

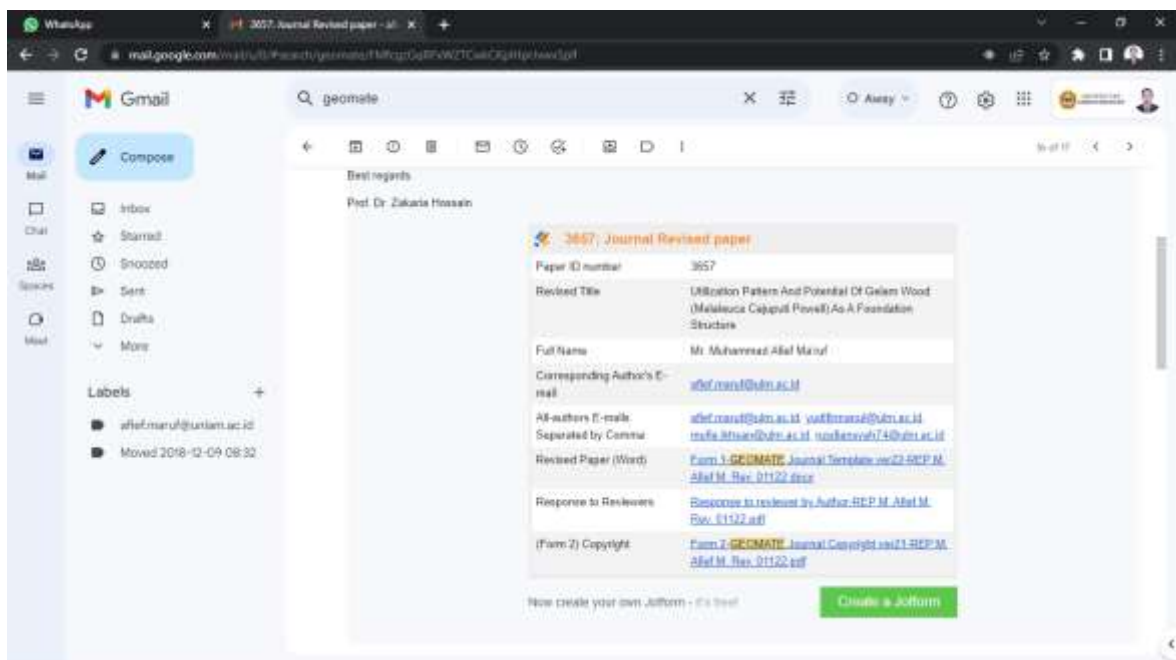
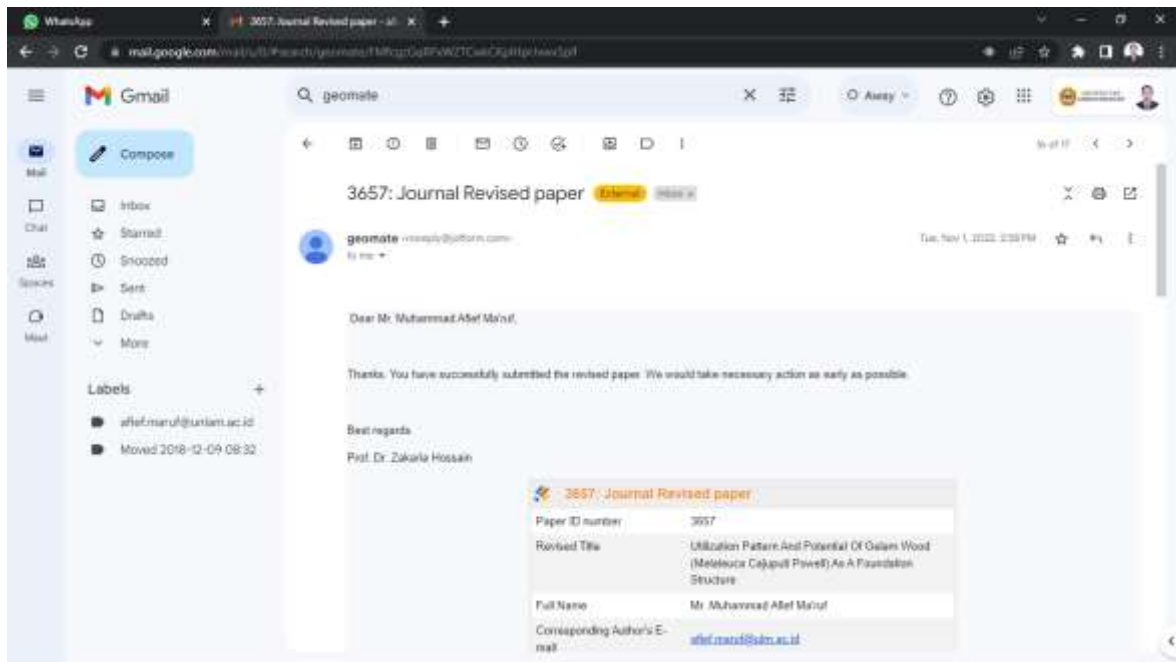
BUKTI KORESPONDEN
PUBLIKASI ARTIKEL PADA JURNAL INTERNASIONAL
BEREPUTASI

“International Journal of GEOMATE ”
(SCOPUS Q3)

UTILIZATION PATTERN AND POTENTIAL OF GELAM WOOD
(MELALEUCA CAJUPUTI POWELL) AS A FOUNDATION
STRUCTURE

* Muhammad Afief Ma'ruf^{1,3}, Yudi Firmanul Arifin², Mufidah Asy'ari¹ and Rusdiansyah³

TAHAP 1 SUBMIT ARTIKEL



NASKAH ARTIKEL SUBMIT :

UTILIZATION PATTERN AND POTENTIAL OF *GELAM* WOOD (*MELALEUCA CAJUPUTI* POWELL) AS A FOUNDATION STRUCTURE

* Muhammad Afief Ma'ruf^{1,3}, Yudi Firmanul Arifin², Mufidah Asy'ari¹ and Rusdiansyah³

¹Doctoral Program of Agricultural Science, Postgraduate Program, University of Lambung Mangkurat, Banjarbaru, Indonesia; ²Faculty of Forestry, University of Lambung Mangkurat, Banjarbaru, Indonesia;

³Faculty of Engineering, University of Lambung Mangkurat, Banjarbaru, Indonesia

*Corresponding Author, Received: 00 Oct. 2018, Revised: 00 Nov. 2018, Accepted: 00 Dec. 2018

ABSTRACT: Gelam wood (*Melaleuca cajuputi* Powell) is one of the raw materials for traditional foundations in South Kalimantan. The purpose of this study is to identify the pattern of using gelam wood as a foundation structure and its potential. The method used in this research is qualitative research that using an interview survey and literature review. The results showed that the most dominant use of gelam wood was for residential houses and other simple buildings. The most widely used size of gelam wood is a diameter of 8-12 cm with a length of 3-6 m. The origin of gelam wood used in Banjarmasin City itself is mostly from Barito Kuala and Kapuas region. The need for gelam wood for residential foundations in Banjarmasin City is roughly 13500 m³ in 1 year and an average of 14000-20000 gelam logs is needed for 1 road project. The advantages of using gelam wood as a foundation are the cheap price, easy to obtain, and the relatively light weight of its own. Another advantage is that it is durable during wet or submerged conditions. The disadvantages of gelam wood are easily broken and the length and diameter are not uniform. Constraints that may be faced regarding the potential for sustainable use of gelam wood as a foundation are the difficulty of finding the diameter and length of gelam wood that is more than 4-5 m, and the next obstacle is its availability which is dwindling, and even tends to become extinct.

