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A Case Study of MSMEs' Involvement in Palm Oil Waste Management

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Abstract - *The transition of palm oil Micro, Small, and Medium Enterprises (MSMEs) toward green practices plays a vital role in achieving Indonesia's carbon emission reduction targets. This paper investigates the transformation process of palm oil MSMEs from traditional, carbon-intensive operations to environmentally friendly models. Employing a qualitative approach, the study identifies drivers, barriers, and strategic actions undertaken by MSMEs in the palm oil sector. Findings reveal that challenges such as limited access to green technology, inadequate support systems, and low sustainability awareness persist. However, opportunities arise through institutional frameworks, innovation in waste utilization, and increasing demand for sustainably produced palm oil products. This study offers a framework to support green transitions among palm oil MSMEs, contributing to climate and economic goals.*

Keywords - *Case Study, MSMEs, Palm Oil, Waste Management*

I. INTRODUCTION

Indonesia has agreed to reduce greenhouse gas emissions by 31.89% by 2030 [1], [2]. The agreement, which is part of the Enhanced Nationally Determined Contribution (NDC), emphasizes green transformation across sectors, including palm oil. Its massive activities cause the palm oil industry to be associated with deforestation and environmental degradation[3], [4]. This industrial activity involves many MSMEs in their activities ranging from upstream to downstream. In aggregate, MSME activities greatly contribute to producing emissions [5]. This study emphasizes the green transition of MSMEs in the palm oil sector which can significantly support Indonesia's low-carbon development goals.

The palm oil sector in Central Sulawesi Province is one of the leading commodities that has experienced significant growth in recent years. Central Sulawesi has a large oil palm plantation area managed by large companies and independently [6], [7]. The palm oil industry is proposing vast new palm oil plans encompassing around 1 million hectares of new plantations across the Indonesian island of Sulawesi [8]. Indonesia palm oil lobby pushes 1 million hectares of new Sulawesi plantations, indicating the strategic importance of this region for palm oil development. The development of increased palm oil production can be an economic opportunity and the waste from the transformation is also increasing [9], [10].

The waste produced by the palm oil industry consists of several types of waste, including empty fruit bunches (EFB), palm kernel shells, palm mill waste (POME), and other by-products [11]. The resulting waste can be used for subsequent product transformation. MSMEs can play an important role in turning waste into high-value products [12], [13], [14]. However, they are often faced with structural challenges, so their involvement is still very limited. The process of transforming palm oil waste requires capital investment in the fields of processing equipment, technology, and infrastructure [3], [15].

MSMEs are still struggling with financial resources, so they are hampered by the inability to invest in advanced waste management technology [16], [17]. In addition, palm oil waste treatment also requires specialized knowledge of treatment technology, market demands, and quality standards. MSMEs are generally still constrained in gaining access to technical expertise and training programs that allow them to participate [18]. Another challenge is that MSMEs' final products often face limitations in terms of marketing and distribution [18]. MSMEs are limited in distribution networks, and their products do not have certification standardized by the market.

Difficulties in coordinating the responsibilities of various levels of government remain a challenge. The development of small palm oil in Indonesia requires strong institutional pressure to provide a place for MSMEs to participate in using palm oil industry waste [12]. The palm oil industry is facing increasing pressure to address environmental issues. The important socio-economic and environmental impacts of the palm oil

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sector remain unresolved, including conflicts over land tenure, biodiversity loss, air pollution and greenhouse gas emissions [19].

Effective waste management through the participation of MSMEs can contribute to overcoming these sustainability challenges while creating economic opportunities [9]. The palm oil industry can produce waste that can be used as raw materials for various industries. Export activities that have increased by almost 60 percent produce palm oil waste. This is an opportunity to develop the processed waste MSME business into new derivative products, namely, products such as biofuels, animal feed, building pairs, and other value-added products [20], [21]. Central Sulawesi Province is very strategic in increasing the role of MSMEs in this area to take part in the development of waste that is used as a new value-added product. Local governments can inclusively develop this opportunity for MSMEs to minimize environmental impact through effective waste management. This background establishes the foundation for examining why MSMEs remain underrepresented in palm oil waste management despite the apparent opportunities, and what interventions might be needed to enhance their participation in Central Sulawesi's palm oil value chain.

