

**ASSESSMENT OF ANNUAL UTILIZATION RATES OF FARM TRACTORS IN
MBARALI DISTRICT, TANZANIA**

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**A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE
REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN
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ABSTRACT

The study was conducted in Mbarali District of Mbeya Region with the objective of assessing the average annual utilization rates of farm tractors for both on-farm and off-farm activities during the cropping season of 2012/13. The study conducted aimed at addressing the following research questions: who are the owners of farm tractors in the study area, what models were in use and what were the available support services that could enhance sustainable utilization of tractors? Questionnaire and a log-book were the instruments used for data collection for this study. A total of one hundred and eleven (111) farm tractors were involved in this study, of which 90 were power tillers [or 2 wheel tractors (2WT)] and 21 were conventional tractors or 4 wheel tractors (4WT)]. Results obtained show that all conventional tractors were privately owned and 94.6% of the power tillers were privately owned with the remaining 5.4% being owned by farmer's groups. The age of the tractor owners ranged from 31 to 50 years old and all were able to read and write. Siam Kubota and Amec power tillers were the most popular 2WT in the area. The average annual utilization rates of 4WT was 1093 hours and 627 hours 2WT. Results of annual utilization rates of farm tractors in Mbarali District conclude that both conventional tractors and power tillers are optimally utilized. The study has also revealed that there are many dealers of tractors and spare parts in the District. Most repairs of farm tractors were performed by local mechanics in their respective villages; this therefore ensuring the long term sustainability of utilization tractors in the District.

DECLARATION

I, EMMANUEL MJOBEGE LWESHA do hereby declare to the Senate of Sokoine University of Agriculture, Morogoro, Tanzania, that this dissertation is my own original work, and that it has never been submitted nor concurrently being submitted for a degree award in any other University.

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LIST OF ABBREVIATIONS AND SYMBOLS

AGITF	Agricultural Inputs Trust Fund
ASDP	Agricultural Sector Development Program
DAP	Draught Animal Power
DAICO	District Agricultural, Irrigation and Cooperative Officer
FAO	Food and Agriculture Organization
FYDP	Five Year Development Plan (2011/12- 2015/16)
GDP	Growth Domestic Product
IRRI	International Rice Research Institute
MALDC	Ministry of Agriculture, Livestock Development and Co- operatives
MAFC	Ministry of Agriculture and Food Security and Cooperatives
PV	Present value amount
NBS	National Bureau of Statistics
SACCOS	Savings Associations and Credit Cooperatives Society
SPSS	Statistical Packages for Social Sciences
SSA	Sub Saharan Africa
SUA	Sokoine University of Agriculture
TAMCO	Tanzania Automobile Manufacturing Company
TIB	Tanzania Investment Bank
TAFSIP	Tanzania Agriculture and Food Development Security Investment Plan
TRAMA	Tractor Manufacturing Assembly
UNIDO	United Nations Industrial Development Organization
URT	United Republic of Tanzania
UVIP	Usangu Village Irrigation Project
hp	Horse power

ha Hectare

i Interest rate

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Agriculture is the backbone of Tanzania's economy and employs 74% of the country's labour force (TFYDP, 2011). Smallholder farming dominates agricultural production. Agriculture contributes about 24.8 % of the Tanzania's Gross Domestic Product (GDP) and contributes about 35 % of foreign exchange earnings while the industrial sector is largely dependent on agriculture for its raw materials (Lyimo, 2011). Tanzania has an area of 94 million hectares, of which 44 million hectares is arable land but only 23 percent (10.1 million ha) is cultivated (TFYDP, 2011). There are 29 million hectares suitable for irrigation but only 461 000 hectares (one percent) are under irrigation (TFYDP, 2011). This means that there is a significant proportion of large potential agricultural land which remains untapped and could be developed to become more productive. This low level of cultivated land is partly a result of low levels of use of modern agricultural implements and machinery in production (Kwiligwa *et al.*, 1992). Most farmers in Tanzania are smallholders who cultivate between 0.2 and 2.0 hectares. The dominance of the hand hoe in farming is one among the causes of poverty in rural areas particularly to smallholder farmers (Hendricksen, 1999).

In Tanzania farm power sources include the use of human muscle estimated at 63 % while animal traction is estimated at 24 % and mechanical power is estimated to be 13 % of the cultivated land (Lyimo, 2011). Modernization of the sources of farm power available to farmers is therefore a pre-requisite to increased agricultural production, poverty reduction in rural areas, improving human life conditions and developing rural areas.

Mechanization of agriculture has the potential to turn productive idle land into productive land for national economic growth. In order to increase the cultivatable land and improve labour productivity, farmers have to shift from using rudimentary tools such as hand hoes to modern technologies such as ox-ploughs and farm tractors.

Farm power in Tanzania is categorized into three types namely human, draft animal and mechanical power. Human power is the most common source of energy for most agricultural operations; it involves the use of simple implements using human muscle as the main power source. Draft animal power, entails the use of animals like oxen and donkeys in agricultural production processes such as tillage and transport operations. Mechanical power sources embrace all modern agricultural machinery, tractors and combine harvesters which obtain its main power from sources other than muscular power.

1.2 History of Tractor Utilization in Tanzania

Tractor utilization in Tanzania started back in 1930s when tractors were used for cultivation, farm transport and agro-processing (Mpanduji, 2000). By then tractor utilization was mostly in foreign owned estates for growing tobacco, wheat, coffee, tea and sisal. In 1960 the population of tractors increased to around 1600 units (Mpanduji, 2000). The number of tractors increased because of the emergence of medium to large scale private commercial farmers. Tractors utilization by Tanzanians farmers was mainly in Iringa, Arusha and Shinyanga Regions for growing maize, wheat and cotton respectively (Mpanduji, 2000).

The population of tractors expanded to about 17,000 units in 1970 (Mpanduji, 2000). Most of these tractors were supplied to government-mechanized capital-intensive estates and to the village development block farming schemes. The village schemes were

established after nationalization of medium to large-scale private farms at the end of 1960s and early 1970s. However, many of these schemes failed due to the following main reasons (Mpanduji, 2000).

- Lack of competent management and strict supervision
- Poor training of personnel responsible for operating, repairing and maintaining the equipment, inadequate workshop and repair facilities, lack of skilled and responsible operators;
- Lack of adequate availability of cash and credit when needed;
- Inefficient utilization of the machineries and
- Dishonesty among the operators, managers and committee members of the scheme.

The failures of these schemes therefore forced the government to change its strategy and instead stress more the use of Draft Animal Power (DAP) instead of using tractors (Mpanduji, 2000). However, tractor numbers peaked to a total of 18 500 tractors by 1985 (most of them 4 wheel tractors (4WT)). During the period after 1985 the Government was implementing economic structural adjustment plans and this led to the decline of support to mechanization programs which had a tractor component. Also donors reduced their support to mechanization programs. These changes in Government and donor support to mechanization led to a significant decline in the tractor population in Tanzania from over 18 500 in 1985 to about 6000 by 2005 (Mpanduji, 2000 and Mrema *et al.*, 2008).

Tractors have been imported from different countries including Great Britain, Japan, India, United States of America and Germany. The establishment of Tanzania Tractor Manufacturing Assembly (TRAMA) in 1980 led to a reduction in numbers of tractors being imported from abroad. TRAMA was established as a joint venture between the

State Motor Corporation on behalf of the Tanzania Government and the Valmet Tractor Company of Finland. The share capital of the Tanzania Government was 90% while 10% was owned by the Valmet tractor company of Finland (Mrema, 1992 and Mpanduji 2000). The main objectives of TRAMA Company were to:-

- a) Manufacture Valmet tractors after obtaining the license from Valmet Corporation of Finland.
- b) Incorporate locally manufactured parts and components in Valmet tractors.
- c) Provide after sale service to customers through its service workshops and established dealer workshops in all regions.
- d) Sell tractor-drawn implements and spare parts to customers.
- e) Train customers and dealer representatives so as to ensure adequate after sale service and maintenance of tractors are provided.
- f) Export Valmet tractors to other African countries.

In the late 1980s private companies were allowed to import tractors from abroad. The tractors imported by private companies were cheaper and much more reliable than those manufactured by TRAMA (Mpanduji, 2000). This led to a decline in the production of Valmet tractors in the early 1990s, and by mid 1990s TRAMA had to stop manufacturing of tractors.

Initiatives such as *Kilimo Kwanza* established in 2009 and *MKUKUTA* for Tanzania mainland or *MKUZA* for Zanzibar, Millennium Development Goals (MDG) and Agricultural Sector Development Strategy (ASDS) have been promoting the use modern technologies by farmers such as increased use of draft oxen and tractors in order to improve labour productivity and increase agricultural production. For example the Ministry of Agriculture Food Security and Cooperatives (MAFC) encouraged farmers to

use modern technologies in agricultural production and as a result of this in 2008/09 the ministry imported 472 conventional tractors and 495 power tillers (Ngeze, 2010).

Power tillers were introduced in Mbarali District from 1986 by the Usangu Village Irrigation project (UVIP). These power tillers were designed and fabricated by the International Rice Research Institute (IRRI) based in Philippines which promoted the use of power tillers in Mbarali District by smallholder farmers (Kinyaga, 1992). According to reports by the Mechanization Department (2010), of the Ministry of Agriculture, Food Security and Cooperatives, by June 2010 Tanzania mainland had about 8500 units of conventional tractors and 4571 units of power tillers. Mbarali District was reported to have 208 conventional tractors and 1041 power tillers.

1.3 Justification

Since the introduction of power tillers in Mbarali district in 1986, there has been an increasing demand by farmers to acquire their own power tillers and/or tractors. This increased demand has led to Mbarali district to have the highest number of power tiller units in Mbeya region as well as in Tanzania (Mechanization report, 2010). Power tillers are designed to work in wet soils especially preparation of fields for cultivating paddy - a dominant crop in Mbarali District. Conventional tractors are also available in Mbarali District but their use has not increased significantly over the past decade. The large number of power tillers in use in Mbarali District motivated this study on assessing their utilization rates because lack of such data on annual utilization rates of tractors whether 2-wheel tractors [2WT] or the four wheel tractors [4WT] gives a gap of knowledge of the rational utilization of tractors whether effectively utilized or not. The study on assessment of the annual utilization rates of farm tractors was conducted in order to determine the efficacy and effectiveness of their utilization.

The information obtained from this study will be useful to policy makers in decision making pertaining to improve utilization of farm tractors in Mbarali as well as to Tanzania as whole by provision of infrastructure that would facilitate sustainable use of tractors. Also the results from the study will be useful to extension officers in Mbeya Region and in Tanzania in general to advise tractor owners on how best to achieve profitable utilization of their investments in farm power equipments

1.4 Objectives of the Study

1.4.1 Overall objective

The overall objective of this study was to assess the average annual utilization rates of farm tractors [both 2WT and 4WT] and evaluate the sustainability of their use in Mbarali District.

