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FIELD PERFORMANCE OF VST SHAKTI POWER TILLER ON SAWAH RICE PLOTS IN NIGERIA AND GHANA

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Abstract

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The paper reports the Field performance of VST SHAKTI power tiller on sawah rice plots in Nigeria and Ghana. This is based on the fact that power tillers were re- introduced in Nigerian agriculture in 2001 by Watershed Initiatives Nigeria by importing few units for sawah rice production technology. The field performance evaluation of the model was carried out in different rice fields located at Shaba-Maliki and Ejeti village near Bida on a clayey loamy, sandy soil, under the guinea savannah ecology of Nigeria. The process was repeated in Biemo No1 and Adugyma in Ghana. These study sites are located about 40 kilometers northwest of Kumasi on the Kumasi - Sunyani main road in Ahafo Ano South District which is at the north-western part of the Ashanti Region. The result shows that 93% and 92% were recorded for field efficiency at Ejeti and Shaba-Maliki respectively. The difference in effective field capacity obtained at Shaba- Maliki (0.089 ha/hr) and Ejeti (0.047 ha/hr) was due to the variation in the average time of operation, the operational time at Ejeti (21.7 hr/ha) almost doubles that of Shaba-Maliki (13.15 hr/ha). In Ghana the field efficiency of VST SHAKTI 130D1 power tillers Biemso 1 and Adugyma were 80.52% and 82%. On the other hand, the effective field capacity are 0.15 ha/hr and 0.11 ha/hr for Biemo1 and Adugyma; while the average time of operation are 7.92 hr/ha and 8.9 hr/ha respectively for the locations in Ghana. The results of One way analysis of variance for field performance of power tillers in 4 locations show that average time of operations only Ejeti is significantly different from the 3 other locations, while Adugyma and AhabaMaliki, the effective field capacity differs significantly from Biemso and Ejeti. In terms of field efficiency, Biemso 1 is significantly different from Adugyma but not any difference between Ejeti and Shaba-Maliki. The means for slippage is highest in Ejeti and Shaba-Maliki though not significantly different between them but shows high significance difference between the locations in Ghana that is Biuemso 1 and Adugyma.

Key words: field performance, VST SHAKTI power tiller, sawah rice, field efficiency, slippage, field capacity

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Introduction

Power tillers were re- introduced in Nigerian agriculture in 2001 by Watershed Initiatives Nigeria by importing few units for sawah rice production technology. Fashola et al. (2006) noted that the Sawah system offers the best option for overcoming the above stated constraints because of utilized the inland valleys which are reported to be high in fertility and sustained and enhances the water management for rice production through pudding and the inlet and outlet canals for irrigation and drainage. Despite the predominance of rainfed agriculture in Nigeria, the Sawah system use of inland valleys will enhance continuous cropping and less distribution of the production activities. Sawah is a multi-functional constructed wetland, which is a prerequisite for realizing the green revolutions as well as for pressing and even restoring ecological environments.

Wakatsuki and Masunaga (2005) reported that the potential of Sawah based rice farming is enormous in West Africa in order to stimulate the long awaited green revolution. This is predicated on the fact that the agro-ecological conditions of the core region of West Africa are quite similar to those of northeastern Thailand, where is a one of the rice center in the country. Ten to twenty million ha of sawah can produce additional food for more than 300 million people in future. The sawah based rice farming can overcome such soil fertility problems through the enhancement of the geological fertilization process, conserving water resources, and the high performance multi-functionality of the sawah type wetlands. The term sawah refers to leveled and bunded rice fields with inlet and outlet connecting irrigation and drainage.

The role of farm power in the development of agricultural is well established. The total area under cultivation and the timeliness and efficiency of accomplishing crop husbandry tasks is strongly influenced by the amount of available far power and its efficient use. The increased usage of farm power for cultivation creates further demand for related agricultural machinery for harvesting and storage and generates employment opportunities in the agricultural service industry (Kong et al., 1983). It is therefore important to seek information concerning available farm power and its application in various agricultural activities (e.g soil preparation, sowing, weeding, spraying, harvesting, processing, etc.) this information is also of great importance for planning exercises as it influences the design and implementation of future policies. A large number of power tillers (Akitu, Yanmar, Mitsubishi, Satoh, Kubota, Hako and Agria) were imported from Japan for study at various research centers during 1955 to 1960 in terms of their suitability to local conditions. On the basis of the observations of the testing, plans were made to manufacture the power tiller in the country and to popularize the same among farmers.

