

Not really a waste! Exploring sustainable ways of managing waste from post-harvest processing of oil palm by households in Twifo Wawase community of the Central Region of Ghana

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ABSTRACT

To help achieve sustainable development and reduce the impact of improper waste disposal, all aspects of waste disposal must be looked at. This study explored how rural households, especially women (who processed palm fruit and extracted palm oil for household use) disposed of the solid and liquid residue that is left after the process. A qualitative approach with descriptive research design was used to collect primary data from study participants. Purposive sampling was used to select 20 participants (women) for focus group discussion, whereas some women leaders of the community were also interviewed to gain in-depth knowledge on the subject matter. An observation checklist was also used as data collection tools. Data collected were analyzed systematically, by taking into consideration, the various themes of the study.

Study participants indicated that the palm tree has endless value as they saw its usefulness from the fruits to the tree's kernel. It was further revealed that whereas some residents and participants would dispose of the waste indiscriminately, several other places value on the by-product as being useful. The fiber waste was either treated to be used as fertilizers or as energy fuel for domestic activities. Though the palm kernel was mainly used for palm kernel oil for cooking and other purposes, they were sometimes hoarded and sold for money to buyers although this was seldomly done due to inadequate market for it. It was therefore recommended to the local government and other community-based organizations in the district pay attention to investing in sustainable ways with which the waste from palm trees could be used as a resource in the circular economy. Groups and agencies are also recommended to further educate the women on other means to use the waste as this would not only transform the livelihood of the households by reducing poverty but also be employed as a conduit to prevent pollution and environmental degradation.

Keywords: *rural household waste; women in waste management; circular economy; sustainable development; oil palm; Ghana.*

1. Introduction

Waste in general terms can be described as the residue or by-product from a process or an activity. The world bank reports that globally about 2.01 billion tonnes of waste are generated annually with only 33% being managed in an environmentally safe manner. Vinck et al. (2019, 45) noted that as the population continues to increase around the world, so was the need to pay attention to all the types of waste generated to ensure that the harmful effect of bad disposal practices on the environment is avoided. Thus, other forms of waste generated in rural areas must be also considered. The waste materials generated out of processing agriculture crops such as palm fruits are very useful materials that can serve as raw materials for other products. These can generate a lot of income for farmers and help reduce health problems posed by improper disposal of waste.

Palm oil obtained from the fleshy mesocarp of the palm fruit (*Elaeis guineensis*) forms 35% of global vegetable oil production as well as serving as the basis for other products such as soap production. In Africa, oil palm is native to the West and Central countries and is a source of employment for people while providing food for the household. In Ghana, for instance, oil palm is one of the most important edible oil

crops with over 2.4 million tonnes of palm oil being produced each year. Paramount among this production is done by smallholder households and the post-processing done by women in small- sized mills owned by households while some use the manual way of processing the fruit. The post- harvest processing of palm oil results in the generation of solid, liquid, and gaseous waste. The types of waste produced whether at the mill for large processing factories or at the small-scale level could include empty fruit bunches (solid) and palm-pressed fibers (solid), palm nut shells and oil palm mill effluent (liquid). Oil palm is one of the dominant crops grown in Twifo Wawase, a rural community in the Twifo-- Hemang-Lower-Denkyira District of the Central Region of Ghana.

