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Assessment of Operational Standards for Wood Processing in Selected Sawmills in Oyo State, Nigeria

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Abstract
Operational standards are guidelines that aim to achieve effective and efficient sawmilling operations, unfortunately, few sawmills strictly adhere to the guidelines which result in low conversion efficiency in sawmills. Therefore, this study assessed operational standards which can guarantee sustainable utilization of timber in selected sawmills in Oyo State, Nigeria. Based on the abundance of operational sawmills, Owode and Abaletu sawmills were purposely selected. At 50% sampling intensity, 20 and 30 operational sawmills were randomly selected respectively from Owode and Abaletu. Structured questionnaire was administered and data were analysed using descriptive analysis.The study revealed that 83.3% and 85.0% of respondents were male and 93.3% and 82.3% had formal education in Owode and Abaletu sawmills, respectively. Most of the respondents (93.7%) agreed that guidelines for log processing exist. Log storage (11.3%); equipment used (15.7%); environmental, regulatory and electric power (53.7%); labour (5.0%); sales and marketing issues (6.0%) and maintenance and operation (8.3%) were identified as factors that could influence sawmilling operations. Grade (43.0%), Species (32.0%) and Scale (25.0%) are used to value logs for processing. Respondents opined that the main requirements for sawmilling operations are sawmill certification and use of Hoppus Measurement Book (HMB, (30.7%), log and sawmill certification (28.0%) and hammered log and use of HMB (22.0%). Most (57.3%) of the respondents stated that they never use any safety or health measures. Operational standards do exist in Oyo State, however, few sawmills strictly adhere to the guidelines for sawmilling operations. To ensure good log conversion efficiency, appropriate policies and implementation strategies in the form of code of conduct and penalties should be developed.

Keywords: *Sawmilling operations, Wood processing, Operation guidelines and Sawmill workers*

INTRODUCTION

Sawing log is a necessary step in their proper and ultimate use, according to Savindi (2015), and sawmilling plays an important role in wood utilization. Sawmilling is a primary industry that provides raw materials to other industries such as construction, joinery, and furniture manufacturing. Sawmills are distinguished by the type of wood they cut, the size of their operations, the machinery used to break down the logs, and the degree of automation. Thus, log processing in a sawmill, in this regard, is a high-throughput process that begins with a raw or rough log and ends with a smooth finished product (lumber). Borz *et al.* (2021) also affirmed that sawmilling operations are one of the most important phases of the wood supply chain because they connect the flow of raw materials into finite products.

According to Fasoro *et al*. (2021), sawmills are equipped with various wood processing machines that can be used in sawing woods in various sizes of lumber. However, sawmill wood processing operations are inefficient, with low recovery rates and low-value products. The industry generally relies on old, low-technology equipment across the equipment suite, and efficiency and productivity. The study further stated other factors working against sawmills which include lack of skilled labour, regulatory and power supply issues, securing of logs supply, the use of outdated equipment in sawmills, not having the exact blade for each log cutting, and so on. This in turn resulted in low conversion efficiency and because of the low conversion efficiency, a large amount of waste is generated, affecting sawmill profits, the economy, and causing environmental problems.

Ogunwusi (2014) reported that the sawmill industry generated over 1,000,000m^3 of waste in 2010 alone, including bark, sawdust, trimming, split wood, planer shavings, and sander dust. Ogunsanwo (2001) also reported that the majority of wastes generated during log processing are unavoidable but can be reduced with high-level technology and personnel management. Furthermore, Bluff (2014) stated that reducing logging waste is one way to ensure efficient wood management. As a result, while it is impossible to eliminate wood waste during log processing, it can be significantly reduced by improving operational standards.

Consequently, to maximize value in log processing, saw operators must consider some criteria and standards. According to the Guyana Forestry Commission (2012), the most frequently considered criteria are grade, scale, and species. The grade of a log indicates the quality of the log and the lumber produced from it. The amount of lumber contained within a log is measured by scale, and various species can be used for various products and have

intrinsically different values, despite the quality of the lumber. Log grades, according to the University of Tennessee's hardwood grading handbook, could be used to estimate the proportion of high-quality lumber produced from a given log, as well as to help measure sawmill efficiency. Scaling a log is the process of estimating its weight or volume while allowing for features that reduce product recovery; in other words, scaling is used to predict how much lumber will be sawn from a log. Another important factor in determining log value is species.

