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Manual energy contribution to palm oil processing by semi-mechanized mill in Bayelsa state, Nigeria

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ABSTRACT: Manual energy are often used in most processing/manufacturing sector in Nigeria. The contribution of manual energy depend on the scale (size) and owner of the establishment. This study assessed manual energy contribution in semi-mechanized palm oil mill in Bayelsa state, Nigeria. Literature were the source of data used during the study. Results showed that 1.0854 MJ of manual energy is utilized for the processing of 1 tonne of fresh fruit. Off these, 68.66% are contributed by male during bunch reception, bunch loading on stripper and oil drying, while 31.34% are contributed by female during sieving activity. The result also shows that total manual energy contributed is about 2% of the energy content of 1 liter of diesel fuel or about 5% of energy content of 1kg of oil palm processing solid waste that is typically used as solid fuel in the palm oil mills.

***Keywords*:** Energy, manual, Nigeria, palm oil, semi-mechanized

INTRODUCTION

Nigeria is the fifth lightest producers of oil palm, accounting for 930,000 metric tonnes of palm oil (1.7% of global output). Before 1960, Nigeria used to be the leading producers of oil palm contributing significantly to the global market. Presently the Nigeria palm oil demand in nearly double the production rate, hence the country supplement her deficit through importation from Indonesia and Malaysia. The fall of Nigeria oil palm sector could be attributed to weak agricultural policies, civil war, discovery of crude oil (i.e. preference of crude oil to agriculture), poor financing, lack of basic amenities and infrastructure, land tenure challenge, use of obsolete processing equipment and over dependence on smallholder processors. The smallholder processors harvest oil palm from small plantation (1 – 5 ha) and wild. Besides, the smallholder covers 80% of Nigeria oil palm industry (Ohimain and Izah, 2014a; Ohimain et al., 2012; 2014; PIND, 2011), the semi mechanized and mechanized processors process oil palm, though in lesser quantity (about 20%). The semi mechanized processors shares about 50% of both smallholders and mechanized processors characteristics (Ohimain and Izah, 2013), using manual energy in some processing activities like bunch reception, bunch loading on stripper, sieving and oil drying and mechanical/electrical energy for stripping, oil extraction (digestion and pressing, boiling, clarification and fiber separation (Ohimain, 2014).

Oil palm is one of the most productive oil bearing plant with diverse economic importance. Oil palm are mostly cultivated in tropical and subtropical regions. It processing in Nigeria have been source of employment to several families especially in rural areas in oil palm producing states such as Akwa Ibom, Abia, Rivers, Edo, Imo, Ondo, Bayelsa, Cross River Delta, Oyo, Ogun, Ondo, Ekiti, Anambra, Enugu, and Ebonyi. according to Ohimain. (2012), semi-mechanized palm oil mill is capable of employing 11 people which could be distributed to all their operational activities. Similarly, the smallholder palm oil mill can employ 3 – 12 persons (Ohimain, 2012). Generally, the mill that is distributed throughout the country is capable of employing millions of people (Olagunju, 2008). Authors have

reported that most operational stages (sieving) of palm oil processing are mostly carried by female while other are carried by men in southern Nigeria irrespective of scale of processing (i.e smallholder or semi-mechanized). Studies have also shown that oil palm processors in southern Nigeria is 20 – 38% and 62 – 80% female and males respectively in terms of gender (Ohimain, 2012; 2014; Ajayi and Solomon, 2010; Ekine and Onu, 2008; Soyebo, 2005).

During oil palm processing energy is required in the form of manual and thermal and mechanical energy. The thermal energy basically provides heat for the sterilization. While mechanical energy often converted to electrical energy to carry out operation such as stripping, oil extraction, and fiber separation using hydraulic presser. The energy is mechanical because is being powered by fossil fuel (diesel). This is attributable to poor electricity supply in the country and perhaps the manufacturing sectors. Unlike the smallholder mills, semi-mechanized mill is connected to the national grid but their operational activities are met by manual and fossil fuel.