II. LITERATURE REVIEW

A. Conceptual Framework of Green Economy

The green economy is increasingly seen as the foremost paradigm for sustainable development, indicating a fundamental shift from traditional economic models to growth patterns that are environmentally sustainable and socially inclusive [22], [23]. According to the United Nations Environment Programme (UNEP), a green economy promotes human well-being and social equity, while greatly reducing environmental dangers and ecological deficiencies [24]. This conceptual framework includes multiple dimensions, such as resource efficiency, low-carbon development, biodiversity conservation, and mechanisms for inclusive growth [25]. The green economy is underpinned by a variety of economic perspectives, such as ecological economics, environmental economics, and sustainable development theory. Recent research has embraced complex systems thinking, acknowledging that the shift to a green economy encompasses interrelated social, economic, and environmental transformations that necessitate coordinated policy actions and involvement from stakeholders.

B. Low-Carbon Transition

Strategies for decarbonizing various economic sectors are the focus of the low-carbon transition, which is an essential component of the green economy framework [26]. Recent systematic literature reviews have identified significant barriers to low-carbon energy transitions, which can be categorized into five main dimensions: social, economic, environmental, technical, and institutional challenges [27], [28]. Seventeen challenges to the transition to low-carbon energy were identified and categorized into social, economic, environmental, technical, and institutional categories. This dialogue shows how complicated the transition is. Due to the complex nature of these challenges, it is vital to have a deep understanding of them and to offer coordinated responses that encompass multiple levels of governance and economic activity.

C. MSMEs in Green Economy Transitions

Micro, Small, and Medium Enterprises (MSMEs) are crucial to the transition to a green economy, embodying significant opportunities as well as substantial challenges [29]. MSMEs (micro, small, and medium enterprises) continue to be the driving force behind growth in numerous emerging economies, underscoring their significance for economic advancement and their possible contribution to fostering sustainable growth models [30]. MSMEs are essential stakeholders in any thorough strategy for transitioning to a green economy. Nevertheless, MSMEs encounter difficulties when it comes to implementing sustainable practices and engaging in low-carbon transitions [25], [27], [31]. SMEs encounter difficulties in adopting green practices and seizing new green opportunities because their access to knowledge, technology, and financial resources is limited. The limitations obstruct MSME involvement in green economy opportunities, which may restrict the scope and effectiveness of wider sustainability transitions.

D. Sectoral Applications and Waste Management

Recent studies have put more emphasis on the application of green economy principles to sectors, such as waste management. In the waste management sector, especially in developing nations where waste management systems are often inadequate and the informal sector is significant, there are distinct opportunities for MSME participation in green economy transitions [32], [33], [34]. Waste management of palm oil is a specific area where the tenets of a green economy can be put to good use. It is consistent with circular economy principles to convert waste from palm oil into higher-value products, and this can create economic opportunities for MSMEs while addressing environmental problems associated with palm oil production [9], [35]. The literature shows that supportive policies are essential, along with targeted initiatives focused on capacity building and innovative financing, for the successful integration of MSMEs into transitions to a green economy [36], [37]. In developing countries, micro, small, and medium enterprises (SMEs) are regarded as a key engine of economic growth, underscoring the need for policies that promote the participation of MSMEs in sustainable development efforts.

III. METHODOLOGY

A. Research Design

This study examines MSMEs involved in palm oil processing and by-product innovation in Central Sulawesi using a qualitative descriptive methodology and multiple case studies. This choice of methodology aligns with the aim of the research, which is to comprehend the intricate phenomenon of limited MSME involvement in palm oil waste management in its natural context. Researchers can use qualitative case study methodology to explore complex phenomena in their contexts. This makes it particularly suitable for investigating the various challenges and opportunities that MSMEs face regarding palm oil waste management.

B. Study Subject

This research examines micro, small, and medium enterprises (MSMEs) within the palm oil industry that engage in or are impacted by waste management practices. Study subjects were deliberately selected, focusing on MSMEs that either produce palm oil waste or have begun managing it through methods like reuse, recycling, or conversion into value-added products. Participants include business owners, employees, and managers who are directly involved in the operational or environmental facets of the businesses.