Keywords: Gelam, Foundation, Utilization, Structure, Potential

1. INTRODUCTION

Gelam wood (*Melaleuca cajuputi* Powell) is one of the raw materials for traditional foundations in South Kalimantan and its surroundings, which is widely available along the swamps of Kalimantan. *Gelam* wood which belongs to the *Melaleuca* genus of the *Myrtaceae* family is a plant that grows naturally in the peatlands of South Kalimantan, Central Kalimantan, and other areas. Seven types of *Melaleuca* are common throughout the world, namely *Melaleuca cajuputi*, *Melaleuca dealbata*, *Melaleuca leucadendra*, *Melaleuca nervosa*, *Melaleuca quinquenervia*, *Melaleuca stenostachya*, and *Melaleuca viridiflora* [1, 2]. *Gelam* wood in South Kalimantan generally comes from Batola Subdistrict, Tanah Laut Regency, Tapin Regency, South Hulu Sungai Regency, and partly from Central Kalimantan, especially Dadahup Village in Kapuas Regency. Batola subdistrict as the center of *gelam* wood production in South Kalimantan has the potential for *gelam* wood between 2.9 to 7.1 m³/ha and tends to decrease every year [3, 4].

Gelam wood (Fig. 1) has special properties so it is very suitable to be used as part of the foundation of house buildings along the riverbank. The nature of *gelam* wood is that the more it is submerged the

more strength becomes durable. *Gelam* wood submerged in mud continuously has strength for decades. Research conducted on peat swamps in Central Kalimantan states that the *gelam* wood foundation used in Central Kalimantan peat swamp soil can last up to 35 years. The *gelam* wood foundation used on peat swamp soil for 10-38 years in Central Kalimantan experienced an increase in wood dry density by 28.13%, hardness by 12.83%; and silica content of 1.25% [5].



Figure 1. *Gelam* wood (*Melaleuca cajuputi* Powell)

The potential use and utilization of gelam wood

in the City of Banjarmasin and the Province of South Kalimantan is quite large. The *gelam* wood foundation has several advantages when compared to precast concrete foundations, both in terms of cost and in terms of adaptability to swamp land. The use of *gelam* wood is more dominant in the form of logs such as piles [6, 7]. The use of *gelam* wood as a foundation is generally in the form of group piles or rafts because raft foundations have a 24% smaller reduction than single piles [8]. *Gelam* wood is one of the most suitable foundation materials because it was able to adapt to surrounding conditions [1]. This form of adaptation of *gelam* wood is important, especially in dealing with tidal effects on soil water content and soil temperature, which other studies have shown that changes in soil temperature affect the bearing capacity of the pile foundation [9, 10].

Gelam wood is still a leading commodity and a potential source of local government revenue if managed properly. In South Kalimantan itself, the current governance and administrative regulations regarding *gelam* wood management can be said to be not running well and threaten the sustainability of *gelam* wood because of its potential which tends to decrease every year [1, 6]. To maintain the sustainability of the use of *gelam* wood foundations, one of the first steps is to identify the actual pattern of using *gelam* wood as a foundation structure and its potential, especially in Banjarmasin City today.

2. RESEARCH SIGNIFICANCE

The significant factor of this study is as the first research that try to identify the pattern of *gelam* wood as a foundation structure especially in terms of wood size and volume based on the actual usage in Banjarmasin City. This study is also the first research that utilize the construction society in Banjarmasin City as the respondent in terms of usage of *gelam* wood as a foundation structure. The result of this study will provide the necessary information for all the stake holder and government for the formulation of the future *gelam* wood utilization strategy in order to prevent the extinction of *gelam* wood itself.

3. METHOD

This study aims to identify the pattern of utilization of *gelam* wood and its potential as a foundation structure for construction in Banjarmasin City. This study is based on the use of *gelam* wood which is very common among the people of Banjarmasin City and its surroundings, where traditional people believe that the longer *gelam* wood is stuck in the ground, the stronger it will be. The use of *gelam* wood in large numbers in

the construction world in Banjarmasin City also causes the sustainability of the existence of *gelam* wood to decrease over time, so there needs to be a strategy or action to maintain the sustainability of the *gelam* wood potential.

The scope of the research area is the City of Banjarmasin, South Kalimantan. The method used in this research is qualitative research that using an interview survey and literature review with a cultural approach [11, 12]. In this study, the primary data used is the result of a questionnaire given to users of *gelam* wood in the construction world in Banjarmasin City (construction society). Questionnaire interviews were conducted individually in a semi-structured form. The questionnaire form has previously been evaluated (expert judgment) by 3 experts to ensure that the language and questions used in the questionnaire can be understood by the respondents. This is important to avoid miscommunication regarding the questions asked [13]. Interview questionnaires were given to 25 respondents according to the minimum number of respondents for a single case study on a small scale [14, 15]. Respondents consist of academics and practitioners who have experience in the field in terms of using *gelam* wood as the foundation structures in the Banjarmasin City area. The data obtained from the interviews were then analyzed to provide a broader picture and understanding as well as to provide a practical overview of phenomena in the field [16-18].

The questions asked are:

1. What do you think about the use of *gelam* wood as a foundation construction material?
2. What is the size of *gelam* wood that you generally use for foundation construction, whether simple buildings, buildings, or roads?
3. Where was the *gelam* wood purchased/obtained?
4. How much volume (m^3) is the average use of *gelam* wood in 1 work project or 1 year?
5. What are the advantages of using *gelam* wood as a foundation structure material?
6. What are the disadvantages of using *gelam* wood as a foundation structure material?
7. What are the prospects regarding the availability of *gelam* wood for construction?
8. What are the challenges regarding the availability of *gelam* wood for construction?

The provision and collection of questionnaires were carried out directly using face-to-face interviews or through online social media. To support the results of the interview questionnaire, secondary data is used, namely literature and related research results,

as well as related government policies and other relevant secondary data.

4. RESULT AND DISCUSSION

What about the use of *gelam* wood as a foundation construction material? 40% of respondents answered that the use of *gelam* wood as a foundation is very suitable for simple 1 or 2-storey buildings in Banjarmasin City. This is based on the building load which is not too large and the price of *gelam* wood which is relatively cheap. 44% of respondents stated that *gelam* wood is very suitable to be used as a foundation in Banjarmasin City because the typical soil of Banjarmasin City is swamp or soft soil. *Gelam* wood in terms of strength and durability when immersed in peat or swamp soil conditions will be very durable. In addition, its availability which is still abundant for now makes it very suitable to be used. Another opinion is that *gelam* wood is a form of local wisdom of the people of South Kalimantan which has been used as a foundation since old time.

This answer is in line with other studies which state that *gelam* wood is very suitable to be used as a pile foundation for tidal swamp soil, namely as a friction pile foundation. Research conducted on two different 3-storey shophouses in Banjarmasin City shows that the *gelam* wood foundation was able to carry the load of a 3-storey shophouse [19, 20]. This results also in agreement with other studies that show that the longer the wooden piles were used, the shear strength of the soil increased [21].

