TRACTOR AND IMPLEMENT MANAGEMENT AND MAINTENANCE IN MECHANIZED FARMS IN NIGER STATE

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DECLARATION

I hereby declare that this work "Tractor and Implement Management and Maintenance in Mechanized Farms in Niger State" was conducted by me under the supervision and guidance of Dr. M. G. Yisa and Mrs Z. D. Osunde of the department of Agricultural Engineering, Federal University of Technology, Minna during the 1997/98 academic session.

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Date:.....

DEDICATION

This work is dedicated to my late uncle, Mallam Mohammed Aminu and family.

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I am most grateful to Almighty Allah for his guidance and mercies. And who had made it possible for me to carry out this project successfully.

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ABSTRACT

Tractor and implement play a significant role in advancing agricultural production. And there has been considerable investment on agricultural equipment and mechanization generally.

However, the frequent breakdown of agricultural equipment shortly after purchase or after utilization for one or two seasons has become a problem, and therefore, makes the drive towards mechanization or agriculture in this country an unachievable task.

This effort is an investigative survey aimed at establishing the problems associated with tractor and implement management and maintenance in mechanized farms in Niger State. The major findings from the study are:

(a) Low literacy level, unskilled tractor operator

(b) Fragment farm holdings

© Lack of planned and preventive maintenance culture

(d) Lack of maintenance and repair facilities and unavailability of spare parts.

(e) Poorly to near zero equipped workshops

And recommendations given on proper management and maintenance of tractor and implements.

It is hoped that the outcome of this work would go a long way in helping the

government in policy formulation, the government agricultural establishment and the managers of the privately owned mechanized farms in Niger State in adopting measures for the efficient and effective utilization of both human and material resources in their establishments.

CHAPTER ONE

1.0 INTRODUCTION

Mechanization of agriculture is a progressive development of steadily increasing scope and importance. Tractor and implements play a significant role in advancing agricultural productivity and Agricultural Industry in Nigeria (Oni, 1996).

Over the years, Nigerian government and the private sector have expended a lot of resources though various programmes to procure farm power and machinery of different makes, models and sizes to mechanize agriculture and hence improve food supply. But unfortunately most of these tractors acquired could not be used for long, not even for two seasons in some cases, before being abandoned or considered to be beyond economic repair (BER). (Zanna,1997). The incessant breakdown of tractors and implements in this country have been one subject of discussion as it affects our agricultural sector. It is a fact that majority of our few agricultural Equipment in this country are not in good or working condition. Mainly due to inconsistent policy, bad management, lack of appropriate maintenance culture, operative behavior, abuse and misuse of the machinery.

This study is out to establish the reasons for this state of affairs, it is also an objective of this study to be able to at the end recommend the proper management and maintenance procedures for agricultural tractors and implements in mechanized farms

in Niger State.

From a previous report on the effective management and maintenance of agricultural equipment in Nigeria, farm equipment failures, especially during the peak farming season, can result in inefficient equipment and labor utilization and serous losses in farm output (Oni,1996).

This report is in five chapters, which is entirely an investigative survey aimed at establishing the problem associated with tractor and implement management and maintenance in mechanized farms in Niger State.

1.1 JUSTIFICATION

The frequent breakdown of agricultural tractors and implements is of utmost concern as it affects agricultural production. Since the government and the private sector have expended a lot of resources in procuring farm machinery and equipment, which have unfortunately not yielded the desired result of increased agricultural production.

This study is out to establish the causes of the breakdowns and to proffer solutions as to proper management and maintenance of tractors and implements in Niger State.

1.2 AIMS AND OBJECTIVES

The aims and objectives of this project are:

1. To establish the reasons responsible for the frequent breakdown of farm machinery and equipment.
2. To find out the state of agricultural machinery management and maintenance in mechanized farms and agricultural establishments in Niger State.
3. To come out with recommendations that will help in the proper management and maintenance of agricultural tractors and implements.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 MANAGEMENT OF AGRICULTURAL EQUIPMENT

Mechanization of agriculture began centuries ago with simple device for harnessing the power of man himself, this further developed into the construction of implements and machines designed to make use of the greater power of domestic animals notably horses (Drought Animal Technology DAT) and continues with exploitation of the use of mechanical and electrical power for almost every farming task. A rapid acceleration in the use of tractors and other engine driven field machines has followed. (Engine power technology - EPT). All in an effort to increase food production (Culpin, 1975) 3rd ed.

In a mechanized farm, the ability of the farm manager to harness the human and material resources available at his disposal for enhanced agricultural productivity is most desired.

However, in an agriculture which is highly mechanized, uses many technological innovations and operates with large amounts of borrowed capital, management takes on a new dimension and importance. It explains why some farmers make more money than others, why some farm business grow and expand while others struggle to maintain their current sizes. Good or bad luck does not explain all the differences observed in the profitability of farms. (Kay, 1986).

The application of agricultural equipment must be in relation to the size of farm or the farm output for each target farmer. The need therefore, to optimize the machinery and equipment selection in order to study the effects of parameters such as field efficiency, purchase prices and fuel costs on the overall systems annual costs (Oni,1996). Oni,(1996) concludes that the field efficiencies of most agricultural equipment in use in Nigeria are relatively low, which is further compounded by the ineffective utilization of agricultural machinery and equipment, poor management of human and material resources and the difficult terrains which culminate in sub-optimum turn around time for farm tractors.

2.2 MAINTENANCE OF AGRICULTURAL EQUIPMENT

In the local governments, State governments and Federal agencies the issue of tractor and implement maintenance pose the biggest constraints since it directly affects availability of the farm power and machinery for the use of farmers. The State ministries of agriculture, river Basins Development Authorities, AAPS tends to go about the maintenance of their machinery- in- house by establishing big workshops structures which are in most cases not sufficiently equipped). The Local Governments handle maintenance through contractors, the national agricultural land development Authority has an in between arrangement. Some repairs are done in house and major repairs are referred to experts garages. (Zanna,1997).

It must however, be noted that repair and maintenance outfit no matter how basic would depending on location, require the following for the effective discharge of its function (Sargana et al, 1986). Lathe machine, drilling machine (Hand and Pedestal), bench grinders, electric welding sets (Ac or DC) sharper, disc cutters, power press, cutting and bending machines and a modest outfit of foundry, blacksmithery, metal forming and metal forging equipment and heat treating equipment. And a few of the common raw materials which should be readily available for effective operation of the repairs and maintenance outfit include mild steel, cast iron, high carbon steel, aluminum alloys, wood, coal and spinning steel. (Oni, 1996).

A number of equipment breakdown as early as few days after purchase due to either ignorance , abuse and misuse. Other breakdown during use long before the expected life span due to lack of maintenance of agricultural tractors. For any new equipment purchased e.g. tractor or after a major overhaul of the engine

(I) thorough checking for any possible leakage and greasing of necessary parts is required before it is started.

(ii) Running-in maintenance should actually be started in the factory and should be continued by the user according to specification given by the manufacturers. This aspect is normally ignored by many tractor owners in Nigeria leading consequently to breakdown of newly acquired equipment (Yisa, 1997).

Maintenance fall under the following categories:

I) Preventive service maintenance

ii) Running-in maintenance

iii) Periodical maintenance

(I) preventive service maintenance has three main important factors:

(a) reduce failure

(b) saves operational cost

© saves the equipment from breakdown

Periodical maintenance in tractors depends on the number of hours the tractors is put to use, this are in different folds, daily, weekly forthinightly, monthly, quarterly and yearly.

Farm equipment failures, especially during the peak farming season, can result in inefficient equipment and labour utilization and serious losses in farm operations. In a bid to avoid this, efficient and timely repair and maintenance programme for farm equipment would guarantee a profit oriented enterprises (Oni 1996).

From the NALDA experience on farm power, service delivery and maintenance management. Machinery fleet standardization. It relates that NALDA projects lands are contiguous and site specific, which makes the deployment of farm power subsequent supervision (monitoring and maintenance) easier than those being operated in diffused and scattered locations. Among the lessons from NALDA are

that:

(I) That tractor hire - services to be efficient and successful the farming system must be at an intensity sufficient to warrant the use of tractors.

(ii) That the establishment of sophisticated and expensive workshops by government may not hold the key to successful tractor maintenance and service delivery in Nigeria. (Executive secretary, 1997)

The criteria for evaluating repair and maintenance requirements of farm machinery or equipment include:

(a) Annual use of the machinery or equipment

(b) Age of the machinery or equipment

© Annual repair cost (Oni,1996)

The reliability of farm equipment was also discussed by Oni,(1996). He analyzed it on the basis of the equipment breakdown, lost time and repair cost. The study of field equipment reliability therefore, is a study of its failure or lack of it. The relationship between maintainability of an equipment and its reliability is reciprocal, since preventive maintenance reduces the occurrences of failures.

The problems of inadequate maintenance are due to ignorance of how various factors and processes interact to affect maintainability and hence the reliability of equipment.

Adigun and Oni,(1995) identified tractors responsible for short useful life of

agricultural machinery and equipment in Nigeria to include:

(l) Inadequate maintenance personnel

(ii) Ill-equipped repair and maintenance facilities.

(iii) Lack of spare parts.

The problems are further worsened by the economic down-turn, which makes acquisition of new equipment and spare parts difficult. There is therefore, an urgent need to put in place a nationally coordinated programme on farm machinery and equipment management and maintenance, that would be consistent and adaptable at State and Local Government levels.

CHAPTER THREE

3.0. METHODOLOGY

The Methodology adopted in this study is the investigative survey approach. The frame work involves data collection and analysis.

In this study, the twenty-five local governments Area of Niger State were taken into consideration. The study involved administering questionnaire to the farm managers, the farm engineers and the tractor operator were interviewed with the mechanics of the privately owned mechanized farms.

And at the government agricultural establishments surveyed, the response to questionnaire were by the heads of department of engineering services, the tractor operator and mechanic if any were also interviewed. And also station assessment for facilities on ground. The total number of questionnaires distributed is seventy three (73), and from this the number retrieved is fifty -four (54), of which the highest number of retrieved were from Suleja, Bosso and Wushishi Local Government area.

3. 1 PROCEDURE FOR DATA COLLECTION

The questionnaires were administered to all the establishments surveyed, personal interviews were also conducted to get some vital informations necessary for this study. The farm managers and farm engineers and also the head of departments engineering services were in the best position to give the required information by virtue of their position and working experience .Averagely two persons were interviewed from each establishment. The establishment visited apart from the various local government departments of Agriculture and natural resources, are the ADP Headquarters Minna, ADP Bida, National Agricultural Land Development

Authority (NALDA), Minna Upper River Niger Basin Zone B Wushishi, Nati

Cereal Research Institute N.C.R.I

Badeggi and Maimasa farms Maizubi farms, Madabe and sons, Umarson farms Folawiyo farms, Acinbi ventures are just few of the mechanized farms visited too numerous to mention here.

The questionnaire designed for this purpose were in four sections. Each section was prepared with relevant questions to address the objectives of this study.