1.4.2 Specific objectives

The specific objectives of the study were to:

- i. Identify the socio-economic characteristics of owners of tractors
- ii. Determine the available type and models of farm tractors in use
- iii. Determine the average annual utilization rates of farm tractors for both on-farm and off-farm as well as off- season utilization rates
- iv. Determine the support services and infrastructure available for sustainable utilization of tractors.

1.5 Research Questions

The study therefore aimed at addressing the following research questions in relation to Mbarali District.

- i. Who are the owners of tractors?

- ii. What are the available types and models of farm tractors in use?
- iii. What are the average annual utilization rates of farm tractors for both on-farm and off-farm activities?
- iv. What are the support services and infrastructure available for sustainability of tractor use in the District?

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Agricultural Mechanization

FAO and UNIDO (2008) defined agricultural mechanization as the application of mechanical technology to increase power to agriculture largely as a means to enhance productivity of human labour and often to achieve results beyond the capacity of human labour.

Dihenga *et al.*, (1989) defined agricultural mechanization as the application of engineering principles and techniques in agriculture and involve the utilization of all forms of energy through mechanical assistance in agricultural production processes. Mechanical assistance is provided when a device is used to transmit force and movement to produce a desired effect. Devices that provide mechanical assistance include tools, implements (disc ploughs, disc harrows, moldboard ploughs) and machines. The machines could be tractors, combine harvesters, trans-planters, boom sprayers and irrigation pumps. Similar definition of agricultural mechanization have been provided by other researchers, among them are; Kolawole (1972); Lufti and Al-Chaff (1988) and Clarke and Bishop (2002).

2.1.1 Advantages of mechanization

The main reason for mechanizing agriculture is to increase production and productivity. Improvement in production can be in two ways (Dihenga *et al.*, 1989). First mechanization can bring more intensive production through effectively and timely operation. Also mechanization can improve production by putting more land in

production. Based on the two ways listed above, therefore agricultural mechanization has the following advantages:

- i. Increasing labour productivity (more output per worker) and employment during slack periods.
- ii. Increasing land productivity by doing each operation at the proper time.
- iii. Reducing drudgery involved with arduous tasks or dirty work, such as manure spreading and land clearing.
- iv. Relieving labour bottlenecks at peak periods such as those occurring during weeding and harvesting.
- v. Encouraging human and industrial development through increased profit from mechanized agriculture.
- vi. Possibility of reducing cost of production and increasing agricultural incomes.

2.1.2 Categories of mechanization

Lufti and Al- Chaff (1988) categorized mechanization in three major development stages: Elementary stage which implies the use of hand power only, intermediate stage which incorporate both human and machine power and the advanced stage which denotes the complete use of motorized and automated power. According to Lufti and Al-Chaff (1988), Mbarali District where both human and machine are used is placed under the intermediate stage. Herdt (1983), categorized mechanization development in Asia into four major development levels by determining the number of power tillers available per 1000 ha as follows: Initial stage imply when there is one power tiller per 1000 ha, Early stage is referred when there are about 2.5 hand tractors per 1000 ha, the take off stage is referred to when there are about 20 hand tractors per 1000 ha and full mechanization is referred to when there are about 1000 hand tractors per 1000 ha. With reference to Herdt (1983) Mbarali district could be categorized to be about to reach the

take off stage of mechanization because during the time of this study in year 2013, Mbarali district had 1244 power tillers and arable land being 321 500 ha (Mbarali District Council Annual Report, 2012) therefore it constituted of 3.9 power tiller per 1000 ha.

2.1.3 Obstacles to the development of mechanization in Tanzania

The obstacles to the development of mechanization in Sub –Sahara Africa (SSA) countries among them being Tanzania is constrained by several factors. Major factors includes (Shetto, 2008).

- a) Low purchasing power of most small scale farmers - a low level of crop production leads to low incomes, which considerably limit the purchasing power of the majority of small holder farmers, making investment in agricultural machinery difficult;
- b) Low produce prices - farm gate prices offered to farmers, especially at the harvest time are generally low. This further reduces farm income, thus limiting investment capabilities;
- c) Lack of agricultural credit - many commercial banks in Tanzania are reluctant to finance agriculture as they claim that the risks involved are too high, especially in small holder farming. Where such credits are available, stringent conditions have been tied to loans making borrowing difficult for farmers as the majority lack the required security as collateral for the loans;
- d) Lack of well-trained operators of farm machinery- many of the operators who handle agricultural machinery are not well trained despite of handling expensive machines. In most cases, this leads to poor quality of work and expensive breakdowns of machinery. It also leads to costly repairs and reduce economic life-span of the machinery;

- e) Lack of suitable machinery packages for the main agricultural operations- the most mechanized operation is tillage, and transportation to a limited extent. Other operations like planting, weeding and harvesting are rarely mechanized in small holder farming. This limits the advantages of mechanization as the secondary operations are done manually. The use of hand-hoe is common, which in turn delays the completion of these operations, and it decreases crop yields;
- f) Importation of poor tools, equipment and machinery- most of the imported equipments and machinery are of low quality. This problem is caused by little control on the quality of the imported equipments, and the importation of sub-standard tools, implements or machinery at the expense of the end user. Low quality of the equipment and machinery leads to poor performance;
- g) Poor technical know-how- inadequate skills and technical know-how on the part of machinery owners leads to high operational costs, making investment in mechanization expensive. Many tractor owners do not have agribusiness knowledge and lack business expertise. On the other hand, service providers, comprising manufacturers, importers, dealers and after sale services (which include supply of spare parts and provision of maintenance services are faced with the following constraints:
- Inadequate business knowledge and poor technical knowledge in relation to agricultural machinery;
 - Inadequate capital owing to lack of trade financing;
 - Low volume of business - resulting in poor cash flow owing to the seasonality of demand of agricultural machinery and implements;
 - Poor working tools , equipment and underutilized capacity;

- Weak linkage between technology development agencies, manufacturers, distributors, and farmers exacerbate the situation, leading to poor commercialization of development technologies.

2.1.4 Government strategies to cope with obstacles to the development of mechanization in Tanzania

In order to tackle the constraints of mechanization development in Tanzania, the government has devised several strategies (Lyimo, 2011). These include:

- i. Provision of affordable loans to farmers for procuring tractors through the Agricultural Inputs Trust Fund (AGITF). By December 2010 loans for 569 conventional tractors and 193 power tillers had been provided to farmers.
- ii. Empowering farmers to acquire farm machinery through DADPs. In 2009/10 a total of 2154 conventional tractors and 53 power tillers were provided to farmer groups through 20% contribution.
- iii. Empowering farmers to acquire farm machinery through DASIP where 300 power tillers were provided to farmers in the Lake Zone.
- iv. The government negotiated a soft loan through a line of credit from the Government of India to enable procurement of 1860 tractors and implements, irrigation pumps and parts from India.
- v. The Government has established an agricultural window at the Tanzania Investment Bank (TIB).
- vi. The government is in the process of establishing an agricultural bank to offer long term credit.
- vii. The government is promoting contract farming.
- viii. Promotion of Warehouse Receipt System operated by Cooperative Unions.

2.2 Tractor

Tractors can be described as the mobile form of mechanical power used in agriculture. The tractor can supply power in various forms. Firstly by pulling or pushing implements through the grips of the wheels on the ground. Secondly, tractors can supply power to other machines from the P.T.O shaft through belt pulleys. Thirdly, some tractors can also do mechanical work through the hydraulic system (Simalenga, *et al.*, 1991a).

Tractors can be either considered to be wheeled, when using wheels normally with rubber tires, or crawler when its traction devices are tracks. Similarly a tractor is considered to be small when its power is less than 30hp, medium when its power is between 30 and 70 hp, and large when its power is greater than 70 hp. Small and medium tractors can further be divided into 2WT and 4WT (Simalenga *et al.*, 1991b).

Wheeled tractors are further categorized as follows:

- a) Four wheeled commonly referred to as conventional tractors
 - i. Two rear drive wheels, two front steered wheels with conventional rear axle.
 - ii. Two rear drive wheels, two front steered wheels, high mounted rear axle with final reduction close to rear wheels or hydrostatic transmission.
- b) Three wheeled with either
 - i. Two rear drive wheel and single front wheel.
 - ii. One (or two closest set) rear drive wheels and 2 front wheels
- c) Single axle tractor

Single axle tractor is a two wheeled tractor commonly known as walking tractor or power tiller [2WT]. For this study conventional tractors and power tillers were studied because they are the most commonly used in Mbarali District.

2.2.1 Advantages of using tractors

The use of tractors is aimed at making replacement of the cutlass and hoe or draught animals due to the following advantages:

- a. Tractors allow previously unutilized land to be brought under cultivation.
- b. Tractors should result in timelier field operations and as a result increase in productivity.
- c. Tractors can be used to power implements and equipment used in improving and maintaining farm and rural infrastructures (e.g. drainage, irrigation, fencing, and rural roads).
- d. Tractors can overcome seasonal shortages of labour or release labour in critical periods for other productive tasks.
- e. Tractors reduce drudgery associated with farm work.

2.2.2 Tractor population from 2005/06 to 2010/11

In Tanzania the importation of tractors and use was highly promoted from 2009 when *KILIMO KWANZA* initiative was started. As a result, since then, there has been an increase in number of tractors imported. It is said that the increase in importation of tractors in Tanzania was attributed to the increase in demand and access to loans for farm implements (MKUKUTA, 2011). The proportion of farmers using animal-drawn implements also increased from 20 percent to 24 percent during the same period. On the other hand the proportion of farmers using the hand hoe declined from 70 percent during 2005/2006 to 63 percent during 2010/2011 (MKUKUTA, 2011). In year 2010 the government imported 986 new tractors and 991 new power tillers (Economic Survey, 2010). The government distributed 35 tractors to 35 farmer groups with a membership of

880 farmers through ASDP. The beneficiaries contributed 20 percent of the cost as per DADPs guidelines (MKUKUTA, 2011). The trend of importation is shown in Table 1.

Table 1: Importation of tractors from 2005/06 - 2010/11

Year	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11
Tractors	356	445	464	472	558	986
Power tiller	100	160	240	495	1 859	991

Source: MKUKUTA, 2011

2.2.3 Level of utilization of tractors

The use of tractor can be profitable and economic if its utilization rates are sufficiently high. Higher utilization rates could be achieved through such factors as hiring out, asset sharing and careful machine management. Lonnemark (1967) pointed out that, the total cost of conventional tractors would be reduced significantly with increased utilization rates above 1000 hours annually. Similarly, Meghalaya Rural Bank (2014) recommends that the minimum utilization rates of power tiller should be 600 hours per annum for productive work.

In order to maximize the profitability of farm tractors, the owner must control the utilization and productivity of tractors. Tractor utilization can be defined as the period of time over which the tractor is gainfully used and productivity refers to the output achieved as a result of that employment. Utilization is expressed as a percentage of the clock hours the tractor has worked in a year compared to the budgeted hours. For example, if the budgeted working hours per year is 1 000 hours and the tractor only works 500 hours, the utilization is 50%. Mpanduji (2000) defined tractor annual utilization as

the number of annual hours spent by a tractor on various productive tasks. The tasks could be ploughing, harrowing, planting, and transportation; other tasks can be inter-row cultivation, spraying operation, pumping water for irrigation and custom hiring services.