What is the size of *gelam* wood that generally used for foundation construction, whether simple buildings, buildings, or roads? The size of *gelam* wood which is mostly used for simple buildings or 1-story houses generally is a diameter of 8-12 cm with a length of 3-6 m. The respondent's answer is in line with other references which says that the required size is a wood diameter between 8 cm to 15 cm and a wooden pole length between 3.5 m to 6 m [22]. For 2-storey buildings or high-rise buildings generally use a diameter of 10-15 cm with a length of 7-10 m. In order for the pile foundation or *gelam* wood pile to work optimally, the bark does not need to be peeled off as illustrated in Fig. 2. Recent developments, for concrete buildings using reinforced concrete slab foundations on the pile foundation of *gelam* wood piles as well. The addition of the *gelam* wood pile is intended to improve the bearing capacity of the soil [23].

For road construction, *gelam* wood foundation are generally used for road backfill reinforcement, retaining wall, and fence with a diameter of 6-10 cm and a length of 3-4 m. The results of this questionnaire are in line with other research which states that in the *gelam* wood used for road construction reinforcement is a 3.5 m long *gelam*

wood foundation, as seen in Fig. 3 [24].



Figure 2. *Gelam* wood foundation for residential houses



Figure 3. *Gelam* wood foundation for road construction [24]

Where was the *gelam* wood purchased/obtained? The majority of respondents, namely 60% answered that the *gelam* wood used was purchased or obtained from the Barito Kuala (Marabahan), Margasari and Kapuas regency, while 8% answered that the *gelam* wood was obtained at a collector's place in the Banjar District, Liang Anggang. Other respondents generally answered that *gelam* wood was obtained from construction shops and traders around the work site, due to a large number of *gelam* traders in Banjarmasin City. For *gelam* wood sold in Banjarmasin City, apart from coming from South Kalimantan, it also comes from Kapuas, Central Kalimantan.

How much volume (m³) is the average use of *gelam* wood in 1 work project or 1 year? Regarding the average amount of *gelam* wood used, as many as 48% of respondents did not provide an answer or did not know for sure how much *gelam* wood was used. 16% of respondents answered that an average of 1000-2000 *gelam* logs of 7-10 m long pile are needed for 1-storey building. Another 16% of respondents answered that for 1 road construction project, an average 14000-20000 piles of *gelam* wood are needed. Based on the building development permit application submitted in Banjarmasin City in January 2022 until September 2022 for housing development in Banjarmasin City

as shown in Table 1, 10788,263 m³ of gelam wood or around 14000 m³ of gelam wood is needed in 1 year. Another research shows that the ultimate bearing capacity of a single pile of *gelam* wood foundation is 12 cm and 14 cm in diameter and 3.5 m long is in the range between 567.75 kg to 729.25 kg [25].

Table 1. Volume of *gelam* wood used in residential houses in Banjarmasin City

Residential Name	Location	House Unit	Volume (m ³)
Perdana Mandiri Residence	Padat Karya Road	54	346,217
Alamindo Sejahtera Permai Residence	AMD Blok I Road	51	126,946
Berkat Sekumpul Residence	Sungai Andai Road	14	86,240
Green Sunny Estate Residence	Peradapan Karya Road	331	2829,577
Villa Sunny Residence	Tatah Bangkal Luar Road	61	109,277
Asman Banua Anyar Residence	Banua Anyar Road	44	331,886
Citra Modern Type 79 Residence	Tatah Bangkal Road	38	628,290
Citra Modern Type 70 Residence	Tatah Bangkal Road	70	1165,824
Citra Modern Type 54 Residence	Tatah Bangkal Road	26	395,366
Citra Modern Type 45 Residence	Tatah Bangkal Road	71	1071,086

Citra Modern Type 36 Residence	Tatah Bangkal Road	72	1042,725
Antasari Mandiri 3 Residence	Kelayan A II Road	64	263,899
AMD XII Residence	AMD XII Road	46	199,856
Griya Pelangi Residence	Teluk Gampa Road	53	326,480
Kota Asman Graha Residence	Sungai Gampa Road	192	1230,994
Aldi Citra Persada II Residence	Mantuil Permai Road	105	633,600
Total Volume (m ³)			10788,263

What are the advantages of using *gelam* wood as a foundation structure material? The main advantage of using *gelam* wood as a foundation structure material according to the majority of respondents is that it is cheap and easy to obtain. This answer is in line with research conducted for residential buildings in the city of Banjarmasin which shows that the cost of using *gelam* wood is still lower than the cost of using mini-pile concrete for the same type of building construction [26]. This study shows that in terms of construction costs, the selection of *gelam* wood foundations is still more economical than concrete mini pile foundations.

Another major advantage of using *gelam* wood is the weight of *gelam* wood which is lighter compared to concrete pile foundations. This is mainly related to the depth of the hard soil of Banjarmasin City which is at a depth of 28 – 42.4 m [27] which also makes the *gelam* wood foundation more suitable as a friction pile or floating foundation.

Apart from these main reasons, 28% of respondents stated that the advantage of using *gelam* wood is that it is durable during wet or submerged conditions. This is in line with one of the studies that prove the ability of *gelam* wood to adapt to surrounding conditions not only in swamps is a study conducted in Kien Giang Province, Mekong Delta, Vietnam. The study used a fence construction with *Melaleuca cajuputi* wood to protect the coastal

area and the mangrove restoration area in the area. From the results of the study, it can be seen that the fence built from *Melaleuca cajuputi* wood contributes significantly to reducing wave energy and holding unstable mud in the restoration area [28].

What are the disadvantages of using *gelam* wood as a foundation structure material? According to 64% of respondents, the disadvantages is it breaks easily and the length and diameter are not uniform. Other respondents stated that the disadvantages of using *gelam* are that it rots quickly if it is in dry conditions, and the bearing capacity of a single pile is relatively small, so it requires large number of piles.

What are the prospects regarding the availability of *gelam* wood for construction? The majority of respondents answered that the current prospects regarding the availability of *gelam* wood for construction are still in sufficient quantities. However, it has become difficult to obtain for large sizes, for example, more than 4 m. If logging is carried out continuously without any replanting or maintenance of *gelam* forest, then sooner or later the *gelam* wood will become extinct. To overcome this, some respondents suggested that there must be cultivation before it can be reused periodically, and some also suggested starting to switch to other foundation materials, for example, concrete piles.

What are the challenges regarding the availability of *gelam* wood for construction? Constraints related to the availability of *gelam* wood for construction according to 96% of respondents are the difficulty of finding the large size of *gelam* wood and its availability which is getting smaller and even tends to be extinct. This is because the harvesting of *gelam* wood for current use is not accompanied by efforts to replant the *gelam* wood. The scarcity of *gelam* wood is also triggered by the use of *gelam* wood other than as a foundation, for example for scaffolding in building work. Related research states that based on current monitoring its existence is decreasing due to the conversion of forest land into agricultural land and settlements as a result of the rapid population growth rate [29]. In this case, the management system and regulations governing the *gelam* wood must be made to prevent damage to the regeneration of the *gelam* wood. The limitation of the stem diameter of the *gelam* wood that is cut down must be strictly controlled so that the potential of the *gelam* wood can be sustainable [3, 4].

