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Agricultural tractor and machinery performance and serviceability in Delta State, Nigeria

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A sufficient tractor and implements utilizations in agricultural activities and their proper serviceability optimize agricultural productivities in farm operations. A study was conducted in Delta State, Nigeria assessing level of machinery utilization in farm operations and serviceable conditions. Eight (8) government owned tractors locations with 60 tractors and eight private owned farms with 29 tractors were studied. A structured questionnaire, primary and secondary sources of information were employed. Farms, establishments, and individuals connected with tractor utilizations and maintenances were reached. The data obtained were statistically analyzed. The means, coefficient of variation and the coefficient of rank correlation of the observations were determined. The results obtained revealed that 36 of the tractors were serviceable representing 40.45% of the total tractors investigated, a low percentage (23.33%) of the state tractors and a high percentage (75.86%) of the private tractors were with regression coefficients of 0.816 and 0.53; mean number of hours of work per tractor annually was 189 and 572.6 h, respectively. The standard 1000 hours per tractor annually, was not met by both sectors. The analysis indicated that 84.81% of the total hours were field crop farm, 29.97% on bush clearing and 70.03% on transportation. The rank correlation coefficient between serviceable tractors, tractor utilization and work outputs was 0.89 and 0.19, respectively. The tractors and implements performance for state and private reported effective field capacity (FC_e) of 0.10 and 0.12 ha/h, theoretical field capacity (FC_t) 0.46 and 0.43 ha/h and the field efficiency of 22 and 27%. These findings stood to prove that while tractors and implements enhance production, its mere acquisition without proper maintenance and adequate engagement in farm operations would not result in a corresponding increase in production.

Key words: Agricultural machinery, efficient use, productivity, serviceability, tractor management assessment.

INTRODUCTION

The need to improve on agricultural productivity has been one of the major problems faced by the developing countries. Nigeria is one of such countries that are heavily hit by this peculiar problem (Nkakini et al., 2008). Nigeria's agriculture has been dominated by human power for many years. According to Dauda et al. (2010), spears, arrows, cutlasses, hoes, etc., were the early tools in agriculture and some of these especially hoe and

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cutlasses are still widely used in Nigeria. Farm tractors play a major role in the agricultural sector, especially in mechanizing agricultural operations such as ploughing, harrowing, ridging, sowing, inter-cultivation, planting, weeding, fertilizer/pesticide applications, harvesting and transportation (Darshana et al., 2018). In land preparation operations, tillage activities are soil-related procedures; soil type and condition are cardinal factors affecting the field performance of a tractor through their effects on the powered implement. Soil condition is a major factor that affects the performance of field machineries (Oduma et al., 2018). The data obtained from the various tractors and implements performances are important for farm machinery management and their selections for a particular farming situation (Sharm et al., 2016; Saeed et al., 2017).

In agriculture, production of crops and their economics values cannot be over emphasized. Over the years man is in need of food production for him as to derive the full maximum benefit. Efficient food supply in any country depends to a large extend on the level of agricultural mechanization of such nation (Odey et al., 2008). The reports of some researchers have highlighted that farm tractors are being under utilized in Nigeria. This was attributed to limited seasonal application of farm tractors and lack of technical and managerial competence to handle, use and maintain farm machinery (Dauda et al., 2010; Usman and Umar, 2003). However, the cost of purchasing and maintenance of tractor makes it difficult for average Nigerian farmers to privately own a tractor (Dauda et al., 2010).

Other factors are the land tenure system and government policy, which do not give farmers free lands to make use of intensive cultivation methods. It is obvious that low incomes of Nigeria workers and the ever increasing inflation could not make it possible for would be farmers to have machines for tillage operations. Tractors/Equipment is so expensive that many farmers could not afford to buy them thus discouraging their utilizations by farmers (Nkakini and Eguruze, 2009).

The appropriateness of utilization and performance of agricultural machine depend on the reliability of the machinery used, the operating environment, and maintenance efficiency (Najafi et al., 2015). Proper utilization and maintenance enhance the economic benefits of tractors (Kapuwaththa et al., 2018). Oduma et al. (2014b), in their reports advocated that proper attention in terms of maintenance be given to tractors in order to avert undue wears and failures. This is obvious because proper attention means adequate lubrication, cleaning, timely inspection and systematic maintenance. It should be realized that mismanagement, negligence and poor maintenance were the major constraints which hindered the tractor efficiency. Every machine requires maintenance even if it is the best designed. Hence, the maintenance must be done at such a time when it may have the least disruptions in its utilization (Oduma et 2014a).

