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AN ASSESSMENT OF THE STATUS OF SMALL RICE THRESHERS IN NIGERIA

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ABSTRACT

An assessment of existing rice thresher designs and products available within Nigeria and neighbouring countries was carried out. The impetus for the study is the concern that low and poor quality of local rice in Nigeria may be due, in important measure, to lack of appropriate and affordable small threshers. On this basis, a reconnaissance work in Five Local Government Areas in Ogun State, Erin – Ijesha in Osun State, Igbimo in Ekiti State; Abakaliki in Ebonyi State, Makurdi in Benue State as well as Kura - Kano and Tundun Wada areas of Kano State was carried out. Based on the farmers' evaluation and assessment of existing rice threshers available in Nigeria, the study recommended three prototype small threshers that are pedal and petrol engine driven. The pedal operated thresher was recommended for those with farm hectarage of less than 2. For threshing freshly harvested rice at very high moisture content, the IITA/WARDA small plot spike-tooth thresher which has a threshing capacity of about 100kg/h was found to be appropriate for the small – scale farmers provided some little modifications in the area of capacity and mobility were carried out while the multi-crop thresher of the Institute of Agricultural Research and Training (IAR&T) Ibadan with a capacity of about 250kg/h was recommended for those with farm hectarage of more than 5ha.

INTRODUCTION

The increasing rise in rice import bills to meet up local demand has food security, socio-economic and political implications in Nigeria. This has therefore called for some intervention. Several efforts have been made, and are still being made, by the government to bridge the domestic supply – demand gap. Some of these efforts include provision of subsidized rice production inputs, establishment of Agricultural Development Projects (ADPs), River Basins Development Projects (RBDAs), several irrigation schemes whose main mandate crops include rice, and active participation in the activities of West African Rice Development Association (WARDA) by Nigeria (Odigboh, 2004). According to Oyekan *et. al.*(1990), the result of these efforts is that over the years, rice production in Nigeria has been on a steady increase, growing at 9.3% per annum, particularly due to vast increase in rice area (7.9%) per annum) and a lesser extent through increases in rice yield (1.45% per annum).

Despite the efforts to increase rice production, not much commensurate effort has been made to improve local rice processing especially threshing, even though it is one of the most labour intensive activities in the farmer's cropping calendar. Instead the nation has over the years relied on importation of good quality rice. Mechanized threshing has the potential to significantly improve labour productivity and develop it to an industry capable of producing rice of acceptable quality (Sharma and Devnani, 1980; Arnold, 1984; Picket and West, 1988. Threshing is also one of the largest costs in the producer's budget, and therefore an obvious target in any campaign to reduce the cost of rice production. Threshing on the ground typically results in dirt, stones and other foreign matter being swept up and included in the rice. This, along with drying the rice on the ground or along the edge of the road, is the major source of contamination with dirt and stones (Singhal and Thiersttein, 1987; Ogunlowo and Adesuyi, 1999).

Several studies have shown that rice production and processing are profitable ventures in Nigeria and what is required now is to seek to encourage investment in rice processing activity. Well-processed local rice would stimulate consumers demand and in turn stimulate paddy rice production (Nwuba, 1998).

One cannot but agree with the statements in one of PrOpCom's (Promoting Pro-poor Opportunity for Commodity and Service Markets) documents, that access to appropriate threshing machines will give a big boost to rice development and marketing in the Ofada and Kura-Kano rice production areas by reducing the physical drudgery of manual threshing and speeding up the process of threshing. Since paddy rice is often piled in the field to dry and await threshing, more rapid threshing will reduce the exposure to weather (with risk of loss from molding or shattering before arriving at the threshing location), birds, livestock and other sources of predation. It will also limit the amount of contamination and breakage of the grains thereby increasing product quality and competitiveness in the market.

As noted in the PrOpCom's document, there are two main methods of rice harvesting in Nigeria–cutting the rice plant near the ground to harvesting both the straw and the panicle together, or cutting just the panicle (rice head) and leaving the straw standing in the field. Farmers in the Ofada rice project area harvest just the panicle, while farmers in the Kura-Kano area harvest the straw and panicle together. Most, of the existing rice threshers are designed for threshing rice in panicles attached to the straw. Another advantage of using appropriate threshers is that it will boost the adoption of improved new rice varieties by farmers as previous attempts to promote certain high yielding new rice varieties were rejected due to anticipated difficulty in threshing manually.