5. CONCLUSION

The research on the pattern of utilization and potential of *gelam* wood as a foundation structure obtained the following results:

1. The most dominant use of *gelam* wood is as a foundation for residential houses and other 1-story simple buildings. The most widely used size of *gelam* wood is a diameter of 8-12 cm with a length of 3-6 m in length. The origin of *gelam* wood used in the City of Banjarmasin itself dominantly comes from Barito Kuala and Kapuas regency.
2. The potential of *gelam* wood to be used as a foundation structure is very large, where the need for *gelam* wood for residential foundations in Banjarmasin City reaches the range of 13500 m³ in 1 year and an average of 14000-20000 *gelam* logs are needed for 1 road construction project, not including those used for other structures.
3. The advantages of using *gelam* wood as a foundation are that it is cheap, easy to obtain, and has a relatively light weight of its own. Another advantage is that it is durable during wet or submerged conditions.
4. Disadvantages of *gelam* wood foundations are easily broken and the length and diameter are not uniform. Other disadvantages of using *gelam* are that it rots quickly if it is in dry conditions, and the bearing capacity of a single pile is relatively small, so it requires large number of piles
5. The current prospects regarding the availability of *gelam* wood for construction are still in sufficient quantities. However, it has become difficult to obtain for large sizes, for example, more than 4 m.
6. Constraints that may be faced regarding the potential for sustainable use of *gelam* wood as a foundation are the difficulty of finding the diameter and length of *gelam* wood which is more than 4-5 m, and the next obstacle is its availability which is decreasing, and even tends to become extinct.

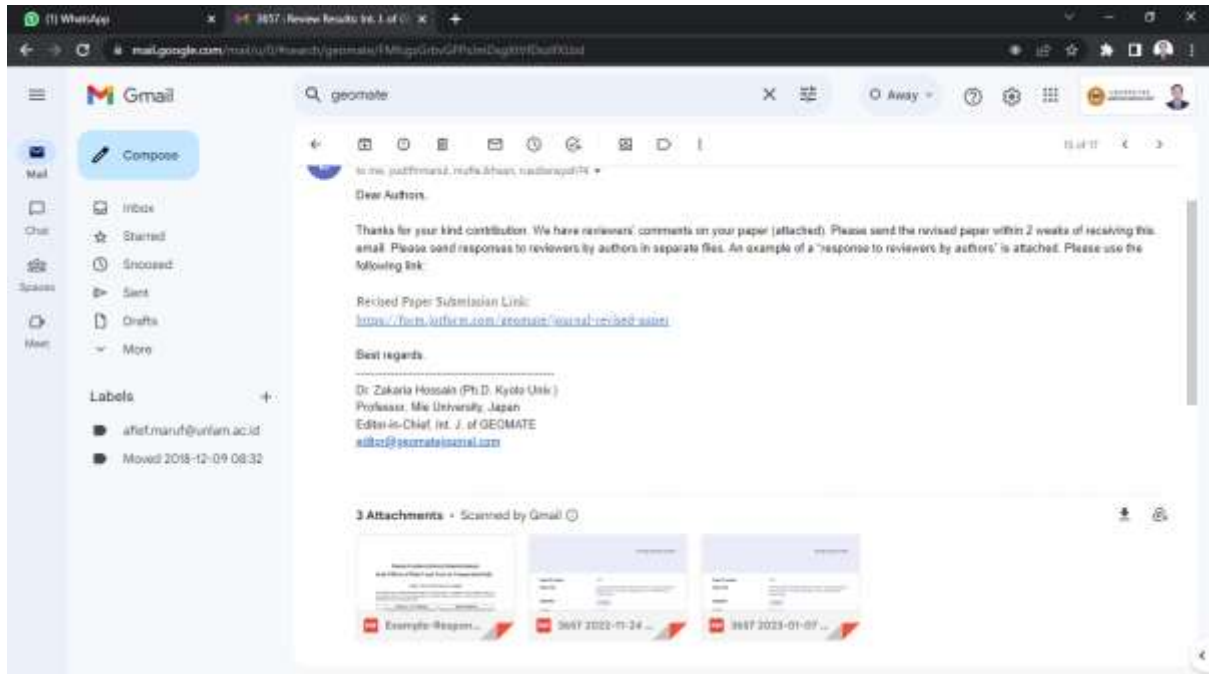
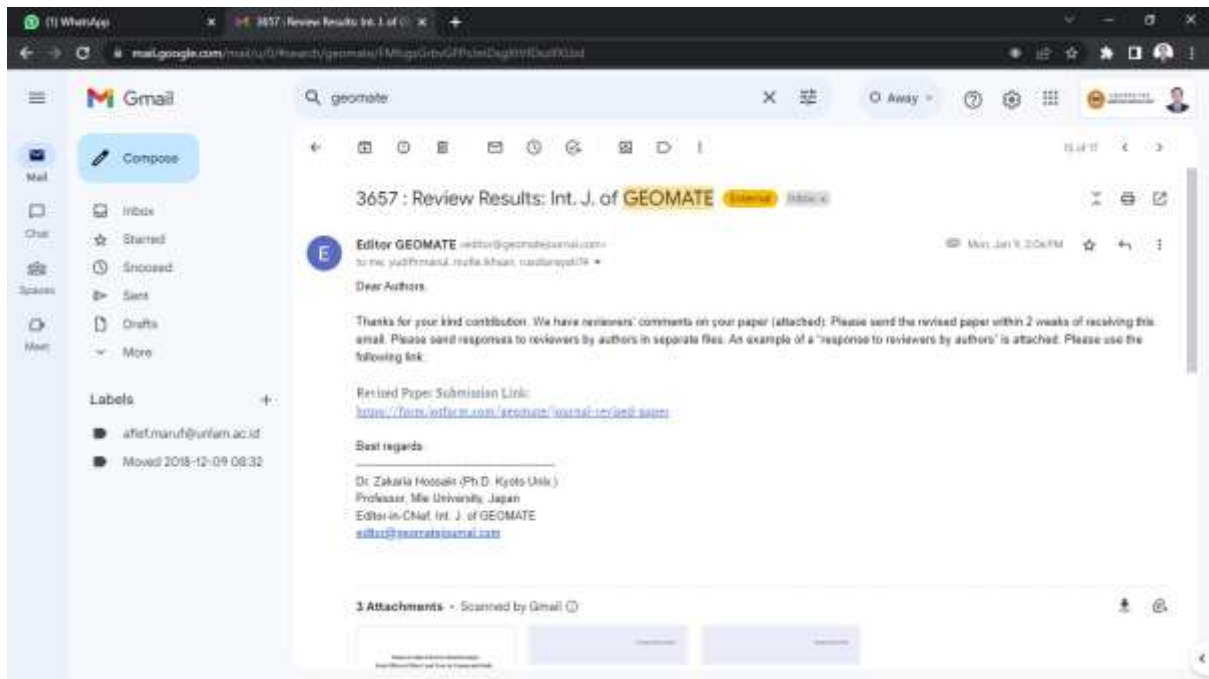
6. REFERENCES