The Guyana Forestry Commission (2012) defined operational standards in sawmills as a code of conduct that contains recommendations and requirements laid down by a specific body, which could be the government or stakeholders in general, to ensure that the resource obtained from the forest (timber) is used effectively and efficiently. These regulations apply to all sawmills that saw and stockpile round logs of any wood species. It applies to all processes involved in the manufacture of sawmills. Also, operational standards are guidelines that coordinate the activities of sawmill operations and operators, and these include having a specific type of machine that is used for specific operations, the specific blade used for each cutting, the operators' skills, the age of the machines, the age of the operators, and so on. These standards provide sawmill owners and equipment operators with general guidelines on sawmilling, with an emphasis on improving safe work practices and developing a conducive environment as part of the process to improve efficiencies and optimize forest resource utilization (timber).

The guidelines address sawmilling requirements, environmental requirements, health and safety requirements, and social requirements. Sawmilling activity requirements (appropriate machines for each sawmilling activity, regular training of sawmill operators, proper waste disposal), the environment (conducive environment), and health and safety (use of personal protective equipment) ensure maximum conversion efficiency, which affects the sustainability of timber and sawmill operations. Essentially, the standards are intended to achieve the following goals: maximize log value recovery for increased competitiveness and profitability, minimize waste, reduce environmental impacts of primary wood processing, enable sustainable and cost-effective use of forest resources, produce quality, high-priced products for local and export markets, as well as provide sawmill and lumberyard owners/operators with a set of guidelines and standards.

As a result, this study investigated operational standards in sawmills in order to recommend appropriate policies and implementation strategies that ensure the sustainable utilization of timber.

Methodology

The Study Area

The study areas are Owode sawmill located at Oyo town, in Oyo East Local Government area of Oyo state and Abaletu sawmill located at Iseyin town in Iseyin local government in Oyo state. Owode sawmill in Oyo town is situated between latitudes 7° 80' 31"N and 8° 13'54"N and longitudes 3° 91'59"E and 4° 21'59"E while Abaletu sawmill is located between latitudes 7° 58' 36"N and 7° 99' 21"N and longitudes 3° 36'23"E and 3° 57'40"E.

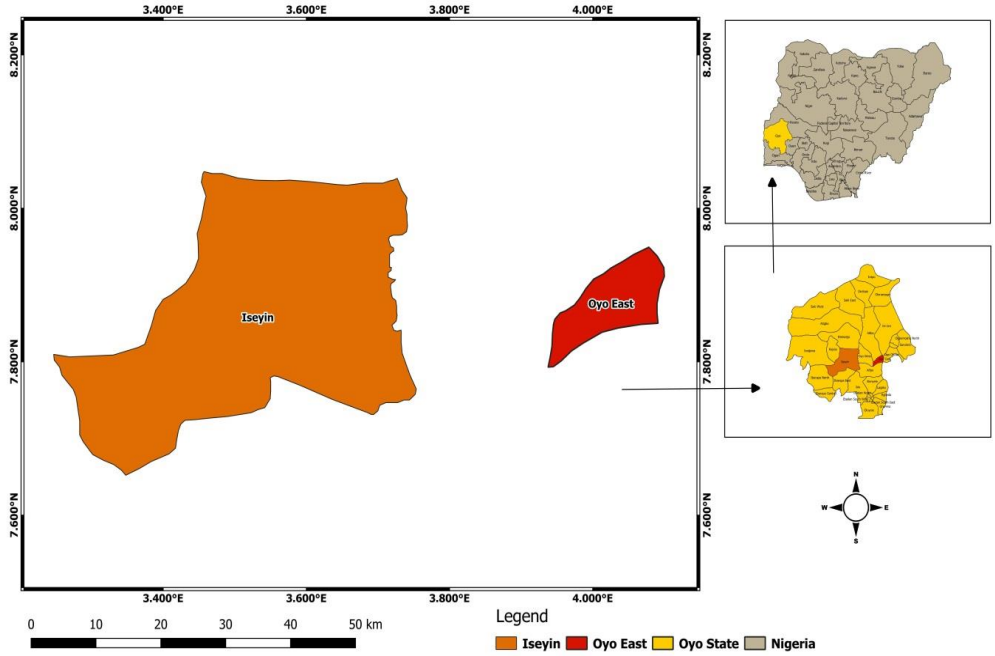

Figure 1: Map of the Study Area
Source: *Quantum Geographical Information System (2022)*