At the Ofada Stakeholder's Planning Workshop, participants generally agreed that the addition of an appropriate, affordable and efficient small scale thresher to the Ofada rice production chain would raise the scale of production of farmers with consequent improvement in income. This study will therefore examine the existing threshing machines and determine the possibility of modification and redesign of some of them to come up with prototypes of appropriate threshing machines for the major rice production systems in Nigeria

MATERIALS AND METHODS

Based on the objectives of the study, the work was conducted in two phases. The first phase was the survey of rice threshing techniques adopted by rice farmers and the various designs of rice threshers available. The second phase was the collation of data from Local fabricators, Research Institutes and Universities. This survey was undertaken in Ogun, Osun, Ekiti, Ebonyi, Benue and Kano States.

A combination of primary and secondary data was used for the study. Primary data were obtained from Individuals, Farmers. Groups and Associations during the survey of rice threshing clusters in Ofada, Abakaliki, Makurdi and Kura Kano. Photographs and, where necessary and feasible, video recordings were obtained of the various designs of threshers found during the survey. Information from literature review, journals, publications, documents of the ADPs, and the other agencies visited and written commentaries of knowledgeable individuals relating to the subject matter formed the bulk of the secondary data used for the study. Specifically, secondary data were obtained from the following agencies: Universities, Research Institutes, Cooperative Organizations and Local fabricators.

The primary data used for the study were collected from the respondents with aid of well structured open and closed ended. These were supplemented where necessary with interviews, discussions and direct observation. Five research assistants recruited from the local communities were trained on how to administer the questionnaires. Relevant information obtained includes:

- Methods of rice threshing; Different types of threshers farmers are familiar with
- Types of farm power used for threshing i.e. Machine, Manual labour, Animal Traction.
- Farm size devoted to rice; Total farm size; Other crops grown
- Nonfarm employment; Input supply for rice production
- Rice yield, Total annual output of rice ; Transportation of farm produce
- Packing of threshed rice ; Cost of threshing
- Cost of threshing machines, source, age, performance, expected lifespan
- Varieties of seeds of seed planted
- Amount of credit obtained; Sources of land
- Training needs for fabrication, maintenance and repairs of threshers

The sampling of rice farmers or farmer groups was carried out based on the location of farms and other criteria determined after the preliminary interaction with the population. Both purposive and simple random sampling techniques were employed to select the one hundred respondents used for the study. They included rice farmers and equipment fabricators. The equipment fabricators and manufacturers were purposively selected.

RESULTS AND DISCUSSION

Review of rice threshing machines

Threshing operation involves the detachment of paddy kernels or grain from the panicle. Depending on the influence of agronomic, economic and social factors, threshing is done in different ways. It can be achieved by rubbing action, impact; and stripping. The rubbing action occurs when paddy is threshed by trampling by humans, animals or tractors. The impact method is the most popular method of threshing

paddy. Most mechanical threshers primarily use the impact principle for threshing, although some stripping action is also involved. The difficulty of the process depends on the varieties grown, and on the moisture content and the degree of maturity of the grain. Paddy threshers may either be hold-on or throw-in type of feeding the unthreshed paddy. In the hold-on type, paddy straws are held stationary while threshing is done by the impact on the particle from cylinder bars spikes or wire loops.

Manual threshing

One of the simplest systems for threshing rice is to pick up the sheaf of rice and strike or beat the panicles against a hard surface such as a tub, threshing board or rack; or beating the sheaves spread out on a threshing-floor with a flail or a stick or tramples it underfoot. The threshing-floors on which the sheaves are spread must have a hard, clean surface. The pedal-operated thresher consists of a rotating drum with wire loops which strip the grains from the panicles when fed by hand. It can be operated by women and can be used in hilly or terraced areas because of its portability. By using one of these methods of hand-threshing, a worker can obtain 15 to 40 kg of product per hour.

Threshing with animals or vehicles

If draught animals are available and there are large quantities of rice, threshing can be done by driving the animals (harnessed, in that case, to threshing devices) over a layer of sheaves about 30 cm thick. This operation, which is also called "treading out", can equally well be accomplished with vehicles. This method of threshing rice is adopted in some Asian countries, using a tractor for power instead of draught animals. Paddy is obtained by running the tractor twice over sheaves of rice that are spread in layers on a circular threshing-floor 15-18 m in diameter.