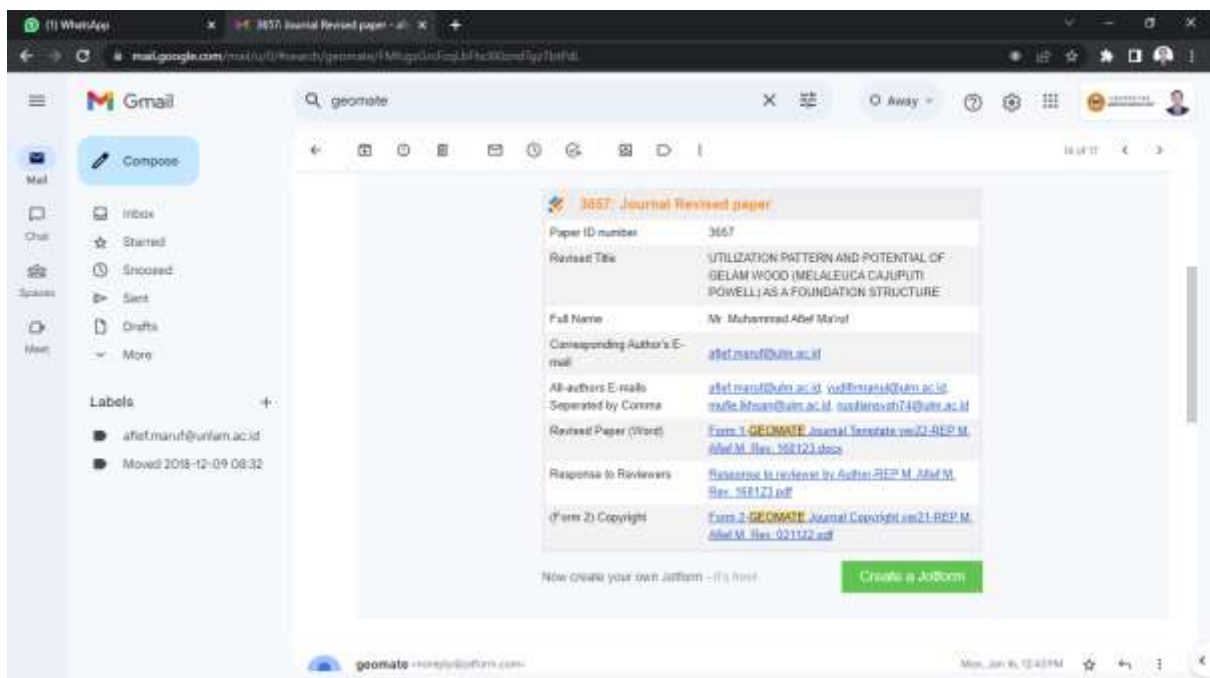
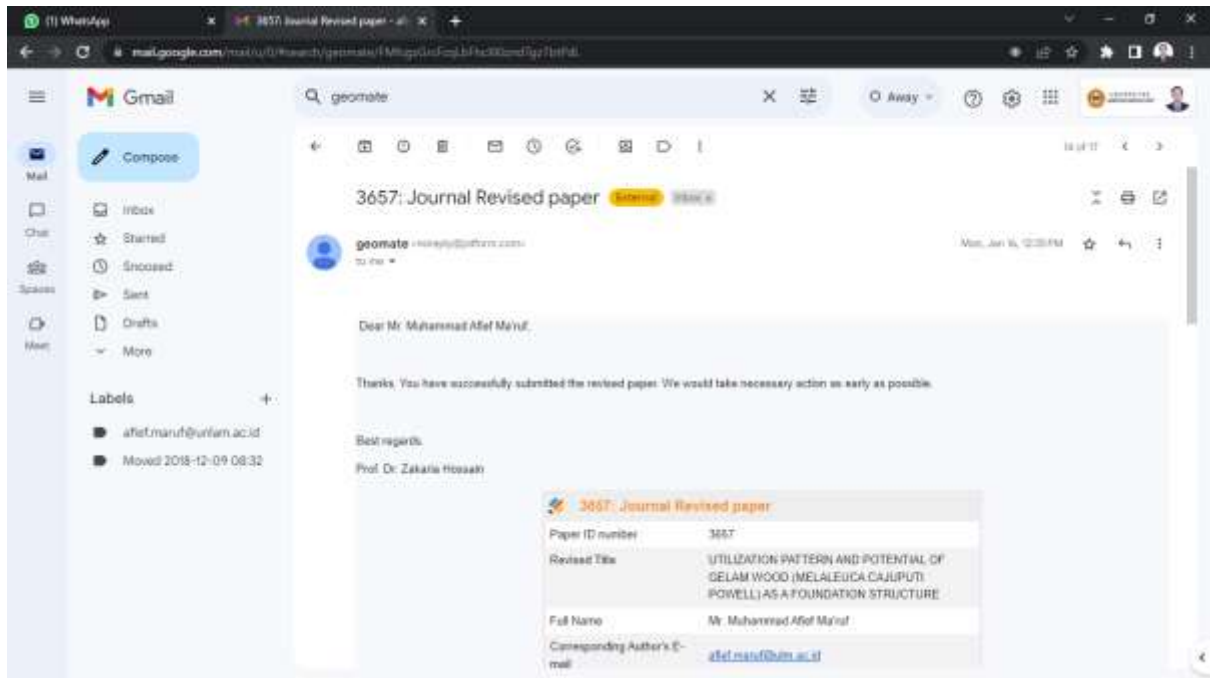
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TAHAP 2 HASIL REVIEW : PERMINTAAN REVISI Ke-1





Thursday, November 24, 2022

Paper ID number	3657
Paper Title	UTILIZATION PATTERN AND POTENTIAL OF GELAM WOOD (MELALEUCA CAJUPUTI POWELL) AS A FOUNDATION STRUCTURE
Originality	Average
Quality	Poor
Relevance	Average
Presentation	Average
Recommendation	4. Reject

General comments

The manuscript discusses the application and patterns of gelam wood (*Melaleuca cajuputi* Powell) is one of the raw materials for traditional foundations in South Kalimantan. The potential application and pattern of this wood for the foundation structure are discussed in detail. A quantitative survey together with interviews is introduced as the methodology of the research. The results are reported as the diameter and patterns that are more common in practice. The advantages and disadvantages of utilizing gelam wood in the foundation are also discussed. Although the research questions and results are interesting to read, their impact is at the local level and more of a report rather than scientific research.

Mandatory changes

NA

Reviewer's E-mail (Remove before sending to author)

Saturday, January 7, 2023

Paper ID number	3657
Paper Title	UTILIZATION PATTERN AND POTENTIAL OF GELAM WOOD (MELALEUCA CAJUPUTI POWELL) AS A FOUNDATION STRUCTURE
Originality	Average
Quality	Average
Relevance	Average
Presentation	Average
Recommendation	2. Accept with minor revision

General comments

This paper presents the investigation of Gelam Wood's utilization pattern and its potential as a foundation structure through a qualitative survey that uses an interview and literature review. Overall, the paper is moderately written.

Mandatory changes

- 1) Please add a conclusion in the abstract reflecting the aim of the study which is to investigate the pattern and the potential of Gelam Wood as a foundation structure.
- 2) Please state the tools used to analyze the data survey (Excel? SPSS?).

Suggested changes

It is suggested to present the result in a chart (Bar chart, pie chart, etc.).

Reviewer's E-mail (Remove before sending to author)

TAHAP 3 HASIL REVISI Ke-1 OLEH AUTHOR

Response by Authors to Reviewer's Remarks/Comments **Utilization Pattern and Potential Of Gelam Wood (Melaleuca Cajuputi Powell) As A Foundation Structure**

Authors: Muhammad Afief Ma'ruf, Yudi Firmanul Arifin, Mufidah Asy'ari, and Rusdiansyah

The authors have summarized their replies to the Reviewers' comments in this response letter in a two column format. A revised manuscript is submitted addressing all the comments to the Journal of GEOMATE for possible publication.

