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An Evaluation of the Available Farm Power Sources for Land Preparation in the North-Central Zone of Nigeria

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Abstract: Successful farming depends upon a range of inputs amongst which energy has a vital influence on both agricultural efficiency and productivity. Agricultural production in the middle belt of Nigeria has suffered many setbacks due to a lack of adequate farm power sources for mechanization especially in the area of land preparation. This paper presents an estimation of farm power sources potentially available and identified the three main sources of farm power in the North-central zone of Nigeria that are used for land preparation. There is a comparison between the levels of contribution of each power source to the agricultural production in the North-central zone of Nigeria. It is shown that human power accounts for more than half the available farm power in the study region. Human power has the highest contribution taking 63% of the total farm power sources spread all over the north central zone of Nigeria. It is supplemented by tractors and draught animal power sources at 24% and 13% levels respectively. It is concluded among other things that the low level of tractor uses all over the north central zone of Nigeria calls for concern, as there is still much to be done to relieve the farmers of laborious manual tasks.

Keywords: Evaluation, available farm power sources, land preparation, north central zone, Nigeria

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INTRODUCTION

It is well known that one cannot obtain an output without a corresponding input or in other words one cannot get something for nothing. Successful farming depends upon a range of inputs among which energy has a vital influence on both agricultural efficiency and productivity? Energy is applied to the production process in many ways. For instance, solar energy governs the process of photosynthesis and evapotranspiration, wind

energy and that of rainfall droplets and run-off risks to cause potentially detrimental effects to the crop yield (Ashburner, 2000). Energy is also essential for the preparation of the seed bed, for seed placement and to undertake crop husbandry exercises such as the control of weeds and pests. But these practices are also time-dependent and any delay in their implementation will have a significant and often negative effect on crop yield. It follows that for any chosen farming system, the cropped area that may be successfully managed will depend upon the rate at which energy may be applied to these tasks. Of course, this rate of energy expenditure is known as power in engineering terminology (Ashburner, 1997). The law of thermodynamics indicates, amongst other matters, that energy may be transformed from one type to another, but unfortunately, it also degrades. So not only can one not get something for nothing, but whatever one eventually gets will be rather less than one might reasonably have expected. The ratio of these two values represents the efficiency of the operation and it follows that the agricultural production capacity of a farmer depends not only upon available power but also in the efficiency of power utilization (Ashburner, 2000).

The power available is a prerequisite for any agricultural farm operations. The source of power may be human, draught animal or motorized/mechanical. In developed countries' agricultural systems, the different forms of farm power available generally are almost taken for granted (Clarke and Bishop, 2002). Their focus is on internal combustion engines (ICEs) or electric motor though the power sources are still principally managed by human effort. Yohanna (2006) stated that power is needed on the farm for a variety of operations ranging from land preparations, which include land clearing and tillage of various kinds to post-harvest operations of reaping, threshing and cleaning. The prime movers could be mobile or stationary.

Power sources used for primary tillage or land preparation represent one of, if not the most significant use of power. Moreover, because it is power intensive as opposed to control intensive (Rijk 1989, Odigboh, 2004), it is usually one of the first tasks to benefit from additional power inputs. Hence any change in the relative contributions of different power sources to land cultivation may act as an indicator for subsequent changes, which may occur elsewhere in the production process (Kutte and Tya, 2001).

In recent years, Food and Agriculture Organizations (FAO 2001a &b) have been collecting information on different sources of power in developing counties (Clarke and Bishop, 2002). The exercise was aimed at obtaining a global picture and making projections as to how this might change over the next 20-30 years identifying which factor will affect these changes. They only concentrated on the farm power used for field cultivation and not all the farm power. Data are not readily available and manually based system field work is probably the most arduous.

Most often, for economic reasons, the farmer opts for the cheapest of the power forces available to him or her although if may be optimally profitable. Hence the draught animals are increasingly becoming the main power source in village systems at least in the semi-arid parts of Nigeria (Ladeinde, 1996). The increase in its popularity has been attributed to the decline in the natural economy and the high cost of tractors and implements (Ademiluyi and Musa, 1996; Baba and Alhassan, 2000; Onwualu *et al.,* 2006). Panin and Ellis (1992) reported that it costs more than twice as much to prepare a hectare of land using a tractor as it does using a draught animal power (Table 1).