Threshing with hand-driven machines

Machines driven by a manual device or a pedal are often used to improve yields and working conditions during threshing. By means of the handle or pedal, a big drum fitted with metal rings or teeth is made to rotate. The rice is threshed by hand-holding the sheaves and pressing the panicles against the rotating drum. The speed of the threshing-drum must be kept at about 300 revolutions per minute (rpm). The hand-held sheaves must all be of the same length with the panicles all laid in the same direction, and the grains must be very ripe and dry. Depending on the type of machine, the skill of the workers and organization of the work, yields can be estimated at a maximum of 100 kg/h.

Threshing with motorized equipment

Although they are gradually being replaced by combine-harvesters, motorized threshing-machines still have an important place in the post-harvest production process, especially for their convertibility. By the simple replacement of a few accessories and the appropriate changes in settings, these machines can treat different kinds of grain (e.g., rice, maize, sorghum, beans, sunflowers, wheat, soybeans, etc.). The use of motorized threshers may require two or three workers. Yields depend on the type of machine, the nature and maturity of the grain, the skill of the workers and organization of the work, and they can vary from 100 to 5 000 kg/h.

General Features of Threshers

Most, if not all powered paddy threshers are equipped with one of the following types of cylinder and concave arrangement: (a) rasp bar with concave (b) spike tooth and con-

cave (c) wire loop with concave (d) wire loop without concave. Tests by the International Rice Research Institute, IRRI indicated that the spike-tooth cylinders performed well both with the hold-on and the throw-in methods of feeding and its threshing quality is less affected by changes in cylinder speed. In the axial-flow thresher, the harvested crop is fed at one end of the cylinder/concave and conveyed by rotary action on the spiral ribs to the other end while being threshed and separated at the concave. Paddles at the exit end throw out the straw and the grain is collected at the bottom of the concave after passing through a screen cleaner. Several versions of the original IRRI design of the axial-flow thresher have been developed in most countries to suit the local requirements of capacity and crop conditions. Thus, there are small-sized portable ones and tractor PTO-powered and engine-powered ones. Many custom operators in Asia use the axial flow threshers to satisfy the threshing and grain cleaning requirements of rice farmers.

Proposed prototype small rice threshers

Based on the capacities, efficiency and assessment of existing rice threshers in Research Centres/Universities, local fabricators and some organization within and outside Nigeria as well as farmers' evaluation (Table 1), this study is recommending three prototype small threshers that are pedal and petrol engine driven. The improved version of the pedal operated thresher supplied by the Federal Government of Nigeria to NCAM, Ilorin and NCRI, Badeggi will be good for those with farm hectarage of less than two. For threshing freshly harvested rice at very high moisture content, the IITA/WARDA small plot spike-tooth thresher which has a threshing capacity of about 100kg/h will be appropriate, provided some little modifications in the area of capacity and mobility are carried out while the multi-crop thresher of the Institute of Agricultural Research and Training (IAR&T) Ibadan with a capacity of about 250kg/h is recommended for those with farm hectarage of more than 5ha. The recommended models will thresh rice panicles harvested with or without straws.

Model 1 – NCAM pedal operated rice thresher (50kg/h)

Model 1 is a pedal operated rice thresher that can be used on an household farm scale of less than 3hectares. The thresher consists of a seed stripping disc which is rotated in vertical plane by a foot operated wheel crank mechanism at 700 to 1100 rpm. Stripper disc is made of mild steel with spikes of 5 mm diameter and 10 to 20 mm length. Spikes are radially welded on disc surface. Flower heads are brought in contact with stripping disc and threshed material is collected and cleaned separately. Output of the machine is 50 kg/h (Plate 1). The autoCAD drawing of the improved version is in Appendix A1.1

Model 2 – IITA/WARDA Plot Thresher – (100kg/h)

This is a thresher that can be used on a cottage farm scale of 3 – 10hectares. The major advantage of this type of threshing machine is that it is easier to clean thereby allowing different crop varieties to be threshed without contamination. It is light in weight and can be easily transported to field. Output of the machine is about 100 kg/h (Plate 2). The autoCAD drawing of the improved version is in Appendix A1.2