It should be noted that government both at federal and state levels have made some advancements in machinery utilization. In fact, in spite of these, a lot of constraints are still militating against agricultural machinery utilization such as: lack of competent management and strict supervision; poor training of personals responsible for operating, repairing and maintaining the equipment; inadequate workshop and repair facilities; lack of skilled and responsible operators; lack of adequate availability of cash and credit when needed and inefficient utilization of the machineries (Mpanduji, 2000).

A tractor with a certain horse power has the capacity to pull certain load and has hourly duration to execute operations. Anything short of this resulted to under-utilization of tractor power and hours of operations (Emmanuel, 2015). It is obvious, that tractors do not operate in a vacuum, they employ other farm machines for operations and their absence reduces tractor usage. The unavailability of farm implements and the use of untrained tractors operators contributed to low utilization of tractors and machinery damage (Nkakini et al., 2006).

Thus, Meghalaya Rural Bank (2014) suggested that the minimum utilization rates of power tiller should be 600 h per annum for effective productive work. Furthermore, it was stated that to achieve maximum profits from farm tractors, the owner must control the utilization and productivity of tractors. The utilization of tractor can be expressed as the duration of time over which the tractor is gainfully used and productivity as the output realized due its usage. Utilization is further expressed as a percentage of the effective hours the tractor has worked in a year compared to the budgeted hours. For example, if the budgeted working hours per year is 1000 h and the tractor only works 500 h, the utilization is 50% (Emmanuel, 2015). Mpanduji (2000) defined tractor annual utilization as the number of annual hours spent by a tractor on various productive tasks.

Mijinyawa and Kisaika (2004) in their studies in Edo State tractors-hiring unit reported that lack of implements to be used with the tractors and poor maintenance culture attributed to tractor under-utilization in the state.

Ogunlade et al. (2004) investigated the maintenance knowledge of tractor operators in Kwara State, Nigeria and reported that only a minority could undertake major maintenance jobs. He then suggested a proper training of operators on maintenance as this would help to make tractors available for use when given quick repair attention.

In spite of the great advance in farm machinery development for improved agricultural mechanization, the fact remains that the level of tractor and implements usage is still low in Delta State. This is evident from the continuous usage of traditional farm tools for various farm activities in the state, despite some available tractors required to be used for maximum utilizations to increase productivity. The effect of this is food and raw materials

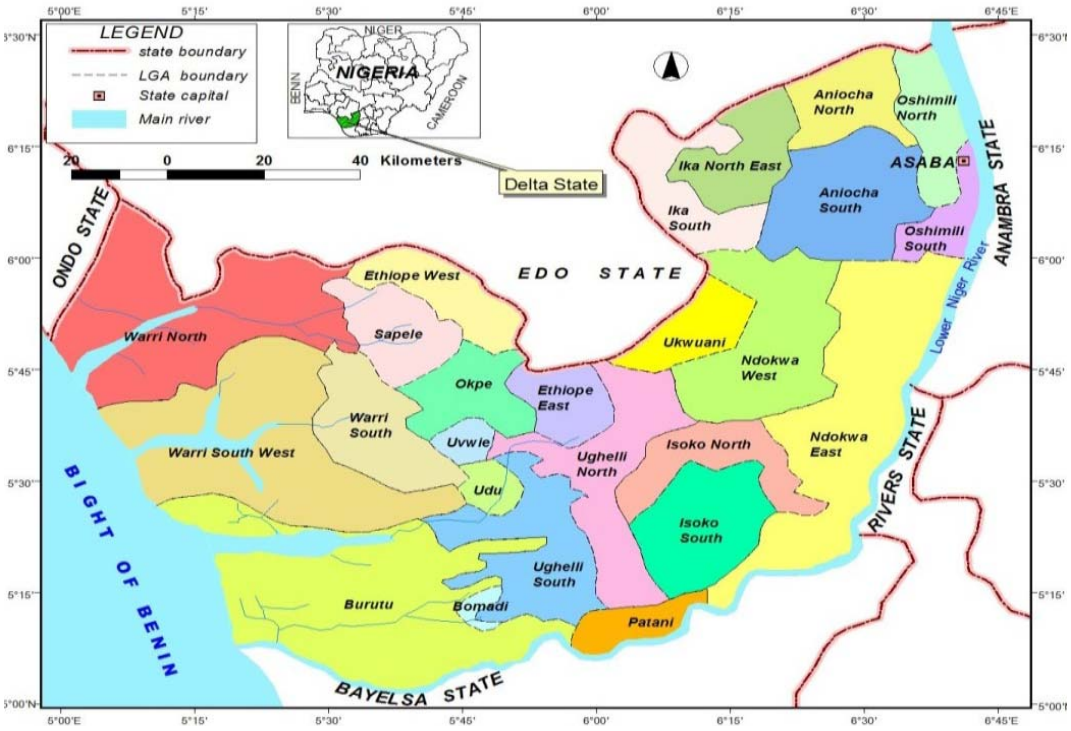

Figure 1. Map of Delta State with Three Senatorial Districts (Zones).
Source: Facts about Delta State of Nigeria

shortage as well as low income for farmers and deprivation of the economy of the income from export of agricultural products. The aim of the study was to assess the average annual utilization rates of farm tractors and implements and their serviceability.

