SURVEY OF THE WORKING CONDITION OF USED IRRIGATION PUMPS IN MINNA AND ENVIRONMENT

BY

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DEDICATION

This project is dedicated to the Almighty God for he is ever Faithful: to my parents Mal. Mamman A. Bosso and my late mother Fati (Binta) Abubakar Bosso for their love, care and support.

TANKO B. WAZIRI BOSSO

TABLE OF CONTENT

1.1 JUSTIFICATION

Water pumps are widely in use in Minna and its environs for Irrigation purposes. Farmers in this area always encounter one problem or the other in the use of these pumps, In the light of this, there is need to survey and examine these problems and fine solution to this problem.

Large areas of Land in arid regions are so situated that available water cannot be brought economically to them by gravity flow in canals and pipes. In many areas, surface or underground water is pumped to the land to be irrigated.

1.2 OBJECTIVE

1. To evaluate the suitability and adaptability of irrigation pump by farmers.
2. Assessing the performance by which the irrigation pump could be use over a certain period of time.
3. To carry out working condition of the existence pumps in order to improve or argument their efficiencies.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 INTRODUCTION

There are two main types of pump, centrifugal and reciprocating. A reciprocating pump is driven by power from an external source and consists of cylinder in which a piston or plunger is moved backwards and forwards.

This movement of the plunger alternately a vacum pressure and a positive pressure in the cylinder by means of which the water is raised. If a plunger is used, or if the water acts on one side of the piston only, the pump is single acting. In this case it sucks the water into the cylinder on the ward stroke and forces it out during the inward stroke. If the water acts on both sides of the piston it will suck and deliver during one stroke, such a pump is said to be double - acting.

The reciprocating pump is always used for producing very high pressures. For very large quantities at low or medium pressures the centrifugal pump is used. E.H. Lewtt (1970)

2.1.2. CENTRIFUGAL PUMPS.

Church, A.H and Jagdish Lal (1973). amongst most widely used in irrigation practice. they are simple in construction, easy to operate, low in initial cost and produce a constant steady discharge. The wearing parts are few. They are adopted to directed motor engine derives without the use of expensive gears. This type of pump is well adapted to usual pumping services such as irrigation, water supply, and sewage service. Having no values the pump can handle liquids having solids in suspension, provided it in constructed to suit such conditions.

Principle of operation of centrifugal pumps. A centrifugal pump is a rotary machine coasting of two basic parts - the rotary element or impeller and the stationary element or casing. The impeller is a wheel or disc mounted on a shaft and provided with a number of vanes or blades usually curved in form. the vanes are arranged in a circular array around on inlet opening at the centre. In some pumps a diffuser consisting of a series of guide vanes or blade surrounds the impeller. A centrifugal pump may be defined as one in which an impeller rotating inside a close - fitting case gran in the liquid at the centre and by vertue of centrifugal force throws out the liquid through an opening or opening at the side of the casing. The underlying hydraulic principle in the design of an imupeller is the production of high velocity and the partial transformation of this velocity into pressure head. In operation the pump is filled with water and the impeller is rotated, the blades cause the liquid to rotate with the impeller and in part a high in velocity to the water. Centrifugal force causes it to be thrown out wards from the impeller into te casing. The outward flow through the impeller reduces pressure at the inlet, allowing more water to be grain in through the suction pipe by atmospheric pressure or an external pressures velocity in reduced and converted into pressure and water pumped out through the discharge pipe. This . conversion of velocity energy into pressure energy is complished either in a volute casin in a diffusion casing.

By changing the form of the vanes, different characteristics are obtained, by enlarging the diameter of the inlet eye and the width of the im .0peller, the quantity of water that the pump deliver against a given head is increased. the number of vanes used in an impeller varies with the service characteristics required. in general, the higher the head , the more the vanes used; and greater the rale of pump if , the fewer the vanes .too few vanes prorate poor guidance for the water ; too many cause excessive frictional resistante .the minimum number of vanes is usually three and the maximum about twelvewhen the flowenters at one side of impeller, thus 5 developed which must be overcome hydraulically or by mechanical beans. the common section at both end of the impeller and, in case of multi-satge pumps by using back back impeller in pairs, in most centrifugal pumps, including vertical turbine, the thrust is taken up by means of thrust hearings.

Since the leakage of water past an impeller from the high pressure give to the low pressure inlet area results in considerable loss of energy , a sealing is provided between the impeller and the pump.These rings may range from a simple of close clearance to an eleborate labgrinth ring.

