Implementation of Green Supply Chain Management Toward Utilization of Palm Oil Waste

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Abstract. Green Supply Chain Management is a supply chain business model that involves an economic and sustainable business practice through environmental-friendly plants. This model is seen to improve the performance of an industry by reducing environmental risks and impacts, efficiency of ecology. Palm oil industry is considered as a big business but has generated a large volume of waste. This research was aimed to discover how to become more sustainable in managing and utilizing the palm oil industry waste. This research used a literature review method and the data is sourced from secondary data. This research found that the waste of the palm oil industry can promote waste management and convert from an evil to a necessity to maintaining the environment and sustainable economic development.

Keywords: Green Supply Chain Management (GSCM), Palm Oil Waste, Sustainable Development.

INTRODUCTION

This warning about the increasingly acute role of the environment in the modern era relates specifically to waste. The palm oil industry, which is the backbone of the largest economies in many countries, including Indonesia, generates significant amounts of palm oil waste. Palm oil waste is a source of pollution and exploitative use of natural resources. If not managed properly, the waste generated can cause significant problems in the environmental ecosystem, ranging from water to soil pollution. On the other hand, there is great potential to turn palm oil waste into a valuable resource against all odds. The palm oil sector is the “food industry” that contributes most to economy-wide growth, accounting for about 42 percent of the world's total vegetable oil supply. In fact, its global market share reaches 60%. That is why palm oil is not only a staple commodity, but also a determinant of national economic stability. Each ton of oil palm produces waste in the form of empty bunches as much as 23% or 230 kilograms which will decompose within 7-15 months; shells as much as 6.5% or 65 kilograms; wet decanter solid as much as 4% or 40 kilograms; fiber 13 or 130 kilograms; and 50% liquid waste. The research object used consists of various macro and micro nutrients that are important for plant growth. The content of TKKS in the tested liquid waste reached 42.8% C, 2.9% K2O, 0.8% N, 0.22% P2O, 0.30% MgO and 23 ppm Cu, and 51 ppm Zn.

In recent years, awareness of environmental sustainability has increased significantly. This pressure has led palm oil companies to seek more environmentally friendly approaches to processing their production waste. One solution that is gaining popularity is green supply chain management. Green supply chain management (GSCM) is a way

to integrate environmentally responsible principles into the management of supply chain operations. This means reducing supply chain operations, replacing materials with environmentally friendly options, using renewable sources of energy, and so on. The implementation of palm oil GSCM demands that every responsible environmental principle be incorporated into the company's operations. The most important thing about GSCM is to use environmentally friendly supply chain principles that reduce, mitigate, and avoid negative effects on the environment. This is in line with research conducted by [1], namely the main aspect in the green supply chain is to improve performance from two aspects, namely economic and environmental. GSCM has the aim of eliminating waste in the supply chain or supply chain which includes energy, emissions, hazardous chemical gases, and waste.

Palm oil waste is often regarded as a useless by-product. But in fact, this waste has economic potential that can be used. Many efforts have been made to convert palm oil waste into welfare-labeled products. This study will identify and evaluate the potential of usable palm oil waste and analyze the economic impact for the community.

METHODS

In this study, researchers used a literature review approach to gain a more comprehensive understanding of the application of green supply chain management by utilizing palm oil waste. The type of data used in this research is secondary data, conducting a comparative analysis of previous studies. The information in this journal is only secondary data and then obtained from journals in 2024 which are sourced from legitimate and relevant websites, road information is taken which is described and explained in full. This research of course only looks at efforts to utilize palm oil waste.

RESULTS AND DISCUSSION

Palm oil waste, which is often considered a problem, actually holds great potential to be processed into various value-added products. The organic components contained in it can be used as energy sources, industrial raw materials, and organic fertilizers as follows.

Utilization of Palm Kernel Meal as an Alternative Animal Feed

Research conducted by [2] innovation that can be used is to use palm oil waste as a substitute for corn and rice bran. Utilization of palm kernel cake (BIS) which is a by-product of the palm oil industry where from the nutritional content obtained BIS is very suitable to be an alternative animal feed seen from the nutritional content and is easily available at a relatively cheaper price. research using linear programming method to determine the optimal composition in the preparation of this animal feed ration. The objective function of this model is the minimization of the price of animal feed rations. Before the model is used, verification and validation of the model is carried out which is useful for testing the suitability of logic and compatibility with the real system. The results of the model that has been made can reduce the production cost of animal feed rations by 11% where the actual condition is Rp 6,800 and the model obtained is Rp 6,114 where the nutrition obtained is relatively the same as the actual condition.