Energy is basically on of the profit determinant is any production outfit of the economy. According to Jekanyinfa (2006), energy is an essential costs controllable determinants, which the impacts reflects on the profitability of such firm. Energy is required for the survival of various sectors including manufacturing, transportation, telecommunication and even the energy sector.Energy resources is an essential indicator that can be used to generate foreign exchange reserves, which the government uses for the various developmental programmes (Bamgboye and Jekanyinfa, 2007). Energy requirement for production is dependent on the size and scale of processing of the sector. For instance, during oil palm processing, mechanized processors used mechanized equipment for processing, producing high yield of palm oil at a short time. In the other hands, smallholders' processors, produced low oil at a longer time. While semi-mechanized processors falls in between the smallholders and mechanized processors. Generally during oil palm processing about 98% and 2% of energy is met by biomass and fossil fuel combusted in diesel generator/plant respectively in sterilization and oil extraction. According to Ohimain and Izah (2014a) 2219.43 - 3014.31 MJ (boiling) and 33.78 - 45.04 MJ (digestion) of biomass and fossil fuel respectively are utilized for the processing of one tonne of fresh fruit bunch by smallholder mills in Nigeria. But despite the use of manual energy in most operations, they often go unreported. Besides the work of Ohimain and Izah (2014b) on the contribution of manual energy to palm oil processing by smallholder processors in Nigeria, no other work have been focused have been focused on the manual energy requirement of semi-mechanized palm oil mill, hence the need of this study. The study also showed the gender ratio (i.e. male to female) with regard to manual energy contribution in Bayelsa state, Nigeria.

MATERIALS AND METHODS

The data used for this study is mainly from literature. Information on the number of people, time spent in each processing operation and gender from the production of 1 tonne of fresh fruit bunch of oil palm by semi-mechanized palm oil mills in Bayelsa state in Nigeria is presented in Table 1. Ohimain et al. (2014) also presented other data inventories such as number of fresh fruit bunch that composed of 1tonne (74), average weight (13.4), and volume of palm oil produced (100 liters).

Table 1. Semi-mechanized palm oil processing activities, gender, and duration of processing and number of persons that involved in the processing of 1 tonne of fresh fruit bunch

Processing activities	Gender	Time in hours	No. of persons
Bunch reception	Male	0.55	2
Bunch loading on stripper	Male	0.58	2
Sieving	Female	0.42	3
Oil drying	Male	0.50	1

Modified from Ohimain, (2014)

The manual energy was estimated based on literature values reported by Goyal (2012) cited in Sunday (2013) and Odigboh (1997) cited in Fadare (2009). The authors have reported that 0.30KW is the maximum continuous energy consumption rate at 25% conversion efficiency for physical power outfit for normal human labor at 8 – 10 hours workday to be 0.075KW in tropical climates. The manual energy was determined mathematically as;

$M_E = 0.075T.N$ (KW)

Where 0.075 is average power for normal human labor in KW; T is time spent to accomplish each processing activities in hour; while N is the number of individual involved in the processing activities.

The manual energy (KWh) obtained in each of the processing activities was multiply by a conversion factor of 3.6 to present the unit in MJ (Ohimain and Izah, 2014b).

RESULTS AND DISCUSSION

Table 2 and Figure 1 presents the manual energy contribution in the processing of 1 tonne of fresh fruit bunch in a semi-mechanized palm oil mill in Bayelsa state, Nigeria. The processing of 1tonnes of fresh fruit bunch into 100 liters of palm oil requires 1.0854MJ of manual energy. Off these, bunch reception account for (27.30%), bunch loading on stripper (28.86), sieving (31.34%) and oil drying (12.44%). The manual energy reported in this study is comparable to previous study from smallholder palm oil mill in Nigeria. Ohimain and Izah (2014b) reported that 1.2709MJ of manual energy is required in the processing of 1 tonnes of fresh fruit bunch of oil palm in Nigeria, with bunch reception accounting for 14.65%, bunch slicing (18.79%), bunch threshing (17.93%),sieving (19.96%), pressing (5.16%), fiber separation (12.07%) and fiber repressing (11.44%). Despite the manual energy being employed in several processing out fit in semi-mechanized palm oil mill, its contribution is relatively lesser than the heating values of 1kg of solid waste biomass used as boilers fuel and calorific value of 1 liters of diesel fuel. Ohimain and Izah (2014a)have reported that the gross calorific values of the oil palm processing waste biomass as16.970 – 18.537 MJ/kg (empty fruit bunch),16.472 – 21.037 MJ/kg (palm press fiber), PKS 19.378 – 21.614MJ/kg (palm kernel shell) and 15.67 – 19.88 MJ/Kg (chaff).The energy content of liter of diesel is 56.3MJ/l (Nanaki and Koroneos, 2012). This could be translated that about the manual energy is account for about 2% of the energy content of 1 liter of diesel fuel or about 5% of energy content of 1kg of oil palm processing solid waste. The study shows that semi-mechanized palm oil mill despite sharing about 50% characteristics of both smallholders and mechanized processors, the manual energy is relatively low. This indicates that over >99% of the energy used in palm oil processing are provided by biomass and fossil fuel.