MATERIALS AND METHODS

Description of the study area

The study was carried out in 16 local government areas of Delta State in Nigeria. Delta State is situated on latitude 5° North of the equator and longitude 6° East. The state has an estimated land area of 22,159,000 m^2. It shares common boundaries with Edo State to North, Ondo State to the North-West. The southern flank of the state is Bright of Benin, which covers approximately 160,000 m of the state's coastline (Figure 1). The state is generally low lying without remarkable hills and has a deep coastal belt interlaced with rivulet and streams which form the Niger Delta. The state experiences a climate ranging from humid tropical in the south to sub-humid in the north, marked by two distinctive seasons, namely the dry and raining seasons.

The dry season occurs between November and April, while the raining season begins in late April lasting till October but with a brief dry spell in August. The state has an annual rainfall of about 2265 mm in the coastal areas and 1905 mm in the extreme north with temperature ranging between 25 and 28°C. The vegetation varies from the mangrove swamps along the coast of evergreen forest in the middle savannah in the North (Facts about Delta State; Delta State Handbook). Agricultural practices in Delta State are gender sensitive with more males than females participating in agricultural productivity. Crop farming is the major interest of the farmers. The swampy areas of Delta State are grossly under-utilized with respect to agricultural productivity, while irrigation farming should be encouraged (Vincent et al., 2012). About 70% of poor live in rural areas depend mainly on agriculture for their livelihood using conventional farming equipment.

Experimental procedures

In Delta State, three senatorial districts (zones) were visited and farm equipment/machines accessed. In carrying out this research, prepared questionnaires were issued out. Interviews on individual basis connected with tractor utilization were conducted. Among information sought were the averages working hours of each machines/equipment and their engagements in various farm operations.

Structural questionnaires

The questionnaire was structured to cover the area of research, such as farm type location and size, number of tractors/equipment available in a source location; type, make, model of tractors; type of farm implements available; age of tractors, status at purchase of equipment, type of operation by the tractors, seasons and hours of tractors use in the year, type of condition (serviceability), annually and hourly use of tractors equipment hire-service; and maintenance practices and schedules which were collected from various farms in the state. Among the sixteen (16) visited farms, sixty (60) persons of various categories were randomly administered. In Delta North Senatorial District, the numbers of the visited enterprises were three

(3) for state and four (4) for private enterprises. In Delta Central Senatorial District, visited enterprises were two (2) for state and four (4) for private. In Delta South Senatorial District, visited enterprises were two (2) for state and one (1) for private. Therefore, total numbers of enterprises visited for the study were sixteen (16) enterprises. Out of which were seven (7) tractor locations visited with total average land size area of 224 ha for agricultural activities in the state mainly for this study. Thus, nine (9) tractor locations visited with total average land size area of 324 ha for agricultural activities were private enterprises.

Primary and secondary sources were used in data collection from relevant farms, establishments and individuals connected with tractor utilization. The primary data were obtained through administration of structured questionnaires, personal contacts, and some inspections which were carried out. The use of secondary sources was adopted using bulletins, workshop/seminar papers and literatures. Through these sources, agricultural operation standards and average working hours of tractor/equipment were obtained.

The data obtained from these sources were analyzed using descriptive statistics as an index to describe or summarize the characteristics of the observations. The data generated were subjected to percentage analysis and statistical method known as t-test (Frank and Althoen, 1994). Also, to estimate the field capacity of the farm machines, the effective field capacity (Fc_e), theoretical field capacity (Fc_t) and field efficiency were employed as appropriate (Hanna, 2002).

The effective field capacity of a machine in the field was calculated using Equation 1.

$$Fc_e = \frac{A}{T_p + T_1} \text{ ha/h} \quad (1)$$

where Fc_e=effective field capacity, ha/h; A=area covered, ha; T_p=productive time, h; T_1=non-productive time, h (time cost for turning loading, fuel adjustment excluding refueling and machine troubles).

Theoretical field capacity depends relatively on the full operating width of the machine and the average tractor forward speed in the field. It is calculated using Equation 2.

$$FC_t = \frac{W \times S}{8.25}, ha/h \quad (2)$$

where W=width of implement, m; S=tractor forward speed, m/s; Fc_t=theoretical field capacity ha/h.

