Utilization of community forest wood harvesting waste in Bone Pute Village, Burau District, East Luwu Regency

Nurdin Dalya, Wahyuni and Andi Vika Faradiba Muin
Faculty of Forestry, Hasanuddin University, Perintis Kemerdekaan Km. 10 Street, Makassar, South Sulawesi, Indonesia 90245
Email: vikafaradiba@gmail.com

Abstract. Timber in community forests can be utilized by the community by first removing it from the forest through the harvesting process. The harvesting process carried out has the potential for waste to be generated. This study aims to analyze the characteristics and potential of harvesting waste and develop alternative uses of waste into products that can be utilized by the community. Data were collected through field observations and making sample plots by purposive sampling on logging plots, skidding paths, plots on TPn, and plots on TPK. Analysis of the data used to determine the characteristics of the waste and its alternative uses, namely qualitative descriptive analysis and calculating the volume of waste using the Brereton empirical formula. The results showed that the characteristics of the wood waste found consisted of stump waste, branch-free stem waste with physical defects, twigs, short pieces, broken wood, and rotten wood. The potential logging waste that can be utilized is in the good category with an average volume of 1.56 m$^3$ in the form of the stump, 2.85 m$^3$ per log in the form of branch-free stems, and 2.45 m$^3$ per log in the form of shortcuts. Alternative utilization of harvesting waste is based on the calculated characteristics and potential, waste can be used as firewood, waste with a diameter of 10 cm and above can be used as raw material for chips, boxes, and poles. Wood waste can also be utilized by the particleboard, fiberboard, finger-joint board, laminated board, pulp, and wood charcoal and charcoal briquette industries if the availability of raw waste materials is sustainable and in sufficient quantities.

1. Introduction
Natural forests as the main wood producer in supplying raw materials for the wood processing industry in Indonesia are decreasing day by day due to deforestation. Based on data from the Central Statistics Agency (2019), the deforestation rate in Indonesia was recorded at 462,458.5 ha [1]. This then makes community forests which are one of the alternative wood producers play an important role in meeting the needs of industrial raw materials.

According to Ramli (2021), the development of community forests is a very strategic national program, both in terms of national interests and from a global perspective, covering economic, ecological and socio-cultural aspects [2]. The development of community forests is currently quite rapid, especially after the timber market is getting better and is supported by the interest of farmers to plant very high types of wood, as can be seen by the existence of community forest plant cultivation centers that have developed. Community forests are managed by developing commercial tree species and then harvested by the community as their source of livelihood [3].

Timber harvesting in community forests goes through the stages of logging, skidding, and transportation. The harvesting process is the process of removing forest products, especially wood, from the forest to the industrial area for further processing. According to Matangaran (2013), the wood
harvesting process will usually generate waste which is residue in the form of pieces of wood and left in the forest [4]. The harvesting waste can then be utilized in order to maximize the potential of stands in community forests. Therefore, research related to "Utilization of Community Forest Wood Harvesting Waste in Bone Pute Village, Burau District, East Luwu Regency" is important to be carried out as an information on alternative uses of waste by the community.

2. Research method

2.1. Time and place
This research was conducted from February to November 2021 in a community forest in Bone Pute Village, Burau District, East Luwu Regency, South Sulawesi Province.

2.2. Data collection technique
The data collection techniques used in this study consisted of:

a. Calculate the potential and identify the characteristics of the waste by first determining and making sample plots using the purposive sampling method. The sample plots/plots were deliberately selected on the logging plots to calculate felling waste, plots on the skidding path to calculate skidding waste, plots on TPh, and plots on TPK. The area of the sample plot made is 100 x 100 m

b. Logging waste which includes stump waste is stump height that exceeds the permitted limit (> 10 cm). The dimensions measured were the diameter of the base, the diameter of the tip and the height of the excess stump. Timber waste which includes wood > 8 cm in diameter scattered in the cutting plot, wood outside the pile and damaged wood (cracked, broken or split). The dimensions measured were the diameter of the base, the diameter of the tip and the length of the board.

c. Skidding waste is waste that occurs as a result of skidding activities (moving logs from the cutting plot to the TPh), consisting of stems (board) scattered on the skidding path which are counted and board that are still in the pile but not being skidded to the TPh. The dimensions measured were the diameter of the base, the diameter of the tip and the length of the board.

d. Landfill waste is waste that occurs at the Landfill as a result of the activities of loading wood onto the transportation means. Waste is calculated based on the number of wood sorties left at the TPh after loading activities.

e. TPk waste is wood waste as a result of rejection by the buyer because the logs have been stored for too long so that it rots, breaks and is attacked by fungus.

f. literature review and data citation in the form of general condition of the research site, potential of community forest, and timber harvesting system used.