C. Interview Outline

The semi-structured interview guide was developed to explore four main themes: (1) What waste management practices are currently in use? (2) How does awareness and understanding of the environmental effects of palm oil waste manifest? (3) What motivates and adds complexity to the implementation of sustainable waste management? (4) How important is the backing of institutions and the engagement of stakeholders, such as government and community involvement?

D. Data Collection

In-depth interviews with key informants from selected MSMEs were used to gather primary data. Depending on accessibility and respondent availability, interviews were conducted in person and/or virtually between [insert month and year]. With consent, each interview, which lasted approximately 45 to 60 minutes, was recorded for transcription purposes. The secondary data were collected from policy documents, reports from local government, and MSME profiles.

E. Data Analysis

The data were subjected to thematic analysis, specifically the approach devised by Braun and Clarke (2006). The procedure consisted of six steps: familiarizing oneself with the data, generating initial codes, identifying themes, assessing themes, clarifying, and tagging themes, and compiling the report. Using NVivo software, the qualitative data was organized and coded. Credibility was established through data source triangulation, member checking, and peer debriefing.

IV. FINDINGS AND DISCUSSION

A. Results

This research included interviews with four MSMEs focused on processing waste from palm oil. The interviewees have between 5 and 12 years of experience in managing palm oil waste in a business context. The traits of the informants are shown in Table 1. An analysis of the interview transcripts and supporting documents identified four key themes that demonstrate how palm oil MSMEs engage in waste management. Table 2 provides a summary of quota copies.

Theme 1: Waste Management Practices among MSMEs

Within the palm oil sector, the majority of MSMEs employ basic waste disposal methods that prioritize minimizing operational disruptions over considering environmental factors. Although a few MSMEs have begun employing basic waste segregation methods, only a small number utilize more sophisticated techniques, including composting or converting palm waste into by-products such as briquettes or organic fertilizer. Limited resources and a lack of technical expertise remain significant barriers.

Theme 2: Awareness and Environmental Perceptions

MSME actors exhibit varying levels of environmental awareness. Some demonstrate a significant worry about environmental impacts and suggest a willingness to implement enhanced waste management practices. Nevertheless, many individuals regard waste as a trivial issue and prioritize production output instead. Cultural attitudes and limited exposure to environmental training contribute to inconsistent perceptions of the environment among different enterprises.

Theme 3: Challenges in Implementing Sustainable Waste Management

Key difficulties include inadequate infrastructure, limited financial resources, and weak enforcement of regulations. Many MSMEs operate in the informal sector and do not have access to structured waste management guidance. The absence of incentives and the difficulties related to obtaining green technology further discourage long-term investment in sustainable practices.

Theme 4: Institutional and Stakeholder Involvement

Collaboration between MSMEs and local governments or environmental agencies is minimal. Most of the support derives from community initiatives or informal networks. While certain MSMEs have gained from training initiatives or collaborations with universities, the overall engagement of institutions remains disjointed. Participants stressed the necessity of clearer policy frameworks and capacity-building support to improve collective waste management.

TABLE 1
BASELINE CHARACTERISTICS OF PARTICIPANTS (n=4)

MSMEs ID	Business Type	Years of Established	Number of Employees	Location	Main Products	Type of Palm Waste Generated	Current Waste Management Practice
MSME-01	Palm oil processing unit	10	5	Central Sulawesi	Crude palm oil (CPO)	Shells, fiber, effluent	Disposal to landfill
MSME-02	Home-scale palm oil mill	5	4	Central Sulawesi	Palm kernel oil	Empty fruit bunches (EFB), shells	Burning, some composting
MSME-03	Organic fertilizer producer	9	7	Central Sulawesi	Compost, fertilizer	EFB, POME (effluent)	Composting, bioconversion
MSME-04	Traditional palm press	12	3	Central Sulawesi	Crude oil (manual press)	Mixed organic waste	No formal practice