Field efficiency is the ratio of actual or effective field capacity to theoretical field capacity and is obtained using Equation 3.

$$\eta_{fe} = \frac{Effective\ Field\ Capacity}{Theoretical\ Field\ Capacity}\ x\ 100$$

$$\eta_{fe} = \frac{F_{Ce}}{F_{Ct}} \times 100 \quad (3)$$

where η_{fe} =field efficiency %; Fc_e=effective field capacity, ha/h; Fc_t=theoretical field capacity, ha/h.

The statistical method of determining the mean, coefficient of variation and the coefficient of rank correlation of the observation was employed as appropriate (Frank and Althoen, 1994). The mean observations to know the central tendency or location of the values were calculated, using Equation 4:

$$m = \frac{\sum x}{n} \quad (4)$$

where m=mean observations, x= observations, and n=number of observations.

The standard deviation(s) was obtained using Equation 5:

$$Sd = \sqrt{\frac{\sum (x = \bar{x})^2}{n}} \quad (5)$$

where x=represents the deviation of each of the numbers x_j from the mean $\bar{x}$, Sd=is the root means square of the deviations from the mean.

The coefficient of variation (CV) is obtained using Equation 6.

$$CV = 100 \left(s/x\right) \quad (6)$$

This coefficient indicates the degree of variability or dispersion of the performances of state and private owned tractors.

The coefficient of ranks correlation (Spearman's) to examine the direction and degree of relationship between tractors and work output was calculated using Equation 7.

$$r = 1 - \frac{6\sum D^2}{n(n^2 - 1)} \quad (7)$$

where r=coefficient of rank correlation, D=rank difference, n=number of observations.

Regression coefficient to indicate how total tractors vary with serviceable tractors was obtained using Equation 8 (Loveday, 1970).

$$Cr = \frac{V_{ts}}{S_1^2} \quad (8)$$

where V_{ts}=covariance. That is the mean of product of deviation of total and serviceable tractors.

$$V_{ts} = \frac{\sum d_i ds}{n} \quad (9)$$

where d_1= total tractors, d_s= serviceable tractors,

$$S_1 = \sqrt{\frac{\sum d_1^2}{n}} \quad (10)$$

where S_1=standard deviation of total tractors.

The t-test is a test that uses the means from two samples sets to determine significant difference at 1 and 5% levels of significance.

$$t = \frac{\bar{x}}{\sigma \bar{x}}, \quad \sigma \bar{x} = \frac{\sigma}{\sqrt{n}}$$

Then

Table 1. Distribution and status of tractor according to zonal location and ownership.

Zone	Location of tractors (Enterprises)	No. of tractors distributions		No. of tractor serviceable (Maintained)	
		State	Private	State	Private
Delta North Senatorial District	Agbor	9	-	2	-
	Aladinma	-	3	-	3
	Asaba	18	-	5	-
	Nsukwa	-	4	-	3
	Ogwashi-uku	-	2	-	1
	Olloh	-	5	-	4
	Owanta	5	-	1	-
	Total	32	14	8	11
Delta Central Senatorial District	Agbarho	9	-	2	-
	Jeddo	-	4	-	4
	Oghara	6	-	1	-
	Okrigwe	-	5	-	2
	Sapele	-	2	-	2
	Amukpe	3	-	1	-
	Total	18	11	4	8
Delta South Senatorial District	Ajagbodudu	-	4	-	3
	Oleh	5	-	1	-
	Patani	5	-	1	-
	Total	10	4	2	3
Overall total		60	29	14	22
% Serviceable (ownership)				23.33	75.86
% Serviceable (overall)				40.45	

$$t = \frac{\bar{x} - \mu}{\frac{\sigma}{\sqrt{n}}} \quad (11)$$

where $\sigma \bar{x} =$ standard error of the mean, $\bar{x} =$ arithmetic mean, $\mu =$ population mean, $\sigma =$ standard deviations, n = number of data.

