Survey of Agricultural Power Units and Machinery Purchase Prices in Selected Locations of Kaduna State – Nigeria

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Abstract. This study was conducted to determine the purchase price of power units and machineries in selected major agricultural towns of Kaduna State (Kaduna, Zaria and Saminaka). Data for the study was obtained from a sample survey that was conducted in 2018 amongst the three selected areas of the state through a well structural questionnaire. It was deduced that 45% of the respondents believed that individual purchase of farm machinery were more often than non-governmental organization having 22%, while government organization and institutions both recorded 11%. The highest unit price of power unit was found to be 169,946.33 Naira/kW, and the lowest was 11,718.75 Naira/kW. Also the highest unit price of machines was found to be 1,500,000 Naira/meter, while the lowest was 70,000 Naira/meter. The research also explored, the most common factor(s) that affects farmers’ decision in purchasing agricultural machines and power unit. It was found that these factors include but not only limited to the cost of spare parts, availability of spare parts and ease of repair and maintenance. Results of this study also show that prices of power units and machines vary from one place to another. There was a non-linear relationship between price and machine width. These were due to the fact that there are other factors that influence the price of machine besides its width. These factors according to most of the respondents includes: make and model of machine, type of material used in construction and efficiency of the machines. It was also found out that the most common machine and power unit sold in the study area were harrow (23%), ridgers (23%), plough (18%) and planters (18%).

1. Introduction
Farm machinery is a collection of machines for agricultural operations. These include all types of implements and devices for applying power on the farms. Examples are ploughs, harrows, seed drills, planters, cultivators, harvesters, and haying machines, processing machines such as silage cutters, feed grinders, cotton gins, trucks and tractors [1]. The burden and drudgery of farm work have been reduced and the output per worker has been greatly increased by the use of these machines. Some of the increased production that has been realized during the past century was credited to better crop varieties, more effective use of fertilizers, improved cultural practices and more essentially, the increased utilization of non-human energy and more effective machines and implements [2]. Farmers have many options for choosing equipment that is required to grow and harvest crops. Farmers may own their own equipment, lease it, or
have the field operations completed using custom operators. For those farmers who choose to own their equipment, there are additional decisions about the size and quantity of equipment needed. This study seeks to address this situation by reporting on the findings of a study that sought to assess the relative importance of brand, model, functionality and power requirement as a factor influencing farm machinery buyer behaviour in selected areas of Kaduna State, and to differentiate the major farm machinery purchased and/used in the study area.

Agricultural engineers and economists use a variety of engineering and economic principles in calculating machines usage and costs. An effective farm manager must know these principles, and apply them when deciding to buy, lease, rent or share machinery [3]. Agriculture is very sensitive to timely operations and weather conditions, and huge amount of money is spent on its investment. This necessitates the need to evaluate the capacitive performance of agricultural machines for proper machinery selection, optimization and farm scheduling [4]. Machinery costs are one of the biggest costs faced by farmers; therefore, many are seeking for joint ownership to strengthen their net return [5].

Consumers make purchase decisions in each and every aspect of their life. Thus studying consumer behaviour becomes vital. Consumer purchase behaviour deals display the consumption of goods right from purchasing, usage, evaluating and disposing them. Understanding the consumer purchase process is critical to a marketer so as to design their marketing strategies effectively. Each step in the consumer decision making process is highly influenced by both internal and external factors. The internal factors include the individual's own motivation personality, perception, learning attitude and his own past experience. External factors such as the company's marketing efforts, ideas/opinions of friends, relations, family members and reference group members also have profound impact on the purchase decision of individuals. Purchase price of machinery is also essential for determining overall farmers’ income/profit and these prices must be proportional to the machine/unit and factors such as its performance, reliability and efficiency [4]. Price of machinery or power unit, especially in study area may vary from place to place due to demand, functionality/usage and accessibility of the machine. A comprehensive and simple guide is therefore needed to assist farmers in making their choice/decision.