Data Collection and Analysis

A reconnaissance study conducted at the Department of Forestry, Ministry of Environment, Oyo State revealed that there are two major locations in the State where concentrated functional sawmills are located, namely Owode and Abaletu. Based on the abundance of operational sawmills, purposive sampling was used to select Owode and Abaletu sawmills. Owode has 40 operational sawmills while Abaletu has 60 operational sawmills. At 50% sampling intensity, 20 and 30 sawmills were randomly selected at Owode and Abaletu sawmills respectively. Each sawmill had a sawmill manager and one of each of machine operators, saw doctors, machine off loaders, wood loaders, and waste packers were purposively selected. A total of 300 respondents in both study areas were chosen. Data were subjected to descriptive statistics and results were presented in form of tables and charts.

Results

Socio-economic Characteristics of Sawmill Workers

Table 1 shows that 83.3% of the respondents at Owode sawmill were male and 15.8% were female, while 85.0% of respondents at Abaletu sawmill were male and 15.0% were female. From the study, 23.3% and 40.0% of the respondents were under the age of 29, 64.2% and 49.4% of respondents were between the ages of 30 and 49, and 11.7% and 8.3% of respondents were between the ages of 50 and 69 in Owode and Abaletu sawmills, respectively.

According to the study, 6.7% and 17.7% of respondents in Owode and Abaletu sawmills, respectively, had no formal education, 35.0%and 48.9% had primary education, 23.3% and 31.7% had secondary school, and 18.3% and 1.7% had tertiary education. It was observed that most of the respondents in Owode sawmill are Muslim (95.8%) and married (85.0%), whereas 88.9% of respondents in Abaletu sawmill are Muslim and married (86.1%). In addition, in both study areas, 100% of the respondents are Yoruba.

Guidelines for Log Processing and Compliance

According to Table 2, 93.7% of the respondents affirmed that there are rules guiding wood processing in the sawmill while 6.3% of the respondents opined that there are no rules guiding wood processing. Most (69%) of the respondents stated that they do not strictly adhere to the guidelines while 31% of the respondents revealed that they comply with the rules and regulations of sawmilling operations.

Table 1. Demographic Characteristics of Sawmill Workers in the Study Area

Demographic characteristics		Sawmill			
		Owode		Abaletu	
		N=120	%	N=180	%
Age	<29	28	23.3	72	40.0
	30-49	77	64.2	89	49.4
	50-69	14	11.7	15	8.3
	No response	1	0.8	3	1.7
Gender	Female	19	15.8	27	15.0
	Male	100	83.3	153	85.0
	No response	1	0.8	0	0.0
Educational status	No formal education	8	6.7	31	17.2
	Primary education	42	35.0	88	48.9
	Secondary education	28	23.3	57	31.7
	Tertiary education	22	18.3	3	1.7
	No response	0	0	1	0.6
Religion	Muslim	115	95.8	160	88.9
	Christian	5	4.2	20	11.1
Marital status	Single	18	15.0	25	13.9
	Married	102	85.0	155	86.1
Tribe	Yoruba	120	100.0	180	100.0
	Hausa	0	0.0	0	0.0
	Igbo	0	0.0	0	0.0

Table 2: Frequency Distribution of Respondents' Response to Operational Rules and Regulations in the Sawmills

	Frequency	Percentage
Guidelines		
Yes	281	93.7
No	19	6.3
Total	300	100
Compliance		
Yes	93	31
No	207	69
Total	300	100

Factors Influencing Sawmilling Operations

Figure 2 shows that most (53.7%) of the respondents indicated that environmental, regulatory and electrical power issues are the major factor that influences sawmilling operations in the study area. Other factors identified by the respondents include the equipment used (15.7%), log storage (11.3), maintenance and operation (8.3%), sales and marketing (6.0%) and labour (5.0%).

Figure 2: Frequency Distribution of Factors that can Influence Sawmilling Operations

Criteria for Valuing Log in Sawmills

According to Figure 2, 43.0% of respondents stated that the scale (quality of the log and the lumber that will come from the log), 32.0% stated that the species (type of log), and 25.0% stated that the grade (quantity of lumber within a log) are the major criteria used to value logs to be processed in the sawmill.