RESULTS AND DISCUSSION

The information contained in the investigations is from three Senatorial Districts of Delta State, where the tractors were used in farming operations. In these three Senatorial Districts visited, only sixteen stations and farms had complete and relevant data which were subjected to analysis. Table 1 shows the tractors distributions in relevant sixteen (16) tractors stations and farms. The number of tractors distributed both private and state owns were eighty nine (89) tractors in all the locations in questions, of which thirty six (36) of them were maintained (serviceable), and this represents 40.45% of the total tractors investigated. Out of these eighty nine (89) tractors distributed according to the zones, sixty (60) of the tractors belong to the state government, while twenty nine (29) of the tractors were owned by private individuals or enterprises. It was observed in Table 1, that there were more tractors assessed in the Delta North Senatorial District than both Delta Central and Delta South Senatorial Districts of the State which served as zones in the investigation. The reporting in the table showed the state's eight tractor locations has total of sixty (60) tractors and only fourteen (14) were maintained (serviceable) tractors representing 23.33%. In the private farms, eight tractor locations with a total of twenty nine (29) tractors had twenty two (22) serviceable ones. In the Delta North Senatorial District the total numbers of tractors distributed for state were thirty two (32) in which only eight (8) tractors were maintained. The private were fourteen (14) tractors in which eleven (11) were maintained. In Delta Central Senatorial District, the total numbers of tractors distributed were eighteen (18). Among these only four (4) tractors were maintained in the state. Furthermore, in this region the eleven (11) of the private tractors were serviceable. This agreed with the findings of Dauda et al. (2010) that majority of the tractors were poorly maintained and that service records for tractors were non-existent or

Table 2. Distribution of tractors according to makes and models, ownership, condition bought, age and serviceable status in locations.

Tractor makes and models	Engine power (hps)	Ownership		Condition bought		Average age		Number serviceable (Maintained)		Serviceable percentage	
		State	Private	State	Private	State	Private	State	Private	State	Private
New Holland 7056	85	22	-	New	-	6	-	4	-	18.18	-
Steyer 768	64	2	9	New	5 New; 4 Old	4	8	1	6	50	66.67
Steyer 8075	N/A	2	3	New	3 New	4	8	1	3	50	100
Steyer 964	64	6	2	New	2 New	8	4	2	2	33.33	100
Steyer Ursus 5312	N/A	24	-	New	-	3	-	5	-	20.83	-
Steyer Ursus 5712	79.8	1	-	New	-	3	-	0	-	0	-
Massey Ferguson 375	75	3	-	New	-	3	-	1	-	33.33	-
Massey Ferguson 2640	120	-	2	-	2 New	-	6	-	2	-	100
Massey Ferguson 281	75	-	5	-	3 New; 2 Old	-	6	-	4	-	80
Massey Ferguson 135	45.5	-	1	-	Old	-	12	-	0	-	0
Case 4210	72	-	3	-	3 New	-	7	-	2	-	66.67
Ford	325	-	3	-	1 New	-	12	-	3	-	100
Eicher	20/(14.7)(*)	-	1	-	Old	-	10	-	0	-	0
Total	-	60	29	-	-	-	-	14	22	-	-
Mean	-	-	-	-	-	4.4	8.1	-	-	-	-
Bought new %	-	-	-	100	65.52	-	-	-	-	-	-
Serviceable %										23.33	75.86

insufficient. In Delta South Senatorial District the total distributed tractors in state were ten (10) and the numbers of tractors maintained in this region of the state were two (2) only. Again, in this region the distributed tractors under private enterprises were four (4), amongst which three (3) of the tractors were serviceable.

The makes and models of tractors with their ownerships, bought condition, ages and serviceable percentage, are shown in Table 2 giving a total of 89 tractors, with which their percentages were calculated. The tractor makes and models which were newly purchased and owned by state were 100% newly bought. In the case of tractor makes and models owned by private, out of twenty nine (29) tractors, nineteen (19) were newly bought, while the rest ten (10) were bought fairly used, totaling the percentage of 65.52% for newly bought tractors. The findings showed that private owned tractors recorded the highest serviceable (maintained) percentage of 75.86% when compared with state owned which recorded 23.33% serviceable. There were thirteen (13) different makes and models of tractors in the various locations. The makes and models are, New Holland product (24.72%); Steyr Urus Products (28.09%); Steyr Products (26.97%); Massey Ferguson Products (12.36%), Case product (3.37%); Ford products (3.3%); and Eicher (1.12%). The multiplicity of tractor's makes and models would demand for multiple spare parts, mechanics and operators sourcing and training since almost all the locations had more than one makes and models of tractors. It is obvious that non implementations of the above suggestions and maintenance would lead to ineffective utilization of the tractors. Table 2 shows that sixty (60) tractors were owned by the state government, while twenty nine (29) tractors are owned by private individuals or enterprise. In fact, all (100%) of the state tractors were newly bought, while 19 (65.52%) of the twenty nine (29) tractors in private farms were newly bought and the rest 10 (34.48%) tractors were bought fairly used. The age's ranges for state new tractors were 3 to 8 age. There were no ranges for old tractors in state because of lack of data. Age range for private tractors is 6 to 12 years of age. Age ranges for private old tractors were 10 to 12 years of age.

Table 3 shows the available farm implements in the locations. There were 21 slashers (12

Table 3. Farm implements in locations.