The power tiller is a multipurpose hand tractor designed primarily for rotary tilling and other operations on small farms. While in operations, an operator walks behind to maneuver it. It is also known as a garden tractor, hand tractor, walking tractor or a two-wheel tractor. Non-availability of matching equipment for different farm operations limits the versatility of the power tillers. Implements initially offered with the power tillers included rotavator attachment, trailer and in some cases a plough and ridger. The initial introduction of power tillers was without a complete range of matching equipment (Kathirvel et al.., 2000).

There are many factors affecting the use and development of tractors, such as agricultural conditions, farming requirements, management scale, economic conditions, technical level of manufacture, and farmer's experience. In consideration of Nigeria's agricultural conditions, small tractors are more adaptable. Small tractors are suitable to agricultural conditions and farming requirements in most areas. Among the arable lands in Nigeria, the hilly area represents a great proportion. In North Central management scale limits are field size while in paddy fields, land leveling limits the field size, using large and medium tractors on small-farm sizes is uneconomical. As the small tractors have the advantage in size, light-weight and good maneuverability. Small tractors are suitable to the level of mechanical knowledge and management in rural areas. The structure of small tractors is simple and this makes the operation, maintenance and repair easy.

Usually repair is done by the operator himself on the spot (Fashola et al., 2007). Operators need not go technical schools for years, as a small tractor can be operated after going through a training course of short period. Walking tractors are suitable to the features of vast paddy field. The wheel performance is the key point in determining the performance of walking tractors in paddy fields. Experience shows that walking tractors used in paddy field area have to meet the need of ploughing, rotary cultivation and transportation. Iron wheels equipped on walking tractors are more economical than high-lug tires (Gupta and Kumar, 2001). However, iron wheels of various types used for draft operation in paddy field have a high rolling resistance coefficient which is between 0.2-0.3 in the flooded paddy field with a plow layer of medium depth. Therefore, power loss due to rolling resistance of tractor in plowing operation is over 30%. Additionally, slip loss is above 25%. Maintenance of the power tiller is set of simple compulsory operations specified in the relevant documents, which if carried out properly will keep the machine available throughout the service life (Gupta and Sinha, 2000). Maintenance can be preventive or curative/breakdown. These include cleaning after daily operation, re-tightening of the tines bolts and other soil engaging part of the power tiller, daily checking of water and fuel level after the daily operation and the changing of engine oil after the machine has worked for 48 hrs or 6 days since it has no engine oil filter.

Materials and Method

The Indian made and model power-tiller VST-SHAKTI 130 DI is a single-axle (two-wheel) tractor with 10 kW (13 hp) rated power, diesel engine of 2400 rpm rated crankshaft speed. The engine is single cylinder horizontal 4 strokes, water cooled and hand-cranking type. The driving wheels are of two types: the pneumatic type for normal traction and the steel or cage wheel for wet puddling. The field performance evaluation of the model was carried out in different rice fields located at Shaba-Maliki and Ejeti village near Bida on a clayey loamy, sandy soil, under the guinea savannah ecology of Nigeria. Bida is 137 m above sea level and lies on longitude 6°01'E and latitude 9°06'N in Niger State of Nigeria.

The 600 mm tine cultivator was attached to the power tiller. The process was repeated in Biemo No1 and Adugyma in Ghana. These study sites are located about 40 kilometers northwest of Kumasi on the Kumasi - Sunyani main road in Ahafo Ano South District which is at the north-western part of the Ashanti Region. The study sites are in transitional forest belt of Ghana. Annual rainfall is around 1300 mm with many streams and rivers, and extends northward from the shore, near the Cote d'Ivoire frontier which is often known as the "Ashanti, area". The data collection process covered parameters such as Average time of operation (hr/ha), Effective field capacity (ha/hr), Theoretical field capacity (ha/hr), Field efficiency (%), Working speed (km/hr), Average Draught (kN), Fuel consumption (L/ha), Fuel consumption (L/hr), and Slippage (%). The data collected were summarized and subjected to One-way analysis of variance to compare the performance in the four locations.