Sawmilling Requirement

This is based on the applicable policies and laws of Nigeria before the log can be processed in sawmills. The requirements concerned for this study are Hammered log, Sawmill certification, and Hoppus measurement book. Figure 4 shows that 4.7%, 3.7% and 3.7% of the respondents respectively opined that hammered logs, sawmill certification and the use of hoppus measurement book are the requirements for sawmilling activities. Respondents (30.7%) revealed that for any activity to occur in the sawmill, the sawmill has to be certified by the government and hoppus measurement book must be used for log processing; 28.0% of the respondents affirmed that the logs must be hammered and the sawmill must be certified by the state government; 22.0% of respondents reported that the logs must be hammered and hoppus measurement book must be used to guide sawing of logs to lumbers and 5.3% of the respondents claimed hammered log, sawmill certification and the use of hoppus measurement book are the requirements for sawmilling activities.

Teaching Programmes, Training and Seminars for Sawmill Workers

According to Table 3, most (74.7%) of the respondents stated that no programme, training nor seminars was organized to educate them while 25.3% of the respondents affirmed that they underwent training, seminars and programmes to further aid the smooth running of the sawmill.

Organizers of the Programme, Training and Seminars for Sawmill Workers

Table 4 shows that 64.5% of the respondents indicated that the association in the study area organises training for them sometimes, 32.9% of the respondents claimed the sawmill owners sometimes organise educative programmes for workers and 2.6% of the respondents reported that they train themselves by asking questions from people and surfing internet.

Occupational Safety and Health Measures for Sawmill Workers

Adequate protective measures are required to prevent hazard. According to Table 5, most of the respondents (57.3%) stated that they never use any safety or health measures; 30.0% of respondents stated that they occasionally use safety and health measures, and 12.7% of the respondents stated that they always use safety and health measures to prevent the hazard.