Implement	Working widths	Total number	No. of functionable implements	% of functionable implements	No. of locations applicable	% of location applicable
Slashers	1800 mm	21	12	57.14	11	68.75
Ploughs	1180-2362 mm	43	28	65.12	13	81.25
Harrows	1200-1720 mm	41	30	73.17	13	81.25
Ridgers	21 mm	28	21	75	6	37.50
Planters	15-38 in (381- 965.2 mm)	2	0	0	-	-
Boom sprayers	2 m	1	1	100	1	6.25
Trailers	8 ft. 6 in (2590.8 mm)	43	34	79.07	16	100
Total	-	179	126	70.39	-	-
Total % Serviceable Implements				70.39	-	-

functional, 57.14%), 43 ploughs (28 functional, 65.12%), 41 harrows (30 functional, 73.17%), 28 ridges (21 functional, 75%), 2 planters (none functional), 1 boom sprayer (one functional, 100%), 43 trailers (34 functional, 79.07%). It should be recalled that there were sixteen assessable locations for the study. However, apart from the trailers which were applicable in all the locations, and being utilized at different degrees, slashers were applicable in only 11 locations (68.75%), plough in 13 locations (81.25%), harrows in 13 locations (81.25%), ridgers in 6 locations (37.50%) and boom sprayer in one location (6.25%). In the whole, 70.39% of the implements were functional. This gives an impression that the implements are of a higher status than the tractors generally. This may be consequent upon non usage of the equipment as discovered in some locations rather than good management. It is regrettable, that equipment such as fertilizer spreader, irrigation pump, harvesters and dryer were unavailable leading to a partial mechanization of these operations.

Table 4 indicates the sum of the hours of tractors in state and private locations reflecting the total hours of 28781 works done by all the tractors. Out of these, state owned recoded a total of 12457 h and private, 16324 h in a year, respectively. Private tractors performed 56.72% of the total hours while the state tractors performed 43.28% of the total hours of work. The total number of hours in a year per tractor in the state was 511.8 h, while the private owned had total number of hours in a year per tractor as 580.7 h. The mean annual working hours per tractor were 189 and 572.6 h for state and private owned tractors, respectively. This clearly showed a very low level of utilization by the state and private owned tractors. The two sets of ownership (state and private) did not meet the standard requirements of 1000 h per tractor annually. This agreed with the findings that tractors largely, Massey Fergusson, Styr and Fiat were used mainly for ploughing and that the average capacity utilization for ploughing by each tractor was 289 ha/year (Dauda et al., 2010). Sinha et al. (2017) reported average annual use of tractor was 856 h out of which 34.18% were used for custom work and 65.82% for own work. All these levels of tractors utilizations had indications of under utilization in agricultural activities.

Yadav et al. (2006) reported that to be economical at least tractors should be operated around 500 working hours annually. According to this, tractor operation in Kurunegala district was fairly economical as majority of tractors were annually operated above 500 working hours.

Their standard deviations are 38.74 and 176.32, respectively and the coefficients of variations are 0.205 and 0.308 for the state and private tractors. It was discovered that while the state tractors have coefficient of variation of 0.205, that of the private tractors was 0.308. This shows that the performance utilizations of the private tractors were more variable than the performances utilizations of the state tractors. These results further showed that private tractors rate of utilization were better than state owned tractors**.**

In Table 5, data obtained from selected locations according to the number of hours for different jobs undertaken by the tractors were analyzed and presented. The results showed that tractors solely engaged in the cultivation of field crops like cassava, yam and maize spent 67.5% of the total hours of farm operations annually on tillage operations such as ploughing, harrowing and ridging. The analysis indicated that 17.31% of the operational hour's tractor was spent on bush clearing while 15.19% of the hour's tractor was spent on the transportation of farm inputs and products. In view of the analysis of data obtained from two main farm locations (Ajagbodudu and Nsukwa) for palm tree showed that 31.40% of the hours of farm operations annually was spent on clearing with tractors and 68.60% of the hours of tractors usage spent on transportation of harvested palm bunches for processing in the mills. In assessing a large poultry enterprise with two tractors in the survey, 23.62% of the total hours annually were used on bush clearing and 78.18% of the operational hours spent on transportation of farm inputs and products. On

Table 4. Tractor total hours utilization in locations.