A bede plate is provide at the basic of the pump body for mounting the pumps and dring motor or engine, thus providing a foundation on which they can be installed as unit.

Horizontal centrifugal pumps. Indian standards institution (1972), A horizontal centrifugal pump has vertical impeller mounted on a horizontal shaft. This type pump most commonly used in irrigation. It costs less, is easier to install and is more accessible inspection and maintain. The pump should be installed so that it is always above the water surface, but as close to it as possible. For satisfactory operation the section lift of the pump should not exceed 4.5 to 6m.

Vertical centrifugal pumps. The vertical centrifugal pump has a horizontal impeller mounted on a vertical shaft. This type of pump has the advantage that it can be how evened to the depth required to pump water and the vertical shaft is extended to the surface where the power is applied. The volute type vertical centrifugal pump may be either submerged or exposed. the exposed pump is set in a pump at an elevation that will accommodate the section lift. In the submerged pump, the impeller and suction entrance remain submerged below the water level. Thus the pump does not require primaing.However, the arrangement is not popular is irrigation practice due to the difficulty in Lubricating the bearings. Volute type vertical centrigal pumps are usually restricted to pumping heads upto about ·15 metres are commonly used to pump from pumps or pits.

2.1.3 VERTICAL TURBINE PUMPS.

A vertical tursive pump, also called a deep were turbine pump, according to India standards institution (1970) is a vertical axis centrifugal or mixed flow type pump comprising of stages which accommodate rotating impellers and stationary bowls possessing guide vans. The bowl assemblies are nearly always located beneath the water surface and hence the deep well turbine pumps are adopted to . seasonal fluctuations in water level in the well. They are specially adapted to tube wells while the pumping water levels is below the practical units of volute centrifugal pump, the comparatively small diameter of turbine pumps suit their installation in tube wells.

Vertical turbine pumps are adopted to high lifts and have high efficiencies under optimum operating conditions. They have, however, higher initial cost and are more difficult to install and repair as compared to volute pumps.

As with all centrifugal pumps the pressure head developed depends on the diameter of the impeller and the speed at which it is related. In the deep well turbine pump, the diameter of the bowl and that of the impeller small diameter of the tube well. Hence the pressure head developed by a siggle impeller is not great. Additional head is head is obtained by adding more bowl assemblies or stages.

2.1.4. SELECTION OF PUMPS.

JOHNSON, C.N. (1950). Irrigation wells and pumps are costly installations which require efficient utilization. A major part of the energy used in agriculture is in pumping. The total energy utilized in irrigation pumping in India in the year 1973-74 was about 8400 million kilowatt-hours. It is estimated that the requirement would double in the next two decades. Efficient utilization of the limited energy resources calls for the selection of the most suitable pump, keeping in view the requirements of Irrigation, characteristics of the well brother sources of water, kind of power avialable, economic conditions of the farmer and other factors.

Criteria and procedures for selection of pumps.

The mian factors influencing the selection of pumping sets are (1) The requirement of irrigation water by the crops to be irrigated, (ii) Yield of the sources of water (Open wells, tubes well, streams, rivers, pounds, etc.) and (iii) The availability and cost of the type by pump and kind of energy.

2.1.5. PRINCIPLE OF WORKING OF AIR-LIFT PUMPS.

An air-lift pump operates by the injection of compressed air directly into the water inside a discharge or educator pipe at a point below the water level in the well. The operating principle of the pump. The injection of the air results in a mixture of air bubbles and water, This composite fluid is liyhter in weight than water so that the wares column of water around the pipe displaces the liyhter mixture forcing it upward and out of the discharge pipe.

The pipe assembly used for air-lift pumping from a well consist of a vertical discharge pipe-called the eductor pipe-air a smaller air pipe on air-lift pump for pumping with the air pipe inside the eductor pipe. It is also possible to locate the air pipe outside the eductor pipe if there is space in the bare hole, as other wise there is considerable friction was when the air pipe is located inside a small diameter eductor pipe. Both the eductor pipe and the air pipe must be submerged in water in the well with 40 percent or more of their lengths extending below the pumping level. The energy that is available to operate the air-lift pump is that which is continued on the compressed air.

The well casing it self can be used for the eductor pipe if the diameter of the casing is not much large than the air line. This provides a practical way to pump sand and mud from the botton of a well during development and clearing operators. When use pumping a well, however, it is better to use a separate eductor pipe since the pumping level can then be measured with steal or electronic tapes.