2.3. Data analysis
The analysis of the data used in this study is that after measuring the dimensions of wood waste on the sample plots, then to calculate the potential for waste, the volume of waste analyzed is calculated using the Brereton empirical formula, namely:

\[
V = \sum V_i = \frac{D_p}{D} \left[ \frac{D_p}{D} \right]^{D_p} \left( 1 - \frac{D_p}{D} \right)^{D_p} \\
V_i = \text{Volume of the to-i (i=1, 2, 3, ...)} \\
D_p = \text{Sorting end diameter (cm)} \\
D_t = \text{Sorting tip diameter (cm)} \\
P = \text{Sorting length (m)} \\
\text{constant (3.14)}
\]

Where:
- \( V \) = Waste volume (m³)
- \( V_i \) = Volume of the to-i (i=1, 2, 3, ...)
- \( D_p \) = Sorting end diameter (cm)
- \( D_t \) = Sorting tip diameter (cm)
- \( P \) = Sorting length (m)
- \( D \) = Constant (3.14)
After knowing the potential waste by analyzing the volume of waste in the sample plots, the identification of waste characteristics is analyzed descriptively qualitatively. Furthermore, the preparation of alternative waste utilization is analyzed based on the characteristics of the potential waste generated which allows producing several alternative products such as woodchips, bioenergy, and compost.

3. Result and discussion

3.1. Potential wood harvesting waste

In this study, the harvesting waste referred to is the part of the tree that is not used and left in the forest. Wood harvesting waste obtained in the research plot consisted of branch-free waste with physical defects, twigs, short cuts, broken wood, and rotten wood, which were classified as follows.

Table 1. Waste volume in sample plots

| Plots                | Waste characteristics | Average of waste volume (m$^3$) |
|----------------------|-----------------------|---------------------------------|
| Cutting Plot         | Arrears               | 1.03                            |
|                      | Branch free stem      | 2.90                            |
|                      | Short cut             | 2.32                            |
| Distributin of Stems Plots | Branch free stem     | 2.80                            |
|                      | Short cut             | 2.53                            |
| PTn Plots and TPk Plots | Branch free stem     | 2.85                            |
|                      |                       | 2.51                            |

Based on the table 1, the average volume of waste found in the sample plots was the largest in the branch-free stem waste in the cutting plots of 2.90 m$^3$. Furthermore, branch-free stem waste in PTn and TPk plots is 2.85 m$^3$. This is because the branch-free trunks left in the forest are generally in a damaged condition due to harvesting or have natural defects from within the tree itself. The research conducted by Sari too, (2009) branch-free stem waste is part of the main trunk that has natural defects or is damaged due to negligence during logging so that this part is usually only left in the forest [5].

Stump waste is only found in abandoned logging plots in the forest. This is because the logging does not take part of the buttress of the tree. The stump is the bottom of the tree which is in the notch and the notch back. The volume of stumps calculated on the plot is an average of 1.03 m$^3$. According to Elias (2002), the variation in stump height that affects its volume is based on the height of the ballast notch [6].

Furthermore, based on the data obtained from the logging plots, skidding plots, TPn plots, and TPk plots, the types of waste and their average volumes are obtained which are presented in the following table 2.

Table 2. Characteristic waste and average volumes

| Characteristic Waste | Average of Volume (m$^3$) |
|----------------------|---------------------------|
| Arrears              | 1.56                      |
| Branch Free Stem     | 2.85                      |
| Short cut            | 2.45                      |

From the table above it can be seen that the type of waste that has an average the largest volume is the branch-free stem of 2.85 m$^3$, which is then in the short cut waste of 2.45 m$^3$, and stumps of 1.56 m$^3$. 
This shows that the volume of waste left in the forest is large enough so that it has the potential to be utilized by the community which is expected to maximize the potential of stands in community forests. According to Astana et al. (2015), a large enough logging waste can be caused by several things including errors in the implementation of felling techniques, errors in determining the direction of falling, and errors in cutting stems [7].