There are necessary conditions for successful utilization of tractors; Dihenga *et al.*, (1989) highlighted those conditions as follows:

- a) The farm must be large enough with plenty of work to be done throughout the year.
- b) There should be enough capital to buy and operate the tractor.
- c) There must be skilled people to operate, repair and maintain the tractor
- d) Spare parts and services must be available and at a reasonable cost.
- e) The return from the farm should justify the cost of running the tractor.

Several researchers have undertaken studies on annual utilization of farm tractors in the world. Mpanduji (2000) found that the mean annual utilization of conventional tractors in Tanzania ranged from 600 to 1100 hours per year for tractors owned by large scale farms. A survey done by Simalenga *et al.*, (1991a) in Morogoro region observed that the average annual utilization of conventional tractors was 1200 hours per year for individual owned tractors, 900 hours per year for village owned tractors and 800 hours per year for cooperative owned tractors, they also noted that 64% of time use was for transportation. Similar study undertaken in Nigeria by Dauda *et al.*, (2010) found that conventional tractors utilized for ploughing were able to cover 289 ha/year at operating speed of 4 km/hr and plough width of 1.8m this resulted to working for 400 hours per annum. Also a study in Nigeria by Kolawole (1972) reported that the annual utilization of tractors in a government tractor hire service was about 500 hours per year, while annual use of privately owned tractors was about 786 hours per year. Yadava and Aggarwal, (2000) reported that the average annual use of conventional tractors for Haryana state was 594.3

hours per year of which 56.46% of the time was used for custom work and 41.54% for own work. Fitzgerald and Charles (1980) observed high annual utilization of conventional tractors in Thailand to be 1350 hours per year servicing about 260 ha and in Philippines conventional tractors were utilized for 1500 hours per year servicing more than 275 ha. Cecil *et al.* (2005) found that conventional tractors in Kgatleg district of Botswana were utilized for 148 hours per year. Cecil *et al.*, (2005) pointed out the reasons for underutilization includes:

- a) The down- time of the tractors, sometimes tractors took long time before it gets fixed;
- b) Spare parts were not easily available;
- c) Mechanics were expensive and not reliable and
- d) Fields were relatively small about 5 ha each.

Gego (1986) suggested that in areas where tractors cannot be utilized optimally, the owner should be advised to look for other alternative tractor usage such as private contract scheme or tractor custom hiring services. Harry and Solie (2007) reported that the improvement of tractors utilization rates could be achieved by joint ownership, increasing the size of the enterprise, or increasing the working season by diversifying production.

Paman *et al.* (2010) studied the utilization of power tillers in rice farms in Indonesia and found that the annual use averaged to 23.13 ha ranging from 7 to 40 ha. Chancellor (1978) found that in Malaysia power tillers used for hiring, served an average area of 27 ha operating about 400 hours per year and in Philippines, power tiller may service as much as 35 ha per year. Taufiqul (1993) found that the average annual use of power tillers in Bogra district in Bangladeshi was 534 hours per year. Duff (1986), argued that farmers

with small sized farms have to use power tillers because it offers substantial economic advantages than large conventional tractors.

2.3 Provision of Loans for Procurement of Tractors

In 2010, the government through the Agriculture Input Trust Fund (AGITF) provided 30 loans for power tillers compared to 57 loans provided in 2009 - this shows a decrease of 47.7%, (Economic Survey, 2010). Likewise the provision of loans for power tillers declined to 46.06% in 2010 (Table 2) as compared to 2009. The report pinpointed the reason for the decrease in loan provisions to be Government financial constraints (Economic Survey, 2010).

Table 2: Credit provision through agricultural inputs trust fund for 2009/2010

Credit type	Credit in 2009	Credit in 2010	% change 2009/10
Power tillers	57	30	-47.7
Conventional tractors	165	89	-46.06
Maintenance of tractors	1	3	200
Crop and livestock Input	238	46	-80.7
Irrigation equipment	0	1	100

Source: Economic Survey, 2010

2.4 Subsidies for Farming Inputs

In 2008/09, the Government opted to provide subsidies through voucher system rather than the old system of effecting direct payment to the company supplying farming inputs. In a voucher system a farmer was issued with three vouchers: One voucher was for seeds; the second voucher was for basal dressing fertilizer and the other for top dressing. These vouchers were for food crops, mainly maize and rice. In addition, in 2009/10 the government decided to grant subsidies for cotton. A cotton grower was issued with two vouchers: one voucher was for cotton seeds and the other for cotton pesticides. Up to 2010, it was reported that 20 regions had benefited from the voucher system (Economic Survey, 2010). There was no subsidy reported for the purchase of agricultural implements or machinery.

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Materials

3.1.1 Location of the study area

Mbarali district (Figure 1) lies between Latitude 7⁰48” and 9⁰25” South of Equator and Longitude 33⁰40” and 35⁰09” East of Greenwich; it is one of the districts of Mbeya Region. The district lies in the heart of the plains of the Great Ruaha River. The crop production in the district relies largely on rain fall supplemented with irrigation. The district lies at an altitude ranging from 1000 to 1800 meters above sea level. Average temperatures range between 25⁰C and 30⁰C. The mean annual rainfall is about 450 to 650 mm. The District is bordered by Iringa district on the North-East, on the west is bordered by Mbeya District while on the East the district is bordered by Njombe and Mufindi Districts. To the North Mbarali District borders Ruaha National Park while to the South it borders Makete District and Mpanga - Kipengere game Reserve.

Mbarali district has a total area of 16 000 km² with an arable land of 3215 km², Game Reserve of 9600 km², Forest of 400 km², Settlement of 1245 km² and Swamp of 1540 km² (Table 3). Mbarali has a total population of 300,517 which comprised of 145 867 male and 154 650 female (National Bureau of Statistics (NBS), 2013). Administratively, Mbarali District is divided in two divisions namely Ilongo and Rujewa, with 20 Wards and 93 registered villages (Mbarali District Council Annual Report, 2012).

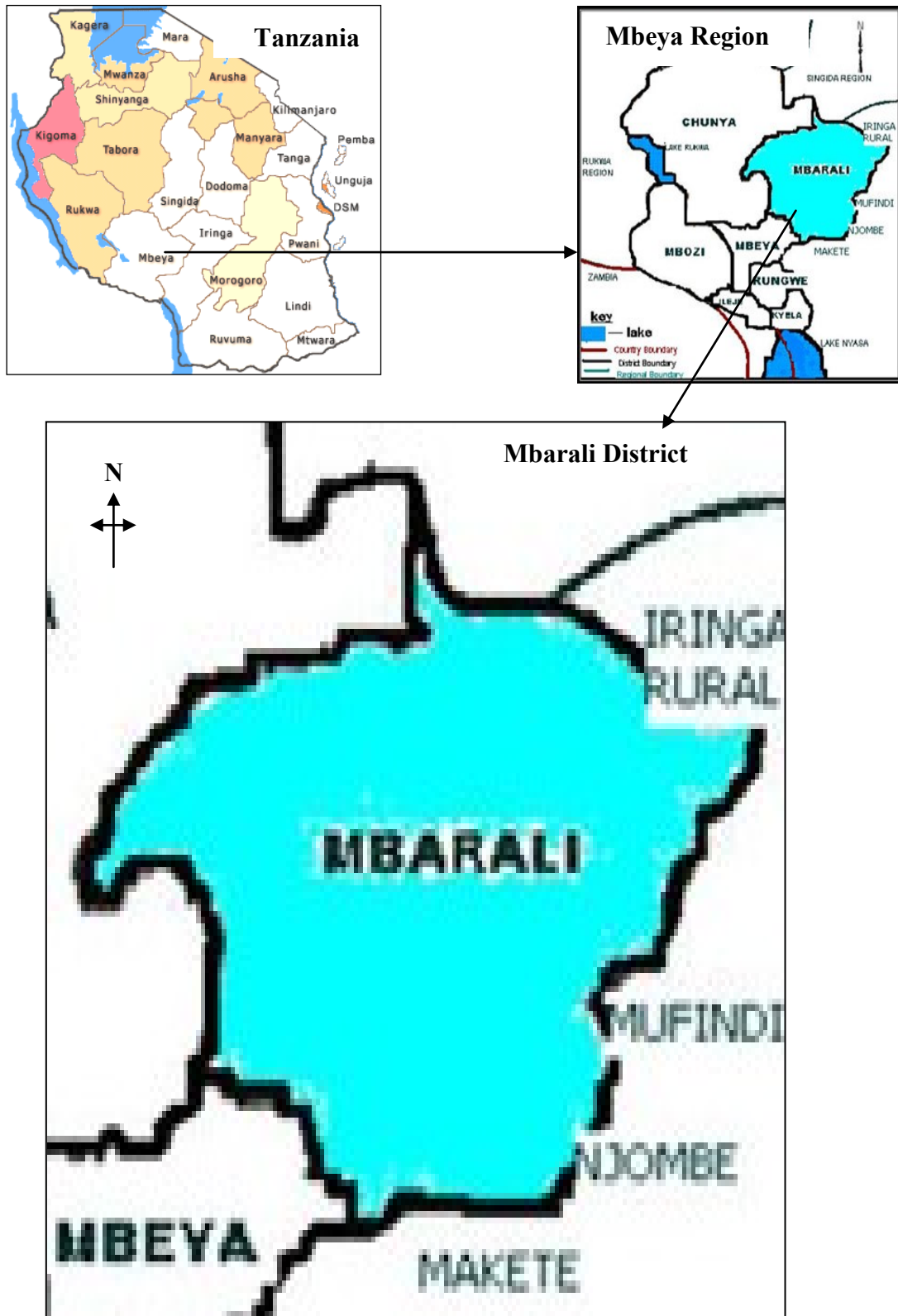


Figure 1: Map of Tanzania showing the location of Mbarali District

Table 3: Land use pattern in Mbarali district before expansion of Ruaha national park in 2008

Classification	Area in Km ²	Square area in %
Arable Land	3215	20.1
Game Reserve	9600	60
Forest Reserve	400	2.5
Settlement	1245	7.78
Swamps, Hills, etc	1540	9.62
Total	16 000	100

Source: Mbarali District Council Annual Report, 2012

3.1.2 District economy

Mbarali's economy depends mainly on agriculture for production of crops and livestock keeping. About 83% of the Mbarali communities are engaged in agriculture mostly paddy farming, and few in businesses, fishing, livestock and civil services. Rice and sunflower are the main cash crops that are used for business transactions within and outside Mbarali District. Other crops include maize, sweet potatoes, sorghum, onions, cassava, beans, ground nuts, and vegetables.