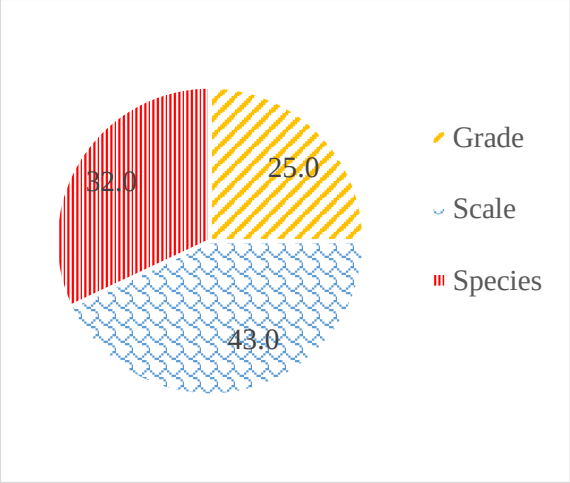

Figure 3: Frequency Distribution of Criteria for Log Processing

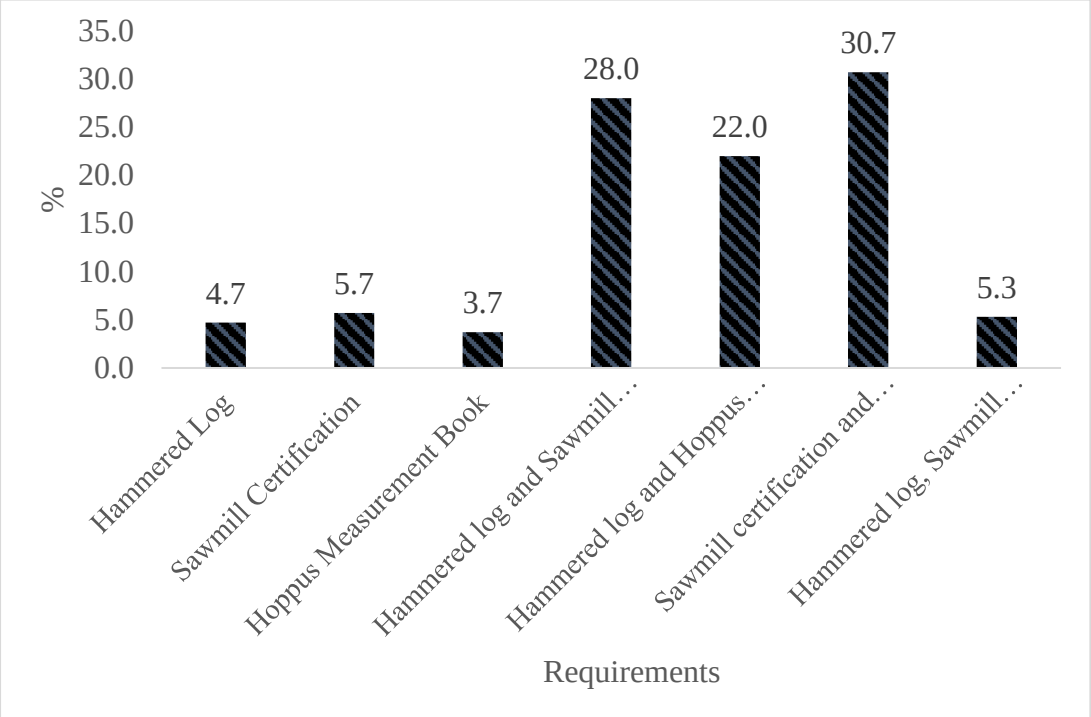

Figure 4: Frequency Distribution of Sawmilling Requirements

Table 3: Frequency Distribution of Sensitizing Programmes for Sawmill Workers

	Frequency	Percentage
Yes	76	25.3
No	224	74.7
Total	300	100

Table 4: Frequency Distribution of Organizers of the Sensitizing Programmes for Sawmill Workers

Organizer	Frequency	Percentage
Non-governmental agencies	0	0
Sawmill Owners	25	32.9
Self	2	2.6
Association	49	64.5
Government	0	0
Total	76	100

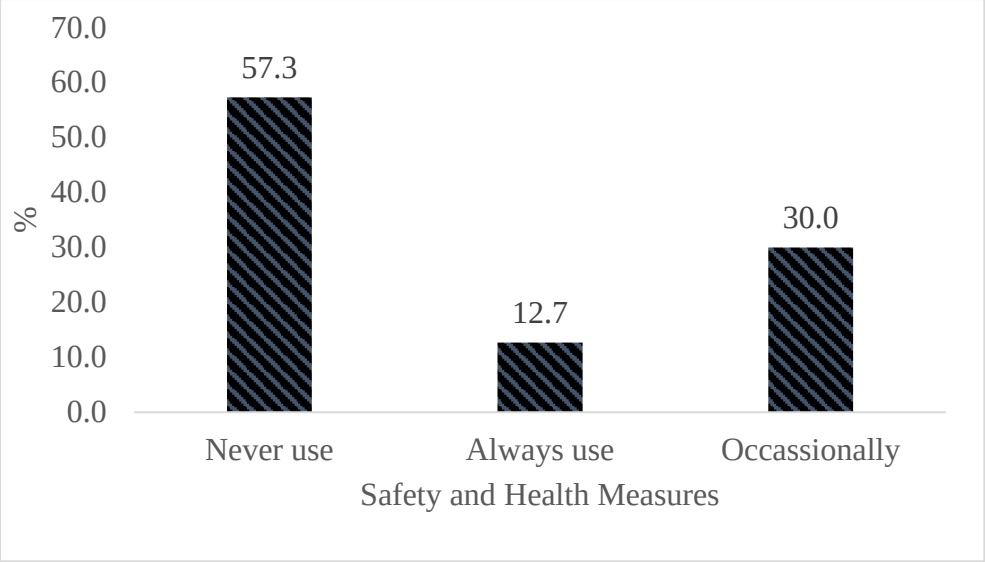

Figure 5: Frequency Distribution of the Use of Safety and Health Measures

DISCUSSION

According to the study, 83.3% and 78.0% of respondents in Owode and Iseyin sawmills, respectively, were male. Male dominance is common in forestry-related activities, and gender differences may be attributed to the laborious nature of sorting, carrying, arranging, and processing logs, which requires a lot of energy. This is consistent with the findings of Ajewole and Fasoro (2013), who found that most capital-intensive and labour-intensive jobs are dominated by men. People in the respondents' modal age group of 30-49 years are burdened with various responsibilities. Respondents in this age group are young middle-class citizens who are under pressure from their families and friends. As a result, they have the energy and stamina to engage in the several activities necessary to generate income to improve their livelihood and reduce poverty. The findings are consistent with the findings of Fasoro *et al*'s (2021) report, which asserted that the average age of respondents engaged in forest development in southwestern Nigeria was 43 years old, and they were in their active phase of life.