The two most important factors in air-lift pumping are the percent submergence of the air line and the relative sizes of the air and eductor pipe. Generally, the air-lift pump, works best with a submergence of copercent or more. Submergence is the proportion of the length of the air line that extends below the pumping level divided by the distance from the level of water discharge to the lower and the air line and multiplied by 100 to given the result as a percentage.

$$\text{Percent Submergence} = \frac{A}{LxA} \times 100$$

The length of air pipe below the statistic water level is of significance only for determining the air pressure required to start the air-lift. Before air can discharge from the lower and of the air pipe, the compressed air must push all the water out of the air pipe. To do this, the pressure must obviously be greater than the water pressure before starting to pump. The depth of water in meters from the statistic water level to the lower and of the air pipe divided by 10 gives the required air pressure in kilograms per square centimeter.

Thus,

$$\text{Starting pressure, kg,/cm}^2 = \frac{A+D}{10}$$

$$\text{Working prosure, kg, cm}^2 = \frac{A}{10}$$

in which A and D are measured in meters.

Pipe sizes for air-lift pumps. The velocity is the eductor pipe depends upon the volume of the air and water being discharged and the area by the annual space between the air line and the eductor. Table below gives the sizes of air lines for various sizes of eductor that should be used under most conditions. When the water yield is usually low, the difference between the sizes of eductor and air pipes may have to less in order to reduce the area of the annualar space and this increase the discharge velocity enough to percent excessive air slippage in the eductor. This condition often dictates using a larger-than-normal air line when pumping directly from the well casing without a seperate eductor pipe.

Pipe sizes for air lift pumps.

Pumping rate Wares/sec			
2 to 4	10.0 or large	5.0	1.25
4 to 5	12.5 or ; ;	7.5	2.50
5 to 6	15.0 or ; ;	8.7	2.50
6 to 9	15.0 or ; ;	10.0	3.13
9 to 16	20.0 or ; ;	12.5	3.75
16 to 25	20.0 or ; ;	15.0	5.00
25 to 44	25.0 or ; ;	20.0	6.25

Best operation of an airlift pump required good regulation by the amount of air injected. Too much of air cause excessive friction in the pipe lines and waste of air. Too little air results in reduced yield and in surging, inter mitten discharge.

When developing or clearing a well with air-lift pumps, the discharge should be started at a very low rate and brought up gradually. The air flow should be slowly increase in proportion to what appears to be the increased in water flow into the well from the water - bearing formation.

Air lift pumping is extensively used in the development and preliminary testing and clearing of tube wells where vertical turbine pumps or submersible pumps cannot be installed. The advantages of air-lift pumps are ; simplicity, tube well need not be perfectly straight or vertical, and impure water will not damage the pump. The main disadvantage is its low efficiency. The maximum efficiency usually obtained is about 30 percent. The initial cost of the pump. Including the air compressor, is high and it requires an extra dept of water for proper submergence. KILL,D.(1973).

ANIMAL POWERED RECIPROCATING TYPE PUMP

An animal powered duplea reciprocating pump development by khepar et al, (1975) is specially suitable for pumping water from shallow* tubewells. The conventional bellock gear of the type commonite used with persion wheels is used to transmit the power of the pair of bucloks or other draft animals to opearte the pump. The pumping unit consist of a pair of ordinary piston pumps each pump has a cylinder diameter of 30cm with pistons having a stoke of 11cm, the suction ends of the two pumps are connected by bens to a T - joint to which a common suction pipe is connected a feet value is fixed to the botten of the suction pipe is conceited. A fast value is fixed to the bottom of the suction pipe as usual. The suction pipe which is smaller in diameter them the tube well home red into the well. The power transmitted through he bullock gear is applied to operate the pistons through a fly wheel to which are commenced the pump the desired piston stroke the drive provides one discharge stroke in pump for each revolution of the flywhel. The suction and discharge strokes pf the pair of pumps alternate with each other i.e when there is suction in one pump there is discharde in the ither. Fly wheel orivides the mertia required for the smooth running of the pump.

The animal operated pump is suitable to lift water from shallow tube wells and open wells when the depth to pumping water level does not exceed 6 metres from the ground surface. It gives a discharge of about 7 litres per second against s head of metres.

Deep well reciprocatinfg pumps. By introducing the pump cylinder with its plunger and values into the water in a well, water can be lifted to almost anyy height required in practical use. The plunger is connected to the pum handle, or other operating device like a mechanically powered crable shaft. As the plunger in which the upper value is located moves upward, the water on the top of the value is forced upward through the delivery pipe and another change of water fills the space between the values. The cycle is repeated in each upward stroke.