3.1.3 Irrigation schemes

Mbarali district is one of the main paddy producers and among the focused district in Tanzania for development of irrigation schemes. There are 80 irrigation schemes in Mbarali district. These irrigation schemes are categorized into three, namely traditional, improved and modern, of which 51 are traditional (15 274ha), 26 are improved (15 018 ha) and 3 are modern (9200ha), (Mbarali District council Annual Report, 2012).

3.1.4 Condition of tractors

Mbarali district has the highest number of both conventional tractors and power tillers in Mbeya region (Table 4). The power tillers being the popular tractors found in Mbarali

district. This big number of power tillers in Mbarali could be due to its suitability in working on wet paddy field conditions.

Table 4: Distribution of farm tractors in Mbeya region in 2010

Type/District	Mbarali	Ileje	Mbeya Urban	Mbeya Rural	Mbozi	Rungwe	Kyela	Chunya	Total
Conventional	208	2	14	29	103	12	27	10	405
Power tillers	1041	10	1	1	4	2	11	3	1073

Source: Ministry of Agriculture, Mechanization Department, 2010.

3.2 Methods

3.2.1 Research design

A cross sectional survey was applied in this study. A cross section survey design was chosen because the design is essentially used to collect data once from randomly selected samples to describe the population at a particular time, (Kothari, 2004 and Bengesi, 2012). This research design technique was selected because of the short time set available for data collection and the design is useful in obtaining an overall picture as it stands at the time of study.

3.2.2 Sampling design

Stratified and purposive random sampling design techniques were used to get the appropriate sample size. The selection of this technique depends on the fact that a heterogeneous population in nature was involved which was power tillers and conventional tractors. A stratified sampling design gives results, which are reliable and detailed information (Kothari, 2004).

3.2.3 Sample size

In this study a sample of 111 farm tractors were surveyed consisting of 90 out of 1244, (7.2%) power tillers and 21 out of 219 (9.6%) conventional tractors. This sample size of tractors were based on acceptance of “owner of tractors” to cooperate in the filling up the log book which was used to record daily farm tractor utilization (Appendix 2) for a period of six months.

3.2.4 Data collection

Data collected in this study were primary and secondary data. The classification was based on the source of the data. In cases where a farmer owned more than one tractor, each tractor was treated as a separate unit and information about its use was collected independently (Cecil *et al.* 2005). The questionnaire (Appendix 1) and log book (Appendix 2) were the instruments used for data collection of the utilization rates of farm tractors.

3.2.4.1 Socio-economic characteristics of owners of tractors in Mbarali district

The primary data collected from the tractor owners or caretakers were: age, sex, level of education, family size, land ownership, percentage of farm cultivated using a tractor, whether attended any training about farm machinery management and whether involved in any activities apart from farming. Data collected from operators of tractors were: number of years of experience for operating a tractor, whether attended any training pertaining to tractor operation and management. Questionnaires and face to face interviews were used in data collection.

3.2.4.2 Current types and models of farm tractors in use in Mbarali District

The primary data collected includes: pattern of ownership, type of tractor, make, year of purchase, initial purchase price, condition of tractor when purchased and reasons or motive for purchasing a tractor. Questionnaire and observation were the techniques used to collect data.

3.2.4.3 Average annual utilization rates of farm tractors for both on-farm and non-farm activities in Mbarali District

A logbook [attached appendix 2] was used to record all daily activities of farm tractors including utilization rates in hours for a period of six months from November 2012 to April 2013. The data collected was for all activities done on-farm as well as off-farm. Tractor owners and operators were trained on how to record the data on tractor utilization in the logbook. A close follow-up of filling in the log book was done throughout the entire period of the study.

3.2.4.4 Support services and infrastructure available for optimum utilization of tractors in Mbarali District

The primary data was collected from tractor owners, tractor selling agents and spare parts dealers. Data collected from the tractor owners were as follows: whether ever acquired any loan for purchasing a tractor, loan interest rate, whether ever received a subsidy when purchasing the tractor, where did he or she purchase the tractor, places for repair of tractors, distance from home to spare parts shops and investigated whether he or she received an after-sale service from the tractor supplier. A questionnaire was employed for data collection. Secondary data was collected from the office of DAICO-Mbarali. The data collected includes; who are the sellers of tractor in Mbarali district, how many tractor operators were trained by the district, how many tractors or power tillers currently in use.

Other information was collected from agricultural documents such as Bulletins, proceeding, workshop or seminar and past research work.

3.3 Data Analysis

The collected data was coded and uploaded using a computer. The Statistical Packages for Social Sciences (SPSS-16) - computer program was used to analyze the data and also descriptive statistics and simple regression techniques including percentages and means were used to analyze the data. The compounding tables were used to calculate the present values (PV) of cost of purchasing tractors by the use of interest rate of 7% which is the current interest rate offered by Tanzania Investment Bank (TIB). The results are displayed using tables and charts.

$$FV = PV(1+i)^n \dots\dots\dots (i)$$

Where:

- | | | |
|----|---|---|
| FV | = | Represents the future value amount |
| PV | = | Represents the Present Value amount |
| N | = | Number of time periods that interest will be paid |
| i | = | Interest rate for the time period n |

The study of utilization rates of farm tractors in Mbarali district has revealed that there was a minimum possibility of ploughing activities undertaken during off-season and major activities performed during off season have been reported to be transportation. Therefore tractor utilization during off season was estimated to be equal to the utilization rates which occurred during on-season for non- farm utilization/activities. The average annual utilization rates of farm tractors was therefore determined as follows:

- i. Determine the on-season utilization rates for both on-farm and non-farm activities for a period of six months.

- ii. Determine the off–season utilization rates which were estimated to be similar to the utilization rates obtained for non-farm activities during on-season.
- iii. Summing up the utilization rates for on-season and off-season to get the annual utilization rates.
- iv. Finally calculated the average annual utilization rates.

3.4 Challenges During Data Collection

During field data collection, there were some challenges encountered:

- i. Some tractor operators refused to cooperate especially in filling up the log-book for tractor utilization; the reason they gave was that they had no time to record the log book for such long period of time.
- ii. Some tractor operators were demanding payments for the job of filling up the log book.

However, the author worked with only those owners of tractors and operators who willingly accepted to cooperate in filling in the log book.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Socio-economic Characteristics of Owners of Farm Tractors in Mbarali

District

4.1.1 Gender of owner's of tractors

Data collected in this study show that owners of all conventional tractors are male while 90% of owners of power tillers were male and only 4.4% were female while 5.5% power tillers were owned by groups of farmers (Table 5).

Table 5: Gender of owners of tractors

Sex	Conventional tractors		Power tillers	
	Frequency	Percentage	Frequency	Percentage
Male	21	100	81	90
Female	-	-	4	4.4
Group owned	-	-	5	5.5
Total	21	100	90	100

Source: Survey data, 2013

4.1.2 Age of owners or care takers of conventional tractors

Majority, 52.5% owners of conventional tractors are between 41 and 50 years old while 61.11% owners of power tillers are between 31 and 50 years old. Also it was found that 9.2% owners of conventional tractors are above 60 years old and 7.77% owners of power tillers are above 60 years old. Other categories are indicated in Table 6.

Table 6: Age of owners or caretakers of conventional tractors and power tillers

Range of age	Conventional Tractors		Power tillers	
	Frequency	Percentage	Frequency	Percentage
21 – 30	-	-	7	7.8
31 – 40	4	19	31	34.4
41 -50	11	52.5	24	26.6
51 – 60	4	19.0	14	15.6
Above 60	2	9.5	7	7.8
N/A	-	-	7	7.8
Total	21	100	90	100

Source: Survey data, 2013

4.1.3 Level of education of owners of tractors

The study found that all owners of tractors surveyed have basic education. This indicates that farmers are able to read and write and hence able to give valid information of tractor utilization. Table 7 shows that 33.3% owners of conventional tractors and 6.7% owners of power tillers have college education, while 14.3 % and 18.9% owners of conventional tractors and power tillers respectively reached secondary level, also 38.1% and 65.5% owners of conventional tractors and power tillers respectively reached primary education level.

Table 7: Level of education of tractor of owners/ care takers of farm tractors

Level attained	Conventional tractors		Power tillers	
	Frequency	percentages	frequency	percentages
Adult Education	1	4.8	3	3.3
Primary education	8	38.1	59	65.5
Secondary education	3	14.3	17	18.9
Vocational training/ university	9	42.8	6	6.7
None	-	-	5	5.6
Total	21	100	90	100

Source: Survey data, 2013

4.1.4 Household size of tractor owners

The study found that 23.8% owners of conventional tractors and 24.2% owners of power tillers have less than 4 dependants and 42.9 % owners of conventional tractors had dependants between 5 and 7 while 36.3% owners of power tillers had dependants between 5 and 7. Generally, it was observed that owners of farm tractors had a normal family size which is between 1 and 7 (Table 8).

Table 8: Family size of the tractors owners

Number of family members	Conventional tractors		Power tillers	
	Frequency	Percent	frequency	Percent
Less than 4	5	23.8	22	24.2
5 to 7	9	42.9	33	36.3
More than 8	7	33.3	30	33.0
Missing	-	-	5	6.6
Total	21	100	90	100

Source: Survey data, 2013

4.1.5 Training of operators in operations and maintenance of tractors

The study found that 52.4% operators of conventional tractors did attend training, and 12.2% operators of power tillers attended training (Table 9). This result shows that 87.8% operators of power tillers did not attend any training; therefore this may result into mismanagement of tractors which could lead to frequent breakdowns. This may result into loss of time waiting for repairs of tractors and hence affect their average annual utilization rates. Fortunately no record of tractor breakdown was reported to occur due to lack of training of the operator.

Table 9: Training for operators in operation and maintenance of tractors

Response	Conventional tractors		Power tillers	
	Frequency	Percentage	Frequency	Percentage
No	10	47.6	79	87.8
Yes	11	52.4	11	12.2
Total	21	100	90	100

Source: survey data, 2013

4.1.5.1 Duration of training for tractor operators

The operators of conventional tractors who participated in the survey, 33.3% responded that they attended two weeks training on operation and maintenance of tractors, most of operators of conventional tractors 10 out of 21 (47.5%) responded that they never had an opportunity to attend any training, other responses are shown on the (Table 10). Also 3.3% operators of power tillers who participated in the survey responded that they received two weeks training on operation and maintenance.

Table 10: Duration of training for tractor operators

Duration of training	Conventional tractors		Power tillers	
	Frequency	Percentage	Frequency	Percentage
One day	-	-	2	2.2
Two days	-	-	2	2.2
Three days	-	-	1	1.1
Five days	1	4.8		
One week	1	4.8	1	1.1
Two weeks	7	33.3	3	3.3
Three months	1	4.8		
Six Months	1	4.8		
Two years	-	-	2	2.2
None	10	47.5	79	87.8
Total	21	100	90	100

Source: survey data, 2013

4.1.5.2 Experience of tractor operators

The study established that 81.0% (Table 11) operators of conventional tractor had experience of more than five years while 27.8% operators of power tillers had experience of five years. The results also indicate that majority of operators of power tillers had one to three years experience while majority of operators of conventional tractors had experience of more than five years. The good performance of operating conventional tractors by most operators was probably due to their longer experience in operating farm tractors.