Many intangible factors (individual and/or government) have hindered the match towards and arrival at the Promised Land, as far as the agrarian revolution is concerned. It is only recent that the government of the day in Nigeria is trying to tackle these problems squarely or head log.

The objectives of this research are that, there is great variation in the proportion of use of the available farm power sources for land preparation in Nigeria due to ecological conditions. These main sources-human, draught animal and tractor have been identified; hence the main reasons of appraising or valuing these power sources and examining some of the implications of these facts in land preparation or agricultural practices in the north-central zone of Nigeria.

MATERIALS AND METHODS

Data collection

A well-structured questionnaire was designed and distributed to agricultural organizations in the study area to collect the necessary data. The questionnaire sought information on the available power sources, their available channels of supply, ease of obtaining the available power sources and wind energy and that of rainfall droplets and run-off risks to cause potentially detrimental effects to the crop yield (Ashburner, 2000). (9) states in the north central zone of Nigeria (Table 2). The method used to collect the information was through collaboration with the Agricultural Development Projects (ADPs). The organizations where the questionnaire was administered were local government council's headquarters (Agricultural Departments), state ministries of Agriculture, State agricultural Development Programmes, lower and upper Benue River Basin Development Authorities, State agricultural mechanization services/Agencies and other mechanized cooperative/ private and individual farms. In each of the organizations surveyed, the questionnaire was administered randomly to Agricultural Engineers, Tractor operators, Technicians/mechanics, field supervisors/officers as the case may be. Out of the 450

Table 1: Work Rates, Daily Outputs and ploughing costs using Different power sources

Items	Human(1man)	Animal (2oxen)	tractor (50kw)
Work rate (hrs/ha)	100	25	2-3
Work day length (hrs)	5	5	8-16
Daily output (ha/day)	0.05	0.2	3-7
Cost (USD/ha)	50-100	30-50	100

Source: Morris, 1983

Table 2. Questionnaire Distribution on State Basis

States	No of Questionnaire Distributed	No of Responses	Response Rate (%)
Kaduna	65	55	84.62
Niger	70	56	80.00
FCT	60	49	81.67
Kwara	60	46	76.67
Kogi	40	29	72.50
Benue	50	38	76.00
Taraba	30	17	56.67
Plateau	35	24	64.57
Nasarawa	40	28	70.00
Total	450	342	76.00

Source: Field survey, 2013-2016

questionnaires administered, 342 representing 76.0%, were completed and returned for analysis (Table 2).

The use of the questionnaire was supplemented with personal contact, oral interviews and observations at the various` study areas to collect information that were not obtained from the questionnaire but was considered very important to the study. The parameters such as number of agencies using a particular power source, channels of supply, available, not available, conditions and degree with ease to which power source is available to farmers were analyzed to assess the level of usage of each of the power sources.

The three main sources of farm power identified for agricultural activities are manual/ human, animal and motorized/mechanical.

The manual power source involved all members of the family although culture and tradition often dictate that particular tasks such as sowing, weeding or harvesting are assigned to a specified gender.

The animals used generally comprised of oxen and donkeys while the mechanical sources comprised of small tractors, power tillers, 2 or 4- wheel tractors of 72 hp (53.7kW) together with track laying tractors. Of course, a number of small engines were also commonly used for spraying, threshing or powering of primary processing equipment, for cleaning, decorticating, polishing, milling and grinding. For the purpose of this study, this available power has not been included.

Data analysis

A modified Area- based approach for the farm power typologies as put forward by Clarke and Bishop (2002) was adopted. It involves focusing on the proportion of total harvested area cultivated by humans, draught animals or tractors at a state level. Two premises ae under-pining in this methodology.

i) Power source used for primary tillage: land preparation presents one of, if not the most significant to use of power in agricultural production process
ii) The area cultivated by each power source as a percentage of the total harvested area
Others have used a similar approach, either at individual state levels or at regional levels (Gifford, 1981 and Mrema, 1992). These data have been used to validate individual country or state classifications generated by the study. The data generated in this study is aggregated at State levels.