Location of tractor	State		Private	
	Total hours	Hours per tractor	Total hours	Hours per tractor
Agbor	2022	224.7	-	-
Aladinma	-	-	1904	634.7
Asaba	4793	266.3	-	-
Nsukwa	-	-	2462	615.5
Oguwashi-Uku	-	-	953	476.5
Olloh	-	-	3589	717.8
Owanta	968	193.1	-	-
Agbarho	1738	193.1	-	-
Jeddo	-	-	2162	540.5
Oghara	895	149.2	-	-
Okrigwe	-	-	842	168.4
Sapele	-	-	1297	648.5
Amukpe	575	191.7	-	-
Ajagbodudu	-	-	3115	778.8
Oleh	772	164.4	-	-
Patani	694	138.8	-	-
Total	12457	1511.8	16324	4580.7
Mean	-	189.0	-	572.6
Standard deviation	-	38.74	-	176.32
Coefficient of variation	-	0.205	-	0.308
% of total hours of work		45.16		54.83
Total numbers of tractor		60		29
Means values of hours		168.3		266.3

Table 5. Type and output of work by tractors in selected farm locations.

Farm type	Location	Total hours	Field work		Transport
			Tillage	Clearing	
Field crops	Aladinma	1904	1334	292	278
	Ogwashi-Uku	953	659	108	186
	Olloh	3589	2358	716	515
	Total	6446	4351	1116	979
	% of total hours	-	67.50	17.31	15.19
	Total % of field work	-	84.81		
Palm trees	Ajagbodudu	3115	-	973	2142
	Nsukwa	2462	-	778	1684
	Total	5577	-	1751	68.60
	% of total hours	-	-	31.40	68.60
Poultry	Sapele	1297	-	309	988
	% of total hours	-	-	23.62	78.18
	Total	6874	-	2060	4814
Non field crop farms	% of total	-	-	29.97	70.03

the whole, field crop farms employed 84.81% of the total hours on filed works, while the non-field crop farmers used 29.97% of the total hours on bush clearing and70.03% of the total hours on transportation.

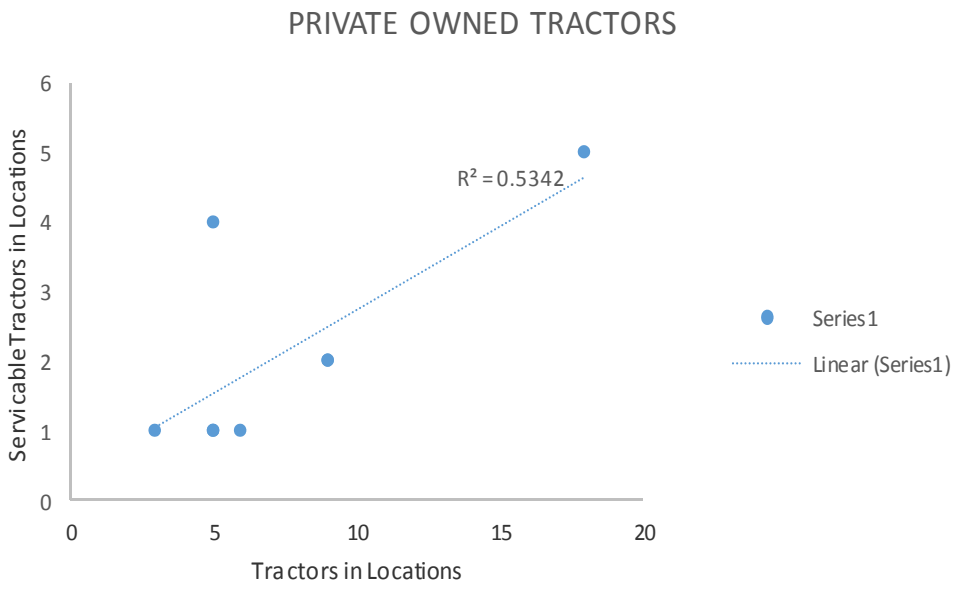

Figure 2. Private serviceable tractors against tractors in locations.

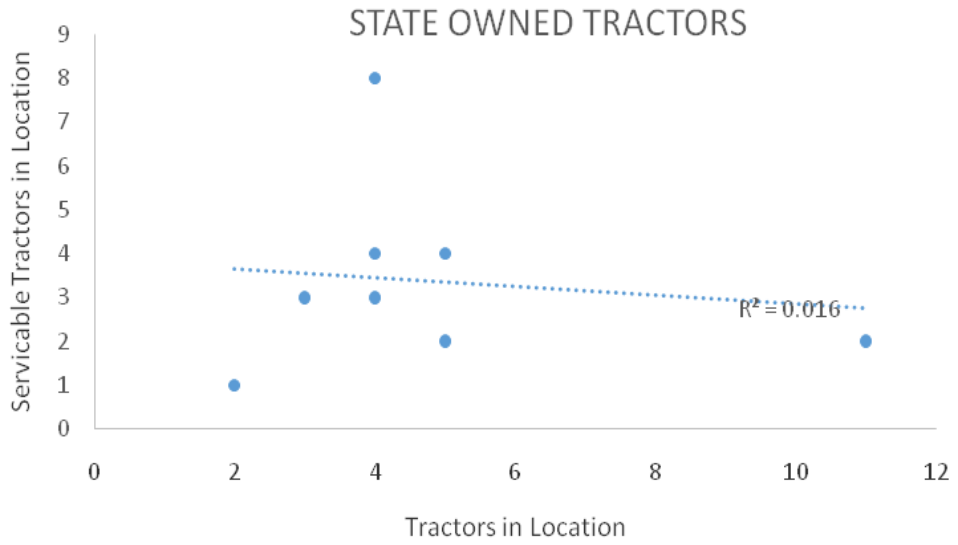

Figure 3. State serviceable tractors against tractors in locations.