Table 11: Experience of operators in tractor operation

Number of years	Conventional Tractors		Power tillers	
	Frequency	Percentage	Frequency	Percentage
1 to 3	3	14.3	47	52.2
4 to 5	1	4.8	18	20.0
Above 5	16	81.0	25	27.8
Total	20	100	90	100

Source: survey data, 2013

4.1.6 Land holdings of tractor owners

Results from the survey show that the majority (79.9%) owners of power tillers had land ranging in size between 0.2 and 11.7 hectares while majority (86%) owners of conventional tractors own land ranging between 8 and 40 hectares (Table:12). However, most tractor owners pointed out that they also do custom hiring services to other farmers for improving tractor utilization.

Table 12: Farmland size owned by owners of tractors

Land owned in hectares	Conventional Tractors		Power tillers	
	Frequency	percentage	Frequency	percentage
0.2 - 3.6	-	-	21	23.3
4 - 7.6	-	-	39	43.3
8 - 11.7	3	14	12	13.3
12 - 15.8	4	19	4	4.4
16 - 19.8	-	-	7	7.7
20 - 23.8	1	5	-	-
24 - 27.9	5	24	2	2.2
28 - 31.9	-	-	1	1.1
32 - 36.0	4	19	2	2.2
36 - 40.0	1	5	-	-
Above 40	3	14	2	2.2
Total	21	100	90	100

Source: survey data, 2013

4.1.7 Percentage of land ploughed by a tractor

The study found that 81% (Table 13) of the owners of conventional tractors reported to accomplish all land preparation using tractors only, and 64% owners of power tillers responded to using power tillers only to accomplish their land preparation.

Table 13: Percentage of land ploughed by tractor

Percentage of land ploughed by tractor	Conventional Tractors		Power tillers	
	Frequency	Percentage	Frequency	Percentage
45	-	-	2	2.2
50	2	9.5	7	7.7
60	-	-	1	1.1
65	1	4.8	1	1.1
75	-	-	1	1.1
80	-	-	2	2.2
86	-	-	1	1.1
90	-	-	4	4.4
95	1	4.8	10	11.0
98	-	-	1	1.1
100	17	81.0	59	64.8
Missing system	-	-	1 (Banio Mbuyuni)	2.2
Total	21	100	90	100

Source: Survey data, 2013

4.1.8 Extra activities apart from farming done by tractor owners

Farmers in the study area are also engaged in other occupation for supplementing their income. The study shows that 61.9% (Table 14) of the owners of conventional tractors are engaged in extra occupation whereas 36.7% of the owners of power tillers also engage in other occupation other than farming. Among the extra activities done include, livestock keeping; business, salaried employees, others include masonry and carpentry (Table 15).

Table 14: Response for the participation on extra occupations by owners of farm tractors

Response	Conventional Tractors		Power tillers	
	Frequency	Percentage	Frequency	Percentage
Yes	13	61.9	57	36.7
No	8	38.1	33	63.3
Total	21	100	90	100

Source: survey data, 2013

Table 15: Extra activities done by tractor owners

Kind of occupation	Conventional Tractors		Power tillers	
	Frequency	Percentage	Frequency	Percentage
Livestock keeping	3	14.3	12	13.3
Business	9	42.9	32	35.5
Salaried employee	1	4.8	9	10
Masonry	-	-	3	3.3
Carpentry	5	23.8	25	27.7
N/A	3	14.3	9	9.9
Total	21	100	90	99.7

Source: Survey data, 2013

4.2 Current types of farm tractors available in Mbarali district

4.2.1 Tractors ownership

All conventional tractors surveyed are individually owned and 93.3% power tillers are individual owned while 6.7% of power tillers are owned by farmer's group (Table 16).

Table 16: Tractor ownership

Type of ownership	Conventional Tractors		Power tillers	
	Frequency	Percentage	Frequency	Percentage
Individual	21	100	85	94.4
Group/ joint- ownership	-	-	5	5.6
Total	21	100	90	100

Source: Survey data, 2013

The study shows that Siam-Kubota and Amec were more popular than other makes. It was found that 53.8% and 34.1 % were Siam-Kubota and Amec respectively (Table 17). The popularity of these two types of models was attributed to ease of availability of spare parts from the dealers. For example, Kubota power tillers has two dealers specialized for Siam-Kubota power tillers only, the names of these Kubota dealers in Mbarali district are Lugawo Store located at Igawa and Nizar Shop located at Chimala. Dealers of Amec Power tillers were found to be available in many business centers in Mbarali District such as Chimala, Rujewa, Igurusi, Igawa, and Ubaruku.

Table 17: Distribution of power tillers in the study area

Make	Percent	Frequency
Amec	30	34.1
Siam Kubota	49	53.8
Shang chai	2	2.2
JD	4	4.4
Taffest	2	2.2
Toyo	1	1.1
Dae dong	1	1.1
Greaves	1	1.1
Total	90	99.9

Source: Survey data, 2013

Table 18: Distribution of conventional tractors

Make	Power (Hp)	Frequency	Percentage
Massey Ferguson	90	2	9.5
Valmet	60	4	19.1
International H- 744	75	3	14.3
Fiat	100	1	4.8
Catic	70	2	9.5
John Deere	75	3	14.3
Swaraj	80	1	4.1
Belarus		1	4.1
Ford 5610		2	9.5
New Holland		1	4.8
YTO (Gong fang Hong)		1	4.8

Source: Survey data, 2013

4.2.2 Make of surveyed tractors

The available tractors in Mbarali District surveyed were of the following makes:

Power tillers: Siam Kubota, Amec, JD, Shang-Chai, Daedong, Taffest, Greaves and Toyo.

Conventional tractors: Catic, Fiat, International harvester- 744, John Deere, Massey Ferguson, Valmet, New Holland, Ford-5610, Belarus, and YTO (Gong fang Hong).

4.2.3 Date of purchase of surveyed tractors

4.2.3.1 Purchase date of conventional tractors

The survey shows that (42%) of conventional tractors are aged between 21 and 35 years (Table 19). The oldest one was purchased in 1978. The depreciation caused by old age (more than 20 years) of conventional tractors could be the main contributing factor to frequent break downs and hence result in low rates of annual utilization.

Table 19: Year of purchase of conventional tractors

Year of manufacture	Frequency	Percentage
1978	3	14.3
1980	1	4.8
1982	1	4.8
1987	1	4.8
1991	1	4.8
1992	2	9.5
2002	1	4.8
2001	1	4.8
2006	2	9.5
2008	1	4.8
2009	1	4.8
2011	1	4.8
2012	5	23.8
Total	21	100

Source: Survey Data, 2013

4.2.3.2 Purchase date of power tillers

The study has revealed that most (84.6%) of power tillers (Table 20) were purchased after 2008 which means they are less than five years old. The oldest power tiller was purchased in 2005.

Table 20: Year of purchase of power tillers

Year of Purchase	Frequency	Percentage
2005	2	2.2
2006	4	4.4
2007	8	8.8
2008	9	9.9
2009	12	13.2
2010	22	24.2
2011	19	20.9
2012	12	13.2
2013	2	3.3
Total	90	100

Source: Survey data, 2013

Another important point to note is that due to low income of most ordinary farmers in Mbarali district, 66.7 % (Appendix 3A) of the conventional tractors were purchased as second hand tractors. Four (19%) tractors purchased as brand-new were obtained through the loans provided by financial institutions such as Madibira SACCOS of Madibira; Chimala SACCOS of Chimala; Ubaruku SACCOS of Ubaruku and Muungano SACCOS of Igurusi.

Further, the study shows that 84.4% of power tillers were purchased as brand new. Many SACCOS are financing small to medium scale farmers to purchase power tillers than conventional tractors (Appendices 3B). Power tillers were either purchased as a complete set or purchased an engine with a chassis only. A complete power tiller set means that the buyer was provided with all accessories such as; power tiller, Cage wheels, disc plough, mould board plough, rake, paddler, rotavator and a trailer, sometimes they were also provided with a water pump.

Table 21: Condition of a tractor during purchase time

Condition during purchase time	Conventional tractors		Power tillers	
	Frequency	Percentage	Frequency	Percentage
New	7	33.3	76	84.4
Used (second hand)	14	66.7	14	15.6
Total	21	100.0	90	100.0

Source: Survey data, 2013

4.2.4 Motive for purchasing tractors

Results show that, farmers were purchasing conventional tractors and/or power tillers in order to use them for land preparation on their own farms as well as use them for transportation of agricultural produce and other non- agricultural activities and for provision of custom hire services. From the results (Table 22), it was found that 82.2% of the power tillers and 57.1% of the conventional tractors were purchased for the purpose of timely accomplishment of the farm work; 14.4% power tillers and 42.9% conventional tractors were purchased for increasing area under cultivation and 3.3% power tillers were purchased to avoid delays in land preparation which normally occur when using a hired tractor.

Table 22: Motive for purchasing tractors

Motive of purchasing a tractor	Power tillers		Conventional tractors	
	Frequency	Percentage	Frequency	Percentage
Timely accomplishment of agricultural farm work	74	82.2	12	57.1
Increase acreage of farm	13	14.4	9	42.9
Delaying to prepare farms due to time lost waiting to get a hired tractor	3	3.3	-	-
Total	90	99.9	21	100

Source: Survey data, 2013

4.3 Annual Utilization Rates of Farm Tractors in Mbarali District

Major tasks performed by farm tractors during on-season were categorized into on- farm and non-farm activities. On-farm utilization consisted of ploughing, harrowing, puddling, water pumping for irrigation and for non-farm utilization was mainly transportation which consisted of transporting agricultural produce, transporting fertilizer or animal manure, transporting paddy seeds or seedlings, transporting construction materials, transporting fire wood, fetching water, transporting animal feeds and used to transport labour to their farms. It was also noted that tractors were utilized for both on own tasks and for hiring to others as well. Tractor utilization rates for off-season was mainly transport because no ploughing operations are done during the off-season.

Generally results shows the average utilization rates during on-farm was higher than off-farm for both conventional tractors and power tillers. On-farm utilization rates was found to be 61% of the total time used for conventional tractors and for power tillers 52% of the total time was spent on-farm activities. It was revealed that four (4) owners (19%) of conventional tractors and two (2) owners (2%) of power tillers had no trailer so they did not utilize their tractors for off- farm activities so they had zero utilization rates on off-farm hence were dropped down in the analysis for utilization rates.

