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Eco-friendly Practices on Utilization of Oil Palm Waste

Oil palm not only high in its oil production, but also produce large quantity of agriculture wastes like oil palm leaves, empty fruit bunches and trunk. The more fibrous wastes generated from empty fruit bunch, leaves etc. are generally make use in different purposes like a mulching of leaves around the palm basins to conserve moisture as well to add organic matter to the soil. For production of biodiesel and biofuel the oil palm byproducts like shells, trunks etc. waste matter produced from oil palm. The organic rich waste products of oil palm can be utilized for electricity generation, piggery industry, as a fuel in boilers as an eco-friendly fuel and in many ways. The waste generated from the palm oil mills like decanter cake, empty fruit bunches after oil extraction, waste water from mill, mesocarp fibre, left over kernel cake after oil extraction, shells etc. byproducts plays an important environmental effects globally. As a consequence over there, the oil palm waste management in different stages is very essential to tackle this waste eco-friendly.

INTRODUCTION

A perennial oil yielding Oil palm (*Elaeis guineensis*) a West African originated plantation crop which rules the world by its high oil productivity nature. This palm initially introduced to India as an ornamental crop later by understanding its oil production behavior, started growing as a commercial oil yielding perennial oil yielding crop. Nearly 98.8% of the income generation generated from



palm oil based oil products like crude palm oil (CPO), palm kernel oil (PKO), oleochemicals, organic matter and biodiesel. The remaining 1.2% of the worth found in the palms waste byproducts. On an average, 53 million tons of oil palm waste production annually with a 5% each year growth projection.



Oil Palm Leaf Mulch



Oil Palm Trunk

One hectare of oil palm planted area produces approximately more or less 10.40 tonnes of leaves and 74.48 tonnes of trunk (Loh, 2017). Cellulose, hemicellulose and lignin are the three main components of oil palm biomass. Palm oil wastes contained substantial amount of nitrogen, calcium, potassium, sulphur, chlorides and extremely less phosphorus content. The composition of oil palm leaf and trunk varies, depending on palm age, agro climatic region and nutrients availability.

Components	Leaf	Trunk
Cellulose (%)	44.46	50.78
Hemicellulose (%)	23.53	30.36
Lignin (%)	17.20	17.87

WOOD CHIPS

After certain age the palms are going to uproot, the uprooted trunk make into chips by using chip bucket. The sizes of wood chips may vary based on

preference of the user. These chips can be used as a fire wood, after decomposing as an organic fertilizer, making paths etc. other uses.



Wood Chip

WOOD PELLET

Wood Pellet is currently the most widely used form of biomass fuel and produces a very low ash content, it provides the best environment for producing maximum heat efficiency, keeping costs down and energy production up.



Wood Pellet

EMPTY FRUIT BUNCH (EFB)

Empty Fruit Bunch is an excellent biomass fuel choice for the sizably voluminous power plant and centralized steam boilers with instant advantages of lower price for a little less calorific value. The left over EFB after oil extraction can be recycled as organic mulch in the oil palm orchards. Mulching with this EFB conserve soil moisture, weed control, reduce soil temperature and additionally escalates soil pH, micro and macro nutrients, hence, amending the potential yield of the oil palm as well other crops. The EFB after proper drying burn it and the extracted. This ash is a rich source of potassium so this can be used as an organic fertilizer.



Empty Fruit Bunches Mulching

PALM MESOCARP FIBER (PMF)

After oil extraction in palm oil mill the left over fibrous material from mesocarp is known as PMF. After separation of fruits from the bunch during oil extraction, the left over materials are empty spikelets and stalk. The empty spikelets are more fibrous and having more tensile strength than the stalk. Empty stalks and spikelet are rich source of calcium and sulphur. The mesocarp fiber richer in cellulose and lignin these fibers are the wastes that contain the most ammonium and nitrates.



Mesocarp Fiber



Empty Spikelets

Empty stalk

BIOENERGY

High-value byproducts like biofuel produced from the fronds and trunk of oil palm is a potential source of lignocelluloses. The biofuel generated from oil palm biomass is less expensive and eco-friendly biofuel with less carbon release.