The study revealed that 93.3% and 82.8% of respondents in Owode and Abaletu, respectively, had some form of education. Most of the respondents hold the West Africa Senior School Certificate, which is the highest level of education. Fasoro *et al.* (2021) affirmed that education improves people's understanding and application of new technology and practices. Furthermore, Fasoro (2019) confirmed that educational status influences skill acquisition, planning, budgeting, processing, and bookkeeping in businesses, all of which are necessary for sustainable development. This means that the higher one's level of education, the more likely one is to accept new methods, experiment with new ideas, and be more willing to participate in sustainable forest development. From the study, all of the respondents are of Yoruba extract, with the majority of them being Muslims and married. Individuals' marital status may reflect their level of societal responsibilities, as married people are burdened with more responsibilities, so they tend to work harder to generate more income to meet the demands and care for their homes.

Most of the respondents (93.7 %) agreed that there are guidelines for log processing in sawmills. However, 69% of the respondents confirmed that they do not comply with the guidelines. Further investigation revealed that some of the respondents act on the spur of the moment. They do things when they feel like it, and they rely on instinct and experience to carry out sawmill operations. According to the study, the following factors influence sawmilling operations: log storage; designed and engineered production facilities (equipment used); environmental, regulatory, and power issues; labour/workers; sales and marketing issues; and maintenance and operation, all of which have an impact on the profitability, competitiveness, and sustainability of wood processing operations. These factors were stated by the Guyana Forestry Commission (2012), but the study confirmed that the people involved in sawmilling operations are the most important single factor in the development of a value-added system. The comprehension, ability, and motivation of workers at all levels of sawmilling determine whether a processing entity will be viable and sustainable or wasteful and unsustainable.

The study affirmed that grade, scaling and species type are used to determine log processing in the sawmills. The main requirement for sawmilling operations is that the log to be processed in the sawmill be hammered. This is a type of legal instrument used to monitor the use of forest produce. It is proof that specific logs were legally taken, i.e. timber contracts satisfied the various conditions for the exploitation of the logs. According to

respondents, another requirement is that the sawmill must be certified before it can perform any operations. This means that the sawmill must be registered with the State government and must pay the required taxes and duties. Furthermore, respondents reported that there is a book called Hoppus measurement book which they use for processing logs. The book was written with the primary design to guide and provide roundwood measurement and to predict product yields. These recommendations and requirements for sawmill operation are known as operational standards. Most of the time, the requirements are set by the country's national government, and these recommendations are used to enforce, improve, and increase the efficiency of wood processing operations.

According to the findings of the study, the majority of sawmill workers stated that no program, training, or seminars were organized for them. It is critical to recognize that the people involved in sawmill activities are the most important single factor at all organizational levels. Given this, establishing a truly professional workforce can make a significant difference in the performance of a sawmill. In order to capitalize on the value recovered, this well-trained workforce must include owners, managers, and operators who understand how to maximize the efficiency and effectiveness of the equipment. From the study, 57.3% of the respondents said they never engage in the use of any safety and health measures during sawmill operations. As defined by Asuzu (2002) and cited by Agbana (2014), occupational health is the sum of all activities and programs undertaken to achieve and maintain the highest level of health and safety for all people engaged in any type of work. Hand gloves, safety goggles, helmets, safety shoes, protective clothing, and respirators are examples of personal protective equipment. Personal protective equipment must be individually selected, properly fitted, periodically refitted, properly worn, regularly maintained, and replaced as needed in order to be effective.

CONCLUSION

Sawmill operations can be hazardous and generate much waste, especially when machines are used incorrectly or without proper safeguards. As a result, there must be guidelines and standards in place to ensure sustainable wood processing. The study revealed that there are criteria for operation in the sawmills. Hammered log, sawmill certification, hoppus measurement book are the major requirements needed for sawmill operation in the study area. To optimize forest resource utilization (timber), it is therefore recommended that appropriate policies and strategies in the form of a code of conduct be developed and implemented. Sawmill operators, supervisors, managers, and owners should be trained and encouraged so that they can follow the rules and regulations to ensure sustainable log processing.

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