2. Materials and Methods

2.1 Study Area

The study was conducted within Kaduna State of Nigeria. Three towns where selected, which are Saminaka, Zaria and Kaduna metropolis. Their selection was based on some unique characteristics they individually and collectively exhibit. Kaduna is a state capital, in northern Nigeria. It is an important commercial center of the north. Many agro-related companies that operate in the country either have branches there or at least have a sales representative. It is thus a major area of agricultural activities in the country. It is located 250 m above sea level and latitude 10.5°N and longitude 7.4°E. Zaria is a major city in Kaduna state, having an elevation of 644m above sea level and located on latitude 11.11°N and longitude 7.7°E. It houses several agro-related research institutions. It also has company representatives of various agricultural equipment, [6]. Saminaka, on the other hand, is located in Lere Local Government of the state. It is the heart of farming in Kaduna and neighbouring states and is located on latitude 10.2°N and longitude 8.4°E.

2.2 Method of Data Collection

The data for this study was obtained from a sample survey that was conducted between April – August, 2018 amongst the three selected areas Kaduna State. A well structural questionnaire was used to collect data. Information on parameters such as sizes of machines (meter), purchase price of each machine in relation to size (meter), power unit size (kilowatt power) and their prices, number of machine and power units sold by each organization in 2017. Major customers, most common type of machines and power units, selling factors that influence customer’s decision in purchasing machines and power units in the selected areas of study were also studied.

The study utilized the primary data obtained from the farmers in the study area. Since the study purposes a large sample of individuals, a survey research method was selected. Multistage random sampling procedure was employed in selecting the sample from where the data was collected, [7]. In the first stage, purposive
sampling technique was used to select fifty (50) respondents from three (3) selected study areas of the state. Respondents were contacted personally explaining the objectives of the project, encouraging them to participate and providing assurance about their confidentiality.

2.3 Data Analysis
The tools of analysis for the study was descriptive statistics such as frequency distribution, charts, mean and percentages employed to analyse the quantitative data to conduct a survey on agricultural power units and machines in the study area in order to determine the purchase price of farm machine and power unit and also to determine the factors that most influence farmers decision in purchasing machine and power unit in the selected locations.

3 Results and Discussions
3.1 Mean distribution of purchase price of power units
The mean distribution of purchase price of power units in the selected area surveyed and each unit price from the result of the study was computed as shown in the Table 1. From the Table, it could be seen that agricultural power unit sold in study area are mostly refurbished rather than new. The least of the unit price is a refurbished Massey Ferguson tractor with price per kilowatts power of 11,718.75Naira/kW, while the highest is a brand new Massey Fergusson tractor with price per kilowatts of 169,946.33 Naira/kW. Interaction with the dealers of these machinery revealed that the cost of new machines is usually higher than the refurbished ones for obvious reasons. It was also observed from Figure 1 that power unit size was in most times directly proportional to price, whether the power unit is new or refurbished. Similarly, the study found a non-linear relationship between the price and kilowatts size of power units in the study area.

Table 1: Estimated Costs of Selected Machinery Based on Power Units and Sizes

| Type of power unit | Size(kW) | Average purchase price for new # | Average purchase price for refurbished | Naira per kilowatts (new) | Naira per kilowatts (refurbished) |
|--------------------|----------|----------------------------------|----------------------------------------|--------------------------|----------------------------------|
| MF3750 tractor     | 55.90    | 9,500,000                        | 5,000,000                              | 169,946.33               | 894,45.43                        |
| TT55 NH Tractor    | 41.00    |                                  | 3,530,000                              | 86,097.56                |                                  |
| New Holland 4635   |          |                                  |                                        |                          |                                  |
| Ford 8210          | 89.50    |                                  | 5,500,000                              | 61,452.51                |                                  |
| Ford Tractor       | 74.60    |                                  | 3,000,000                              | 40,214.47                |                                  |
| Ford Tractor       | 59.70    |                                  | 2,500,000                              | 41,876.05                |                                  |
| Ford Tractor       | 22.40    |                                  | 1,000,000                              | 44,642.86                |                                  |
| MF 3630 Tractor    | 89.60    |                                  | 10,500000                             | 11,718.75               |                                  |
| Ford Tractor       | 89.60    |                                  | 7,500,000                              | 83,705.36                |                                  |
| Fiat (F87)         | 89.60    |                                  | 7,500,000                              | 83,705.36                |                                  |
| Power Tiller       | 10.40    | 1,500,000                        | -                                      | 142,857.14               |                                  |
| Multipurpose       | 8.90     | 395000                           | -                                      | 44,382.02                |                                  |
| Mini Tractor       | 33.60    |                                  | 2,200,000                              | 65,476.19                |                                  |
| Mini Tractor       | 18.60    |                                  | 700000                                 | 37,634.41                |                                  |
| Diesel Prime Mover | 11.20    |                                  | 195000                                 | 17,410.71                |                                  |
3.2 **Mean Distribution of Purchase Price of Machines**