Table 2. Manual energy input during the processing of 1tonnes of fresh fruit bunch by semi-mechanized palm oil mill in Bayelsa state, Nigeria

Processing activities	Energy consumption in KWh	Energy consumption in MJ	% contribution
Bunch reception	0.0825	0.2970	27.36
Bunch loading on stripper	0.0870	0.3132	28.86
Sieving	0.0945	0.3402	31.34
Oil drying	0.0375	0.1350	12.44
TOTAL	0.3015	1.0854	100

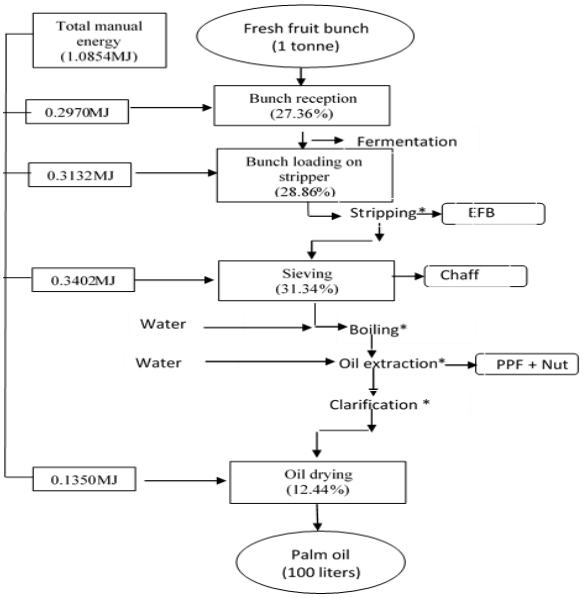

Figure 1. Flow chart for the processing of palm oil by semi-mechanized processor in Bayelsa state, Nigeria (*= operational activities that do not require manual energy)

Manual energy distribution according to gender input in the palm oil operational activities by semi-mechanized palm oil mill in Bayelsa state, Nigeria is presented in Figure 2. The manual energy contributed by men and women are 68.66 and 31.34 respectively. Women are only involved in sieving activities while men involves in several operations including bunch reception, bunch loading on stripper and oil drying. The result of this study is comparable to 32.03% (sieving and nut and fiber separation) and 67.97% (bunch reception, bunch slicing,

threshing, pressing and fiber repressing) from smallholder manual energy contribution according to gender (Ohimain and Izah, 2014b). The higher manual energy contribution by men could be attributed to the men dominance in palm oil processing in semi-mechanized mill in Bayelsa state, Nigeria.

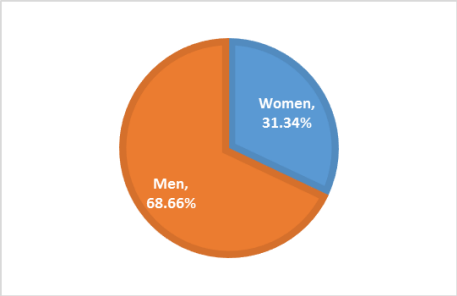

Figure 2. Contribution of gender in manual energy during palm oil processing by semi-mechanized mill in Bayelsa state, Nigeria

Conclusion

Energy is one of the basic requirement in palm oil processing. This study evaluated the contribution of manual energy and gender involvement in the processing of 1 tonne of fresh fruit bunch by semi-mechanized mill that requires manual energy (i.e bunch reception, bunch loading on stripper, sieving and oil drying) in Bayelsa state, Nigeria. The study found that 1.0854MJ of manual energy is involved. Of these, women contributes 31.34%, while men generate the rest 68.66%. The manual energy contributed in palm oil processing is significantly lower than other energy contribution such as biomass, fossil fuel and /or electricity despite its numerous contributions in different operational stages.

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