Utilization of Palm Fronds and Cow Dung into Charcoal Briquettes as Alternative Fuel

Research conducted by [3] on the accumulation of cow dung and palm fronds which are solid biomass waste produced throughout the year by oil palm plantations and livestock businesses which are biomass waste is processed and utilized by making charcoal briquettes as an alternative fuel. The method of implementing this activity is participatory counseling, practice or training and mentoring, until the product can be continuously produced and ready to be marketed. The making of charcoal briquettes starts from the stages of drying the main

raw materials, charring the raw materials, grinding, mixing the ingredients with adhesives, printing briquettes, drying the briquettes again, testing the quality, and packaging. The final results of the activities carried out show that 1) successfully disseminating technological innovations in processing livestock and plantation waste that are appropriate and simple and applicable in the field, 2) training participants or members of partner groups are involved and play an active role in all activities ranging from counseling to practice and training, and 3) the resulting charcoal briquettes meet SNI standards so that they can become a renewable energy source for the community to meet their daily needs.

Utilization of Palm Oil Empty Bunch Waste into Oyster and Merang Mushroom Growing Media

Research conducted by [4] Oil palm empty bunch waste can be used as a basic material for making mushroom growth media. The implementation method used is Forum Group Discussion (FGD). The results obtained can be stated that the community has an increased understanding after participating in educational activities. Community education on the utilization of palm bunch waste is not only important to reduce its negative impact on the environment, but can also create new opportunities for economic growth and sustainable development. This project has increased community awareness of the benefits of palm bunch waste as a medium for mushroom cultivation. In addition, this cultivation business can increase the commercialization of oyster mushrooms and merang mushrooms.

Utilization of Chopped Palm Fronds as Alternative Feed for Cattle

Research conducted by [5] Utilization of palm frond waste into green feed additives or substitutes can increase the growth of cattle with the silage method. utilization of appropriate technology for palm frond chopping machines with the use of alternative green feed palm frond waste into a mixture or substitute in the silage process for the problem of the lack of availability of green feed sources in the form of wild grass, which often occurs during the dry season. This research is expected to increase the income of farms that previously had difficulty meeting the volume of feed needs, because the fulfillment of feed needs will help increase the growth and development of cattle, and can estimate the desired target weight of cattle.

Utilization of Palm Oil Empty Bunches as Compost Fertilizer

Research conducted by [6] Palm oil processing into palm oil which produces solid waste in the form of empty palm bunches which are managed into compost fertilizers needed by plants as natural nutrients. The research method uses the experimental method. The results showed that palm oil empty bunches can be processed into compost using EM4, sugar, sawdust, rice washing water, and manure by fermentation.

Utilization of Palm Oil Mill Solid Waste as an Alternative Planting Media in Oil Palm Nurseries

Research conducted by {7} utilization of palm oil waste to determine the growth response of oil palm seedlings with solid application as an alternative planting medium in the main nursery. This study used a non-factorial group randomized design with 4 repetitions, with a total of 48 samples. The application of palm oil mill solid waste has a significant effect on several parameters observed, namely stem diameter, number of leaves, and root dry weight, while the observations for the parameters of plant height, crown wet weight, crown dry weight, root dry weight and number of primary roots have no significant effect. The data obtained were analyzed statistically with analysis of variance (ANOVA). Based on the results of the research conducted, the best application of palm oil mill solid waste in its utilization as an alternative planting medium is in the S4 treatment, where the dose of subsoil soil is 20% (2 kg) and the dose of solid waste is 80% (8 kg). Where in this treatment has a real effect on the development of the number of leaves, root wet weight, crown wet weight, root dry weight, and crown dry weight.

Utilization of Palm Oil Empty Bunches as Bioethanol

According to research conducted by [8] one of the by-products of oil palm is palm oil empty bunches which shrinks up to 23% of one fresh fruit bunch. Palm oil empty bunches it self is waste from palm oil processing that contains lignocellulose which has the potential to be further utilized into bioethanol. Bioethanol production from palm oil empty bunches uses the SSCF method with Saccharomyces cerevisiae and Scheffersomyces stipites

microorganisms. The use of palm oil empty bunches waste as bioethanol is economically and technically beneficial, because it is able to reduce waste while producing products that have a higher selling value. The plant is designed with three main processes, namely pre-treatment, fermentation, and purification. Later, from 11,936 tons/year of palm oil empty bunches, 5,000,000 L/year of bioethanol products will be produced, which can meet 2.4% of national bioethanol needs. Assuming 330 days of operation, the plant will be established in Dumai Industrial Estate, Riau in 2027. Economic results show that this plant has a Capital Expenditure (CAPEX) value of Rp133,995,418,843, Operational Expenditure (OPEX) of Rp45,759,391,627, with Net Present Value (NPV) of Rp155,179,870,172, Internal Rate of Return (IRR) of 19.62%, Pay out Time (POT) of 5.23 years and Break Even Point (BEP) of 52.52%.