The four Main sections are :-

SECTION A:- This contains questions on the location of the farms or establishments, type of ownership and personal data of both respondent and tractor operation.

SECTION B:- This deals with questions on management , determination of the farm land size, timeliness of operation, tractor utilization, cost of maintenance of tractor and implement associated with the total production.

SECTION C:- Contains questions on inventory, the capacity of tractors number of functional and broken down tractors, models and number of their equipments. It also contains questions on the availability of complex equipment which cannot be utilized, the age of equipments and annual use of equipment.

SECTION D:- Contains question on maintenance structure. Under this section questions on maintenance and repair facilities, ability to make on station repairs servicing of tractors and implement, cost of repairs, frequency of major repairs, acquisition, availability of spare parts, routine servicing and daily preventive maintenance are treated.

On station assessment, apart from personal interviews with relevant staff of

the establishment also includes finding out how equipments are being stored, identifying whether there is a farm/establishment workshop for repairs and servicing is it functional or not? Is it well equipped or not do they have a store for spare parts or not? What about capable hands that make repairs?. Are the tractor operators capable of making or carrying out minor repairs and servicing in case of any fault developed during field operation, so as to minimize down time of tractor.

3.2 PROBLEMS ENCOUNTERED

In an effort to gather these data, I encountered certain set backs due to some uncontrollable circumstances. However, many establishment drawn from all the local governments of the state were visited. Out of these, some gave complete information while others did not, and some misunderstood the questions. It was easier to get information at the government establishment than in the mechanized farms as some thought that it was a way of bringing out their problems and negligence so they were not willing to give out information.

In some other cases I was denied entry, even after presenting the relevant letters from my school not until confirmations were made before permission was granted for me to proceed. That not with standing I even had to walk some distance not less than a kilometer from the main gate, to get to the main farm building.

Finally on several occasions I had to visit such farms more than twice, before I was able to retrieve the questionnaires and in some cases I had to present a fresh questionnaire after the previous one must have been misplaced.

3.3. METHOD OF ANALYSIS.

The type of data, it's nature required for the achievement of the objectives of the study has influenced the choice, the use and type of analysis and method of presentation.

Data are in general terms, facts and pieces of information which constitute the raw material of the subject to which they relate. some are precise mechanical facts which give quantitative rather than qualitative informations on the phenomenon under study. Research data usually exhibit certain characteristics such as associations, relationships, trends, variations, frequencies and patterns etc.

These characteristics may be highlighted through description and summarization in statistical forms or diagrammatic or graphical illustrations.

There is, however a vital quality of the data that dictates the mode of presentation. The scales of our data are norminal and ordinal and are more amenable to non-parametric statistical analysis.

For the purposes of analysis in this project work, our objective is to classify data into like groupings and to uncover relationships, whether correlative or casual. This has helped in employing classification associations and relationships form of analysis with techniques for analysis as cross tabulation, tabulation, grouping technique, and graphs etc.

CHAPTER FOUR

4.0. RESULTS AND DISCUSSION

4.1. ANALYSIS OF THE QUESTIONNAIRE.

Low literacy, unskilled tractor operator, fragmented farm holding, lack of planned and preventive maintenance culture, lack of maintenance and repair facilities, poorly to near zero equipped workshops, inefficient tractor capacity utilization are some of the problems expected to contribute to the understanding of the unique nature of frequent break down of tractors and implement in the state.

4.2. FINDINGS OF THE STUDY.

The major findings of the investigative survey from analysis of data are:-

(i) Low literacy level, unskilled tractor operator.

(ii) Fragmented farm holding

(iii) Lack of Planned and preventive maintenance culture.

(iv) Lack of Maintenance and repair facilities and unavailability of spare parts.

(v) Poorly to near zero equipped workshops.

4.2.1. LOW LITERACY LEVEL, UNSKILLED TRACTOR OPERATOR.

This is the first finding on visiting any government or private farm establishment. Most common in the government establishment in which the tractor operator initially when learning was under another operator (Main) assisting him, the latter goes about his normal field operation with the other trainee, and he (trainee) learns by observation of how the tractor is operated and the field operation so that after some months, the other operator begins to operate the tractor, and if eventually

he is attached to a tractor, he inturn picks up a new trainee, which is not proper. This operator who is unskilled carries out field operation wrongly the tractor is handled poorly, there is poor efficiency in field operation, due to the time lost in turning, incorrect speed required for various field operations.

4.2.2. FRAGMENTED FARM HOLDINGS.

Most of the farm lands in our rural areas are small and irregular. This makes field operation especially difficult as some of these farm holdings are not well cleared and developed.

Tree remains which damage the tractor chassis and tyres are still found in the field. This leads to poor field efficiency, as much time is lost in obstacle negotiation and turning at headlands which are not regular. The speed of operation is also affected.

An indication of the effectiveness of carrying out field work is obtained from the proportion of productive time during the operational time.

Most a times this tractors have to travel long distances to get to the farms. This is underscored by the table 1, As transportation takes quite some time, about 22% for government establishment, This leads to the issue of under utilization of tractors.

If 1000 hrs per annum is the average recommended use of a tractor. (Witney, 1988).

Then from Tables 1& 2 it can be observed that the field operation in mechanized farms is 88% compared to the 78% for government establishment, and in comparison with the standard, number of hours of operation of tractors in table 2 field operation in mechanized farms is 800 hrs/per year about 80% of the annual utilization time, Compared to 552 hrs for the government establishments about 55%.

Considering transportation, it is 100 hrs about 10% for mechanized farms against the160hrs (16%) for government establishments. This agrees with (Oni, 1996). Where he gave an average annual usage of tractor as 485 hrs. This is also in agreement with F.A.O assessment of 500hrs per year in developing countries. (FAO. 1977).

This shows that our farm tractors are under-utilized since little or no mechanical planting weeding, spraying and harvesting were under-taken by these government establishments.

And the low application of farm machinery generally is due to limited seasonal application of farm tractors and the lack of technical and managerial competence to handle, use and maintain farm machinery and equipment.

4.2.3 INVENTORY OF FARM TRACTORS AND IMPLEMENTS.

From data obtained on tractors and implements in the state and from the responses from the various establishment. It was found that Minna Local government has the highest concentration of tractors and implements followed by Magama, Mokwa etc. This could be explained by various government agricultural establishment and mechanized farms in these local governments.

Table 3 gives the statistics of the percentage production cost that is associated with machinery and equipments for both mechanized farms, averaging 42%, and government establishments 46%.

From the raw data, there was an establishment, a mechanized farm with the lowest cost of running tractors and implements as 10%, and the highest claiming 75%. This goes to show the level of maintenance in these establishments. It was found that the annual use of this equipments ranges between 5-6 months, which has the highest expense of 53%, followed by those of 3-4 months annual use with about

47% The age distribution with the highest expense is 4-6 years with 40% , followed by 7-9 years with 32%, next is 1-3 years with 14%, the lowest being over 12 years with 4% with this distribution Table 5. One could generally say that the average age range of tractors within the state is between 4-6 years This could be used to assess the maintenance, costs increment and the frequency of breakdown, so that such machines could be replaced as they age. Since ageing of tractor could be responsible for such problems. Table 6 shows the statistics of complex machine and equipments in the state. Complex in the sense that even if it could be utilized, the spare parts are not available locally and cannot be easily serviceable or needs special training abroad to be able to operate it also the state of the available tractors in the various establishments, as to the total number of tractors available in each establishment, the number of non-functional ones are analysed in Table 7. From the table it can be deduced that the level of management and maintenance is very poor in the government establishment to have out of 120 tractors, only 57 are functional. While for the private mechanized farm out of total of 63 tractors 50 are functional.

Table 8 gives the statistics of the inventory of implements. The percentage as to the total number of implement in use are; disc plough 26%, disc harrow 20%, cultivators 4%, ridgers 17%, planters 7%, seeddrills 3% threshers 3% harvesters 3%, Boomsprayers 3% and knapsack sprayer 14%.

Table 9: gives the statistics of tractor models used in the state Massey Fergusson MF is the most widely used model of tractor in the state with 57% of the total number of tractors available. This is followed by FIAT with 20% , next is Steyr with 17% etc.

The major size of tractors used in the state is the medium size, which has the highest

response of 43 which is 90% , the lowest is the large size with only 4%. Table 10 gives its distribution.

4.2.4. LACK OF PLANNED AND PREVENTIVE MAINTENANCE CULTURE.

Because most of the tractor operators are unskilled the issue of preventive maintenance could be regarded as not necessary, or mere lgnorance, rather it is corrective maintenance as about 62% of them have responded. In the government establishment about 20% responded that the reason for no planned maintenance is due to lack of workshop facilities, 43% claimed lack of funds and spare parts. While 37% gave no response at all.

A particular farmer claimed he keeps a "mental chart" instead of a lubrication and Maintenance chart.

And also the major causes or the problems associated with most of the broken down tractors, seems to be engine problem. This and other causes are analysed in Table II.

4.2.5. LACK OF MAINTENANCE AND REPAIR FACILITIES AND UNAVAILABILITY OF SPARE PARTS.

This is the case of most of our agricultural establishments. Apart from the inability to make major repairs, there is the issue of non-availability of the necessary facilities to make these repairs.

Among the farms visited, only about 5 out of about 18 farms could boast of a store of spare parts and out of the five (5) mentioned, only one (1) is well equipped and fully stocked with spare parts for its tractors and implement, even if they are imported.

In all the government establishment, if a tractor breaks down, and needs a spare part, it takes about 1-2 weeks for repairs to be effected, depending on whether, such

In all the government establishment ,if a tractor breaks down, and needs a spare part, of lakes about 1-2 weeks for repairs to be effected, depending on whether, such spare part can be acquired locally within the immediate environment or not. Table 12 shows that only 28% purchase their spare parts locally. 10% of all the establishments import spare-parts and 62% made no response a at all.

4.2.6. POORLY TO NEAR ZERO EQUIPPED WORKSHOPS

if the standard of a fully well equipped workshop is to be followed as listed in the literature review, then most of farm workshops visited, if not all will get the zero score. But what was tried here was to in a way classify them as in Table 13. Only 4% generally could be classed as having a functional workshop which is well equipped, 16% is functional but not well equipped and 79% are non-functional workshops and zero-equipped most of which are government establishments.

From analysis of data, it was found that the frequency of major repairs of tractors in the state were more in the government establishments than in the mechanized private farms, this also shows the level of maintenance in the privately owned farms compared to that in government established farms. Table 14 gives the main statistics.

Table 15 gives a general response on maintenance on the various forms of maintenance. It shows that the private mechanized farms carry out more maintenance or that the maintenance culture is more in the mechanized private farms than in the government establishment. And this goes to show that there is a better management of agricultural machineries in the mechanized private farms than the government establishments.