Table 1: List and description of threshers manufactured or used in Nigeria

S/N	Make/Type of Thresher	Design Specification	Capacity/ Efficiency	Contact Information on Source / Manufacturer / Representatives in Nig.	Remarks (Availability / Appropriateness / Cost
1	IITA/ WARDA Plot Thresher	It has the following components – the frame, hopper, the threshing unit, the blower and the collecting port. Driven by 5hp Petrol Engine	50kg/h/ 98.8%	Imported from England. Available at IITA/WARDA, Ibadan	Satisfactorily There is need to increase the size of the hopper and introduction of a bigger outlet. Cost - N120,000
2	IITA/ WARDA Multi-crop Thresher	It combines threshing with cleaning. Driven by 7.5hp Petrol Engine	100kg/h 54.5%	Imported from England. Available at IITA/WARDA, Ibadan	Not Satisfactory with rice. N150,000
3	IAR&T Multi crop Thresher	The concave has a rectangular opening of 60 x 30 mm size and cylinder concave clearance is 19 mm. Three rows of revolve stammer saws are provided in cleaning shoe.	250kg/h/ 94.2%	Federal College of Agriculture, IAR&T, Moor-Plantation, Ibadan	Thresher was found technically suitable. Cost:N150,000
4	FGN Pedal Operated Thresher	The thresher consists of a seed stripping disc which is rotated in vertical plane by a foot operated wheel crank mechanism at 700 to 1100 rpm. Stripper disc is made of mild steel with spikes of 5 mm diameter and 10 to 20 mm length. Spikes are radially welded on disc.	50kg/h/ 78.9%	Supplied by the Federal Government of Nigeria. Available at NCAM – Ilorin and NCRI Badeggi	The chamber has to be completely round instead of the present half – size to prevent loss of grain. Cost -N80,000
5	NCAM Multi -crop Thresher	The machine consists of an hopper, the threshing unit, blower and frame. The threshing speed is from 850 – 1300rpm depending on the crop and concave clearance. The overall dimension is 90 x 70 x 14cm3. Power source is petrol or electricity.	200 – 550kg/ h. ;96 – 100%	National Centre for Agricultural Mechanization (NCAM) Km 20, Ilorin – Lokoja Highway, Idofian. email – ncam@skannet.com	Cost -N150,000
6	FUT Multicrop Thresher	Power source-5 hp electric motor Threshing cylinder – Spike tooth; length of spikes adjustable from 50 to 70 mm	250 – 300kg/ h; 88.5%	Developed at the Federal University of Technology, Minna.	Blower speed is kept at 800 rpm to achieve high cleaning efficiency. Cost - N150,000
7	Vortex Rice Fan	Driven by 5hp engine	500kg/h; 82.3%	Annes Agro Processing Industries Ltd., 17 Gumming Road, Abakaliki, Ebonyi State. Email – atumaapilrice@yaho.com	Cost -N400,000

8	Manual Rice Thresher		100 – 150kg/h; 83.4%	Songhai Farm, Porto Novo, Republic of Benin. Email: songhai@Songhai.org	Cost: N70,000 Satisfactory
9	Senegalese – ASI Motorised Thresher / Cleaner	Spike tooth threshing cylinder is similar to conventional grain thresher but the number of spikes is half of grain threshers.	7tonnes per day. Grain – straw separation rate is 95 – 98%.	Senegalese River Valley Development Agency (SAED), Senegal. Email-warda@cgiar.org	Cost: USS5000 Performance Satisfactory for large scale farmers
10	PAU Groundnut Thresher	The unit consists of feed trough, threshing cylinder, concave, oscillating rack, paddle type centrifugal blower, cleaning shoe with stammer saws, set of sieves, auger convey and transport wheels.	300kg/h at 450 m/min cylinder speed.	PAU, Ludhiana, India	Only dry crop is recommended to be threshed with the thresher.
11	TNAU Groundnut Thresher	It consists of feed hopper, flow-through type spike tooth threshing cylinder, concave, haulms remover, oscillating sieves, blower and power transmission system	105 kg/h at 240 rpm threshing speed. Threshing efficiency was 96%.	Developed at AICRP on Farm Implements and machinery, Tamil Nadu Agricultural University, Coimbatore, India	Percentage of shelled pods was 3.6 to 6.1 percent.
12	GBPUAT, Small Soybean Thresher	Design was based on threshing system of conventional combine harvester.	The unit had a capacity of 200 to 300 kg/h grain	Developed at GBPUAT, Pantnagar, India.	Because of elaborate design features and high cost the machines could not be commercialized.
13	Corn and Wheat Thresher	Operated by 15 hp electric motor or tractor.	800 kg/h	Hadejia River Basin Authority, Kadawa, Kano	Not okay for small rice farmers..
14	CIAE Multicrop Thresher	This thresher incorporates the desirable features of wheat thresher and IRRI axial flow thresher for paddy. It consists of a feed tray, spike tooth cylinder, straw thrower, blower and cleaning sieves.	250 – 300 kg/h; Threshing speed14m/s. Threshing efficiency / cleaning – 99.1/96.9%	Developed at the Central Institute for Agricultural Engineering, CIAE, Bhopal M.P. India	The thresher has been designed to thresh rice by operating cylinder at lower speed. Very effective.
15	APAU Sunflower Threshing Bench	A rectangular shaped bench made of MS angle and top covered with expanded metal screen	output is 3-4 kg/h.	Developed at AICRP on Farm Implements and Machinery, APAU, Hyderabad	Seed damage is low and unit costs about N20,000
16	APAU-All Crop Thresher	The thresher consists of a rasp bar type threshing cylinder, concave, feeding chute and a cover.	34 kg/h at a seed moisture content of 12.8 to 13.5 percent.	Developed at AICRP on Farm Implements and Machinery, APAU, Hyderabad	The machine was evaluated, safflower Output was low due to low yield and bulkiness of crop.
17	Wire loop thresher	Threshing speed is 800rpm	450 to 600	NCRI, Badeggi, Niger State	Concave and top sieve can be changed to suit different sizes