4.3.1 Annual utilization rates of conventional tractors

The annual utilization rates for conventional tractors were found to range between 327 hours to 2272 hours and the calculated average annual utilization rates was found to be 1093 hours (Appendix 4A). Results show that 39% of utilization rates were obtained from off-farm activities. The range between the higher and lower utilization rates was big this shows that some owners of tractors allow their tractors to remain unutilized for most of the time in the year as a result tractors are underutilized. Also it was noted that due to old

age, for example two tractors were procured in 1978 so the owner of such tractors feared breakdown and so he allowed his tractors to work at a low capacity. Most tractor owners said they minimized the utilization of their tractors in off-farm activities because they feared breakdowns. Owners of tractors normally use lorries and trucks for most of off-farm or off-season transportation activities. Owners of tractors who had no trailers also had low utilization rates of their tractors because their tractors relied only on-farm activities. A tractor with the highest utilization rate was fully utilized and was reported to be operated by two operators in shifts. Tractor owners need to be informed that low utilization of tractors lowers the profit of tractors so they have to be encouraged to optimize utilization rates.

Similar results were obtained by Mpanduji (2000) who reported that tractor utilization in Tanzania ranged between 600 hours to 1100 hours per year for tractors owned by large scale farms. Simalenga *et al.*, (1991a) obtained similar results in Morogoro region where utilization of conventional tractors was 1200 hours per year for individually owned tractors; 900 hours per year for village owned tractors and 800 hours per year for cooperative owned tractors. Kolawole (1972) also found similar results in Nigeria that tractors were utilized for 786 hours per year for privately owned tractors and 500 hours per year for government owned tractors. Lower utilization of conventional tractors were reported by Yadava and Aggarwal (2000) that tractors in Haryana state were utilized for 594.3 hours per year and Cecil *et al.*, (2005) reported that conventional tractors in Kgatleng district of Botswana were utilized for 148 hours per year. However, higher utilization of tractors was reported in Thailand and Philippines (Fitzgerald and Charles, 1980) that conventional tractors were utilized for 1350 hours per year in Thailand and in Philippines tractors were utilized for 1500 hours per year.

The result of utilization rates of conventional tractors obtained in Mbarali district is close to the recommended annual utilization rates for productive work of conventional tractors of 1000 hours per year (Lonnemark, 1967 and Meghalaya Rural Bank, 2014). Therefore it was concluded that conventional tractors in Mbarali District are utilized at optimal rate.

4.3.2 Annual utilization rates of power tillers

The annual utilization rates of power tillers was found to range between 239 hours to 870 hours and the calculated average annual utilization rates was found to be 627 hours per year (Appendix 4B). Results show that 48% of the annual power tiller utilization rate was for non-farm utilization. The rate of utilization of power tillers on farm was almost equal to the rate of utilization off-farm. The power tiller with the lowest utilization rate occurred because it was utilized at the lowest rate of 45 hours on non-farm activities.

Similar results were obtained by Taufiqul (1993) in Bogra district of Bangladesh that power tillers were utilized for 534 hours per year. Similarly Chancellor (1978) reported that in Malaysia power tiller used for hiring were utilized for 400 hours per year.

The result of power tiller utilization rates in Mbarali district is close to the recommended utilization rate of 600 hours per year (Meghalaya Rural Bank, 2014). Therefore it was concluded that power tillers in Mbarali District are utilized at optimal rate.

There could be a possibility of improvement of the utilization rates if tractor owners and operators were well informed about the benefit increasing utilization in order to increase profit for power tillers because the more a tractor is given enough productive work to do per year the more the reduction of the ownership cost per hour.

4.4 Support Services and Infrastructure Available for Optimal Utilization Rates of Farm Tractors in Mbarali District

4.4.1 Loans available for the purchase of tractors

The study has revealed that 28.6% owners of conventional tractors and 32.2% owners of power tillers reported that they received loans from several financial institutions when purchasing their tractors (Table 23). More financial credit programs should be arranged to support farmers in order to improve the situation so that more farmers may access credits from financial institutions.

Table 23: Farmers who got loans when purchasing tractors

Response	Conventional tractors		Power tillers	
	Frequency	Percentage	Frequency	Percentage
No	15	71.4	61	67.7
Yes	6	28.6	29	32.2
Total	21	100	90	100

Source: Survey data, 2013

4.4.2 Loan interest rates charged

The loan interest rates charged for purchasing farm tractors was from 6% to 28%, as shown on (Table 24).

Table 24: Loan interest rates charges

Interest rate Charges	Conventional tractors		Power tillers	
	Frequency	Percentage	Frequency	Percentage
6	3	14.3	-	-
8	1	4.8	-	-
15	-	-	5	5.7
17	-	-	1	1.1
18	-	-	1-	2.3
19	-	-	2-	2.3
20	-	-	9	10
22	1	4.8	-	-
25	1	4.8	2	2.3
23	-	-	3	3.4
28	-	4.8	2	2.3
N/a	15	-	61	2.3
Missing	-	-	4	25
Total	21	100	90	100

Source: Survey data, 2013

However, the study has revealed the following reasons as to why some farmers did not acquire loans for purchasing farm tractors in Mbarali District.

- i. Financial institutions are charging high interest rate
- ii. Risk of crop failure due uncertain weather of Mbarali District.
- iii. Some tractor owners said they had enough own capital for purchasing tractors.
- iv. Some tractor owners said they have no collateral which is the basic requirement.
- v. A lot of bureaucracy and corruption by the financial institution officers.

4.4.3 Subsidies for the purchase of tractors

From the study it was revealed that no subsidy was given to individual farmers for purchasing conventional tractors but only 3.3% owners of power tillers reported to have received subsidy when purchasing power tillers (Table 25). One farmer received 100% subsidy (Tsh. 2.5×10^5) for the purchase of power tiller when Mbarali district was promoting the use of power tillers in the rice cultivation in Madibira ward of Mbarali District in year 2000. Another subsidy was given to Igomelo Irrigation Association in year 2010 by Mbarali District Council at 75% of the price of a power tiller. It was also reported that 100% subsidy was received from Makete-District in year 2012 to be used by a farmers group which was formed to save orphans at the Uturo village in Mbarali District.

The government should provide subsidies, as it does for seed for crops such as maize, cotton as well as for fertilizers, to farmers for purchasing tractors so that prices of tractors could come down and allow more farmers to be in a position to own tractors.

Table 25: Subsidies for purchasing tractors

Response	Conventional tractors		Power tillers	
	Frequency	Percentage	Frequency	Percentage
No	21	100	87	96.7
Yes	-	-	3	3.3
			(1 st = 2 500 000/=)	
			(2 nd = 3 300 000/=)	
			(3 rd = 7 200 000/=)	
Total	21	100	90	100

Source: Survey data, 2013

4.4.4 Places where they purchased tractors

It was found that 81% and 45.6% of conventional tractors and power tillers respectively were purchased outside Mbarali District (Table 26).

Table 26: Places where they purchased tractors

Response	Conventional tractors		Power tillers	
	Frequency	Percentage	Frequency	Percentage
Within Mbarali District	4	19	49	54.4
Outside Mbarali District	17	81	41	45.6
Total	21	100	90	100

Source: Survey data, 2013.

It was also found that 52.9% conventional tractors and 68.3% power tillers were purchased in Dar es Salaam. Other places are shown on Table 27.

Table 27: Place outside Mbarali district where farm tractors were purchased

Response	Convention tractors			Power tillers		
	Location	Frequency	Percentage	Location	Frequency	percentage
Outside Mbarali District	Dar es salaam	9	52.9	Dar es Salaam	28	68.3
	Iringa	1	5.8	Iringa	5	12.2
	Mafinga	1	5.8	Kyela	1	2.4
	Malawi	1	5.8	Makambako	1	2.4
	Mbeya	1	5.8	Mbeya	3	7.3
	Mbozi	1	5.8	Makete	1	2.4
	Morogoro	1	5.8	Mwakaleli	1	2.4
	Mtwara	1	5.8	Songea	1	2.4
	Zambia	1	5.8			
Total		17	100		41	100

Source: Survey Data, 2013

It has been found 32.6% and 24.5% of power tillers purchased within Mbarali district were from Chimala and Igurusi respectively (Table 28).

Table 28: Places within Mbarali district where farm tractors were purchased

Response	Conventional tractors			Power tillers		
	Name	Frequency	percentage	Name	Frequency	percentage
Within Mbarali District	Kapunga	3	75	Chimala	16	32.6
	Utengule	1	25	Igurusi	12	24.5
				Ubaruku	9	18.4
				Rujewa	6	12.2
				Madibira	3	6.1
				Mswiswi	2	4.1
				Kongolo	1	2.0
Total		4	100		49	99.9

Source: Survey Data, 2013

4.4.5 Dealers of tractors and spare parts

From this study it has been found that there were many dealers of tractors and spare parts agents in Mbarali District (Table 29). For example, there was Ndingo International Link located at Igurusi village, Nizar Shop (Farm Equipment agent) located at Chimala,

Muheza Hardware located at Chimala, Lugawo Stores (Agent for Siam Kubota tractors) located at Igawa, Keny Hardware located at Rujewa. Others were Mwachembe Hardware located at Madibira and Mdimilaje Agro Dealers located at Igalako village. The network of these tractor agents spread all over Mbarali district is a good indicator that farmers now can service their tractors within Mbarali and hence reducing the cost for travelling long distances like Dar es Salaam to look for the same service.

Table 29: Dealers of power tillers spare parts in Mbarali district

Name of a dealer	Location	Remarks
Lugawo Store	Rujewa	Siam Kubota only
Kenny	Rujewa	JD Amec
Mdimilaje	Igalako	Amec Siam Kubota
Zaire spares	Rujewa	Amec
Mwachembe	Rujewa	Amec
Muheza Hardware	Chimala	Toyo Amec
Mlambya Hardware	Madibira	
Ndingo-International Link	Igurusu	Chang Fang Shang dong Small Kubota tractors
Nizar- shop	Chimala	Siam Kubota Greaves Chang Chai

Source: Survey data, 2013.

4.4.6 Availability of repair facilities and spare parts shops

The study shows that 97.3% of tractor owners did undertake the repair work for their tractors within Mbarali district at the nearby villages by local mechanics. Also it has been found that 76% of spare parts of tractors are found within Mbarali District (Table 30).

Table 30: Availability of repair facilities and spare parts shops

Response		Conventional Tractors		Power tillers	
		Frequency	Percent	Frequency	Percent
Availability of Repair facilities	Within Mbarali District	18	85.7	90	100
	Outside Mbarali District	3	14.3	0	0
	Total	21	100	90	100
Location where purchased spare parts	Within Mbarali District	3	14.3	72	80
	Outside Mbarali District	18	85.7	15	16.7
	Both within and outside	-	-	3	3.3
Total		21	100	90	100

Source: Survey data, 2013

The survey also shows that most spare parts for conventional tractors are found outside Mbarali District. About 85.7% owners of farm tractors travel more than 100 km to purchase tractor spare parts (Table 31). The furthest place was recorded to be in Dar-es-salaam which is about 950 km from Mbarali district; other distances are given in Table 34. It has also been revealed that 75.4% spare parts of power tillers were purchased within Mbarali at a distance ranging between 1 and 30 km.