Another issue of importance is that of machinery and equipment storage, of all

the establishments visited only few could boast of equipment sheds or a proper place to store or park machinery and equipment after use or when not in use. It is a common sight to see implements and its parts scattered on the ground, some in the bush, some parts already getting buried in the soil. This is very common in our government agricultural establishments and some of the mechanized private farms even though they tend to store, some of this machineries better. These implements are left in the open come rain or sunshine and without the necessary maintenance even after use. It is only when this implements breakdown, that they ever get to repair and lubricate them. Lack of lubrication and maintenance has been found to be the major causes of breakdown of implements, because of the increased wear due continuous use without lubrication and when foreign material like sand, gets into or between kinematic pairs etc.

4.2.7 **Nature and frequency of agricultural mechinery breakdown.**

In an attempt to evaluate the nature and frequency of agricultural mechines and equipment breakdown in the state. A number of tractor and implement in different state as explained earlier, lying in different position. Some could still be rehabilitated,some that could have been okay for rahabilitation have ever worsemed due to the long duration, it has stayed in the open. Some tractors, water has found it's way into the engine, got it rusted,and even as far as the transmission system. For some, they are already scrap material.

Such were the sights at some of the establishment. Unused and abandoned agricultural equipment were found in many goverment ministries and agro-industrial establishments.

Although only a few of the establishments visited supplied the required information on this aspect of the investigation. I had taken a serious look around the establishment to get some of this facts.

In general the minor breakdown consists mainly of fuel tank leakage, electrical system malfunctioning, V- belt snaping and failure of wornout replaceable compoment and bearing that are easily replaced. On the other hand, the major breakdowns which consist of engine lubrication defect, engine cooling system defect transmission system defect etc. This was analysis in Table 11.usually major repairs take time, depending on location of the farm or establishment and also availability of funds (especially goverment establishment) to purchase the needed spare parts if available locally.

Zaidi (1992)as ascerted that although repair costitute abbout 10 - 15% of operating cost of any equipment it is difficult to estimate. This is because accurate record of repairs over the life or the equipment may not be available (oni, 1996).

Never the less, repair cost is a major determinant for replacement programme of any equipment and its accurate estimate is essential for computing ownership cost of the equipment (Oni,1996).

Zaidi et al (1992) also proposed a first order exponential model for predicting repair cost of an equipment .

$TAR = A(TAUH)^b$

Where TAR = total annual accumulated repairs, % of purchase price.

A,b = model parramentes

TAUH = total accumulated use in hours, % of wear out life.

from this equation it would be seen that the wear out rate is governed by b. As b approaches 1, the annual rate of repairs approaches a constant value. If b increase further then the repari costs are pushed more to wards the later life of the equipment, (Oni, 1996).

This model predicts very low repair costs at the initial stage of the machine or equipment but this increases progressively with the age of the equipment .

The repair cost, if its to be carried out outside the establishment depends on the cost of parts cost of maintances plus the labour charge.

Based on our finding from analysis of data, graphically, we can say that, the use of an equipment per season from Table 4 and graph{figure 4}that the seasonal use of equipment is directly dependent on the age of the equipment and its reliability.

Then the relation.

$U_s = A_{Eq.} R_{Eq}$ ----------(1)

where U_s = use of equipment per season.

A_{Eq} = Age of equipmen.

R_{Eq} = reliability of equipment.

Again if the relationship between maintainability of an equipment and its reliability is reciprocal, oni (1996).

then we can say that, the following expresson is in order.

$M_t \propto 1/R_{Eq}$

$M_t = C/R_{Eq}$ ----------(2)

Where M_t = maintanability.

R_{Eq} = Relaibility of equipment.

C = constant of proportionality called the cost or maaintianace,spars of the equipment.

Since preventive maintenance reduces the occurenses of failures. The cost of maintenance, according to 0 zero (1979), as reportedby oni, (1996) is governed by

* Frequency of failure
* Time to repair
* Cost of spares and maintenance of equipment.

Considing the frequency of breakdown of equipment we can also relate that the rate of failure of an equipment is directly proportional to its age. So that.

$fr \propto A_{Eq}$.

$fr = M_t A_{Eq}$.----------(3)

When fr = rate of failure

And M_t = the constant of proportionality is maintainability

A_{Eq} = is still age of equipment

So now in relating the rate of failure to the rate at which the equipment are used per season.

hence,

from equation 1. $U_s = A_{Eq} . R_{Eq}$. and from equation 3. $fr = M_t . A_{Eq}$.

* $A_{Eq} = Fr/Mt$, hence, $U_s = Fr/M_t . R_{Eq}$.

$$Us = Fr. R_{Eq}/M_t \quad - - - - \quad 4$$

In defining the rate of failure in terms of the rate to whice the equipment are used per farming season.

hence $U_s, M_t = F_r R_{Eq}$. , $F_r = U_s . M_t/R_{Eq}$ - - - - - - 5

Since field equipment reliability is a study of its failure or lack of it

The problem of determining the maintainability of only equipment is therfore that of determining its reliability; the less complexe an equipment is the more reliable it would be. Simplicity of design generally increases reliability.

Complesent, according to chaodhany and Ahmed (1988) as reported by oni (1996) is determine as $C \# (P_p \times P_t \times P_l) /f$.

WHERE C= complerxity of design of a device. Pp = number of components.

Pt = number of different parts

P_l = number of inter connections and interface f = number of functional the product is expected per form.

Simplicity is therefore associated with low complecity factor. Oni (1987) derived an exponential reliability model based on the assumption that failure rate is constaint over the entire life of a device. Thus $R_{(t)} = e^{-\int_0^t \lambda} dt \quad dt = e^{-\lambda t}$

Where λ = failure rate (or inverce of mean time below failure, MTBF).

Usually, the wear-out period is characteritic by a shap increase in rate due to ageing of the machine.

Now applying equation 1, to an establishment from our data. For N.C.R.I Badaggi, if the annual use is six month and the age or the equipment is 15years. Thenequation 1 is given as $U_s = \frac{A_{Eq} \cdot R_{eq}}{A_{Eq} \times 100}$ Making reliability the subject of the equation. $R_{eq} = \frac{U_s}{A_{Eq} \cdot 100}$

* Substitute into formula $Req = \frac{960unit}{15} = 64 = 0.64\%$

Hence the reliability of equipment is 0.64% for NCRI Badeggi.

For maimasa fars (i.e private owned establshment). with a seasonal use of 4 month = 640 hrs and the age of equipment is 8yrs.

* $R_{eg} = \frac{Us}{Aeq} = \frac{640}{8} = 80 = 0.8\ \%$

According to chandhary and Ahmed (1988), for operation under specified condition, the reliability of thee tractor as a whole should be about 0.75% which implies that there is one - in-four chance that the tractor will breakdown within a specified period of time.

Relating it to N.C.R.I's equipment reliability illustrated above, we can say have that, there is Nine - in - twenty five chances that the tractor will breakdown within a specified period of time.

Which for maimasa farm, there is one - in - five chances that the tractor will breakdown.

From the result of reliability calculated above, we would say that the operational reliability of equipments is higher and satisfactory in private mechanized establishment than a government owned agricultural establishment.

From table 4, fig 2 and table 5, fig 3, we could say that the frequency or rate of use of an equipment is proportional to its age, as well as its reliability.

And also considering the frequency of breakdown of equipment in table 14 and 9. We can say that the rate of failure or freguency of breakdown of an equipment is directly proportional to its age,i.e. Frequency of breakdown is a preduct of its maintainability and the age of the equipment as in equation 3.

Since ageing is characteristic by increase in failure rate, due to wear out. So in relating Table 4, fig 2 and Table 5, fig 3 with Table 14, fig 9. i.e in relating rate or failure to the rate at which the equipment are used per season

hence, from both equation 1 and equation 3

$$Us = \frac{fr.\ R_{eq}}{M_t} \text{---------(4)}$$

This gives us equation 4. Where seasonal use is equal to the production of the rate failure or equipment and its reliability divided by maintain ability. If you make the rate of failure the subject of the equation it becomes

$$Fr = \frac{U_s \,.\, M_t}{R_{Eq}} \text{------(5)}$$

If the seasonal usage is high and its not matched by appropriate preventive maintenance, and if its relaibility is low, there's bound to be an increase in the rate of failure.

We can also say from equation 5 that the more a machine is used, thegreater the wear, reducing performance and hence its reliability.

Farm implement, although the wear rate is largely governed by soil characteristics, by crop flow, by engine hours or by natural deterioration good maintenance can extend the serviceable life.

Problem relating to the hydraulic linkage system is common with government tractor, though it takes time to develop, and even when it worsens, it is usually ignored

by unskilled tractor operators, even if they notice the gradual reduction in the lifting height of implement attached to tractor. It becomes a case for repair when the tractor can no longer lift implement at all.

The result of the frequency of tractor components breakdown in this study compares well with those earlier reported by Anazodo,(1986) and Oni,(1996). It can be reported that most government acguired tractors loose the functioning of the electrical system / electronic dashboard as early as the first 6month of purchase or use.

From the gualitative analysis of the major factors contributing to high frequency of equipment breakdown in Nigeria as reported in the paper presented by Anazodo (1987) on agriculture machinery use in Nigeria. The experience of a decade (1975-1985). It was found that breakdown due to worn out part,poor adjustment and operation of equipment and poor field conditions constitute the major features of breakdown of farm tractor.

Forthermore, it was found that the breakdown due to worn out part were most frequents (i.e pistonrings & sleeve),followed by poor field condition and then poor adjustment and operation of the equipment.

On the availability of spare parts and the repair capability of the technical personnels in the government establishment, revealed that apart from the fact that there is no spare parts readily available, repair facilities are poor and general non existent in some establishments. Reverse is the case for few mechanized farm in the state apart from that, some of the machanized farms in the state apart from that some of the mechanized farm as reported earlier do not make repair on their farms,repair and maintenance are contracted out,any time farm tractor breakdown,be it minor or major. This show the management capabilities of such establishments.

The omission of any revent point not made in this write up should not be judged as being overlooked. But it is for the simple reason that since this is an investigative survey, any incomplete or any information for which its source is guestionnable could not be evaluated and analysed.

TABLE 1: ESTIMATION OF THE ANNUAL UTILIZION OF TRATORS IN THE STATE MECHANISED FARMS / ESTABLISHMENT.

	PRIVATE Mechanised Farms	%	Govt. Establishment	%
Tractor use (hrs) Field Operation	800hrs	88	552hrs	78
Transportation To the Field	100	11	160	22
TOTAL	900 hrs/year		712 hrs/yr	100

Soure : From Data.

TABLE 2: ANNUAL UTILIZATION OF TRACTOR IN COMPARISON TO THE STANDARD ANNUAL UTILIZATION TRACTOR MECHNISED FARMS / ESTABLISHMENT.

	PRIVATE Mechanised Farms	%	Govt. establishment	%
1000 hrs/yr operation Field Operation	800	80	552	55
Transportation to Field	100	10	160	16
Total	900	90	712	61

Sources : From Data

TABLE:3 Average percentage of production cost Associate wiht Mechinery & Equipment.

Mechanised farms/Establishment	percentage (%)	Frequency
Private Mechanied Farms	42	16
Govt. establishment	46	21
Source: From Data: Total =	88	37

TABLE 4: Annual usee of Equipment - % Distribution in state.