Plate 1: NCAM Pedal Operated Thresher

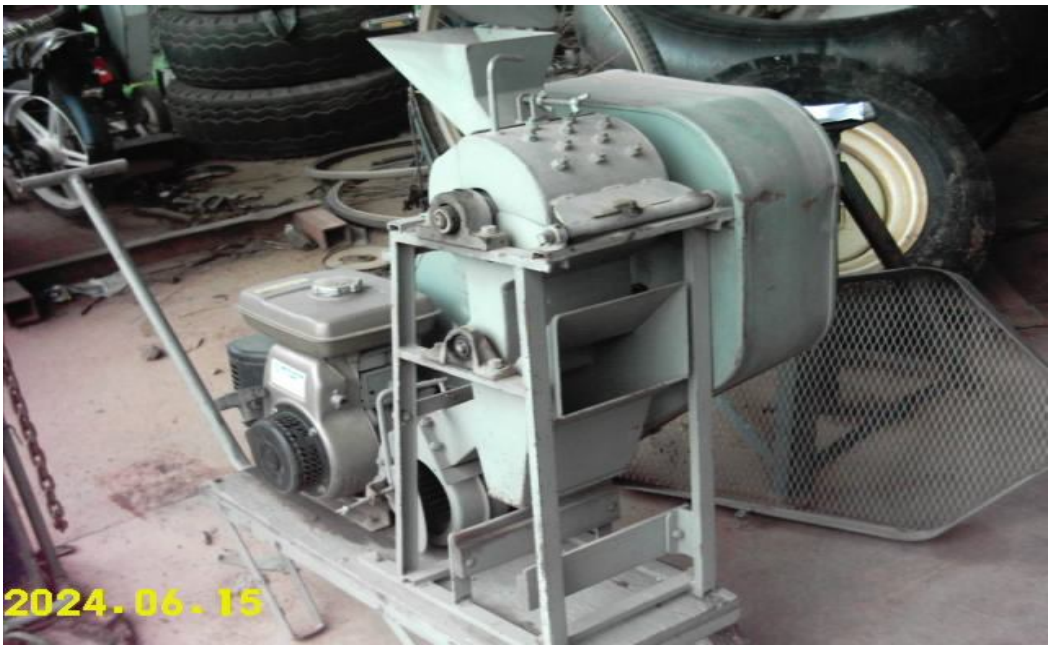
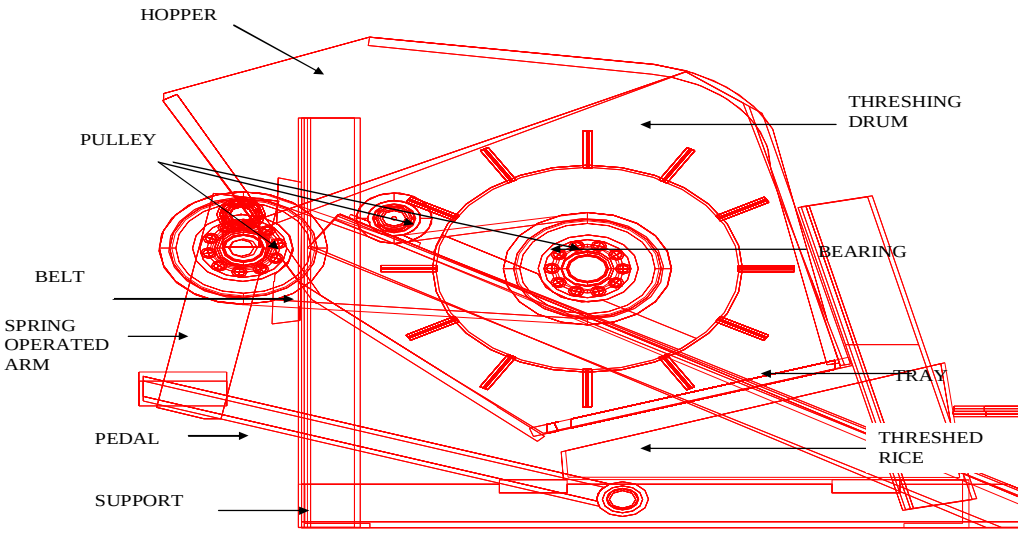