	<i>Reviewer A's Comments</i>	<i>Authors Response</i>
	<p>The manuscript discusses the application and patterns of gelam wood (Melaleuca cajuputi Powell) is one of the raw materials for traditional foundations in South Kalimantan.</p> <p>The potential application and pattern of this wood for the foundation structure are discussed in detail.</p> <p>A quantitative survey together with interviews is introduced as the methodology of the research.</p> <p>The results are reported as the diameter and patterns that are more common in practice.</p> <p>The advantages and disadvantages of utilizing gelam wood in the foundation are also discussed.</p> <p>Although the research questions and results are interesting to read, their impact is at the local level and more of a report rather than scientific research.</p>	<p>The authors appreciate the comments from the reviewer A; Although the respondents are limited in Banjarmasin City, but as stated in the background, <i>gelam</i> wood can be found in majority of Kalimantan Island.</p> <p>This shows that the impact of usage of <i>gelam</i> wood as foundation structure is not only at local level, but larger. The authors also try to elaborate the discussion by comparing the research result with other literature review to give further explanation about the result obtained.</p>
	<i>Reviewer B's Comments</i>	<i>Authors Response</i>
1	<p>This paper presents the investigation of Gelam Wood's utilization pattern and its potential as a foundation structure through a qualitative survey that uses an interview and literature review. Overall, the paper is moderately written.</p>	<p>The authors appreciate the comments from the reviewer B.</p>
2	<p>Please add a conclusion in the abstract reflecting the aim of the study which is to investigate the pattern and the potential of Gelam Wood as a foundation structure</p>	<p>The authors have revised the abstract as per the reviewer's comments.</p>

3	Please state the tools used to analyze the data survey (Excel? SPSS?).	The authors have revised the last paragraph in the Method as per the reviewer's comments: "The answers are compiled using computer spreadsheet software".
4	It is suggested to present the result in a chart (Bar chart, pie chart, etc.)	The authors have added Figure 7 as per the reviewer's comments.

The authors appreciate the valuable comments from the Reviewers.

UTILIZATION PATTERN AND POTENTIAL OF *GELAM* WOOD (*MELALEUCA CAJUPUTI* POWELL) AS A FOUNDATION STRUCTURE

* Muhammad Afief Ma'rif^{1,3}, Yudi Firmanul Arifin², Mufidah Asy'ari¹ and Rusdiansyah³

¹Doctoral Program of Agricultural Science, Postgraduate Program, University of Lambung Mangkurat, Banjarbaru, Indonesia; ²Faculty of Forestry, University of Lambung Mangkurat, Banjarbaru, Indonesia; ³Faculty of Engineering, University of Lambung Mangkurat, Banjarbaru, Indonesia

*Corresponding Author, Received: 00 Oct. 2018, Revised: 00 Nov. 2018, Accepted: 00 Dec. 2018

ABSTRACT: Gelam wood (*Melaleuca cajuputi* Powell) is one of the raw materials for traditional foundations in South Kalimantan. The purpose of this study is to identify the pattern of using gelam wood as a foundation structure and its potential. The method used in this research is qualitative research that using an interview survey and literature review. The results showed that the most dominant use of gelam wood was for residential houses and other simple buildings. Based on the respondents' answers, it can be concluded that the pattern of using gelam wood as a foundation is dominated by gelam wood with a diameter of 8-12 cm and a length of 3-6 m which is mostly used for simple buildings or 1-storey houses. The majority of the gelam wood used as foundation came from Barito Kuala (Marabahan), Margasari and Kapuas regency. The potential of gelam wood to be used as a foundation structure is very large, where the need for gelam wood for residential foundations in Banjarmasin City reaches the range of 13500 m³ in 1 year and an average of 14000-20000 gelam logs are needed for 1 road construction project, not including those used for other structures. Constraints that may be faced regarding the potential for sustainable use of gelam wood as a foundation are the difficulty of finding the diameter and length of gelam wood that is more than 4-5 m, and the next obstacle is its availability which is dwindling, and even tends to become extinct.

Keywords: Gelam, Foundation, Utilization, Structure, Potential

1. INTRODUCTION

Gelam wood (*Melaleuca cajuputi* Powell) is one of the raw materials for traditional foundations in South Kalimantan and its surroundings, which is widely available along the swamps of Kalimantan. Gelam wood which belongs to the *Melaleuca* genus of the *Myrtaceae* family is a plant that grows naturally in the peatlands of South Kalimantan, Central Kalimantan, and other areas. Seven types of *Melaleuca* are common throughout the world, namely *Melaleuca cajuputi*, *Melaleuca dealbata*, *Melaleuca leucadendra*, *Melaleuca nervosa*, *Melaleuca quinquenervia*, *Melaleuca stenostachya*, and *Melaleuca viridiflora* [1, 2]. Gelam wood in South Kalimantan generally comes from Batola Subdistrict, Tanah Laut Regency, Tapin Regency, South Hulu Sungai Regency, and partly from Central Kalimantan, especially Dadahup Village in Kapuas Regency. Batola subdistrict as the center of gelam wood production in South Kalimantan has the potential for gelam wood between 2.9 to 7.1 m³/ha and tends to decrease every year [3, 4].

Gelam wood (Fig. 1) has special properties so it is very suitable to be used as part of the foundation of house buildings along the riverbank. The nature of gelam wood is that the more it is submerged the

more strength becomes durable. Gelam wood submerged in mud continuously has strength for decades. Research conducted on peat swamps in Central Kalimantan states that the gelam wood foundation used in Central Kalimantan peat swamp soil can last up to 35 years. The gelam wood foundation used on peat swamp soil for 10-38 years in Central Kalimantan experienced an increase in wood dry density by 28.13%, hardness by 12.83%; and silica content of 1.25% [5].



Figure 1. Gelam wood (*Melaleuca cajuputi* Powell)

The potential use and utilization of gelam wood

4. How much volume (m³) is the average use of gelam wood in 1 work project or 1 year?
5. What are the advantages of using gelam wood as a foundation structure material?
6. What are the disadvantages of using gelam wood as a foundation structure material?
7. What are the prospects regarding the availability of gelam wood for construction?
8. What are the challenges regarding the availability of gelam wood for construction?

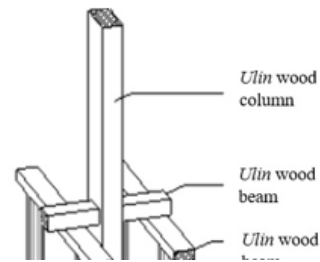
The provision and collection of questionnaires were carried out directly using face-to-face interviews or through online social media. The answers are compiled using computer spreadsheet software. To support the results of the interview questionnaire, secondary data is used, namely literature and related research results, as well as related government policies and other relevant secondary data.

4. RESULT AND DISCUSSION

What about the use of gelam wood as a foundation construction material? 40% of respondents answered that the use of gelam wood as a foundation is very suitable for simple 1 or 2-storey buildings in Banjarmasin City. This is based on the building load which is not too large and the price of gelam wood which is relatively cheap. 44% of respondents stated that gelam wood is very suitable to be used as a foundation in Banjarmasin City because the typical soil of Banjarmasin City is swamp or soft soil. Gelam wood in terms of strength and durability when immersed in water or swamp soil

a pile foundation for tidal swamp soil, namely as a friction pile foundation. Research conducted on two different 3-storey shophouses in Banjarmasin City shows that the gelam wood foundation was able to carry the load of a 3-storey shophouse [19, 20]. This results also in agreement with other studies that show that the longer the wooden piles were used, the shear strength of the soil increased [21].