Deep well reciprocating pumps may be manually operated or mechanically driven. Manually operated deep well pump are suitable only for lifts up to about 45m, beyong which manual pumping becomes progressively difficult due to increasing weight of the water column and the connecting rod that must be liffted when each stroke. Engine or motor operate reciprocating pumps usually employ a crankshaft arrangement called the working head, placed at the top of the well, to change the rotating motion of the power to that of reciprocating motion at the piston.

Installation of mechanically power deep well reciprocating pumps. Engines or electric may be used to operate mechanically reciprocating pumps. As the pump has to work at a low speed, a speed reduction device fixed to a working head in used in the power transmission system. The working head is usually provided with fast and loose pulleys. The head is fixed on a sturdy frame placed over the top of the well. Power is transmitted to the working head by a belt drive.

CHAPTER THREE

3.0 METHODOLOGY

3.1 METHOD OF DATA COLLECTION

Primary source of data collection was used in the study. Data from this source was collected through the administration of questionnaire to individual farmer at home and on the farm 50 copies were administered. In addition verbal interview was also carried out. The village extension agent was equally contacted for details information on the use of pumps by the farmers.

3.2 METHOD OF DATA PRESENTATION AND ANALYSIS

Collected data was presented in tabulated form to ease the analysis of the data. In this method data was summarized and grouped into frequency table. In the analysis of the result, frequency distributrion and percentage were used to arrive at a reasonable conclusions. Frequency distribution is the tabulation of a collection of data in an order with frequency attached to each value or group of values. The number of respondents interviewed were combined with those that answer the questionnaire. Areas visited are Barkin Saleh (Kpakungu, Soje (Kpakungu) K/wari, Gbaganu Chanchaga, Okada road site.

CHAPTER FOUR

4.0 RESULT AND DISCUSSION

4.1 TYPE/ MAKE OF IRRIGATION PUMPS.

The typelmake of irrigation pumps observed are presented in table

Table 1: Type/Make of Irrigation Pumps

Type of Make Pumps	Frequency	Percentage
Honda Yamaha.	36 6	85.7 14.29
TOTAL	42	100

From Table it can be seen that 85.7% of the respondents respresent the majority in this analyseds, the hypothesis is therefore positively proved that Honda is the major pump is used in the research area.

4.2 NUMBER OF PUMPS AND THEIR AGES

The number of pumps and their ages analysis are presented in table 2.

Table 2: Number of Pumps and their Ages.

Ages (Yrs)	Frequency	Percentage.
1 - 4 5 - 9 10 - 14 15 - 19	21 7 10 4	50 16.67 23.81 9.52
TOTAL	42	100

Since 50 percent respondents represent the majority of respondes in this analysis, the hypothesis proved that pumps ages are between 1 and 4 years, this result indicated that majority of the Irrigation pumps analysed are fairly new.

4.3 WORKING CONDITION OF PISTON .

The result of the analysis of the working condition of piston is presented in table 3.

Table 3. Working Condition of Piston

Working Condition of Piston	Frequency	Percentage
1	0	0
2	22	52.38
3	15	35.71
4	0	0
5	5	11.90
TOTAL	42	100

In Table 3, 52138 percentage of the respondents represent the majority is responds in this analysis, the hypothesis is passively proved that majority of the pumps are not good working condition

4.4 WORKING CONDITION OF RINGS.

The result of the analysis of the working condition of rings is presented below.

Table 4. Working Condition of Rings

Working Condition of Piston	Frequency	Percentage
1 2 3 4 5	0 25 8 0 9	4 0 59.52 19.05 21.43
TOTAL	42	100

4.5 **WORKING CONDITION OF CRANKSHAFT.**

The result of the analysis of the working condition of crankshaft is presented in table 5.

Table 5. Working Condition of Crankshaft.

Working Condition of Crankshaft.	Frequency	Percentage
1 2 3 4 5	0 2 24 8 8	0 4.76 57.14 19.05 19.05
TOTAL	42	100

from table 5 it can be seen that 57.14 percentage of this respondents represent the majority in this analyses, the hypothesis is therefore positively proved that majority of the pumps are in good working condition.

4.6 **WORKING CONDITION OF CONNECTING ROD.**

The result of the analysis of the working condition of connecting Roy is presented in table 6.

Table 6 Working Condition of Connection Rod.