BIO-BASED CHEMICALS

Different useful chemicals like lactic acid, Succinic acid, oxalic acid, furfural, 2,3-butanediol, xylitol and levulinic acid produced from oil palm fronds and trunk. These multiple chemicals generated from oil palm biomass may be used for different industrial purposes.

FERTILIZER AND ANIMAL FEED

Oil palm kernel waste after oil extraction has a higher nutritional value compared to other waste generated from oil palm. Kernel waste has 15% of protein content with 4.230 kcal/ kg of energy so that it can be used as a concentrate animal feed in different forms.

PALM OIL MILLING WASTES

Fiber, kernel shells, empty fruit bunches and other solid wastes are the waste by-products left over after crude palm oil extraction in palm oil mills. Available milling wastes having significant multiple uses economically as listed.

Milling waste	Usage
Empty fruit bunches (EFB)	<ul style="list-style-type: none"> • Power generation • Mulching • Composting • Burning • Reinforcement • Bio-oil • Biochar
Solid waste	<ul style="list-style-type: none"> • Palm Press Fiber • Kernel shell • Burning • Bio-oil • Bio-char • Reinforcement • Extraction of bio-active compounds • Cattle feed

PALM PRESS FIBER

This fiber is oily in nature and generated after the palm oil extraction in mills. Some industries extract oil from the left over palm press fiber and can be used for soap making etc. This fiber can be used as a mulching in field to conserve soil moisture.

BIO-OIL

The engendered oil palm byproduct under quick pyrolysis of biomass is known as bio-oil. The chemicals like phenols, furans, ketones, alcohol, acids, and pyrans are present in bio oil which is produced from EFB. Bio-oil can be utilized as fuel in various engines, gas turbine, and boilers after up gradation. Bio-oil is potential energy product which can be worked as substitute to fossil fuel.

BIO-CHAR

The charcoal product produced after decomposition of oil palm biomass under high temperatures is known as Bio-char. This product is rich in carbon so this can be supply to soil to enrich soil fertility and nutrient retention capacity of soil.

BIOGAS

After oil extraction oil palm waste biomass can be recycled to provide green energy such as biogas. This biogas can be utilized for multiple purposes.

PALM OIL MILL EFFLUENT (POME)

Palm oil mill effluent (POME) is a high-strength wastewater with a lot of organic matters. During the crude palm oil extraction process in mill POME is produced. It is used as an organic fertilizer in plantations after being treated at our waste water treatment pond to reduce acidity, levels of BOD (Biochemical Oxygen Demand) and COD (Chemical Oxygen Demand). By using methane capture technique POME can also be used as biogas energy.

PALM KERNEL SHELL (PKS)

The unprocessed form of PKS is readily applicable to boilers and furnaces as a fuel. These PKS having multiple uses if we able to make use of it.



Oil Palm Shell

OIL PALM SHELL CHARCOAL

The oil palm shell after kernel extraction having high calorific oil and with low ash content. The charcoal

from oil palm shell also having very high calorific value and can be utilized in different occasions like contaminated water refinement, industrial deodorization and air purification.



Oil Palm Shell Charcoal

PALM KERNEL CAKE (PKC)

The left over PKC after oil extraction can be used as cattle feed and has been shown to be a very promising source of energy and proteins. This PKC can be utilized in piggery, cattle, poultry industries as a substitute of nutrient supplements.

LIGHT WEIGHT AGGREGATES (LWA)

Palm oil mill waste materials such as oil palm shell as LWA can be used as potential construction material for building and roads as a freely available, cost saving and design flexibility substitute.

CONCLUSION

The renewable oil palm biomass after crude palm oil extraction can be made use in different value added products like bio-composites, road constructions as a substitute of concrete roads, construction board fillers, plywood manufacturing, paper industry, furniture woods, eco-friendly crockery items, electricity generation, poultry and piggery feed, soil organic matter etc. furthermore countless other purposes.

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