What is the size of gelam wood that generally used for foundation construction, whether simple buildings, buildings, or roads? The size of gelam wood which is mostly used for simple buildings or 1-storey houses generally is a diameter of 8-12 cm with a length of 3-6 m. The respondent's answer is in line with other references which says that the required size is a wood diameter between 8 cm to 15 cm and a wooden pole length between 3.5 m to 6 m [22]. Gelam wood foundation for 1-storey houses usually in form of group pile foundation consist of four gelam wood, such as in Fig. 4. For 2-storey buildings or high-rise buildings generally use a diameter of 10-15 cm with a length of 7-10 m.



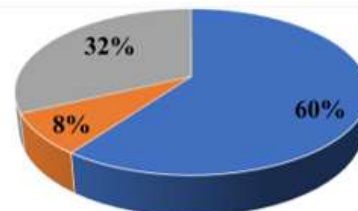
states that in the gelam wood used for road construction reinforcement is a 3.5 m long gelam wood foundation, as seen in Fig. 6 [24].



Figure 5. Gelam wood foundation for houses



development permit application submitted in Banjarmasin City in January 2022 until September 2022 for housing development in Banjarmasin City as shown in Table 1, 10788,263 m³ of gelam wood or around 13500 m³ of gelam wood is needed in 1 year. Another research shows that the ultimate bearing capacity of a single pile of gelam wood foundation is 12 cm and 14 cm in diameter and 3.5 m long is in the range between 567.75 kg to 729.25 kg [25].



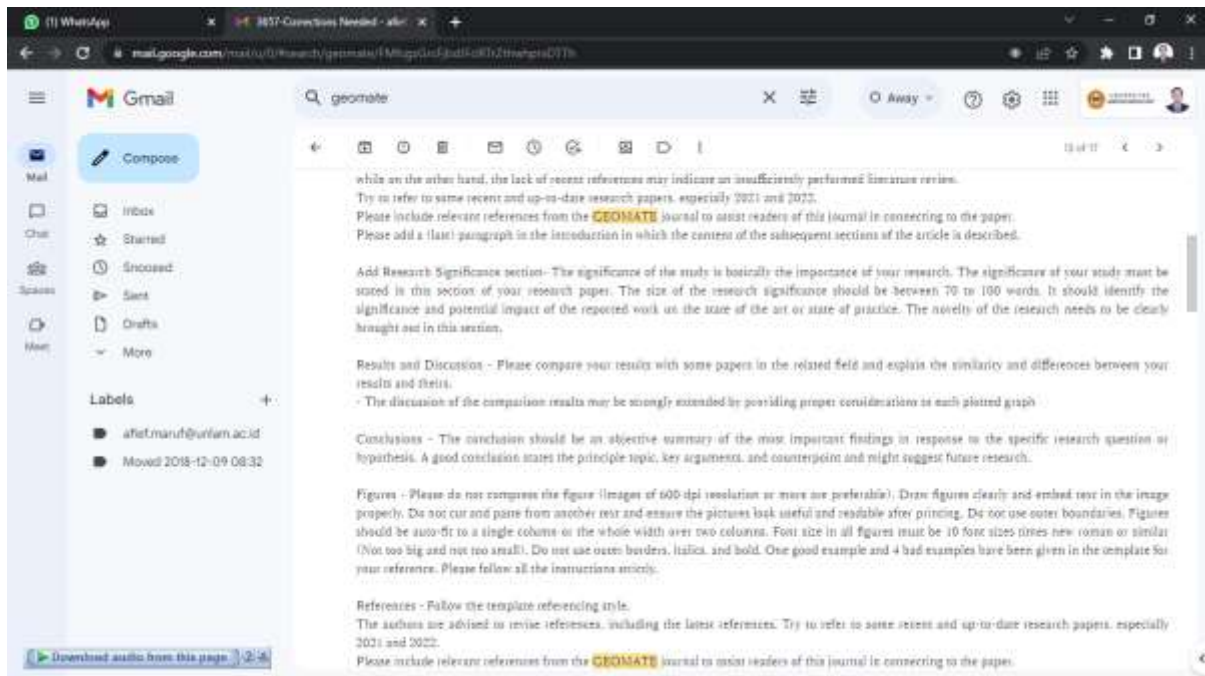
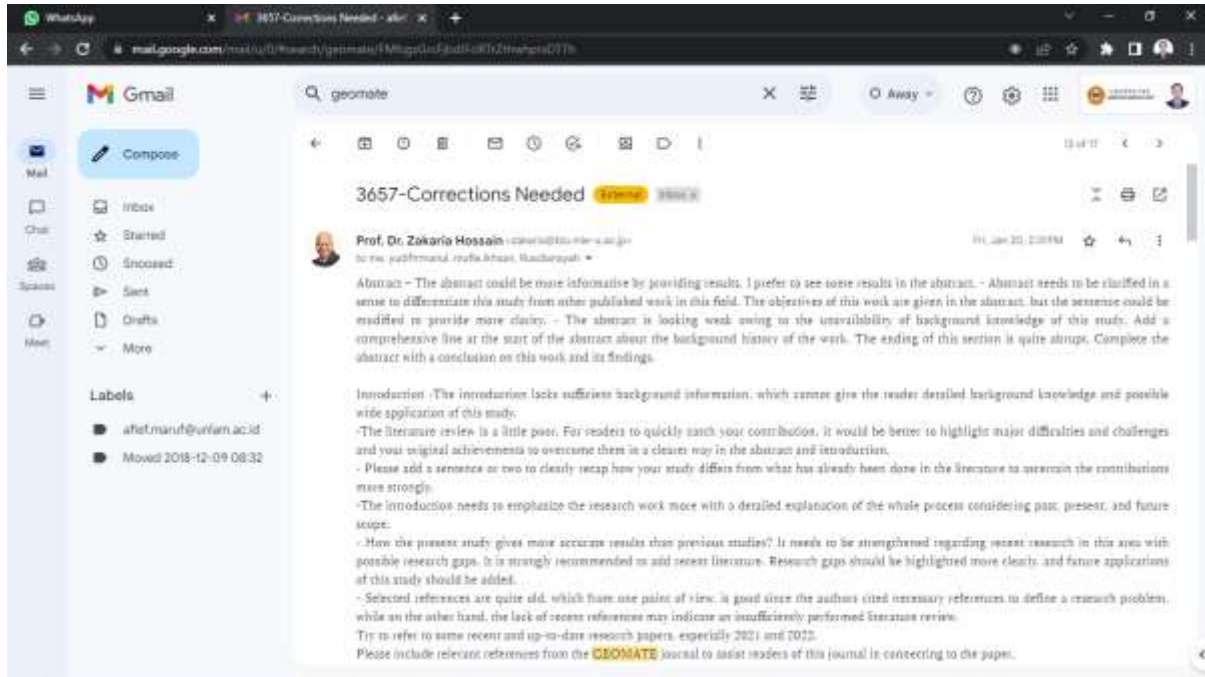
- Barito Kuala (Marabahan), Margasari and Kapuas regency
- Banjar District, Liang Anggang
- construction shops and traders