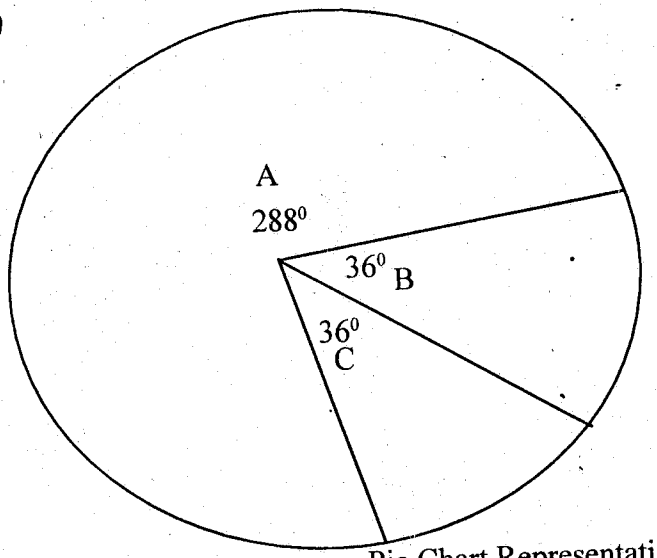
	Mechanised Farms / Establishment. Private Mechnised Farms		Govt. Establishment		
Time intaral Duration (Months)	Freqency	%	Freguency	%	%
3 - 4	3	18	5	29	47
5 - 6	2	12	7	41	53
Source: Data					

TABLE 5: Age Distribution of Equipment used in the State

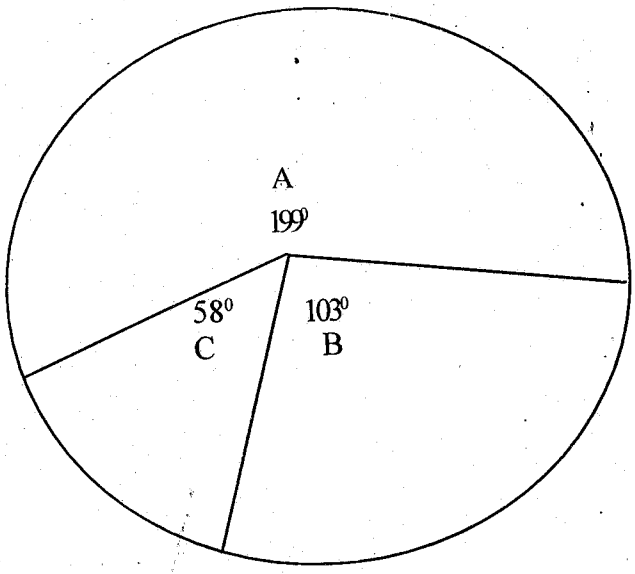
Years	Frequency	%
1 - 3	7	14%
4 - 6	20	40%
7 - 9	16	32%
10 - 12	5	10%
Over 12	2	4%
Total	50	100%
Sources Data		

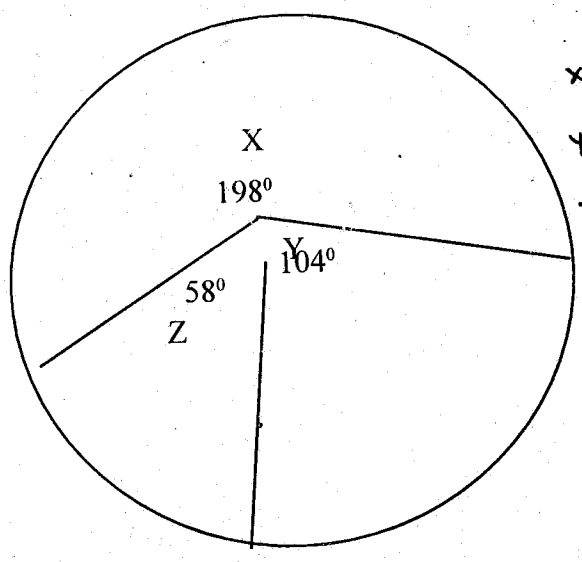
Further Analysis from table 1-2
Private Mechanised farm.

A. Field Operation
B. Lost time
C. TRANSPORTATION



Pie Chart Representation of annual utilition





X - FIELD OPERATION
Y - LOST TIME
Z - TRANSPORTATION

TABLE:6 Available Complex Machine / Equipment / Implement

Establishment	Equipment	Implement	Type % Make.
Mazubi Farms	Cereal thesher		Cybotar 500MD.
Gurara Agric. dept		Planter	Massey fergussan. MF dept
N.C.R. I Badeggi.		Power Tillers	Asia make.
Madabe & sons	CAT challenger		Catapilar 65B.
Madabe & sons	Tractor 65B		Catapilar 65B.
Madabe & sons	Silo Plant.		
Northern Nigria Flour mills		Rotavator	Case.

TABLE: 7 State of Farm Machinery and functionality

Mechanised Farm Establishment	Frequency	Number of Tractors	No of Functional Tractor	No of Non-functional or broken - Down Tractors
Private Meech ined Farms	18	63	50	13
Govt. EStablishment	31	120	57	61
Total	49	183	107	74

TABLE: 8 Inventory of Implements.

	Mechanised Farms/Establishment			
Implements	Private Mechnised Forms	Govt. Establishment	Total No in use	Percentage(%)
Disc plough	37	73	110	26
Disc Harrow	35	52	87	20
Cultivators	12	6	18	4
Ridgers	31	44	75	17
Planters	22	6	28	7
Seeddrills	10	1	11	3
Thresters	10	5	15	3
Harvesters	9	2	11	3
Boom sprayer	14	1	15	3
Knapsack spryer	35	26	61	14

TABLE:9 Tractor Models used in the State.

Tractor model	Mechanised Farm/Establishment					
	Private Mechanised Farms		Govt. Establishment		Total	%
	Frequency	%	Frequency	%		
Steyr(8075,768)	8	28	21	72	29	17
Massey Frequsson(MF)	40	40	60	60	100	57
Ford	3	43	4	57	7	4
Fiat	8	23	27	77	35	20
Other [case,hmt	1		3		4	2
30hn Deere. etc TOTAL	60		115		175	

TABLE:10 Type and size of Tractor used in the State

	Mechanised Farms/Establishment				
	Private Mechnised Forms		Govt.Establishment		
Tractor Capacity(KW)	Frequency	%	Frequency	%	%
Small size (15-35)	-	-	3	6	6
Medium size (35-70)	18	38	25	52	90
Large size (70-110)	1	2	1	2	4

Source: From Data.

TABLE:11 Statistics of major causes of Breakdown of Tractors

	Mechanised Farms/Establishment				
	Private Mechnised Forms		Govt.Establishment		%
Causes	Frequency	%	Frequency	%	
Engine Problem	6	50	15	48	48
Cooling System	-				
Transmission System	1	8	4	12	12
Hydraulic System	-		6	19	14
AUXILLIARY EQUIPMENTS	3	25	4	13	16
STEERING SYS. PROBLEM	—	32	1	3	2
NEED REHABILITATION (wheels & tyres etc).	2	16	1	3	7

TABLE:12 Statistics on the acquisition of spare parts for Tractor

	Mechanized Farms/Establishment		
	Private Mechanized Farms	Govt.Establishment	
Mode of Acquisition	%	%	%
Purchased Locally	36	64	28
Imported	100	-	10
NO Response	**33**	**67**	**62**

TABLE:13 Farm workshops functionality and repail facilities

	Mechanized Farms/Establishment				
	Private Mechanized Forms		Govt.Establishment		%
Repair workshops	Frequency	%	Frequency	%	
Functional workshops	2	11	-	-	4
Functional Workshop Not-Well-Equipped	6	33	2	6	17
NON-FUNCTIONAL WORKSHOP: ZERO-EQUIPPED	10	55	28	93	79

TABLE: 14 Frequency of major repairs of Tractors in the State.

10 times Mechanised Farm Establishment %	One Yearly ↓		2-4 times Yrly ↘		5-10 time Yrly ↘	
	Frequency	%	Frequency	%	Frequency	%
Govt. Establishment -	9	50	17	97	4	57
Private Mechanised Farms -	9	50	5	23	- 3	43

TABLE:15 Statistics on Maintenanece

	Mechanised Farm /Establishment	
	private Mechanised Farm	Govt. Establishment
Forms of Maintenance	%	%
Preventive Maintenance	39	17
Running - in Maintenance	42	38
Periodical Maintenance	60	40
Corrective Maintenance	20	64

Source: from Data.

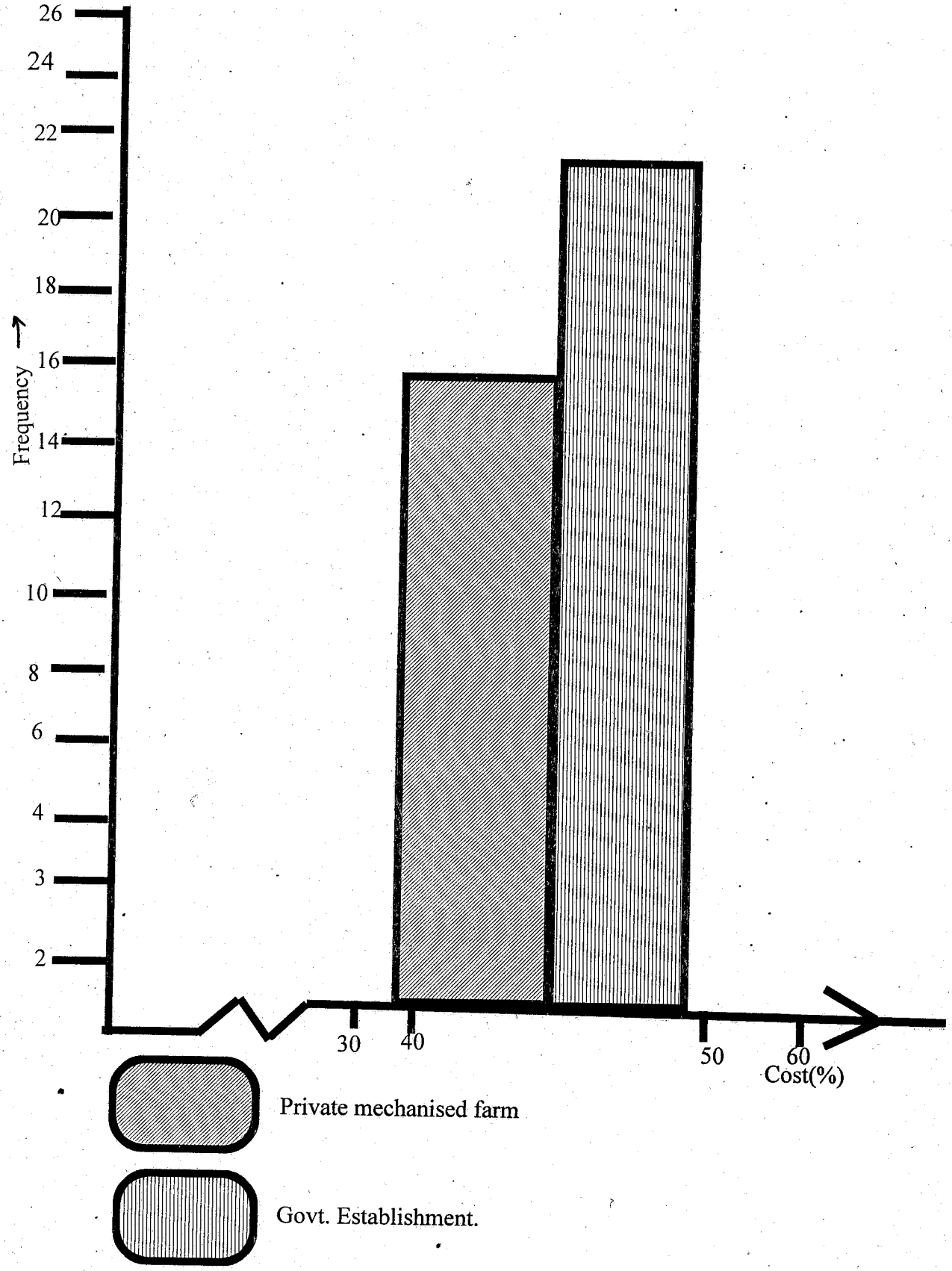


Fig:1. Cost Against frequency. Histogram.
: Percentage cost of Production associated with Machnised and Equipment.