A large quantity of the fruit is sold to Twifo Palm Oil Palm Plantation while the rest is processed in mills and manually by women in various households. In the processing of the palm fruit, the generated residue is disposed of basically in the open or nearby gutters. When it rains, the rainwater pushes these wastes into nearby water bodies impacting negatively on the environment, even though the waste could have brought some benefit if it was reused or recycled. Recycling the waste from the processing by women from various households in this community could help contribute to improving their sources of income, and consequently, reduce poverty levels (i.e., contributing to the circular economy) while reducing the negative impacts of improper waste disposal on the environment and the ecosystem. The use of agricultural waste as organic fertilizer for farming due to the high costs of synthetic fertilizers and their harmful effects on the ecosystem is highly suggested (Adzawla et al., 2019; Nasution et al., 2018; Baron et al., 2018). Even though solid waste from this processing may be of no value to those disposing of it, once someone sees the need or use of the material it becomes a resource. Premised on this, this study was conducted to explore how households in Twifo Wawase manage the solid waste from the post-harvest processing of oil palm. Specifically, the study sought to answer research questions including how the waste was being disposed of, the knowledge level of respondents on the value of the waste, and lastly, the challenges that limit households in sustainably transforming the waste.

Reno (2018) noted that an element or product can be termed as waste when it is no longer beneficial to the owner or it fails to achieve its purpose with which it was acquired. A World Bank Report in 2020 noted that about 37% of waste is disposed of at landfills and 8% in sanitary landfills with landfill gas collection systems. The report continues to note that open dumping accounts for about 31% of waste, with 19% being recovered through recycling and composting and over 11% incinerated for final disposal. Although urban areas are noted for facing problems on the management of waste, rural areas are no exception. Demirbas (2011, 5) and Poku (2002, 2) explains waste management as a process where gathered waste is moved and processed ahead of discarding of any remaining excesses. For Velis (2018; 758), waste management includes collecting, transporting, regulating, handling of waste in a manner that protects the environment and people. In highly developed countries management of solid waste from palm fruit processing is far advanced. Like the case in many advanced countries, this proper management of waste could be attributed to the high level of knowledge and technology available.¹ Indonesia for instance has also established kernel factories in the country to manage the shells that result from the activity. This is not the case in most developing countries, hence, evidence of improper waste disposal, with its consequences are obvious and gloomy.

Improper waste disposal, on the other hand, has tremendous economic and health costs including the spread of sanitation-related illnesses and lost income through reduced or lost productivity and the government costs of providing health services at the household levels, loss of potential income source and health problems could be experienced due to improper waste disposal. Additionally, poor sanitation also leads to reduced income from tourism (due to the high risk of contamination and disease) and clean- up costs. In other jurisdictions, technology and education have aided the management of waste, and are done through several means by reducing, reusing, recycling, etc. (Figure 1) of some material which may have been considered as waste. To Wetherell (2003) it is essential to recycle waste so that you can at least conserve some of our natural resources for our generations to come and avoid pollution that comes with other management practices such as dumping at the landfill site. Recycling waste not only saves our natural resources but also helps save energy (Brunner and Rechberger, 2015;5). Improved environmental sanitation management reduces environmental burdens, increases the sustainability of environmental resources, and allows for a healthier, more secure future for the population (Adzawla et al., 2019, 52; Reno, 2018). For proper waste management, the hierarchy below is suggested by Demirbas, (2011) as a possible way of managing waste.

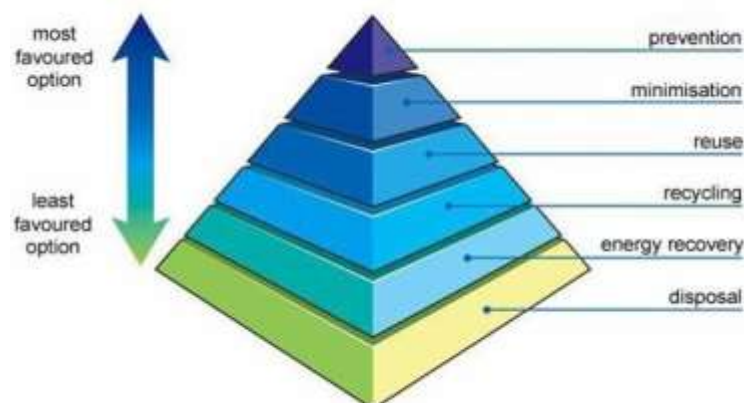


Chart 1: Waste Management hierarchy

Source: <https://www.open.edu/openlearncreate/mod/oucontent/view.php?id=80395§ion=5.2>