Results and Discussion

From Table 1, for locations in Nigeria, the average values of 93 and 92% were recorded for field efficiency at Ejeti and Shaba-Maliki respectively. This shows that the power tiller is efficient for the operation in terms of work rate, quality of work done, fuel economy and ease of management on farmer's small farm holding. The difference in effective field capacity obtained at Shaba- Maliki (0.089 ha/hr) and Ejeti (0.047 ha/hr) was due to the variation in the average time of operation, the operational time at Ejeti (21.7 hr/ha) almost doubles that of Shaba-Maliki (13.15 hr/ha). This shows that the turning time, time to clearing of clogs/trash from the machine was greater at Ejeti, also the operator's capability and ease of handling the machine plays another role there. Ejeti field was grass fallow while Shaba-Maliki was cultivated with dry season tuber crop. Ejeti therefore had more grown weeds than Shaba-Maliki. Same value was obtained for draught at both locations, the average fuel con-

Table 1
Field performance test for VST SHAKTI 130D1 power tillers

Plots				
Ejeti	I	II	III	Average
Average time of operation, hr/ha	25.45	21.74	17.92	21.7
Effective field capacity, ha/hr	0.0393	0.046	0.0558	0.047
Theoretical field capacity, ha/hr	0.0416	0.0492	0.0605	0.0504
Field efficiency, %	94.44	93.55	92.13	93.37
Working speed, km/hr	2.66	24139	2.66	2.66
Average draught, kN	1.73	1.73	1.73	1.73
Fuel consumption, L/ha	9.35	10.94	13.28	11.19
Fuel consumption, L/hr	0.367	0.503	0.741	0.537
Slippage, %	10.53	10.53	10.53	10.53
Shabamaliki				
Average time of operation, hr/ha	7.06	17.89	14.51	13.15
Effective field capacity, ha/hr	0.1416	0.0559	0.0689	0.0888
Theoretical field capacity, ha/hr	0.1517	0.0606	0.0763	0.0962
Field efficiency, %	93.37	92.17	90.34	91.96
Working speed, km/hr	2.66	2.66	2.66	2.66
Average draught, kN	1.73	1.73	1.73	1.73
Fuel consumption, L/ha	11.98	13.3	13.46	12.91
Fuel consumption, L/hr	1.696	0.743	0.927	1.122
Slippage, %	10.53	10.53	10.53	10.53
Biemso 1				
Average time of operation, hr\ha	7.92	7.85	7.99	7.92
Effective field capacity, ha/hr	0.157	0.155	0.159	0.157
Theoretical field capacity, ha/hr	0.1263	0.1265	0.1264	0.1264
Field efficiency, %	80.48	80.5	80.6	80.52667
Working speed, km/hr	2.24	2.4	2.1	2.246667
Average draught, kN	0.083	0.085	0.082	0.083333
Fuel Consumption (L/ha	21.25	21.25	21.27	21.25667
Fuel consumption, l/hr	2.68	2.66	2.67	2.67
Slippage, %	0.44	0.45	0.46	0.45
Adugyma				
Average time of operation, ha/hr	8.9	9	8.8	8.9
Effective field capacity, ha/hr	0.1111	0.1113	0.1114	0.111267
Theoretical field capacity, ha/hr	0.1341	0.1355	0.134	0.134533
Field efficiency, %	82	82.9	82.4	82.43333
Working speed, ha/hr	2.66	2.62	2.67	2.65
Average draught, km	0.07	0.076	0.075	0.073667
Fuel consumption, l/ha	26	25	24	25
Fuel consumption, l/hr	2.77	2.8	2.76	2.776667
Slippage, %	1.15	1.16	1.13	1.146667

Table 2
One way analysis of variance for filed performance of power tillers in 4 locations