RESULTS AND DISCUSSION

Table 3 shows the total estimated number of humans, draught animals and tractors working in each of the states in the north central zone of Nigeria. The means of the respondents' responses were used in the table. In Table 4, each farm power source for different typologies was given as a percentage of the total power workforce available in each state of the north-central of Nigeria. In the nine (9) States within the north-central zone of Nigeria, human power contribution of the power source was more than 50% in all the states (Table 4). However, Taraba State contributed the highest percentage (22.5%) of draught animal power usage. The federal capital territory, Abuja has the highest contribution of 27.4% in the use of tractors as power sources while Niger State has the lowest use of tractor with 17.1%.

Table 3: Estimated Number of Human, Draught Animal and Tractors working in each State

States	Human	Draught Animal	Tractors	Total
Kaduna	780	205	308	1293
Niger	800	170	200	1170
FCT	710	105	307	1122
Kwara	800	200	350	1350
Kogi	700	185	320	1205
Benue	750	100	300	1150
Taraba	800	250	305	1355
Plateau	700	105	250	1055
Nasarawa	780	75	310	1165

Source: Field survey, 2013-2016

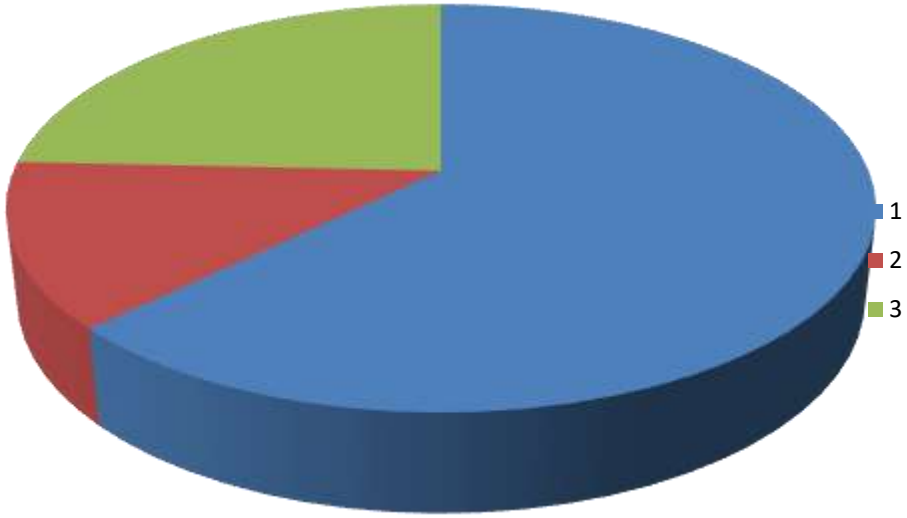
Table 4: Each power source contribution as a percentage of the total power sources

State	Human power sources (%)	Draught Animal power sources (%)	Tractor power (%)
Kaduna	60.3	15.9	23.8
Niger	68.4	14.5	17.1
FCT	63.3	9.4	27.4
Kwara	59.3	14.8	25.9
Kogi	58.1	15.4	26.6
Benue	65.2	8.7	26.1
Taraba	55.0	22.5	22.5
Plateau	66.4	10.0	23.7
Nasarawa	67.0	6.4	26.6
Total	567.0	117.6	219.7
mean	63.0	13.1	24.4

Sources: Field survey, 2013-2016

Figure 1 shows the graphical (pie chart) representation of the farm power sources available in the north-central zone levels of Nigeria. Figures 2a, b, c and 3a, b, c are bar charts representations of human, draught animal and tractors numbers working and human, draught animal and Tractors power sources respectively in each state of the study region/area.