Based on this hierarchy, Demirbas (2011) and Ahmad et al (2005, 60) argued that waste management practices institutions could follow for efficient ways of management. The least option is disposal or dumping at landfill site without any recycling. The process of extracting resources or value from waste is generally referred to as recycling, which invariably includes recovery and reuse of the item considered waste. Different methods by which waste material is recycled exist. For instance, the raw material may be extracted, or the calorific content of the waste may be transformed into electricity (Demirbas, 2011). Mention can also be made of new methods of recycling consisting of physical and biological reprocessing. For Vinck et al., (2019, 756) reusing entails less energy as compared with recycling, though designs that are both flexible and durable are vital to its success (Reno 2018; Demirbas, 2009). Other factors, such as the consumer desire for 'newness', can conspire against reuse. In urban centers around the world, Poku (2000) noted that solid waste such as plastic bottles, clothes, cars, books, buildings, and other materials are currently either reused or sent to the trash and treasure market for further recycling. For prevention Brunner (2015) argued that, is the best waste preference is the highest point on the hierarchy although (Berkun et al., 2011) believe that this remains an imaginary level with which society cannot reach. Thus, it is impossible to prevent waste from being generated since the production of food and other commodities is yet to stop. However, Reno (2018) has opined that household waste needs to be managed effectively to address the zero waste and climate change agenda. Thus, there is a need to be a move beyond recycling into the largely unexplored territory of the higher end of the hierarchy, to reuse, reduce and prevent, with a special emphasis on eco-efficiency, where same or greater utility is done from less material input.

Post-harvest processing of oil palm

Singh et al. (2012) explained that post-harvest handling and processing refers to the stage of crop production directly following harvesting the crop. It includes activities like gathering the fruit, transporting it, and sorting it out. The primary aim of the post-harvest treatment of oil palm fruit is to generate the red palm oil and the palm nut. Apart from the mechanized way in which oil palm fruit is processed in factories, the fruit can be processed locally by households in most developing nations. In the case of household processing the fruit, Nwajiuba and Akinsanmi (2000) explained that the fruits are picked by family members and taken home for separation and parboiling. Locally, the parboiled fruits are pounded to produce a mash from which oil is extracted using a local press. The processing of the parboiled fruits is performed manually using local pestles and mortars. This is typically done on a subsistence basis.

Managing Waste from Oil Palm Processing

Seven main types of waste are generated from oil palm extraction. The first is Palm oil mill effluent (POME), a liquid waste generated mainly from oil extraction, washing, and cleaning processes in the mill and these contain cellulosic material, fat, oil, and grease, etc. POME also contains significant amounts of solids, both suspended solids and total dissolved solids commonly known as palm oil mill sludge (POMS). The solid wastes that are produced in the process of extraction are the leaves, trunk, decanter cake, empty fruit bunches, seed shells, and fiber from the mesocarp (Barison, 2007). In several factories, Empty Fruit Bunches (EFB) are used as fertilizers. According to Singh et al. (2012), Empty Fruit Bunches are usually air-dried until the moisture content reaches about 40% when it is ready to be used as fuel in the palm oil processing plant. The burnt waste is then used as fertilizer in plantations. Other than that, Empty Fruit Bunches also serve as

mulch² for plantation. This can serve as a key replacement for inorganic fertilizers hence reducing farm cost while helping in environmental conservation.

Another waste element from the processing is fibers and shells which could be used as boiler fuel for energy demand and a relevant resource in crude palm oil mills. Also, shells are key resources that could be burnt to produce steam energy or even electricity. Embrandiri et al. (2016) noted that most of the crude palm oil mills harness the energy from the shell and fiber in their low-pressure boilers and normally the oil palm trunk would be left to decompose naturally at the plantation. The utilization and generation of oil palm biomass are widely accepted and offers benefits for rural areas. It could provide avenues for employment, aiding rural infrastructure, and being used as fertilizers for the conservation of cultivated fields.