Using distribution free spearman's rank correlation to examine the direction and degree of relationship between serviceable (maintained) tractors and work output, the rank correlation coefficient (r) was calculated to be 0.89. There is a high degree indication of direction correlation between the numbers of serviceable tractors in the locations against the total hours worked. A straight line graph was obtained in private owned tractors as shown in Figure 2 and inversely proportion line in state owned tractors in Figure 3. These were actualized, as a result of the degree of the functional tractors that were engaged in the locations. The rank correlation coefficient (r) to examine the relationship between tractors utilization and work out-put was calculated to be 0.19. This was obvious because mere possession of farm tractors, even when new, without adequate utilization could not translate to productivity.

Table 6 shows the tractor and implements performance for state and private enterprises. The state enterprises on tractor and implements performance showed effective field capacity (Fc_e) of 0.10 ha/h, theoretical field capacity (F_{Ct}) of 0.46 ha/h and field efficiency of 22%. The private

Table 6. Tractors and implements performance.

Ownerships	Tractor forward speeds, m/s	Widths of plough, m	Time= $T_P + T_I$	Area covered, ha	Distance covered, m	Effective field capacity (Fc_e) ha/h	Theoretical field capacity (Fc_t) ha/h	Field efficiency η (%)
State	1.90	2	1069.4	224	70	0.10	0.46	22
Private	1.76	2	2725	324	70.5	0.12	0.43	27

Tp = productive time, h; T_I = non-productive time, h.

Table 7. T-test results for means of state and private tractor/implements utilizations for annually used hours.

Parameter	Variable 1	Variable 2
Mean	1.473684	2.315789
Variance	4.48538	8.894737
Observations	19	19
Pearson correlation	0.537915	-
Hypothesized mean difference	0	-
df	18	-
t Stat	-1.43045	-
P(T<=t) one-tail	0.08486	-
t Critical one-tail	1.734064	-
P(T<=t) two-tail	0.169719	-
t Critical two-tail	2.100922	-

ownership on tractor and implement performance reported effective field capacity (Fc_e) of 0.12 ha/h, theoretical field capacity (F_{Ct}) of 0.43 ha/h and field efficiency of 27% for ploughing operation only in both enterprises. This has the indication that private sector had better management than the state sector. The percentage of 23.33% of the state tractors and 75.86% of the private tractors were serviceable (maintained) with regression coefficients of 0.016 and 0.534, respectively.

These results stood to prove that while tractors and implements helped to improve production, mere acquisition of the machines without proper maintenance and productive engagement in farm operations would not result a corresponding increase in food production. The use of tractors can be profitable and economical if its utilization rates are sufficiently high. In order to maximize the profitability of farm tractors, the owner must control the utilization and productivity of tractors. A judicious use of agricultural inputs that include farm tractors and implements is required by farmers to maximize production with minimum cost (Yohanna, 2004).

Table 7 indicates the statistical analysis of t-test used to determine the significant differences between the means of state and private tractor utilizations at 0.05 level of significance. The result of the t-test is shown in Table 7. The t critical values of 1.734064 and 2.100922 are greater than t stat of -1.43045 ($t_{tab} > t_{cal}$) at both one and two tails tests. This indicates that there is no significant difference ($P > 0.05$) between state and private hours in agricultural activities.

Conclusion

The result of the study showed that there were different makes and models of farm tractors in Delta State. In the North Senatorial District, more concentration of tractors and implements, tractor utilization in farm activities such as bush clearing and transportation of farm products was observed. Field crop farming utilized 84.81% of the total hours on field works of tillage (67.50%), bush clearing (17.31%), while 15.19% of the total hours on transportation. Non-field crop farming utilized 29.97% of the total hours on bush clearing and 70.03% on transportation. The level of tractor utilization is low, especially with state owned tractors. The average number of hours of work per tractors annually was 189 h for the state owned tractors, while 572.6 h per tractor for the private owned tractors both of which did not meet the standard 1000 h per tractor annually. The coefficient of variations of the performances utilizations of state and private owned tractors are 0.205 and 0.308, respectively.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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