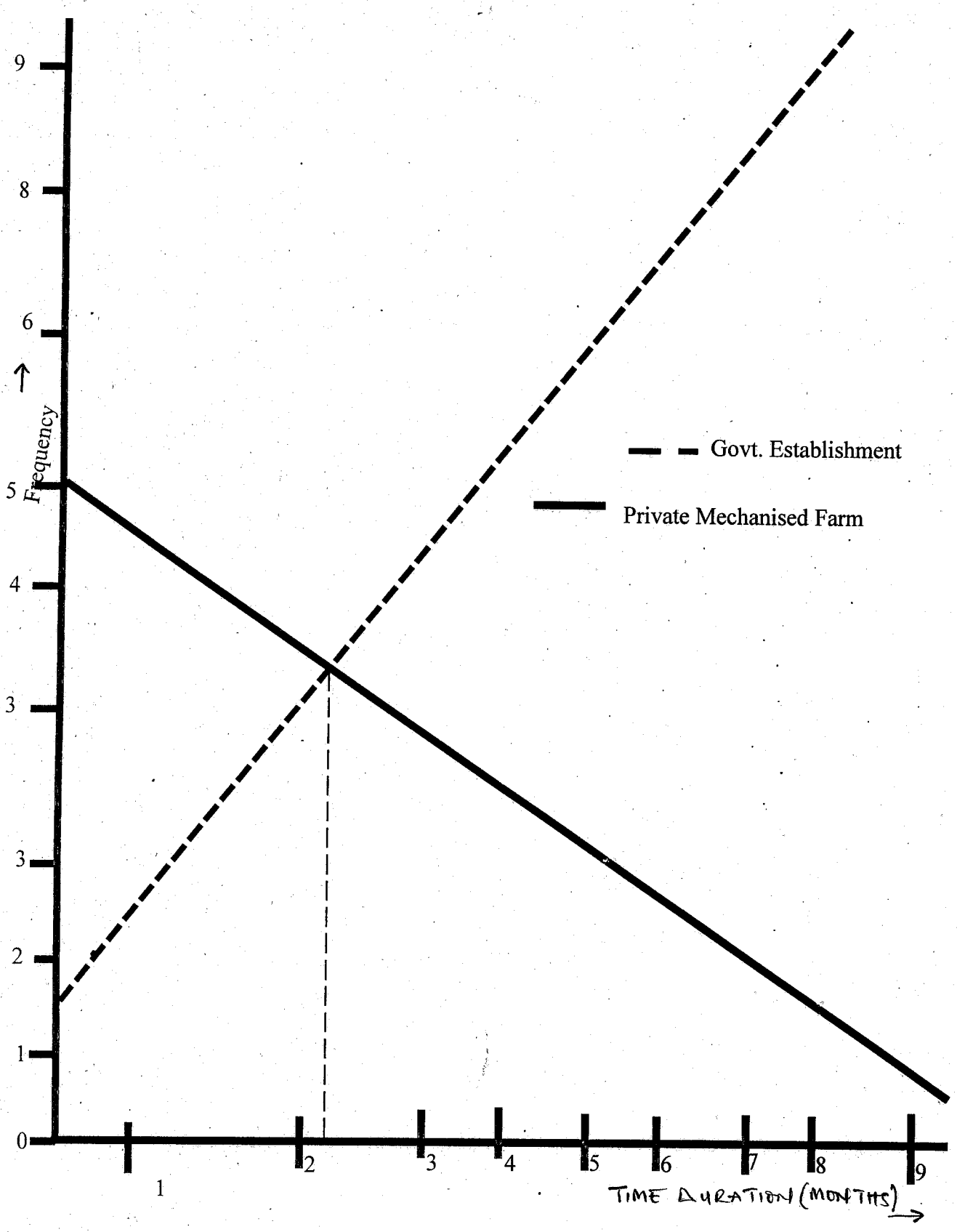


Fig: -2 Gragh of annual use of equipment

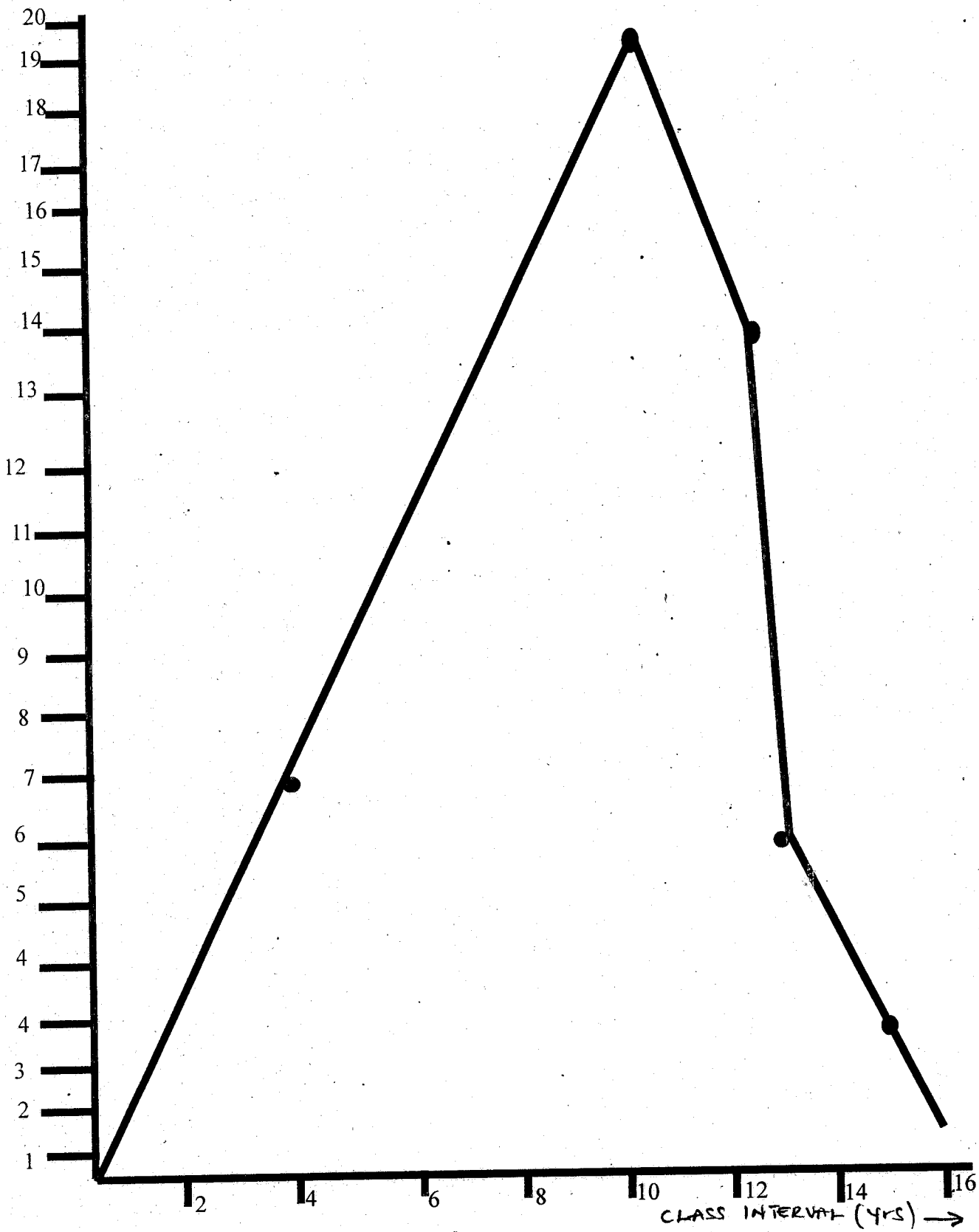


Fig: **3**. Age Distribution of Equipment used in tthe state Representation in line Graph.