Table 31: Distances from home to spare parts shops

Distance in Kilometer	Power tillers		Conventional tractors	
	Frequency	Percentage	Frequency	Percentage
0.2-10	36	40	1	4.8
11-20	17	18.8	-	-
21-30	15	16.6	-	-
31- 40	1	1.1	-	-
41-50	1	1.1	-	-
51-60	9	10	1	4.8
61- 70	1	1.1	1	4.8
71- 80	2	2.2	-	-
81 -100	1	1.1	-	-
101- 160	4	4.4	1	4.8
161- 950	3	3.3	17	80.8
Total	90	100	21	100

Source: Survey data, 2013

4.4.7 After sale service

After sale service means the provision of services to customers like provision of spare-parts before, during and after a purchase of tractors. From this study tractor owners were asked whether they received an after sale service or not. Result show that 46.2% of the owners of conventional tractors received after sale services, where as only 36.3% owners of power tillers received the after sale service Table 32. The after sale service offered were about the general service of farm tractors such as engine oil service and lubrication.

Table 32: After-sale service

Response	Conventional tractors		Power tillers	
	Frequency	Percentage	Frequency	Percentage
No	12	57.1	58	63.7
Yes	9	42.9	32	36.3
Total	21	100	90	100

Source: Survey data, 2013

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

From the study, the following conclusions can be made:

- i. All owners of both conventional tractors and power tillers have basic education, therefore they are able to read and write. About 61% of owners of power tillers are middle aged between 31 and 50 years and about 52% owners of conventional tractors are aged between 41 and 50 years.
- ii. All conventional tractors are individually owned while 93.3% power tillers are individually owned and only 6.7% power tillers were owned by farmers group.
- iii. Siam Kubota and Amec power tillers were the most popular power tillers in Mbarali District. About 54% were Siam Kubota and 34% were the Amec.
- iv. The average annual utilization rates for conventional tractor was found to be 1016 hours per year and the average annual utilization of power tillers was 627 hours per year. Generally both Power tillers and conventional tractors were optimally utilized.
- v. On-farm utilization rates were higher than off-farm utilization rates for both conventional tractors and power tillers in Mbarali District.
- vi. There are many of dealers of power tillers and spare parts in Mbarali district, repair work of power tillers was done by local mechanics within Mbarali District. This could be an indicator that there will be sustainable tractor utilization in Mbarali District.

5.2 Recommendations

From this study, the following recommendations can be made:

- i. There is a need to conduct another study of tractor utilization in Mbarali District during off-season (May to October) in order to compare the results of off- farm utilization that was obtained from the tractor utilization during the cropping season (November 2012 to April 2013).
- ii. There is a need for extension officers to advice farmers on the importance of diversifying the utilization of farm tractors in order to improve utilization rates especially to those tractors which were utilized below the average values. The improvement could be to use tractors for weeding, pumping water for irrigation, threshing maize or paddy.
- iii. Government policy makers should continue to create an enabling environment for operations of the private sectors who supply tractors and spare parts in order to ensure sustainable availability of spare parts.
- iv. Government should improve the availability of credit facilities to farmers by providing soft loans for purchasing farm tractors and other agricultural implements having low interest rate.

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APPENDICES

Appendix 1: Questionnaire for assessment of annual utilization rates of farm tractors in Mbarali District

A. General information

- 1. Name of a tractor owner
- 2. Date.....
- 3. Age
- 4. Telephone.....
- 5. Village.....
- 6. Ward
- 7. Division

B. Socio- economic Characteristics of Tractor owners and operators

8. Gender: a) Male

b) Female

9. Highest Education level reached:

- a) Non- formal education b) Adult education
- c) Primary education d) Secondary education
- e) College/ University

10. What is the size of your family members?

- a) Less than 4
- b) Between 5 -7
- c) More than 8

 Tractor owner

11. What is the size of land you own in hectares?

12. What is a percentage of land you are ploughing using tractor?

13. Did you attend any training for tractor operation and management?

a. Yes ...

b. No.....

14. If yes, what training did you attend?

15. Do you have any other occupation other than farming?

a. Yes.....

b. No.....

16. If yes, what occupation?

 Operator

17. How many years of experience do you have in operating a tractor?

.....

18. Did you ever attend any training for tractor operation and maintenance?

a) Yes.....

b) No....

19. If yes, what was the duration of your training?

C. Current situation of Farm tractors available in Mbarali District:

20. How do you own a tractor?

a. Individual

b. Cooperate

c. Farmers -Group

21. What is the type of your tractor?

a) Single axle tractor

b) Conventional tractor.

22. What is the model of your tractor?

23. When did you purchase your tractor?

24. What was the purchase price of your tractor?

25. What was the condition of a tractor when you purchased it?

a. Brand new

b. Used tractor

26. What motivated you to purchase a tractor?

E. Support services and infrastructure for mechanization available in Mbarali District

27 Have you ever acquired a loan from a bank for the purchase of tractor? Yes No
.....

28. If yes, how much

29. If yes, what was the interest rate?

30. If no, why?

31. Did you receive any subsidy from the Mbarali District for the purchase of your tractor?

a) Yes

b) No

32. If yes, how much?

33. If no, what is your comment?

34. Where did you purchase your tractor?

a) Within Mbarali district

b) Outside Mbarali District

35 If outside Mbarali District mention the place.....

36. Where do you send the tractor for repair works?

37. Where do you buy spare parts for your tractor?

38. How many kilometers from your home to a spare parts shop?

39. Did you receive after-sale training from the tractor sellers for maintenance and operations of a tractor?

a) Yes b) no

THANK YOU FOR YOUR COOPERATION!!!!

Appendix 3A: Present Values of purchasing price of conventional tractors.

Make	Year purchased	Number of years Utilized up to 2013	Purchasing price of a tractor	Present value (PV) At i=7%	Remarks
International 744	1978	35	300 000	3 02 974	Used
International 744	1978	35	1 200 000	12 811 898	Used
International 744	1978	35	2 200 000	23 488 479	Used
Valmet	1980	33	3 000 000	27 976 019	Used
Fiat	1982	31	8 000 000	65 160 903	Used
Massey Ferguson	2008	5	18 000 000	25 245 931	Used
Catic	2012	1	30 000 000	32 100 000	New
John Deere	2012	1	51 000 000	54 570 000	New
John Deere	2012	1	51 000 000	54 570 000	New
Swaraj	2012	1	45 000 000	48 150 000	New
Massey Ferguson	2011	2	-----	-----	Used
Catic	2009	4	55 500 000	72 093 781	New
Ford	2001	12	7 000 000	15 765 342	Used
Valmet	1987	26	2 550 000	14 808 750	Used
Valmet	1991	22	300 000	1 329 121	Used
Valmet	1992	21	700 000	2 898 394	Used
Ford	1992	21	4 500 000	18 632 531	Used
Belarus	2006	7	46 000 000	73 865 948	New
YTO	2006	7	40 000 000	64 231 259	New
New Holland	2012	7	18 000 000	28 904 067	Used
John Deere	2002	11	12 000 000	25 258 223	Used

Appendix 3B: Present Values of Purchasing of power tillers

Make	Year of purchase	Number of years Utilized up to 2013	Purchasing price of a tractor 201	Present value (PV) At i=7%	Remarks
Siam Kubota Siam	2010	3	10 700 000	13 107 960	New
Kubota	2011	2	8 600 000	9 846 140	New
Amec	2006	7	4 400 000	7 065 438	New
Siam Kubota	2008	5	8 800 000	12 342 455	New
Amec	2009	4	4 500 000	5 898 582	New
Amec	2010	3	250 000	3 062 608	New
Siam Kubota	2010	3	12 000 000	14 700 516	New
Siam Kubota	2007	6	5 000 000	7 503 652	New
Amec	2008	7	3 000 000	481 344	New
Siam Kubota	2010	3	11 700 000	14 333 003	New
Amec	2008	5	2500 000	3 506 379	New
Siam Kubota	2005	7	630 000	10 116 423	Second hand
Siam Kubota	2010	3	10 500 000	12 862 952	New
Amec	2012	1	7 300 000	7 811 000	New
JD	2010	3	4 000 000	4 900 172	New
Tuffest	2012	1	4 800 000	5 136 000	New
JD	2009	4	3500 000	4 587 786	New
JD	2012	1	2 500 000	2 675 000	New
Siam Kubota	2012	1	8 000 000	8 560 000	Second Hand
Siam Kubota	2000	11	2 000 000	4 209 704	New
Amec	2011	2	2 600 000	2 976 740	New(engine)
Siam Kubota	2009	4	9 000 000	11 797 164	New
Siam Kubota	2011	2	1 200 000	13 738 800	New
Siam Kubota	2007	6	7 000 000	10 505 112	New
Siam Kubota	2008	5	9 000 000	12 622 966	New
Siam Kubota	2013	0	9 000 000	9 000 000	New
Amec	2011	2	6 000 000	6 869 400	New
Siam Kubota	2013	0	12 000 000	12 000 000	New
Chang Chai	2011	2	4 800 000	5 475 520	New
Amec	2011	2	4 800 000	5 475 520	New
Amec	2010	3	2 400 000	2 940 103	New
Siam Kubota	2011	2	7 100 000	8 128 790	New
Siam Kubota	2010	1	1 1000 000	11 770 000	New
JD	2009	4	4 000 000	5 243 184	New
Amec	2009	4	5 000 000	6 553 980	New
Tuffest	2011	2	2 400 000	2 747 760	New

Amec	2008	5	250 000	506 379	New
Siam Kubota	2007	6	4 000 000	6 002 921	Second hand
Amec	2011	2	2 500 000	2 862 250	Second Hand
Siam Kubota	2011	2	12 000 000	13 738 800	New
Siam Kubota	2007	6	7 200 000	10 805 259	New
Amec	2005	8	3 400 000	5 841 833	New
Amec	2009	4	1 800 000	2 359 433	Second hand
Siam Kubota	2012	1	8 500 000	9 095 000	New
Amec	2011	2	450 000	5 152 050	Second hand
Siam Kubota	2010	3	1 200 000	14 700 516	New
Amec	2008	5	6 000 000	8 415 310	Second hand
Daedong	2012	1	9 200 000	9 844 000	New
Siam Kubota	2011	2	12 000 000	13 738 800	New
Siam Kubota	2012	1	13 500 000	14 445 000	New
Siam Kubota	2010	3	9 800 000	12 005 421	New
Amec	2007	6	5 000 000	7 503 652	Second hand
Amec	2008	5	3 800 000	5 329 697	Second hand
Siam Kubota	2009	4	6 800 000	8 913 413	Second hand
Siam Kubota	2010	3	9 000 000	11 025 397	Second hand
Siam Kubota	2010	3	9 180 000	11 245 895	New
Siam Kubota	2010	3	9 200 000	11 270 396	New
Siam Kubota	2010	3	9 000 000	11 025 387	New
Chang Chai	2006	7	2 000 000	3 211 563	Second hand
Greaves	2010	3	9 000 000	11 025 387	New
Siam Kubota	2008	5	5 000 000	7 012 759	New
Amec	2010	3	5 500 000	6 737 737	Second hand
Siam Kubota	2006	7	5 000 000	8 028 907	New
Siam Kubota	2011	2	5 500 000	6 296 950	Second hand
Toyo	2012	1	7 500 000	8 025 000	New
Siam Kubota	2012	1	13 520 000	14 466 400	New
Amec	2008	5	5 500 000	7 714 035	New
Siam Kubota	2010	3	13 000 000	15 925 559	New
Siam Kubota	2009	4	12 000 000	15 729 552	New
Amec	2010	3	5 000 000	6 125 215	New
Siam Kubota	2009	4	5 800 000	7 602 617	New
Siam Kubota	2012	1	13 550 000	1 498 500	New
Amec	2007	6	3 700 000	5 552 702	New
Siam Kubota	2011	2	90 00 000	10 304 100	New
Siam Kubota	2011	1	9 000 000	9 930 000	New
Siam Kubota	2007	6	12 000 000	18 008 764	New
Siam Kubota	2007	6	12 000 000	18 008 764	New