Parameters		Sum of squares	df	Mean square	F	p	Duncan multiple range test	
							Groups	Means
Average time of operation, hr/ha	Between Groups	355.085	3	118.362	10.54	0.004	Biemso	7.92[a]
							Adugyma Shabamaliki	8.90[a]
	Within Groups	89.788	8	11.223			Ejeti	13.15[a]
	Total	444.873	11					21.70[b]
Effective field capacity, ha/hr	Between Groups	1.89E-02	3	6.30E-03	11.42	0.003	Biemso	0.15[a]
							Adugyma	0.11[b]
	Within Groups	4.41E-03	8	5.52E-04			Shabamaliki	8.88E-02[b]
	Total	2.33E-02	11				Ejeti	4.70E-02[c]
Theoretical field capacity, ha/hr	Between Groups	1.30E-02	3	4.35E-03	7.059	0.012	Biemso Adugyma	0.12[a]
							Shabamaliki	0.13[a]
	Within Groups	4.93E-03	8	6.16E-04			Ejeti	9.62E-02[a]
	Total	1.80E-02	11				Biemso Adugyma	5.04E-02[b]
Field efficiency, %	Between Groups	383.874	3	127.958	131.5	0	Shabamaliki	80.52[a]
							Ejeti	82.43[b]
	Within Groups	7.786	8	0.973				91.96[c]
	Total	391.66	11					93.37[c]
Working speed, km/hr	Between Groups	0.378	3	0.126	21.71	0	Biemso	2.24[a]
							Adugyma	2.65[b]
	Within Groups	4.65E-02	8	5.81E-03			Shabamaliki	2.66[b]
	Total	0.425	11				Ejeti	2.66[b]
Average draught, kN	Between Groups	8.182	3	2.727	9E+05	0	Biemso	8.33E-02[a]
							Adugyma	7.36E-02[b]
	Within Groups	2.53E-05	8	3.17E-06			Shabamaliki	1.73[c]
	Total	8.183	11				Ejeti	1.73[c]
Fuel consumption, L/ha	Between Groups	393.551	3	131.184	94.24	0	Biemso Adugyma	21.25[a]
							Shabamaliki	25.00[b]
	Within Groups	11.136	8	1.392			Ejeti	12.91[c]
	Total	404.687	11					11.19[c]
Fuel consumption, L/hr	Between Groups	11.29	3	3.763	51.56	0	Biemso	2.67[a]
							Adugyma	2.77[a]
	Within Groups	0.584	8	7.30E-02			Shabamaliki	1.12[b]
	Total	11.874	11				Ejeti	0.53[c]
Slippage, %	Between Groups	284.844	3	94.948	1E+06	0	Biemso	0.45[a]
							Adugyma	1.15[b]
	Within Groups	6.67E-04	8	8.33E-05			Shabamaliki	10.53[c]
	Total	284.845	11				Ejeti	10.53[c]

sumption of the machine at both sites with other parameters assessed conform with derivation of basic desiring of small tractors.

Table 1 further reveals, that in Ghana the field efficiency of VST SHAKTI 130D1 power tillers Biemso 1 and Adugyma were 80.52% and 82%. This may be due to the fact that the nature of soils in these locations. The soils are generally more clayey than what obtains in Nigerian locations of Ejeti and Shaba-Maliki. The work rate is high enough to guarantee the quality of work done and ensures the fuel economy on farmers' plots. On the other hand, the effective field capacity are 0.15 ha/hr and 0.11 ha/hr for Biemo1 and Adugyma; while the average time of operation are 7.92 hr/ha and 8.9 hr/ha respectively for the locations in Ghana

Table 2 presents the results of the one way analysis of variance for filed performance of power tillers in 4 locations. For all the parameter under consideration, significant differences exist for the 4 locations. A further post hoc analysis using the Duncan Multiple Range Test shows that some of these locations are not significantly different from one another. For Average time of operastions only Ejeti is significantly different from the 3 other locations, while Adugyma and AhabaMaliki, the effective field capacity differs significantly from Biemso and Ejeti. In terms of field efficiency, Biemso 1 is significantly different from Adugyma but not any difference between Ejeti and Shaba-Maliki. The means for slippage is highest in Ejeti and Shaba-Maliki though not significantly different between them but shows high significance difference between the locations in Ghana that is Biuemso 1 and Adugyma.

Conclusion

The paper has highlighted the performance of VST SHAKTI power tillers on sawah plots in Nigeria and Ghana. The difference in the parameter such as Average time of operation (hr/ha), Effective field capacity (ha/hr), Theoretical field capacity (ha/hr), Field efficiency (%), Working speed (km/hr), Average Draught (kN), Fuel consumption (L/ha), Fuel consumption (L/hr) and Slippage (%) were examined and the implications of these for rice production were brought to the fore. It is important that farmers using this model of power tillers for rice production should be trained in order to achieve the maximum potential of the power tiller and reduce wastages that may arise from the use of power tillers.

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