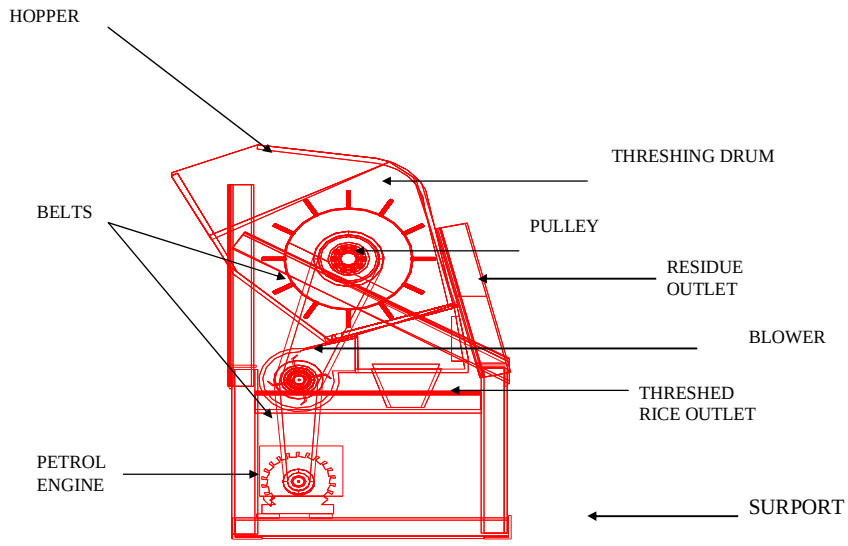
Plate 2: IITA/WARDA Plot Thresher (Inset – The multi – spike drum)

Plate 3: IAR&T Multi crop Thresher

Appendix 1 Autocad Drawings of recommended Thresher



A1 .1: Pedal operated rice thresher



A1.2: Power operated rice thresher

***Model 3 – IAR&T* MULTI – crop thresher – (250kg/h)**

The multi – crop thresher built at the Federal College of Agriculture, IAR&T, Ibadan Agricultural Engineering Technology was demonstrated to the farmers and found to be efficient with rice. It can be used for threshing rice cultivated on small scale farmland of 10 – 25hectares and can thresh up to 250kilogram's of rice per hour. It is economical, faster and efficient in operation. Plate 3 shows the side view of the thresher. It has the following components units: the frame, hopper, the threshing unit, the sieve, the reciprocating mechanism, the blower and the collecting port

CONCLUSION

The study has examined the rice threshing activities in Ofada farming communities of Ogun State, Erin-Ijesha in Osun State, Igbemo in Ekiti State, Kura–Kano, Abakaliki in Ebonyi State and Makurdi in Benue State. Efforts were also made to assess the various threshing machines available in Research Centres, Universities and Agro – Allied Organizations within and outside the country. From the study, it can be concluded that:

- The average quantity of rice threshed by rice farmers during the production season under consideration was 300kg while the manual threshing capacity was 30kg/hr.
- The provision of affordable threshing machine will reduce drudgery, increase efficiency in rice threshing, quantity of rice threshed and the level of profitability.
- The quantity of rice threshed can also be increased with increase in the income of rice farmers (to meet the financial requirement for purchase of threshing machines) and reduction in the labour cost.

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