tshs

31. In 2007/2008 season, what were the prices of animal-drawn implements? (Mention)

S/N	Type of implement	Tshs per implement
1	Ploughs	
2	Weeders	
3	Harvesters	
4	Cultivators	
5	Planters	
6	Carts	
7	Harnessing equipments	
8	Others specify	

32. How far is it to the sources of implements mentioned above? (Explain)

33. Do you use your working animals throughout the year?

Yes.....No.....

34. If answered Yes in Q 33 above, what activities do draft animals do in your household? (Tick)

Farm practices	Oxen	Donkeys	Tractor
Land clearing			
ploughing			
Harrowing			
Planting			
Weeding			
Harvesting			
Ridging			
Transporting			
Packing			
Others specify			

35. Who mostly works with draft animal in the following farm activities in your household? (Tick)

S/N	Farm practices	Children		Adult	
		boys	girls	men	women
1	Land clearing				
2	Ploughing				
3	Harrowing				
4	Planting				
5	Weeding				
6	Harvesting				
7	Ridging				
8	Transporting				
9	Packing				
10	Others specify				

36. What is the schedule (working time table) for your working animals? (Mention)

S/N	Time	Activities
1		
2		
3		

7. Has your income increased, decreased or remained the same since you started using animal draft as a source of power in your household? (Tick) (a) I

a) Increased [ ]

(b) Decreased [ ]

(c) Unaffected [ ]

38. At what age are cattle expected to start working as draft animals?

(Mention).....years

39. At what age are bullocks intended for draft power castrated? years

40. Do you keep any records of your draft animals? (Tick) Yes... No.....

41. Have you attended any training on animal draft power technology elsewhere?

Yes..... No.....

42. If answered No in Q 43 above, do you need any training on animal draft power?

Yes.....No.... ....

Section D

The purpose of this section is to get farmers views on the utilization of animal power in agriculture farming. Kindly indicate whether you agree or disagree with each of the following statement as I read them to you.

43. Respondent's views on utilization of animal draft power in agriculture farming

S/N	Information statement	agree	Neutral	Agree
1	Use of animal draft power in agriculture if well organized will help improve agriculture production			
2	Provision of credit to farmers will help sustain the technology			
3	The government subsidies of animal- drawn implement most of farmers can afford to buy the implements			
4	Farmers benefit from use of animal draft power			
5	Low crop pricing discourage smallholder farmers to use animal draft power			
6	Improved extension services may create the sustainability of the technology			
7	Low crop pricing discourage smallholder farmers to use animal draft power			

Thank you for your cooperation