According to Izah et al. (2016, 136) biomass produced as waste in the processing of oil palm contains bio-oil, a renewable material, which is produced from biomass through a process known as fast pyrolysis. Fast pyrolysis signifies a possible route to develop the biomass to value-added fuels and a possible substitute for petroleum. Nasution et al. (2018,1032) argued that bio-oil is a clean energy source that can aid in the reduction of greenhouse gas emissions. Additionally, it is easy to use, to store, and to transport. However, Baron et al., (2018) are of the view that further work is still required to demonstrate the long-term dependability of the bio-oil. Table 1 summarizes the key waste from household and factory processing of oil palm and how these wastes could be key resources for other purposes.

Table 1: Forms of waste generated in oil palm processing and the common use pattern.

Waste elements	Uses
Fronds, trunk and Leaves	mulching agent in the plantation which helps in moisture retention. roofing material and some are processed as furniture.
Empty Fruit Bunch	As raw material for products such as panelling, composites, fine chemicals, pulp and paper as well as compost and bio-fertilizer.
Palm Press Fiber	Fuel for the mills/extraction process substrate for animal feed in addition to soymeal, fishmeal. fibreboards, coir fibre Polymeric composites for building materials for products like wall panels, sub-floors, doors and furniture parts. as potting material for ornamental plants.
Decanter cake	animal feed Used in combination with inorganic fertilizer
Palm nuts	Palm Kernel oil
Shells	Raw material for road construction in rural areas for fuel for the mills/extraction process. Converted into activated carbon for water purification purposes
Liquid from the process (Palm oil Mill Effluent)	Mainly used for irrigation purposes. However, due to its acidic nature it needs to be treated to avoid harming flora/plant life

Source: Embrandiri et al., (2016,145)

Waste management and circular economy

International institutions and government bodies in Europe, for instance, are calling for 'end of waste' structural approach to waste management and a look at how waste can serve as a resource for the circular economies around the world. This is to say that each item considered waste (from household consumption to industrial processing activities) should rather be considered as a resource that could fit into a cycle called circular economy where mediums such as recycling, reuse, and energy recovery practices can be used to transform the waste and make it beneficial to society. The European Union Science and Knowledge hub noted that for the 'end-of-waste' concept to be successful, criteria consisting of thorough techno-economic-

environmental assessments that verify when the recyclable waste material is safe for the environment and is of a high enough quality to no longer have to be classified as waste should be implemented. Thus, Velis (2018) and Vinck et al. (2019) assert that waste disposal needs to be reduced drastically but where complete disposal cannot be achieved, desirable waste management practices should be implemented and done in a controlled manner so that the negative impact on human health and the environment is reduced. This would then require for urban households to separate their waste and help waste management workers achieve this goal.

Similarly, rural household waste from fruit or crop processing can be encouraged to follow a similar trend. Thus, apart from preventing the negative improper disposal of waste on the environment, recycling and reusing solid/liquid waste from households and even bigger corporations can generate income and employment opportunities. For instance, Izah et al. (2016) reported on how recycling activities are providing income-generating opportunities for the urban poor in developing countries such as sub-Saharan Africa. It is estimated 17,000 people are involved in recycling activities around the world³. Nevertheless, the employment capacity of recycling appears to be under-utilized due to inadequate skills and funds to support this cause as well as a ready market for recycled materials (Adzawla et al., 2019). Thus, both rural and urban waste should be regarded as a conduit for livelihood improvement and income opportunities that can be harnessed while preventing environmental pollution in the same space.