Working Condition of Connection Rod	Frequency	Percentage
1	0	0
2	3	7.14
3	23	54.76
4	10	23.81
5	6	14.29
TOTAL	42	100

In table 6, 54.76 percentage of the respondents represent the majority of respondent in this analysis the hypothesis is positively proved that majority of the pumps are in good working condition.

4.7 WORKING CONDITION OF VALUE

The result of the analysis of the working condition of value is presented below.

Table 7. Working condition of Value.

Working Condition of value	Frequency	Percentage
1	0	0
2	4	9.32
3	29	69.05
4	4	9.52
5	5	11.90
TOTAL	42	100

From table 7 it can be seen that 69.05 percentage of the respondents represent the majority in this analysis, the hypothesis is therefore positively proved that majority of the pumps are in good working condition.

From table it can be seen that 47,65 parentage of the respondents represent the majority in this analysis the hyponesis is therefore posively proved that mazority of the pumps are in good working condition

4.10 WORKING OFCYLINDER HEAD.

The result of the analysis of the working condition of cylinder head.

Table. Working condition of Cylinder head.

Working Condition of Cylinder head	Frequency	Percentage
1 2 3 4 5	0 4 26 6 6	0 9.52 61.90 14.29 14.29
TOTAL	42	100

In table 10, 61.90 percentage of the respondents represent the majority of responded in this analyses, the hypothesis 5 positively proved that majority of the pumps are in good working condition.

4.11 WORKING CONDITION OF GASKET.

The result of the analysis of the working condition of gasket.

Table 11. Working condition of Gasket.

Working Condition of Gasket	Frequency	Percentage
1	0	0
2	5	11.90
3	27	64.29
4	5	11.90
5	5	11.90
TOTAL	42	100

Table 11, 64.29 percentage of the respondents represent the majority of responds in this analyses the hypothesis is positively proved that majority of the pumps are in good working condition.

CHAPTER FIVE

5.0 CONCLUSION

The survey of the working condition of used irrigation pumps indicated that Honda is the commonest pump in use and most are fairly new. The working condition of the piston and rings are fair while the crankshaft, valve, carburators, hammer, cylinder head and gasket of the pumps showed a fairly good working conditions. Honda pump showed a good performance and is more adoptable for irrigation. However, the component mentioned above should be replaced promptly whenever the need arise to ensure efficient working condition of pump.

5.2 RECOMMENDATION.

Based on the result of the research, the following are the recommendation made.

1. prompt replacement of piston and rings should be ensured.
2. Awareness should also be created on the important of Honda type of pump, by organising workshop through extension officer.
3. The government should assist the farmers with irrigation pump. This can be provided inform of loans which should paid back over reasonable period of time.
4. Honda type should be best suitable for farmers in minna because of its spaire parts are readly available.

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APPENDICES

FEDERAL UNIVERSITY OF TECHNOLOGY MINNA
SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY
DEPARTMENT OF ARCHITECTURAL ENGINEERING

QUESTIONNAIRE ON THE SURVEY OF THE WORKING CONDITION OF USED IRRIGATION PUMPS IN MINNA AND ENVIRONMENT

The aim of this survey is to investigate the working condition of used irrigation Pumps in order to identify the parts which get damage more frequently and the cause the damage. All information provided would be treated confidentally. Your cooperation would be highly appreciated.

PART I

1.1 Name of organisation, parastatal or farm:...

1.2 Local Government Area:...

1.3 Location (Town/Village/Street/Road):...

1.4 Number of irrigation pumps available in the organisation, parastatal or farm:.......................

....

PART II

2.0 **PUMP TYPE AND CHARACTERISTICS**

2.1 Types of pump you have in your organisation, parastatal or farm.

A...

B...

C...

D...

E...

Qualify of the pump:..

....

At what interval is the pumping machine put into use;

....

....

2.2 Source of pump power

A. Diesel

B. Petrol

C. Electric

2.3 Pump Rating

A. HP

B. 2HP

C. 3HP

D. 5HP

Inch

A. 1

B. 1 ½

C. 2

D. 3

PART IV

Using the grading system stated above please assess the working condition of these parts of Irrigation pumps.

Piston	Rings	Cranshaft	Gasket	Cylinder head	Bearing ring (Specify)	Vales if any	(Carburettor) Injection pump	Connecting/ hammer	Any other part

3.1 COMMENT:..

....

3.2 Name of the Officer incharge of the farm:..

....

3.3 Signature:..

3.4 Date:..