Siam Kubota	2011	3	12 000 000	14 700 516	New
Siam Kubota	2012	2	7 300 000	8 357 770	New
Siam Kubota	2001	12	2 000 000	4 504 383	New
Siam Kubota	2006	7	5 000 000	8 028 907	New
Amec	2008	5	5 500 000	7 714 035	New
Amec	2009	4	3 000 000	3 932 388	New
Amec	2009	4	2 500 000	3 276 990	New
Siam Kubota	2009	4	5 700 000	7 471 537	New
Amec	2010	3	6 000 000	7 350 258	New
Amec	2012	1	3 000 000	3 210 000	New
Amec	2011	2	2 500 000	2 862 250	New
Siam Kubota	2010	3	7 900 000	9 677 840	New
Amec	2011	2	3 000 000	3 434 700	New

Source: Survey data, 20

Appendix 4A: Annual Utilization Rates of Conventional Tractors

Name	Type	Make	On-Farm Utilization	Off-Farm Utilization	Total Utilization	Off-Season Utilization	Annual Utilization
Thobias Mahenge	2	John Deere	402	132	534	132	666
***Renatus R.Mdindile	2	international 774	825	0	825	0	825
Daniel Maliga	2	Massey Ferguson 2640	295	160	455	160	615
Atilio z. Mboka	2	John Deere	396	325	721	325	1046
Damian Mponzi	2	Valmet -604	435	272	707	272	973
Zuberi Makweta	2	Fiat	497	362	859	362	1221
Crimton Mgimba	2	Catic	363	47	410	47	457
Meshack Mtema	2	SWARAJ	692	245	737	245	1182
***Renatus R. Mdindile	2	international 774	614	0	614	0	614
***Renatus R. Mdindile	2	international 774	668	0	668	0	668
Juma A. Samson	2	Massey Ferguson 2640	439	317	756	317	1073
Emmanuel Mwasese	2	Catic	675	310	985	310	1295
Benny Msena	2	Ford 5610	562	341	903	341	1244
Abdallal Mshalikwao	2	Valmet -604	602	234	836	234	1070
Abdallal Mshalikwao	2	Valmet -604	572	249	821	249	1070
***Malago Jisena Masalaga	2	Valmet -604	660	0	660	0	660
Edson Ndogoro	2	Belarus	1369	126	1495	126	1621
Emmanuel Msigwa	2	YTO (Gongfanghong)	354	212	566	212	778
Twalib Tamimu	2	New Holland	1024	324	1348	324	1672
Twalib Tamimu	2	John Deer	1440	416	1856	416	2272
Meriki K Saro	2	Ford 5610	279	24	303	24	327
Total Annual utilization (Hours)			10396	4096	14292	4096	18582
Average Annual Utilization rates (Hours)			611.5	240.9(39%)	840.9	240.9	1093

Appendix 4B: Annual Utilization rate of power tillers

Name	Type of Tractor	Model	On-farm utilization	Non-farm utilization	Total utilization	Off-season Utilization	Annual Utilization
Kalumeta Mileta	1	Siam Kubota	268	208	476	208	684
Award Kabuje	1	Siam Kubota	468	180	648	180	828
Yagale Mbaule	1	Amec	276	196	472	196	668
Laurensi Mwinuka	1	Siam kubota	413	163	476	163	739
Deo John Chalamila	1	Amec	458	154	612	154	766
Agostino Myinga	1	Amec	344	126	470	126	596
Emmanuel Mkongwe	1	Siam Kubota	399	160	559	160	719
Alex M Kigola	1	Siam Kubota	264	223	487	223	710
Daniel Maliga	1	Amec	325	123	448	123	571
Idy Kinyaga	1	Siam Kubota	322	243	565	243	808
Thomas Nyimbo	1	Amec	234	117	351	117	468
Jackob Lyandala	1	Siam Kubota	188	120	308	120	428
Alexander Lusuva	1	Siam Kubota	420	106	556	106	632
Julius Uhagile	1	Amec	217	170	387	170	557
Castho Mpembela	1	JD	302	205	507	205	712
Jani D Mdimilaje	1	Tuffest	320	195	515	195	710
Neema W.Makafu	1	JD	267	160	427	160	587
Moses Msemembo	1	JD	400	120	520	120	640
Kain Ngole	1	Siam Kubota	378	131	509	131	640
Pascal Mbarale	1	Siam Kubota	425	204	629	204	833
Dismas Sanga	1	Amec	325	186	511	186	697
Simon Kivambe	1	Siam Kubota	149	45	194	45	239
Julius Kivambe	1	Siam Kubota	138	60	198	60	258
Lutengano M. Mgimba	1	Siam Kubota	268	172	440	172	612
Raphael Kibona	1	Siam Kubota	354	207	561	207	768
Bashari Katimba	1	Siam Kubota	244	189	433	189	622
Igomero irr.Association	1	Amec	287	174	461	174	635
Izidory Kihaga	1	Siam Kubota	310	210	520	210	730
Joseph Lugono	1	chang Chai	290	242	532	242	774
Ally Mchomvu	1	Amec	316	135	451	135	586
Edward Mamboleo	1	Amec	290	125	415	125	540
Feston Sanga	1	Siam kubota	138	104	242	104	346
Aloyce B. Mgengela	1	Siam kubota	246	215	461	215	676
R. Nkatala	1	JD	315	145	460	145	605
Deo Mpekesa	1	Amec	302	174	476	174	650

Milton Mram	1	Tuffest	300	285	585	285	870
Thomas Nyimbo	1	Amec	122	112	234	112	346
De- Paul Ngalla	1	Siam Kubota	487	69	556	69	625
** De- Paul Ngalla	1	Ameki	649	250	899	250	1149
Edson Mahenge	1	Siam Kubota	199	113	312	113	425
Challii Gogo	1	Siam Kubota	298	149	447	149	596
David Shibanda	1	Amec	250	152	402	152	554
Ally Mohamed	1	Amec	327	205	532	205	737
Zena Shinangonela	1	Siam Kubota	294	137	431	137	568
Shudi Isote	1	Amec	269	107	376	107	483
UWATA -Majenje	1	Siam Kubota	498	174	672	174	846
Gideon A. Mwakitalu	1	Amec	249	110	359	110	469
Mussa Adam Ngulo	1	Daedong	269	134	403	134	537
Ezekia Ndabhila	1	Siam Kubota	290	62	352	62	414
Blackson Nguvilla	1	Siam Kubota	297	126	423	126	549
Livingstone Mwalwimo	1	Siam Kubota	272	193	465	193	658
Yuda Mwatebela	1	Amec	304	123	427	123	550
Anyandwile J. Chilembe	1	Amec	196	105	301	105	406
Paul Mwalukoba	1	Siam kubota	340	126	466	126	592
Francis Mwasumbi	1	Siam Kubota	320	142	462	142	604
WATOTO YATIMA	1	Siam Kubota	346	194	540	194	734
John A. Chaula	1	Siam Kubota	286	140	426	140	566
Stivin Mkwama	1	Siam Kubota	245	122	367	122	489
Ayubu Lupaya	1	Shang shai	296	104	400	104	504
UWATA -LUNWA	1	Greaves	307	174	481	174	655
Timoth Myegeta	1	Siam Kubota	336	205	541	205	746
Obeli Luka Mhami	1	Amec	317	201	518	201	719
Raphael A. Magomela	1	Siam Kubota	212	70	282	70	352
Mbila Abel Kamwela	1	Siam Kubota	330	196	526	196	722
Kinana Halifa	1	Toyo	150	120	270	120	390
Hamisho Ramadhan Kasisi	1	Siam Kubota	474	190	664	190	854
Mashaka Ramadhan	1	Amec	56	360	416	360	776
Frugence Mhegele	1	Siam Kubota	236	124	360	124	484
KKKT Mswiswi	1	Siam Kubota	374	36	410	36	446
Albert Mwakisambwe	1	Amec	484	161	645	161	806
Isaack Mtega	1	Siam Kubota	612	32	644	32	676
George Kajange	1	Siam Kubota	252	159	411	159	570
Ismail Elmiliki	1	Amec	40	191	231	191	422
Hussein Vahaye	1	Siam Kubota	410	212	622	212	834
Hussein Vahaye	1	Siam Kubota	410	212	622	212	834

Christina Raphael	1	Siam Kubota	322	155	477	155	632
Christina Raphael	1	Siam Kubota	434	155	589	155	744
** Geophrey Nata Mahele	1	Siam Kubota	558	288	846	288	1134
Labani Nselu	1	Siam Kubota	612	112	724	112	836
Shaibu Abdallah	1	Siam Kubota	444	96	540	96	636
Shaibu Abdallah	1	Siam Kubota	444	80	524	80	604
John Maharage	1	Amec	582	256	838	256	1094
*Msafiri E. Mtengule	1	Amec	371	0	371	0	371
*Jumanne Ali	1	Amec	336	0	336	0	336
Banio- Mbuyuni	1	Siam Kubota	173	36	209	36	245
Amil Nkenjahi	1	Amec	160	99	259	99	358
Gervas Sihama	1	Amec	544	75	619	75	694
Benson E. Mwinuka	1	Amec	630	312	942	312	1254
Yawanga Clemence	1	Siam Kubota	730	13	743	13	756
Brayton Mwinuka	1	Amec	472	174	646	174	820
Total Annual utilization (Hours)			27889	13053	40862	13053	53995
Average Annual Utilization rates (Hours)			324	151.7(48%)	475	151.7	627.8

Source: survey data, 2013

KEY

- *** Means conventional tractors with no trailers were dropped down in the analysis of utilization rates because they were not used for off-farm and off-season operations
- ** Means power tillers with no trailers were dropped down in analysis of utilization rates because they were not used for off- farm and off season operations.
- * Means Power tillers with more than 1000 hours were omitted in analysis for average annual utilization because they are outliers.