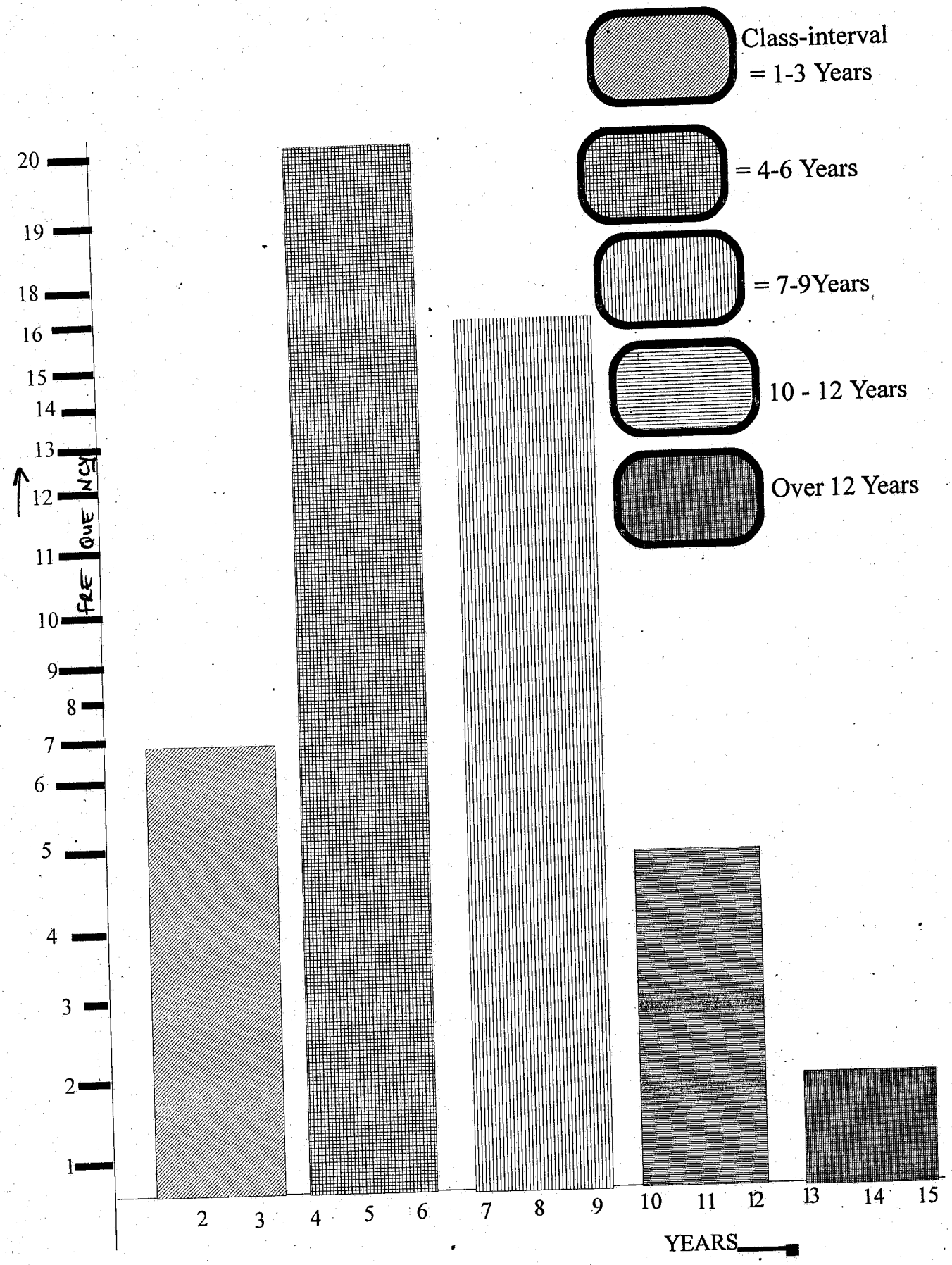


Fig 4. Age distribution of equipment used in the state.

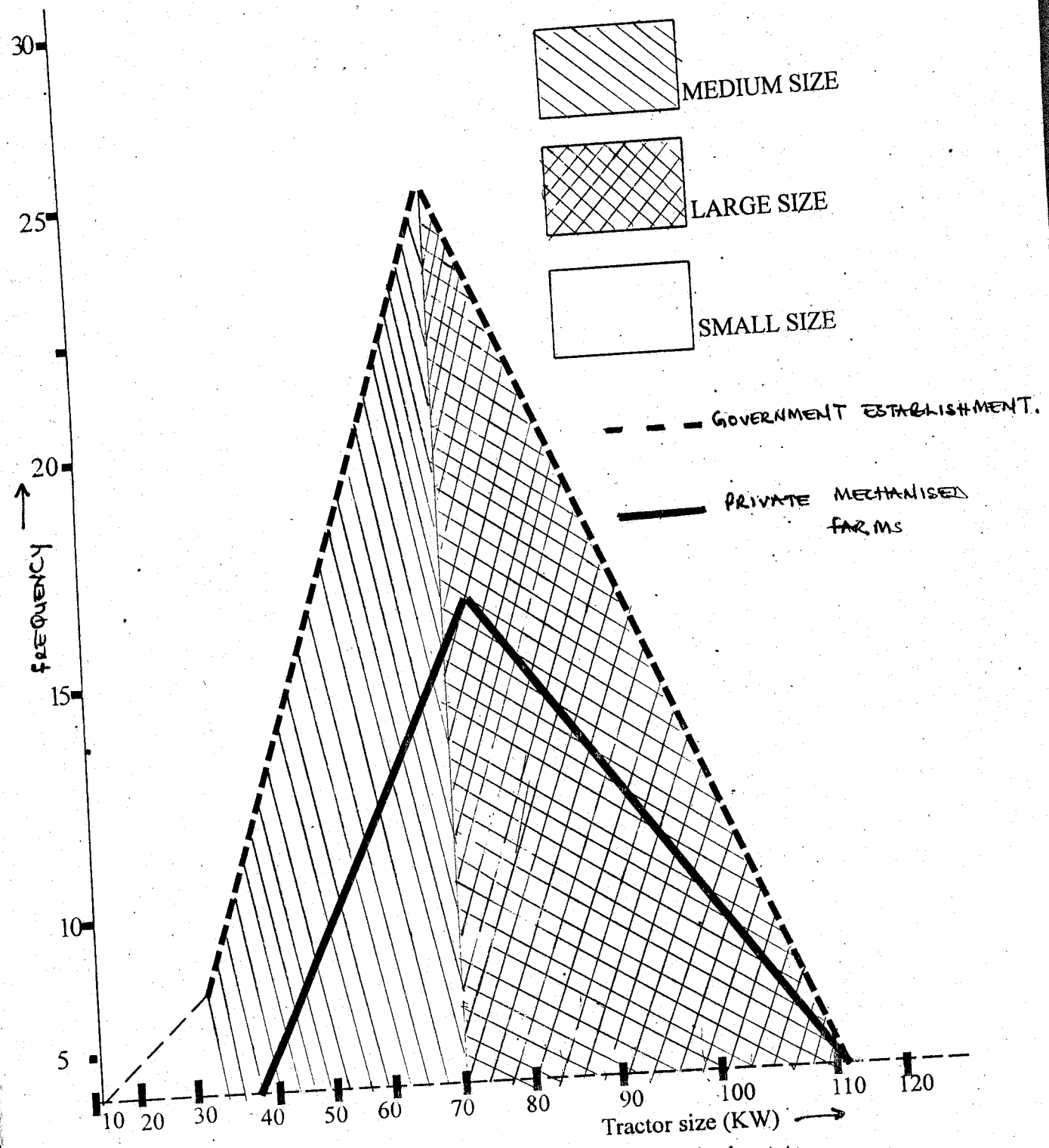


Fig:5 Line Graph Representation of Capacity of Tractor used in the state.
-: Frequency aganst Tractor size(KW)

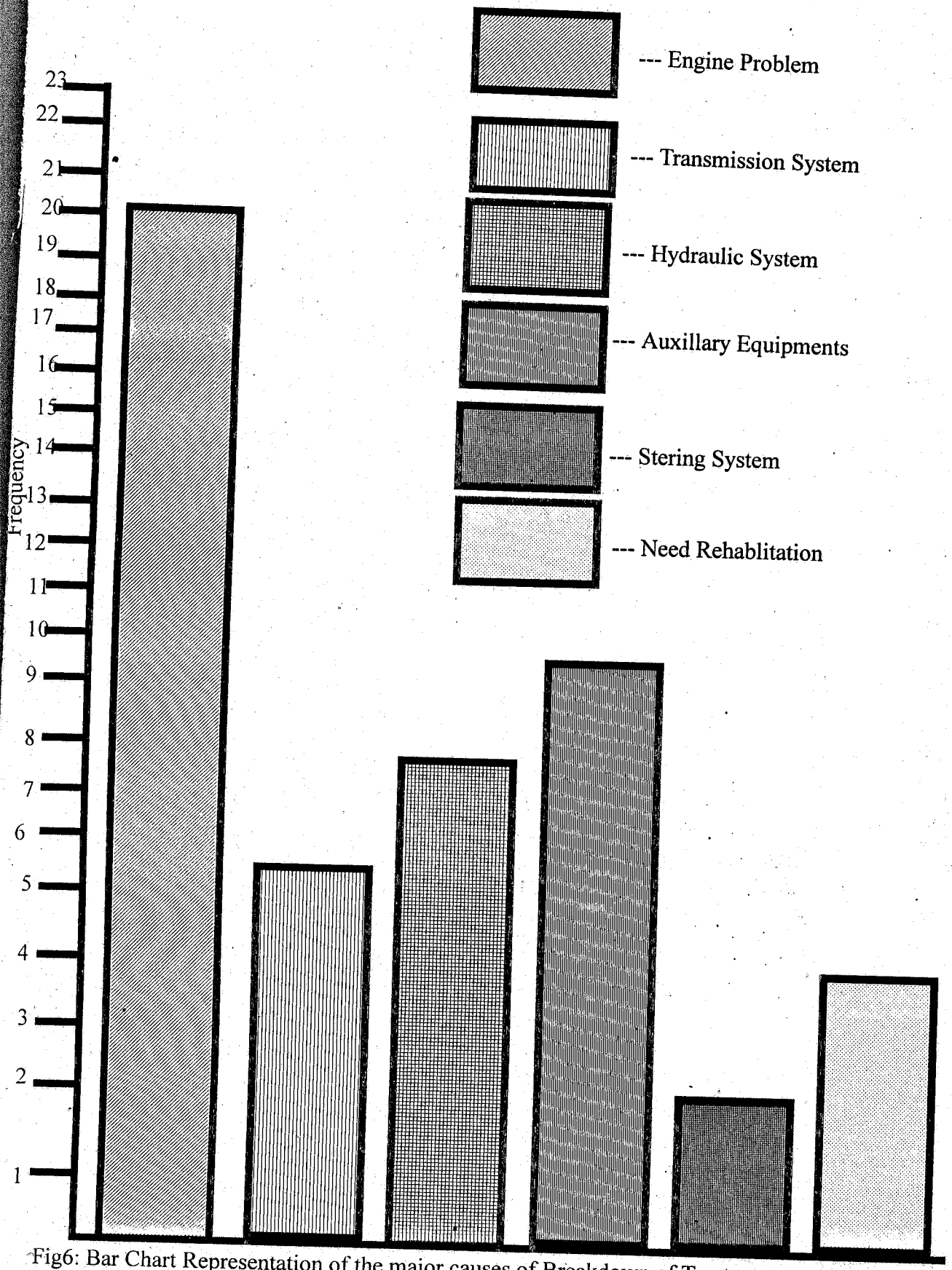
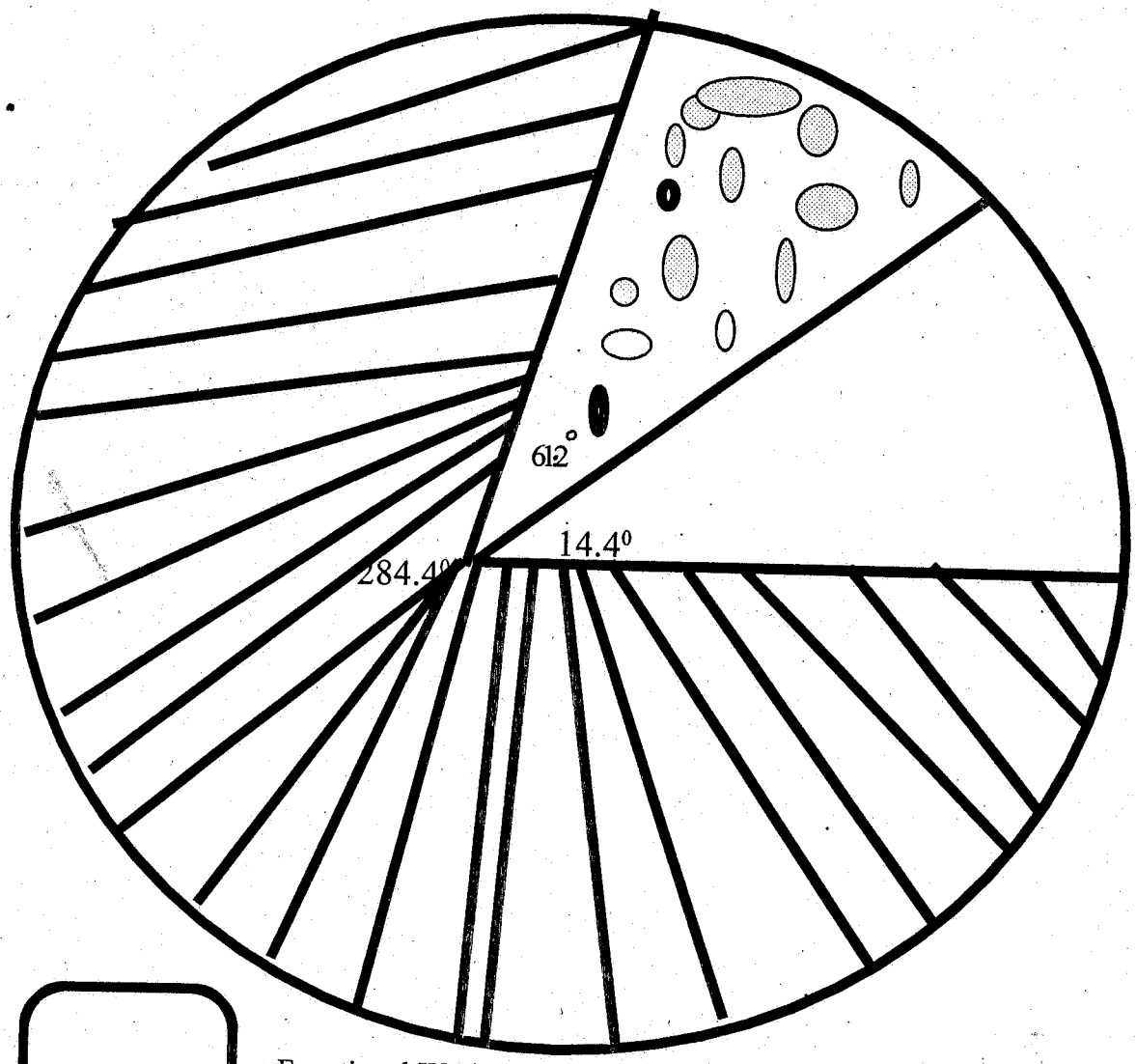