TABLE 2
THEMES IDENTIFIED THROUGH INTERVIEWS WITH MSMEs

Theme	Sub-theme	Quotation
1. Waste Management Practices	Limited infrastructure and methods	"We usually just burn the leftover shells. There's no facility for processing." (MSME-01)
	Occasional reuse and innovation	"We tried making compost from the empty fruit bunches, but it's not consistent." (MSME-03)
2. Environmental Awareness	Mixed perceptions about waste	"Some of us care about the environment, but most just focus on production." (Participant-02)
	Lack of training and technical support	"Nobody ever taught us how to manage waste properly." (MSME-03)
3. Barriers to Sustainable Practices	Financial and operational constraints	"We want to do more, but managing waste costs money and time." (MSME-01)
	Lack of access to technology	"If we had better machines, maybe we could recycle more." (MSME-02)
4. Stakeholder and Institutional Support	Limited government engagement	"Local officials never really check or support our waste activities." (MSME-04)
	Need for partnership and training	"We need help from universities or NGOs to know what to do with our waste." (Participant-02)

B. Discussion

This research offers significant insights into the participation of palm oil MSMEs in waste management, emphasizing both practical initiatives and structural limitations that influence their environmental behavior. The results correspond with the current literature that emphasizes the crucial but frequently neglected function of MSMEs in guiding agro-industrial sectors toward sustainable waste practices [29], [37], [38].
Practices for managing waste within MSMEs remain basic, focusing primarily on keeping operations running rather than on environmental accountability [29]. Although a handful of businesses have creatively converted palm oil waste into valuable by-products, such practices are not widespread and remain isolated [36], [37]. This illustrates the absence of access to technology, technical expertise, and financial resources, corroborating research that highlights the vulnerability of MSMEs to resource limitations [18]. Even the implementation of basic waste segregation is mainly motivated by practical needs, rather than regulatory or ecological factors, indicating a reactive approach to sustainability rather than a proactive one.

Even though MSMEs demonstrate a progressive perspective, most respondents' regard waste management as secondary to their primary business functions. This discrepancy may be influenced by varying educational attainments, familiarity with environmental campaigns, and whether local sustainability advocates are present. The outcomes are consistent with Ajzen's Theory of Planned Behavior (1991), which asserts that attitudes and perceived behavioral control have a significant impact on environmental actions. Without sufficient environmental literacy, it is challenging to cultivate a culture of environmentally conscious business practices among MSMEs.

Institutional deficiencies such as unclear regulations, insufficient enforcement, and a lack of motivation for eco-friendly innovation worsen financial constraints. In informal settings where MSMEs often operate, limited formal oversight leads to a fragmented adoption of environmental standards. This concurs with earlier findings, which emphasize the structural and market-based barriers that impede small businesses from engaging in circular economy practices [39]. Moreover, the lack of appropriate technologies restricts MSMEs' capacity to convert waste into value-added products that could enhance their profitability and environmental results.

Despite occasional partnerships with NGOs or academic institutions, systematic backing from government organizations remains lacking. This signifies a lost chance for policy intervention and cooperation among stakeholders. The collaboration of multiple actors is crucial for attaining sustainable entrepreneurship in low-income contexts. Lack of a supportive ecosystem diminishes the ability of palm oil MSMEs to adopt more sustainable practices.

V. CONCLUSION

The results indicate that palm oil MSMEs' waste management practices are still basic and fragmented, often driven by immediate operational needs rather than long-term environmental goals. While some creative methods—such as composting and using palm waste to make briquettes—are emerging, they have not yet become mainstream or institutionalized. The differing levels of environmental awareness among participants highlight the disparities in ecological literacy and the scarcity of sustainability training in the MSME sector.

Furthermore, the limited financial resources, lack of infrastructure, and minimal governmental support create challenges that continue to impede the adoption of sustainable practices. Due to insufficient strong collaboration among institutions, the majority of MSMEs function without direction or encouragement from pertinent stakeholders. The results highlight the necessity of a more integrated approach that encompasses policy, training, and technology transfer.

Limited number of participants, the findings cannot be generalized to the broader palm oil MSME sector. While qualitative insights are valuable for their depth, future research should include a more diverse and representative sample to capture the full range of experiences, practices, and institutional dynamics across different regions and operational scales. Despite technical solutions, strengthened institutional support, and capacity-building initiatives. Involving participants from a wider variety of backgrounds in future studies will strengthen the evidence supporting policy efforts to encourage inclusive and sustainable practices among agro-based MSMEs.

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