The mean distribution of purchase price of machines in the surveyed area and each unit price was computed as shown in the table 2. From table 2, it could be seen that most of the machines sold in study area were new rather than refurbished and there was no true relationship between price and widths of machine. The machine with the highest unit price is an Israeli multi-crop thresher with 1,500,000 Naira/meter, while the lowest was found to be a single row planter at 70,000 Naira/meter. Also the data shows that there are other factors which greatly affect or influence the price of machinery other than its width; these factors as shown from table 2 may include the availability of spare parts, ease of repair and maintenance and sometimes material of construction and make/model of the machine etc.

| Type of machine | Width (m) | Average purchase price (New) | Average purchase price refurbished- | Price per width (New) | Price per width (Refurbished) |
|-----------------|-----------|----------------------------|------------------------------------|-----------------------|-------------------------------|
| Rom Plough      | 6.50      | 4,200,000                  |                                    | 646,153               |                               |
| Rom Harrow      | 1.80      | 1,300,000                  |                                    | 722,222               |                               |
| Baldan Plough   | 1.65      | 1,200,000                  | 900000                            | 727,272               | 545,454                       |
| Bhamasali Plough| 1.80      | 700,000                    |                                    | 388,888               |                               |
| Barmford Harrow | 1.48      | 750,000                    | 500000                            | 360,000               | 337,837                       |

**Figure 1:** Graphical Representation of Machinery Price versus Kilowatt Size
| Machine Description                  | Width | Price  | Efficiency |
|-------------------------------------|------|--------|------------|
| MF Harrow                           | 2.00 | 720,000| 267,857    |
| Alvanbalach Harrow                  | 2.80 | 750,000| 250,000    |
| Disc Ridger                         | 2.20 | 550,000| 300,000    |
| Belarus Plough                      | 2.00 | 600,000| 318,181    |
| Belarus Harrow                      | 2.20 | 700,000| 368,421    |
| Fieldking Plough                    | 1.90 | 700,000| 375,000    |
| MF Plough                           | 2.00 | 750,000| 86,666     |
| 3 Phase Ridger                      | 0.30 | 26,000 | 92,500     |
| SH Ridger (Single)                  | 0.40 | 37,000 | 214,814    |
| Moldboard Ridger (3 Mold)           | 2.70 | 580,000| 303,571    |
| Moldboard Ridger (4 Mold)           | 2.80 | 850,000| 562,500    |
| (Baldan) 4 Row Planter              | 3.20 | 1,800,000| 609,656    |
| 6 Row Planter                       | 4.10 | 2,500,000| 481,481    |
| Indian Planter                      | 2.70 | 1,300,000| 625,000    |
| Rice Seed Drill                     | 4.00 | 2,500,000| 720,000    |
| FIONA Seed Drill                    | 2.50 | 1,800,000| 880,000    |
| NORDSTEN Seed Drill                 | 2.50 | 2,200,000|           |
| Fertilizer Broadcaster              | 1.70 | 750,000| 441,176    |
| Baldan Mower                        | 1.70 | 800,000| 550,000    |
| Ford Mower                          | 1.50 | 1,600,000| 1,06666    |
| AGRIPAC Trailers                    | 3.00 | 1,500,000| 500,000    |
| Fieldking Trailer                   | 3.00 | 1,000,000| 450,000    |
| Row Planter                         | 1.00 | 70,000 | 70,000     |
| Rotary Cultivator                   | 1.00 | 90,000 | 90,000     |
| Rice Reaper                         | 1.50 | 350,000| 233,333    |
| Large Rotary Cultivator             | 1.50 | 500,000| 333,333    |
| Maize Thresher                      | 1.50 | 480,000| 320,000    |
| Rice Thresher                       | 1.00 | 175,000| 175,000    |
| Alvan Blanch Thresher               | 2.40 | 750,000| 312,500    |
| Israel Multi Crop Thresher          | 1.00 | 1,500,000| 1,500000   |