From the available data, human power as a source accounts for more than half the available farm power sources in the 9 states surveyed (fig 1). This has the highest contribution taking 63% of the total land preparation labour force of the entire region. Animal traction is most predominant in Taraba state, providing the highest contribution of 22.5% though the same 22.5% for tractor use, which implies that a significant reduction in the use of manual labour could be achieved through the introduction of additional tractors and animal traction in the state respectively. The low use of draught animal power may be due to the problem of tsetse flies in the surveyed region, it is used on light tillage and land preparation operations in already cleared land of very light soils. Draught animals suffer stresses from high



KEY
1 – Human power source 63%
2 - Draught Animal power source 13%
3 - Tractor power source 24%

Figure 1: Pie chart showing the farm power sources at the North central zone of Nigeria

Figure 2a: Bar chart showing number of Human working in each state of the

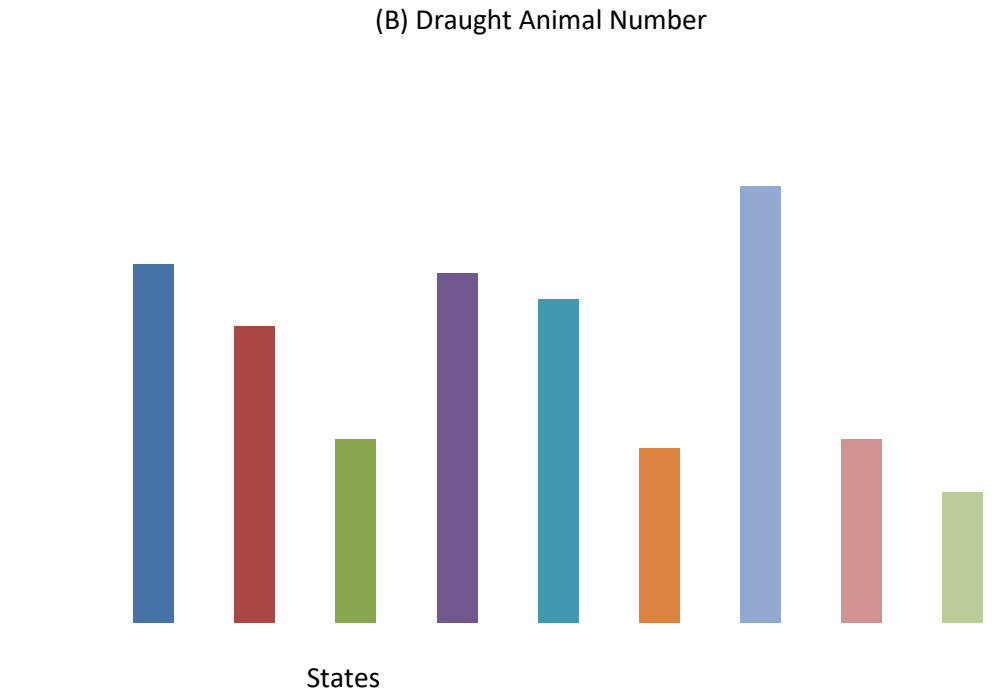


Figure 2b: Bar chart showing number of Draught Animals working in each state of the study area