Methodology

This study was based on the principles of qualitative research approach within the descriptive research design framework. The qualitative research approach was used because based on Sarantakos (2013, 38) argument, it provides tools for describing social systems in- depth. To gain in-depth knowledge, the interview and focus group discussion techniques were used to solicit information from research participants who were mainly women who engaged in the post-harvest processing of the oil palm. A total of 20 of these women were purposively sampled and participated in FGD for the study. Likewise, two 2 key stakeholders (Assemblyman and one-unit committee member) in the community were also interviewed on the effort being made to support waste management. Data collected were then manually categorized under specific themes and analyzed.

Results and Discussion

The study sought to answer research questions including how household waste from the processing of oil palm was being disposed of, whether respondents knew the value of the waste they generated, the challenges they faced in transforming the waste for profitable and sustainable use. But first, to understand how post-harvest processing of the palm fruits was done by the women, a question was asked on how palm fruits were processed.

Generally, through the focused group discussion, (twelve12 of them) noted that due to the laborious nature of the processing, they resort to the use of a local mill, whereas others resort to manual means of processing the palm fruit. This involved mortar and pestle in their various homes. With the use of the mill in Twifo Wawase, the process begins when the palm fruits are brought from the farm. The fruits are left for three days so that it can easily be separated from the bunches. When the three days are due, it is separated, half-boiled, and sent to the mill. This is followed by storing the partly cooked fruits into a bamboo basket for five days to help ferment it and to help generate more oil. This is followed by mashing, using machines in the mill. It is then cooked again and thereafter transferred into a pressed machine to help extract the oil. A similar process, according to the respondents, was done with the manual way of handling the palm fruit, however, the pressing and mashing stages are done manually by the women without machines.

Forms of waste and disposal method

The waste derived from the processing of palm fruits includes 'liquid waste' (likened to the palm oil mill effluent 'POME' in large factories), fiber, decanter cake, and palm nut which is separated manually by the women and members of their households. The participant noted that the liquid waste is usually disposed of in the bushes nearby. For the fiber obtained from the process, respondent stated that it is dried for several days after which it becomes an excellent

material to be used as boiler fuel. For instance, a 33-year-old woman noted during a FGD that *'the local press at the mill extract the oil out and after leaving the fiber in some sort of cake form with some nut in it, I separate the fiber and spread them on the floor or in a sag during the day for the sun to dry it so that I can use it as a source of fuel for my next processing or even in preparing my daily meals'*.

Those who processed it manually explained that the fiber is separated using a wooden basket or sieve and this can be used as boiler fuel later use'.

On how they dispose of the nuts. Respondents noted that they usually hoard the nuts with the hope that they could sell to buyers. However, the buyers hardly come and even if they came, the amount they offer to pay was usually very insignificant. Hence, the women often reused or recycled the nut. One respondent stated that

'I usually sell the nut to other people who use it as a raw material for producing palm kernel oil but sometimes if I do not get it in large quantities, it will not command high price so I dump it in the nearby bushes to save myself the worry (32-years-old woman).

However, some of the respondents (two of them) during the discussion stated that they knew how to transform the nut into palm kernel oil. They stated that they dry the nuts, crack and process them later into palm kernel oil while using the shell of the nut as a fire element. They also explained that the shells of the nuts are also a useful resource for the local blacksmith, so they sometimes sell the shells to them for a fee.

The participants explained that the process of making the palm kernel oil as well as processing the waste for sale is a laborious one, but the return is not worth the investment since according to them, very little income is often realized from the venture. This, they also explained could be the reason why most of the women who engage in the processing do not bother themselves treating the waste. Some do not even recycle or reuse them. In an interview with a key stakeholder in the community, it was explained that the shells and bunches can also be used to check erosion by placing them in gullies which were common in the community. Additionally, the trunk, bunches, and decanter cake from the process, according to the respondents can also be used as fertilizer by spreading them around plants such as the plantain tree. Specifically, the respondent mentioned that

'with the prices of fertilizer on the increase, I do not worry myself going to buy fertilizer for things like plantain, the trunk and the decanter cake from the processing of palm oil is a great source of fertilizer which helps crops or plans in their growth. (55-year-old -female-teacher).