Fig6: Bar Chart Representation of the major causes of Breakdown of Tractors.



= Functional Workshop & Well Equipped

= Functional Workshop & Not well Equipped

= Not Functional Workshop - Zero Equiped.

Fig: 7 Pie Chart. Representation of Form workshop functionality and repair facility in Mechanised farm in the state.

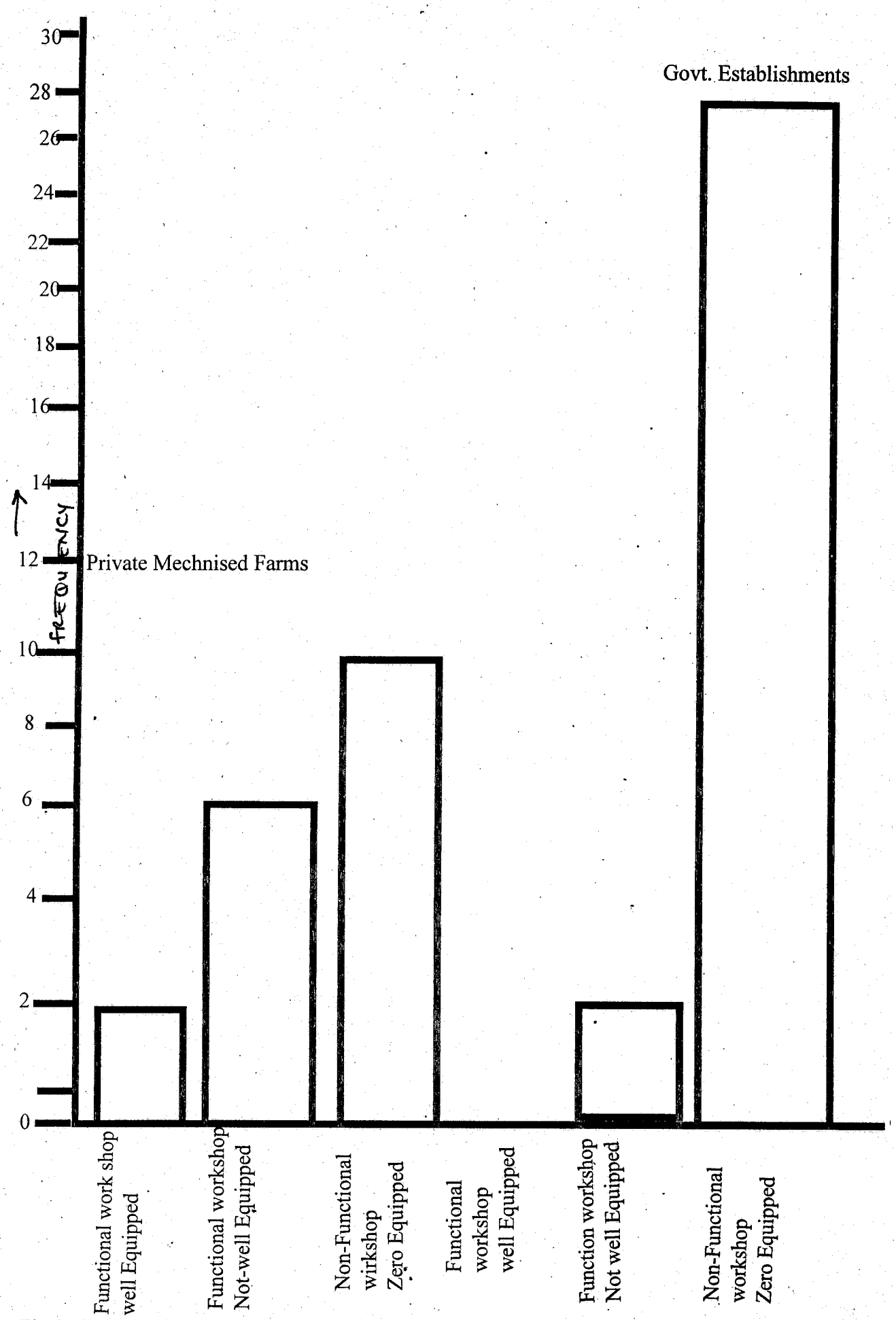


Fig 8: Farm Workshop functional and Repial facilities represented by a Histogram.

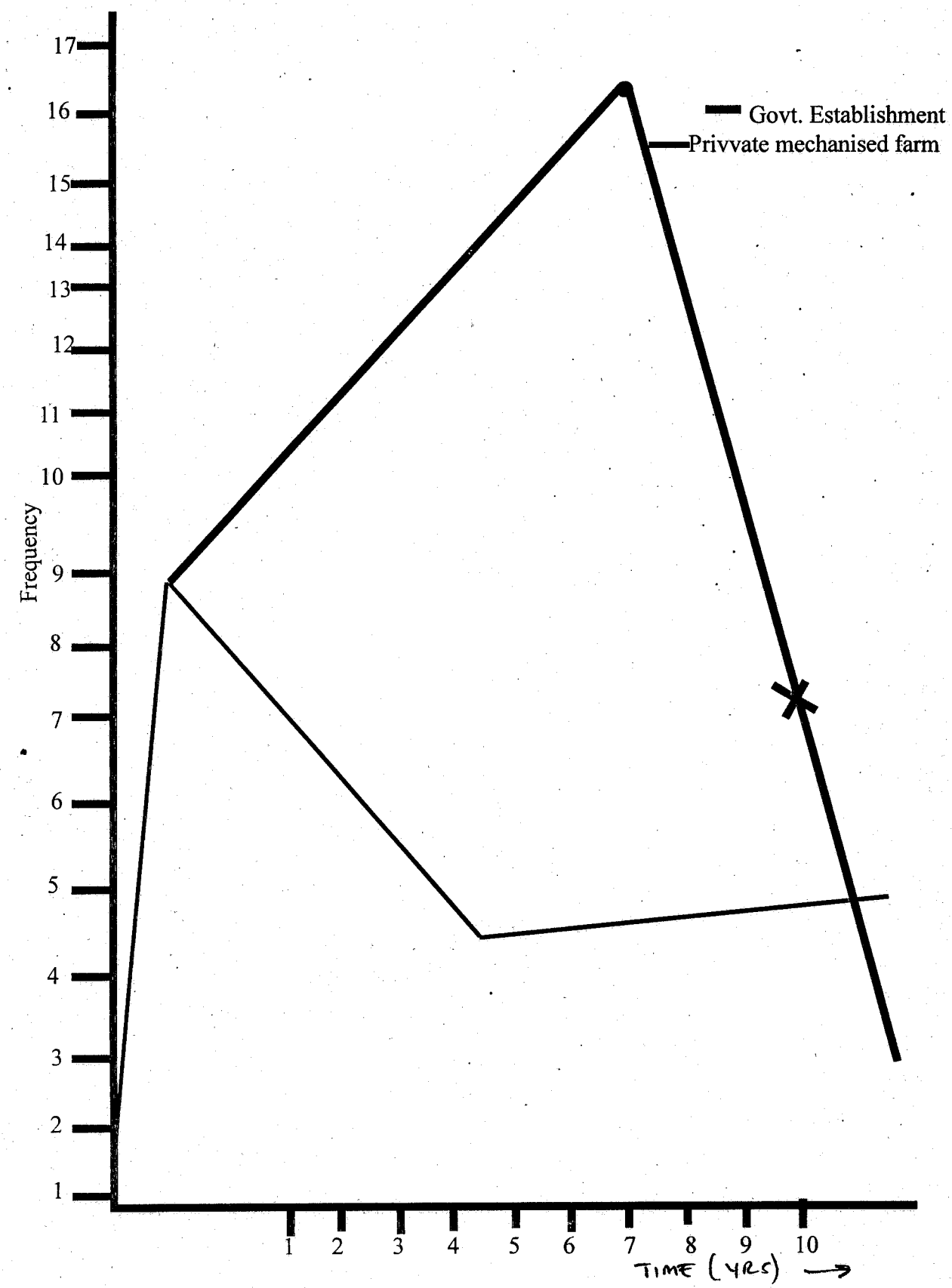


Fig:9 Line Graph Representation of frequency or major repairs of Tractor in the state.