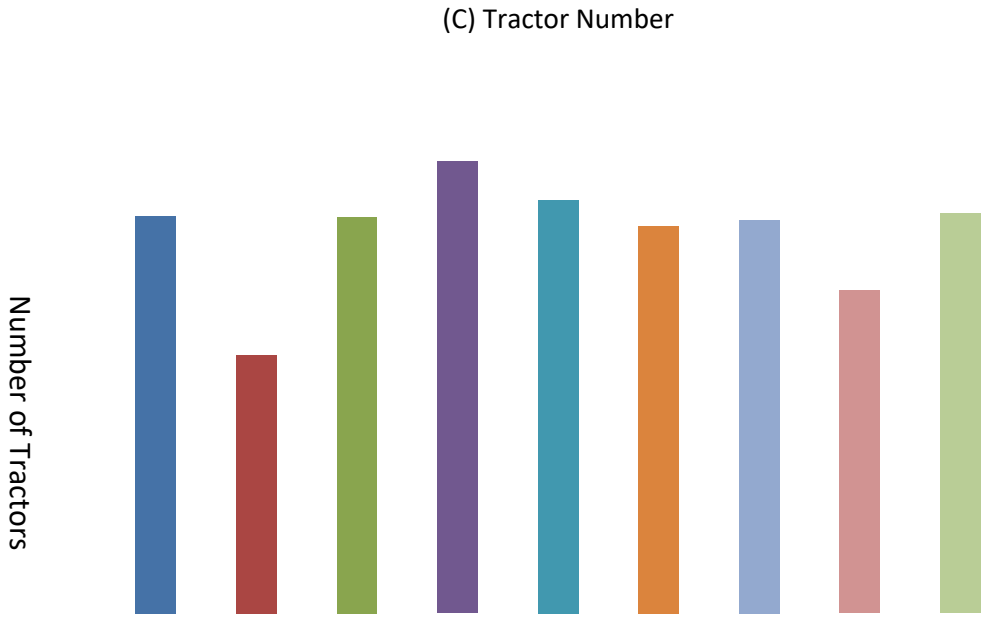


Figure 2c: Bar chart showing number of Tractors working in each state of the study area