Figure 2 shows a non-linear relationship between the price and width of the machines surveyed. This was because there were other factors which influence the price of machine far more than its width. These factors according to most of the respondent in the study include make and model of machine, type of material used in construction and efficiency of the machines.
3.3 Factors Motivating Customer’s Decision in Purchasing Farm Machineries

The factors that motivated buyers in purchasing agricultural machinery in the study area were given in Figure 3. The Figure shows some of the factors that influence decision of customers in purchasing equipment for their respective organizations. It shows that 10% of the respondents believed that government subsidy affect decision of customers in purchasing equipment, 26% of the respondents believed that what motivated buyers mostly is the availability of spare parts while 16% are of the respondents are of the opinion that ease of operation of equipment/machine plays an important role in buyer’s decision. Furthermore, 10% of the respondents suggest that cost of spare parts influences their decision. Only 5% of the respondents believed that make/brand and model affect the decision of the buyers while 16% or of the view that repair and maintenance have serious effects on their decision. It was also observed that size of power unit, manufacturer’s adverts, promotion and emotions doesn’t have much effect on the decision of the buyers.
3.4 Distributions customers who patronize Agricultural Machineries

Figure 4 represents the type of customers that patronized/purchased various agricultural power units and machines in the study area. From this Figure, it could be seen that 45% of the respondents agreed that major customers/buyers of farm machineries and power units in the study area were individual owners, while 22% of the buyers were non-governmental organisations. However, only 11% of the respondents believed that government organization, corporate bodies and institutions were the major buyers of such equipment. Sadly, it was observed that private organization has no impact in purchasing farm machinery in the study area.
3.5 Most available and sold farm machines/equipment

Figure 5 summarized surveyed data on the farm equipment that were most available and sold in study area as at the time the survey was conducted. It was observed here that 64% of the respondents agreed that the farm equipment often sold in the study area were land preparation equipment (plough, harrow and ridgers), while 18% believed that planters are the most sought equipment as at the time of the survey. However, 6% each of the respondents were of the opinion that crop protection machinery equipment, dryers and threshers were the mostly sold equipment in the study area.

Similarly, results of the survey conducted indicated that 28% of the respondents agreed that the most tractors were the most sold power units in the study area, Figure 6. This was closely followed by harvesters/rippers and other prime movers such as irrigation pumps that accounted for 27% each, while 18% of the respondents believed that power tillers that were recently introduced in the study area were gaining much acceptance as power sources in the study area.
4 Conclusion
The results of the data obtained in this study show that purchase of farm machinery/equipment in the study area mostly done by individual owners. This is far more than those of governments (state and local), non-governmental and other institutions. It was also deduced that land preparation equipment (plough, harrows, and ridgers) were the most available equipment, while the most available power units are tractors, harvesters and prime movers in the study area. The study also showed a nearly proportional relationship between the price and kilowatts size of power unit, while there was a non-linear relationship between price and machine/equipment width. This was because there are other factors that influence the price of machine/equipment that should also be considered. These include make and model of machine, type of material used in construction and efficiency of the machines. Similarly, it was found that, the most common factor(s) that affect farmers decision in purchasing agricultural machines and power unit include but not only limited to cost of spare parts, availability of spare parts and ease of repair and maintenance.

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