CHAPTER FIVE

5.0 Conclusion and Recommendation

5.1 Conclusion

The problems militating against effective tractor and implement management and maintenance in mechanised farms in Niger state have been discussed. The issues involved center around lack of planned and preventive maintenance culture, lack of maintenance and repair facilities which is worsened by the unavailability of spare parts and the poorly equipped or no workshop.

We keep trying to emphasize maintenance without actually enforcing it. Enough of the writing, we should begin to make it our culture. The state government should plan and enforce maintenance of its machinery, install effective professional management. Accord reguisite level of recognition and importance to agricultural machinery maintenance.

And the establishment of sustainable repair and maintenance programme for farm machinery and equipment appears to be the antidote to the sporadic breakdown of these equipment. In addition the establishment of service center to cater for the repair and maintenance needs of farm machinery and equipment would go a long way in alleviating the problems.

5.2 RECOMMENDATION

Following the findings of this study, it clearly implies that a foundation is being set for this important requirement for a sustainable, tractor and implement management and maintenance in Niger State. This has also made it necessary to re-emphasize the following

recommendations:-

strict adherence to the principle of preventive maintenance instead of the generally practised curative fire brigade " approach to repairs and maintenance.

POOR TO ZERO EQUIPPED WORKSHOPS

In view of the minimal facilities available on ground for tractor repairs the general degree of mismanagement, pilferage, and the associated heavy finances a clear distinction has to be drawn between routine services, minor repairs, major repairs and works that require special expertise and equipment. Because of these reason the state government. Should establish functional well-equipped workshops, manned with well trained mechanics that have undergone training at manufacturers workshops, this workshops should be located at about 4-5 central locations in the state. So that even other private farmers and government establishments can have access to make repairs at reasonable rates. The government should also endeavour to have stock of spare parts of

the major tractor models in the state, for prompt repairs, the revenue generated can be used for up keep and maintaining the facilities there.

The services of manufacturers workshops and then accredited network in the

The services of manufacturers workshops and then accredited network in the state i.e. Steyr and MF should also be involved for major repairs eg engine overhauls transmission system work, calibration etc. there is allow a need to streamline revitalize the engineering divisions of the ministry of agriculture in the state for effective services delivery.

LOW LITERACY LEVEL, UNSKILLED TRACTOR OPERATOR

Tractor operator should be given adequate training on how to handle the tractors, set revenue targets for all operators and determine level of performance efficiency against this target.

- All repairs works on implements should be done in every establishment, be it government or mechanized farm.

-For field operation especially for the government, establishment that engage T.H.S (tractor hiring services) operation log books should be provided for each tractor . The log-books should be designed to contain information on the farmer's plot area, time spent, collectable revenues, quantity of fuel and oils used per day dates when routine servicing, minor and major repairs were carried out and their costs. This is necessary for good record keeping, as if will provide ready information for researchers and the engineer in charge of such tractors.

- On maintenance of tractors and implements, each tractor and implement should be provided a file in which all issues of maintenance and repairs should be recorded. Pre and posts season maintenance, frequent failure and hence prompt repairs.

-government should make adequate provision of funds for essential maintenance of the its machinery, below is some coarse guides for regular maintenance of tractors.

EVERY 10 HRS OF OPERATION (DAILY)

1. Check and service the air cleaner
2. Check the crankcase oil level, and top up if found below the recommended level.
3. Check the cooling system liquid level. If it falls short top it up.
4. Lubricate grease fittings.
5. Check the fuel sediment bowl.
6. Check miscellaneous items, such as brakes, leaks drive belt etc.

EVERY 50 HRS OF OPERATION (WEEKLY)

1. Check and replenish battery electrolyte
2. Check and replenish the oil in the hydraulic and transmission systems respectively.
3. Check tyre pressures and inflate to the appropriate required guage.
4. Clean the dry type air cleaner and crankcase breather.
5. Perform 10 hrs service

EVERY 100HRS OF OPERATION (FORTH NIGHTLY)

1. Change the crankcase oil and filter

2. Perform 10 hr and 80 hrs service

EVERY 250 HRS OF OPERATION (MONTHLY)

1. Clean, check gap or replace spark plugs.
2. Clean, battery and sediment bowl.
3. Adjust carburettor, carburettor, clutch pedal tree-play and steering free play.
4. Lubricate clutch- release bearing.
5. Perform 10,50, 100 hour services.

EVERY 500 HRS OF OPERATION (TWO MONTHS)

1. Service distributor starter and generator.
2. Check ignition timing.
3. Replace diesel fuel filters.
4. Perform 10,50, 100 and 250 hour services.

EVERY 1000HRS OF OPERATION (YEARLY)

1. Service oil-bath air cleaners
2. Change oil in power train and hydraulic system.
3. Adjust engine governor.
4. Repack front wheel assembly.
5. Drain, clean and refill cooling system.
6. Perform 10,50 , 100, 250, 500 hour services.

PERIODIC MAINTENANCE

1 Clean radiator and grill.
2. Adjust clutch.

3. Adjust and balance the brake.
4. Remove water from sediment bowl.
5. Maintenance of battery, other than adding distilled water.
6. Adjust valve clearance.
7. Check the tension of nuts and bolts generally.
8. Clean crankcase breather.

Adjustments, tune-up and minor repairs are part of the complete preventive maintenance programme when a tractor is not properly maintained, higher repair costs and higher fuel costs will be the likely result

FRAGMENTED FARM HOLDINGS

The average Nigeria rural farmer can be sensitized to disengage from fragmented shifting agriculture and embrace intensive permanent agriculture, if the needed inputs are readily available to him at the right time and place. And alternatively groups of farmers can come together to form a cooperative society, where they can join resources to hire machinery to work on their combined plots of land. This might be a way of incurring initial cost on machinery investment.

Tractors should be decentralized to job concentration centres where services can economically be provided to avoid tractors having to travel long distances on poorly constructed road or animal track to arrive at site of operation which are not properly cleared, poorly drained and fragmented.

For the rural farmer, given the abundant human labour available in most of the rural farming communities it is not advisable to fully mechanize all farm operations.

FREQUENT BREAKDOWN.

-Proper attention should be given to both routine and preventive maintenance, proper selection of field of operation.

- establishment of workshop facilities, and training of technical staff for the job.

- proper clearing or agricultural fields for mechanization.

-The farmer should be advised to diversify operation, since most operation have been limited to tillage.

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SECTION B.

MANAGEMENT

7. What is the size of your farm. Please state accordingly.

   Total Area.....(ha) or M^2

   Agricultural Area.....

   Non-Agricultural Area.....

   Area cultivated.....

8. Do you perform your key farming operations like land preparation, planting, weeding or plant protection operations timely? (A) yes (B) NO

   (C) Sometime yes

9. If No be specific which operation? .....

10. Could you please give a rough estimate of the annual utilizations of your tractor (S) under the following in hours.

    - Field operations.....
    - Transportation.....

11. What percentage of the total production cost is associated with machinery and equipment?.....

12. Operating cost, maintenance and repair cost escalate with the age of machinery and equipment. Do you agree? (A) Yes (B) NO (C) Not Completely

13. Do you normally evaluate your programmes and techniques of production?

    (A) Yes (B) No

SECTION C

INVENTORY OF EQUIPMENTS

14. What is/are the size (s) of your tractor (s) in HP/Kwh

(A) Small size (15 - 35kw) (B) Medium size (35-70kw (C) Larger size (70-110kw)

15. How many tractors do you have on your farm? .....

(A) State their various make.....

.....

(B) And how many are presently in working condition?.....

.....

(C) why and what is wrong with the one not working?.....

.....

16. Number of their equipment/machinery?

(i) Ploughs.....

(ii) Harrows.....

(iii) Cultivators.....

(iv) Ridgers.....

(v) Planters.....

(vi) Seeddrills.....

(vii) Threshers:.....

(viii) Harvesters:.....

(ix) Sprayers: (Boom sprayer, knapsack etc.).

17. Do you have any implement that cannot be utilised?

If yes, state type and givereason?.....

.....

.....

18 Do you have a complex machine/equipment? (A) Yes (B) No

If yes, please state type and make .....

.....

19. What is the age of your equipment?.....

20. What is the annual use of the equipments?

.....

SECTION A

MAINTENANCE STRUCTURE

21. Do you undertake major repairs in your farm workshop? (A) Yes (B) No

22. Do you have competent hands that make repairs? (A) Yes (B) No

23. If repairs are done outside the farm, what is the estimated annual cost of repairs i.e cost of spare part + labour charge?.....

(b) Would you have spent more if you recruited a capable hands in your farm?

(A) Yes (B) No

24. How often do you undertake major repairs of your tractors (A)Once yearly (B) 2-4 times yearly (C) 5-10 times yearly (D) Over 10 times yearly

25. Do you have a lubrication and maintenance chart for your tractor? If No give reason why? .....

.....

26. Do you observe routine servicing of your tractors (A) Yes (B) No

If No give reasons:.....

.....

27. When do you change oil in the oil pan, clean oil filters, check level of brake fluid, clean and grease battery terminates and check level of electrolyte

(A) Forth nightly or after 133 hrs of operation

(B) Monthly

(C) After every 4 months about (500hrs)

28. When do you drainoff the transmission oil, the differentia and drive axles, change the oil in the crankcase, change the oil in filter element, check the steering year oil, flush and clean radiator, clean the fuel tank.

(A) After every six months (B) Yearly

29 Are the spare parts of your machine. Equipment available locally?

(A) Yes (B) No

(b) If No, how are they procured?.....

(c) Can it be serviced locally, is in your workshop (A) Yes (B) No

30 Do you overhaul your engines when each of these occurs

(i) When the oil consumption is high and blue smoke is given out

(A) Yes (B) No

(ii) When you have low compression in engine (A) Yes (B) No

(iii) Ignition fault. (A) Yes (B) No

(iv) After effect of an accident (A) Yes (B) No

(v) When you notice an abnormal noise at the engine (A) Yes (B) No

(vi) Lack of power etc. (A) Yes (B) No

(b) Do you keep record of repairs made on equipment? (A) Yes (B) No

31. Have you had any major equipment breakdown? (A) Yes(B) No

If Yes, what was it?.....

.....

.....

APPENDIX

QUESTIONNAIRE

SECTION A

Background information (please tick and fill in as appropriate where necessary).

1. LOCATION: NAME OF ESTABLISHMENT/FARM:.....

   State.....L.G.A.....

2. Farm ownership? (A) Government Ownership (B) Private ownership

   (C) Joint ownership

PERSONNEL DATA.

3. Age at respondent

   (A) Less than 20yrs (B) 21-30yrs (C) 31-40yrs (D) over 40yrs

4. Educational qualifications (A) Secondary School (B) Diploma Degree

   (C) Bachelor's Degree (D) Master's Degree (E) ph.D.

   (F) Any other qualification

5. Years of working experience of respondent

   (A) Less than one year (B) 1 - 5yrs (C) 6 - 10yrs

   (D) Over 10yrs

6. Years of working experience of the tractor operator

   (A) Less than one year (B) 1 - 5yrs (C) 6 - 10yrs (D) Over 10yrs