The findings above agree in with most empirical studies carried out under similar circumstances and settings. For instance, Poku (2002) and Izah et al. (2016, 134) found in Nigeria, Benin, and other West African countries that wet empty bunches are partially dried in the sun and later used as fuel. Additionally, another economic use for the empty bunches was to restore it into plantation or farming areas as a mulch to enhance moisture retention and organic matter in the soil. Accordingly, the solid waste not only served as fertilizers in the palm plantations, but it was also applied in other vegetable farms as a nutrient supplement. Again, in Twifo Wawase, it was found out that shells of nut could be

used to check erosion. This confirms the studies done by Nasution et al. (2018) and Baron et al., (2019) which revealed that the residual shell of palm nuts was used for maintaining roads in plantations in Indonesia. Likewise, the findings on the shells being used as fuel material in their casting and forging operations confirm studies done by Embrandiri et al. (2016, 145) in Malaysia.

Income generated from waste management

The study found two contrasting views as to the income gotten from the waste generated from the palm oil production process. Whereas some shared that the sale of the waste such as the palm nut as well as the reuse of it was a source of some extra funds for household upkeep and that sometimes, the income generated from this source was even more lucrative generated actual palm oil business itself, others respondent, on the contrary, did not see the need for that business of selling the waste generated because of the small income generated from it. These respondents did not actually know how to reuse, especially the palm nut. According to the respondents, the only way to dispose of the waste materials like the POME since they did not know how to make them useful. Below are some of the responses: One participant noted that:

'Apart from the family using the oil for household consumption, the transformation of the nuts brings extra income from that end'. The sale of palm kernel oil for example, together with their shells can provide income which can exceed what is earned from the sale of palm oil itself (40-year-old-woman) I do not have the skills to process the nut, and selling them to buyers in small quantities brought less money so I don't worry myself; I just throw them away' (35-year-old-woman).

One woman stated that *'if I had skills or knew how to reuse the nut into other products, then I think I will be really rich because when I sell it to others, the money is very less but if it was processing it to other forms of oil, I think the price will be higher'. (62-year-old woman)*

This argument and findings could be likened to the research review paper done by Wu et al (2009, 45) who noted that many oil palm processors do not have adequate knowledge on how to use POME from the processing hence dispose of the waste. However, they noted that 'POME can be sustainably reused as a fermentation substrate in the production of a variety of fertilizers, metabolites, and animal feeds through biotechnological advances. Wu et al (2009, 45) studies in Malaysia confirmed this. Poku (2002, 6) also found

similar trends in Cameroon where the nut from the processing was being transformed into other products. Nonetheless, Poku (2002,6) also noted that a large part of the waste was left at the dumping site due to issues like inadequate ready market and meager income from the sales.

Current management and problems associated with it.

The study found that the current disposal method has had some environmental and health consequences. The POME that is disposed of into nearby bushes breeds mosquitoes and produces unpleasant smell or stench. Moreover, when the palm press fiber is left for so many months without use, it also harbors some insects and makes the processing areas an uncomfortable place to stay. Respondents agreed that they were not satisfied with the current form of disposal but were quick to add that with more training, they could acquire knowledge about how to effectively manage the waste. Although all the respondents were willing to adapt to new ways of managing waste, only a few of them were willing to pay for the training. The majority suggested that the local assembly could come in and give them knowledge and training on how best to utilize the waste properly or transform them into something useful. To the women, any help from any agency or organization in the processing of the palm oil itself to make it less laborious it would be welcomed. The research participant also argued that if the lack of ready market for the processed waste is reduced and the local authorities or even the district assembly helps bring in potential buyers, then they would be motivated to engage in recycling the waste and putting them into good use. Similar findings have been reported in Cameroon and Nigeria where women earned income from the sale of recycled waste from the processing of Palm oil (Poku 2002, 10). Singh et al. (2016,

424) and Baron et al. (2018, 24) had also noted from their studies that recycling of waste continue to provide income and job opportunity for the people around the world especially in urban poor areas.