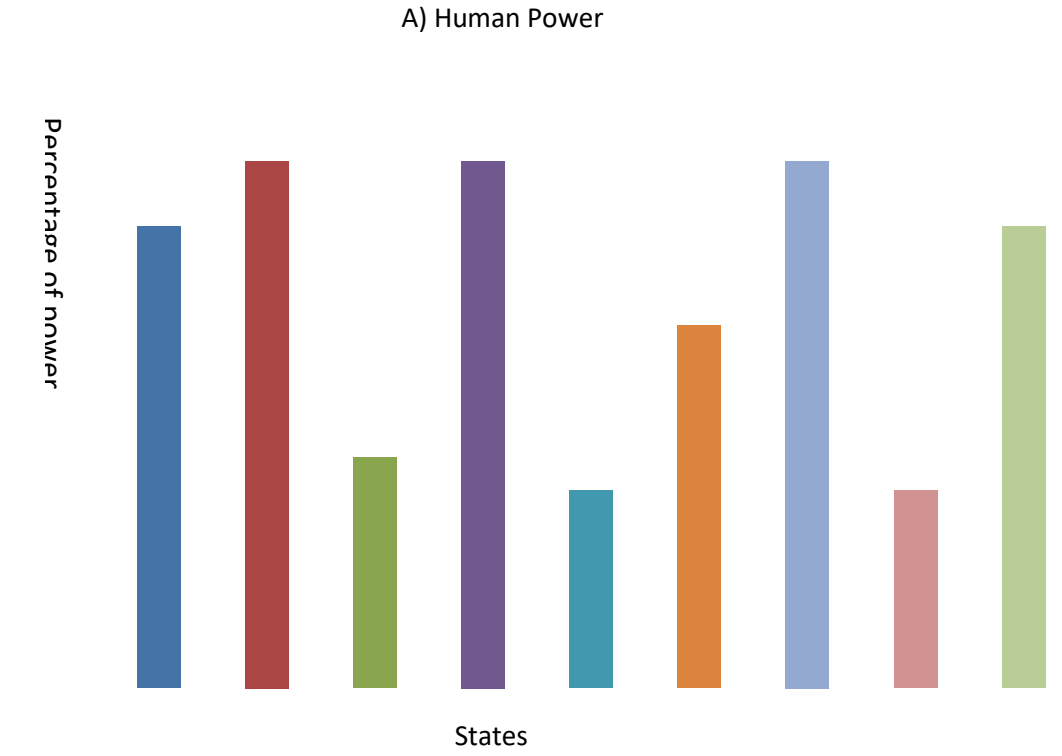


Figure 3a: Bar chart showing Human power in each state of the study area

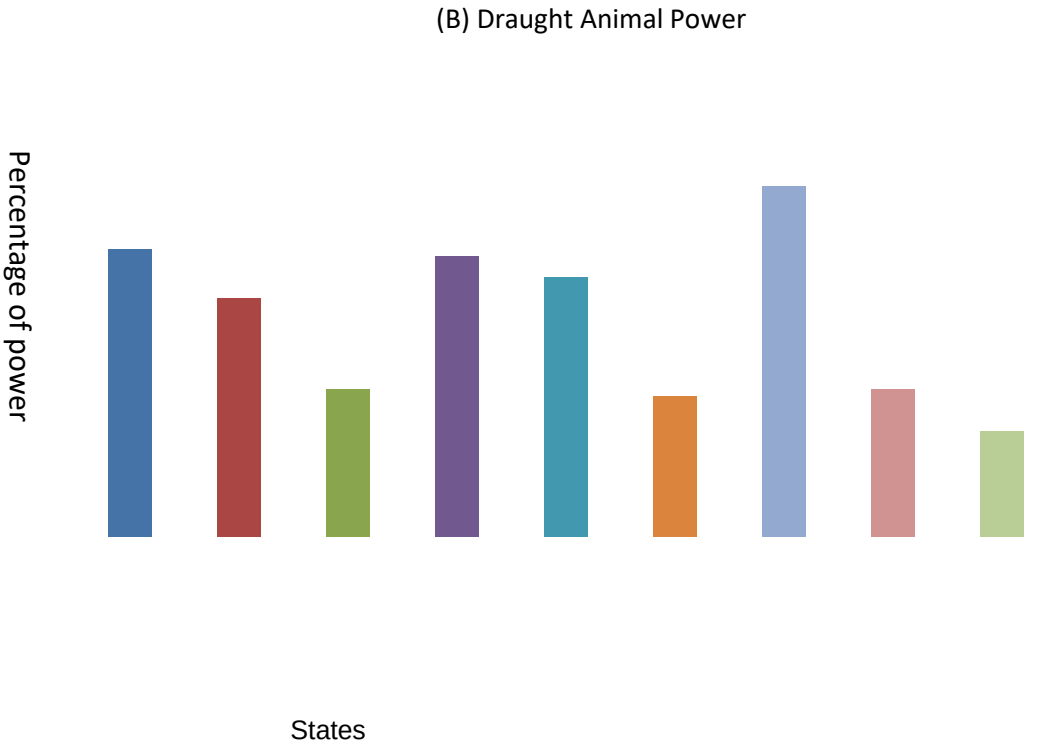


Figure 3b: Bar chart showing Draught Animal power in each state of the study area