3.2. Alternative utilization of wood harvesting waste

Utilization of waste at the research site by the community is as fuel. Most of the land owners after logging use wood, especially short pieces and branch-free stems, as firewood in their daily life [8]. In addition, the results of the interview also found that apart from being used as firewood, people usually also use waste wood as a fence in their gardens.

Based on the characteristics and potential of wood harvesting waste in the community forest where it is harvested, there are several alternative uses that can be used. The recommendations based on secondary data from the Directory General of Forestry Production Development (2006) are:

a. Raw materials chips. The pieces of wood that are waste and left in the forest can then be processed into chips which can then be used by industries processing wood products such as pulp.

b. Particleboard and fiberboard can utilize waste wood as raw material. The market demand for particleboard also has good prospects. Muhdi (2013) noted that every month one furniture factory requires at least 3,000 m$^3$ particle board which is mostly imported from China and Italy [9]. This proves that the limited production of domestic particleboard has not been able to meet domestic market demand. Particleboard which is an artificial board can be made from scrap or waste wood using adhesives. According to Purwanto (2016), particleboard can be made from wood scraps, sawn wood scraps, and other fiber pieces containing lignin and cellulose [10].

c. Joint board and laminate board. This product can also utilize wood waste to produce processed wood products. Laminate boards made by stacking a number of boards to one another which are then glued together using an adhesive using wood scraps have been widely used. Research by Suprijono (2020), states that waste teak wood chips in the furniture industry group are made into laminated wood [11].

d. The wood charcoal and charcoal briquette industry can also take advantage of the waste from wood harvesting.

4. Conclusion

The potential logging waste that can be utilized is in the good category with an average volume of 1.56 m$^3$ in the form of the stump, 2.85 m$^3$ per log in the form of branch-free stems, and 2.45 m$^3$ per log in the form of shortcuts. Alternative utilization of harvesting waste is based on the calculated characteristics and potential, waste can be used as firewood, waste with a diameter of 10 cm and above can be used as raw material for chips, boxes, and poles. Wood waste can also be utilized by the particleboard, fiberboard, finger-joint board, laminated board, pulp, and wood charcoal and charcoal briquette industries if the availability of raw waste materials is sustainable and in sufficient quantities.

References
[1] Badan Pusat Statistik 2019 *Angka Deforestasi Indonesia* (Jakarta)
[2] Ramli M A 2021 *Strategi pemanfaatan lahan hutan rakyat di kabupaten polewali mandar provinsi sulawesi barat* (Universitas Hasanuddin)
[3] Sandabunga R M, Umar A, Millang S, Bachtiar B, Paembonan S, Restu M and Larekeng S H 2019 Land compliance of agroforestry compiler components evaluation in Pangli sub-district Desean district, North Toraja regency *IOP Conf. Ser. Earth Environ. Sci.* 343 012053 343–11
[4] Matangaran J R, Partiani T and Purnamasari D R 2013 Faktor eksploitasi dan kuantifikasi limbah kayu dalam rangka peningkatan efisiensi pemanenan hutan alam *J. Bumi Lestari* 13 384–93
[5] Sari R M 2009 *Identifikasi Dan Pengukuran Potensi Limbah Pemanenan Kayu (Studi Kasus Di Pt. Austral Byna, Propinsi Kalimantan Tengah)* (Bogor: IPB (Bogor Agricultural University))
[6] Elias 2002 *Reduced Impact Logging Buku I* (Bogr)

[7] Satria A, Soenarno S and Endom W 2015 Potensi penerimaan negara bukan pajak dari limbah kayu pemanenan di hutan alam dan hutan tanaman J. Penelit. Sos. dan Ekon. Kehutan. 12 29153

[8] Dalya N and Mujetahid A 2019 Infrastructure Role of Harvesting System In Community Forest *IOP Conf. Ser. Earth Environ. Sci.* 270 012010

[9] Muhdi M, Risnasari I and Putri L A P 2013 Studi Pembuatan Papan Partikel dari Limbah Pemanenan Kayu Akasia (Acacia Mangium L.) *Bionatura* 15 218138

[10] Purwanto D 2016 Sifat fisik dan mekanis papan partikel dari limbah campuran serutan rotan dan sebuk kayu *J. Ris. Ind.* 10 125–33

[11] Suprijono H and Wijaya D K 2020 Edukasi dan Pelatihan Pembuatan Papan Kayu Laminasi dari Limbah Kayu Jati di Kelompok Industri Meubel Rumahan Desa Mangunsari *J. Pengabdi. Masy.* 3 25–33