Conclusions and policy implication of the study

From the study, it can be concluded that oil palm is produced mainly on a small scale in Twifo Wawase and this is done by women in households. During post-harvest processing, the palm oil mill is the dominant means by which oil is extracted by these women while the manual methods of processing are gradually diminishing. The waste from the processing of oil palm is mainly reused as raw material for other processes including using them as a household fuel. Although a huge part of it is dumped at the dumping site. This is attributed to factors such as not having any idea about how to manage it effectively while for some; the inadequate readily market for the recycled product is a disincentive to them given the laborious nature of the recycling process. It was found out that, some amount of income is generated from the reuse of the waste. The study also brought to light the fact that the oil palm processors are willing to adapt to new ways of managing the waste although most suggested that the cost of the training should be highly subsidized by the government. It was also established that no effort has been made by various stakeholders in managing the waste in this area. Thus, the waste is managed on an individual basis. Based on the above findings, Chart 2 summarizes how society will benefit if this waste is considered as a resource and fused in the circular economy being proposed.

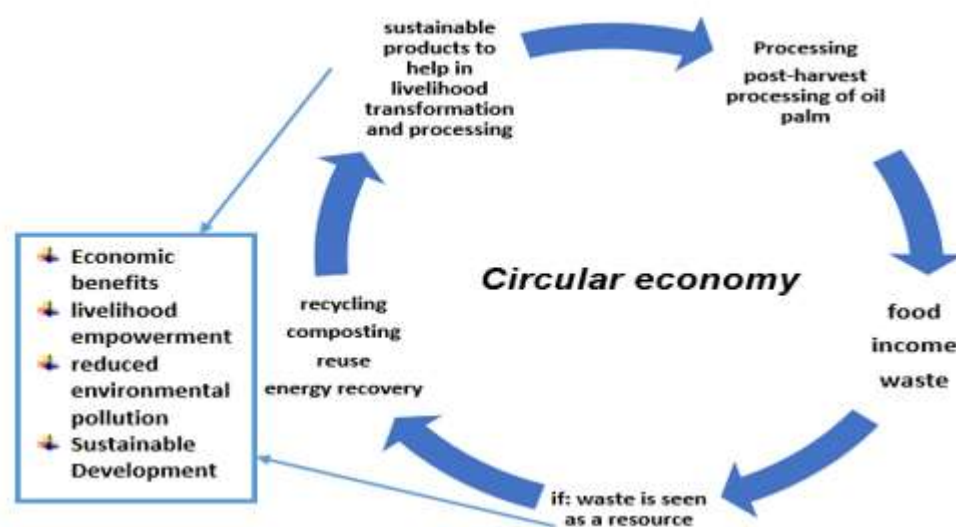


Figure 1: Post-harvest processing of oil palm in rural households and its linkage to circular economy

Source: Author's construct.

It is further suggested and recommended that there needs to be a paradigm shift in waste management. It is recommended that since most of the women spoken to are willing to adopt new ways of effectively managing waste and there are abundant of these waste in Twifo Wawase, stakeholders such as the local government, community-based organizations and other NGO's are encouraged to design programs that will help train them to assist in the efficient management. The concept of waste to be regarded as a resource of value that could help contribute to the circular economy is highly useful in this context. If community-based organizations that are keen to help bring sustainable development and curb improper disposal of waste that affect the environment (including the flora element of the area) show interest and help these women and help the several others who engage in this post-harvest processing, then the negative effects could be curbed. Again, paying attention to this waste materials and helping to establish a ready market for the products can go a long way of helping to reduce the level of poverty in the area as income will be gained from the process.

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