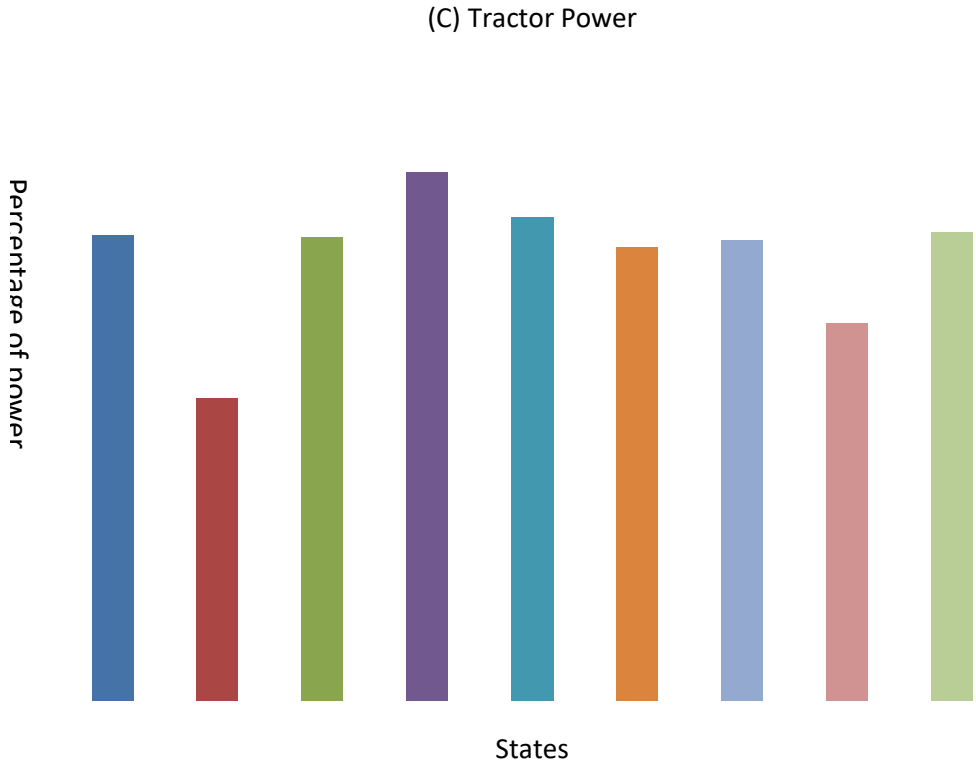


Figure 3c: Bar chart showing Tractors power in each state of the study area

temperature and relative humidity, such that their work rate efficiency is very low. The cost of draught animals and the cost of keeping them is becoming in unattractive relative to the amount of a season's work, which they can give in relation and generally the use of draught animal for field operations does not appreciably reduce the physical labour of the farmers in a given hour or day as reported by Kutte and Tya (2001)

The low level of tractor uses all over the States in the study region could be attributed to the high running costs of the tractors and the implements as stated by Ademiluyi and Musa (1996). Until recently, fuel scarcity and consequent adulteration of the same was another major factor that scared farmers away from using tractors. Other important factors as stated by Onwualu *et al.,* (2006) may include the lack of spare parts for some of these tractors that are in use. This makes the repairs and maintenance difficult, leading to abandonment. Prevalence of small fragmented farm holdings, which hinder efficient use of tractors, poor credit facilities to enable farmers hired tractors for their farming operations, primitive agronomic practices such as multiple cropping, which limit the scope and efficiency of tractor to be use and poor road networks.

The most significant fact coming out of the analysis implies that hand tool technology is still prevalent and that considerable efforts are still required to reduce the drudgery of agricultural tasks in the north-central zone of Nigeria

CONCLUSION AND RECOMMENDATIONS

The study highlights differences in levels of mechanization in the nine (9) states analyzed. Human power is the predominant source of power for land development with modest contributions from tractor and draught animal power in the north central zone of Nigeria. Socio-economic and ecological factors determine to a large extent the type of power sources adopted in any particular state in the north central zone of Nigeria. The low level of tractor uses all over the north central zone of the country calls for concern as there is much to be done to relieve the farmers of laborious manual tasks, particularly now that the federal Government is laying emphasis on commercial agriculture nation side (Agricultural Transformation Agenda (ATA) of the presidency of Nigeria). The crucial national challenge therefore is the revitalization of the Nigerian agricultural sector through consistent policy measures that would identity and tackle the factors inhibiting the competitiveness of agricultural investment. The drive to the composition of the farm power inputs will come from either change in demand for human power or from supply or both. Any increase in total agricultural output either from area expansion in cropping intensity or an increase in yield requires additional power. From the foregoing, it is pertinent that hand toot technology is still prevalent in the north central zone of Nigeria; hence considerable efforts are needed

to alleviate the drudgery of agricultural tasks in the study region of Nigeria

The following recommendations are therefore made:

i) Other sources of power such as wind, solar and electric power should be developed and adopted for common use on the farm

ii) Farmers should increase their power input through the use of improved tools and equipment, adapt different farming practices or change cropping patterns that can led to reduced power requirements such as conservation agriculture.

iii) Ancillary workers should be trained to handle the tractors and the draught animals used for power

iv) There should be a provision of subsidy either as a moderating factor on input costs or as a mechanism to boost output prices or both.

v) Government should establish a well-equipped institution(s) in the north central zone of the country for training and retraining of Technicians and Technologists on the operations and repairing of the agricultural machinery use for farming operations.

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