Utilization of Palm Oil Empty Bunches as an Alternative for Making Printer Ink

Research conducted by [9]. Palm Oil Empty Bunches have a high enough use value because there is fiber content in them. In this research, the utilization of palm oil as a raw material for organic pigments for the manufacture of printer ink is carried out. The organic pigment method in this research is made from Palm Oil Empty Bunches with several stages, including crushing the material with a machete, drying it with sunlight, carbonization (charring) process at 450 ° C using a series of carbonization tools, smoothing Palm Oil Empty Bunches charcoal (carbon), sieving carbon powder with a T200 mesh screen and the stage of making printer ink which is done through mixing Palm Oil Empty Bunches carbon with distilled water, alcohol, and gum arabic. The ink produced will be tested for viscosity, light transmittance test, adhesion test, density test, and ink performance test. The results of this research show that the optimum printer ink product is obtained at a mass composition of 2 g of carbon with 5 mL of alcohol, which is mixed with an adhesive material in the form of 3.5 g of gum arabic in 22.5 mL of distilled water. The print, transmittance and adhesion test results are in accordance with the Indonesian National Standard (SNI), although the viscosity test needs to be further investigated.

Utilization of Palm Stick Waste as Plaiting Plate

Research conducted by [10] The results of research observations have contributed to agricultural production in the region, but there are still obstacles in managing agricultural waste. These wastes, especially those from palm oil farming activities have not been processed properly. The purpose of this research is to improve partner skills by utilizing palm stick waste into products of economic value. The method used in this service is the community participatory method. Training was carried out with theory and hands-on practice of making palm branch sticks into woven plates. The results of this program include a significant increase in partner knowledge and skills related to processing agricultural waste into high-economic value products in the form of woven palm sticks. 35 partner members or 87% are able to make plaits and start marketing offline and online.

Utilization of Palm Kernel Shell Waste as a Substitute Material in Concrete Mixtures

Research conducted by (11) alternatives to making concrete through the utilization of waste as an additional material and substitute for conventional concrete. In this experiment, fine aggregate was varied using glass waste with a percentage variation of 5%, 10%, 25%, 50%, 75%, and 100%, as well as coarse aggregate varied using palm shell waste with a percentage of 10%. The binder was also varied by using 15% type C fly ash, and Portland cement. The results of aggregate characteristics showed that all aggregates met the specifications set for concrete. The use of glass waste, palm kernel shells and fly ash has an impact on strength. The greater the variation of glass waste used, the strength of the concrete decreased. Although there was an increase in compressive strength at 7, 14, and 28 days for each variation, only the 0% and 5% variations met the MPa requirement every day. The optimum compressive strength was achieved in the 5% variation with values of 26.5 Mpa at 28 days, 23.1 Mpa at 14 days, and 17.2 Mpa at 7 days. This success is due to the use of glass waste which does not significantly reduce the use of fine aggregate, thus allowing the concrete to meet the desired compressive strength. In addition, water absorption by glass waste is also relatively low compared to other variations. Based on the results, the optimal use of glass waste and palm kernel shells in the manufacture of environmentally friendly concrete is at levels of 36.39 Kg/m3 and 103.76 Kg/m3 respectively. This discovery contributes to efforts to reduce the use of natural raw materials and create sustainable solutions for the construction industry in Indonesia.

CONCLUSIONS

From the results of the discussion and discussion above, it can be concluded that oil palm waste has enormous potential to be used as raw material for various value-added products, namely the utilization of oil palm empty bunch waste as a growing medium for oyster mushrooms and merang mushrooms, alternative planting media in oil palm nurseries, bioethanol, alternative materials for making printer ink, compost, and alternative animal feed ingredients. Utilization of oil palm fronds processed into charcoal briquettes as alternative fuel, as well as alternative fertilizer for cattle. Then the processing of palm stick waste as the main reference in its utilization, namely woven plate material. The last processing of palm oil waste is the utilization of palm kernel shell waste as a mass of concrete mixture.

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