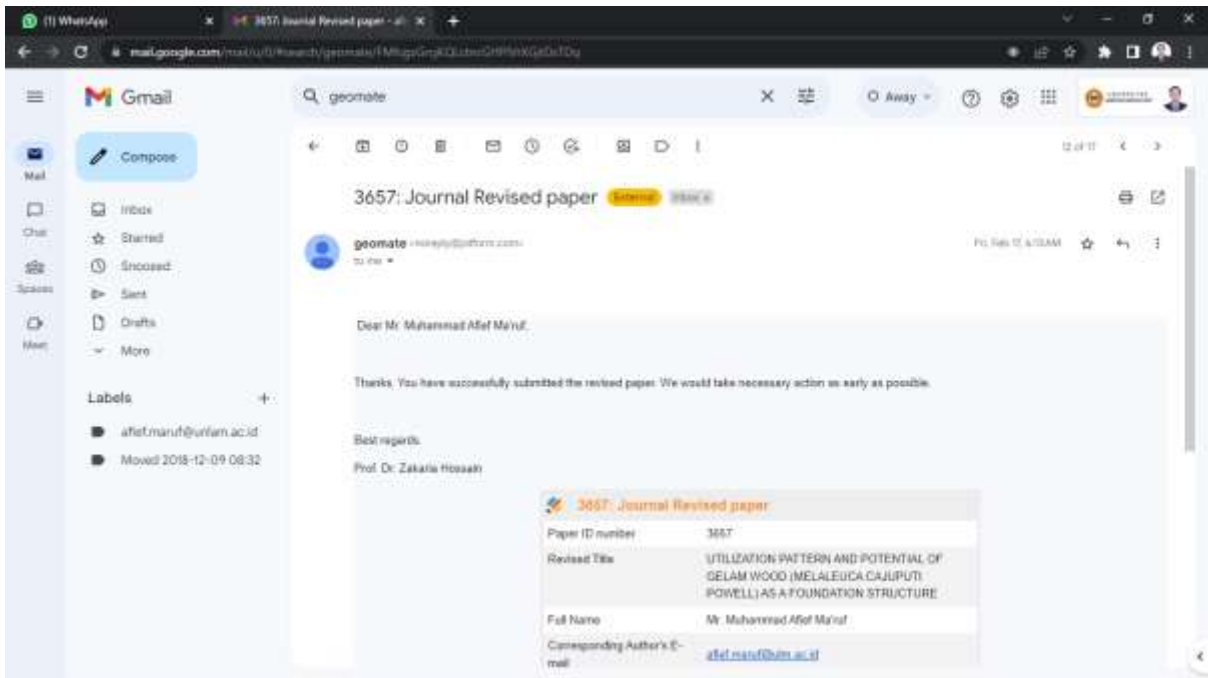
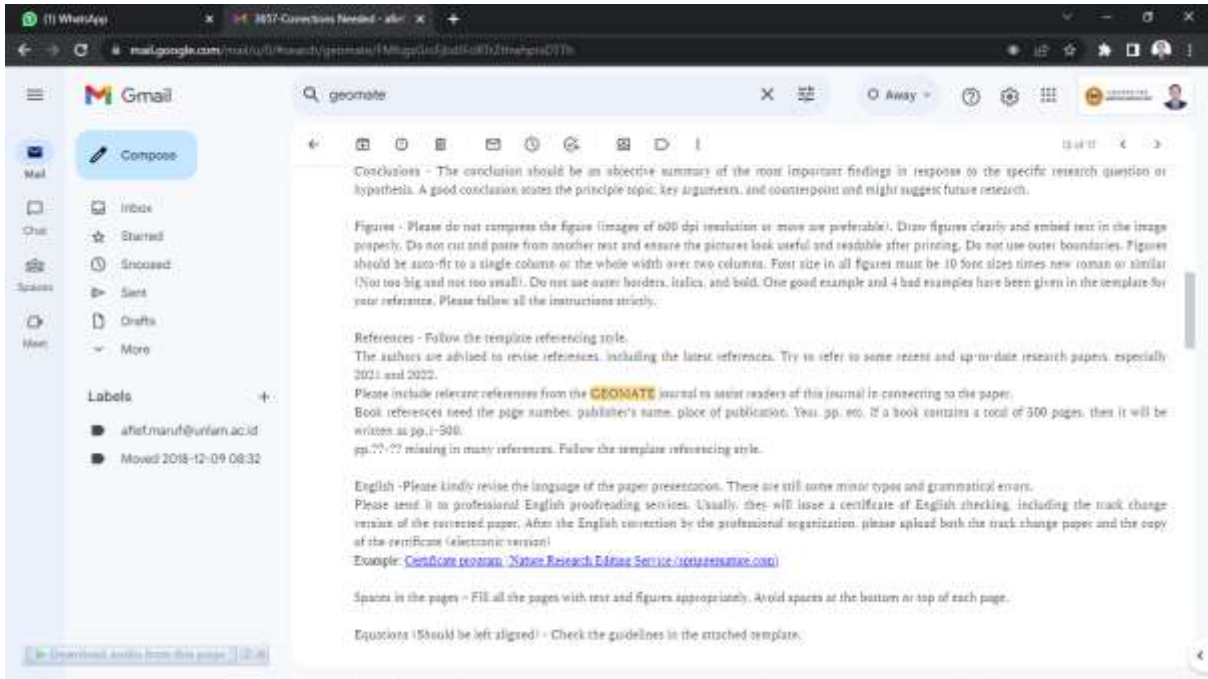
Figure 7. The origin of Gelam wood

Table 1. Volume of gelam wood used in residential houses in Banjarmasin City

Residential	House	Volume
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TAHAP 4 HASIL REVIEW : PERMINTAAN REVISI KE-2





The screenshot shows a Gmail interface with a search bar containing 'geomate'. The main content area displays a card for a 'Journal Revised paper' with the following details:

- Paper ID number:** 3657
- Revised Title:** UTILIZATION PATTERN AND POTENTIAL OF GELAM WOOD (MELALEUCA CAJUPUTI POWELL) AS A FOUNDATION STRUCTURE
- Full Name:** Mr. Muhammad Afef Maruf
- Corresponding Author's E-mail:** afef.maruf@unlam.ac.id
- All-authors E-mails Separated by Comma:** afef.maruf@unlam.ac.id, wahfismata@unlam.ac.id, mufid.khusni@unlam.ac.id, rofadernyati74@unlam.ac.id
- Revised Paper (Word):** [1-GEOMATE_Journal_Template_ver211.M_Afef.M_Rev_175623.docx](#)
- Response to Reviews:** [Cover_of_Certificate_of_Proceedings.pdf](#)
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At the bottom of the card, there is a link to 'Now create your own Jodform - it's free!' and a green button labeled 'Create a Jodform'. Below the card, there are 'Reply' and 'Forward' buttons.

TAHAP 5 HASIL REVISI Ke-2 OLEH AUTHOR

Response by Authors to Reviewer's Remarks/Comments

Utilization Pattern And Potential Of *Gelam* Wood (*Melaleuca Cajuputi* Powell) As A Foundation Structure

**Authors: Muhammad Afief Ma'ruf, Yudi
Firmanul Arifin, Mufidah Asy'ari, and
Rusdiansyah**

The authors have summarized their replies to the Reviewers' comments in this response letter in a two column format. A revised manuscript is submitted addressing all the comments to the Journal of GEOMATE for possible publication.

	<i>Editor's Comments</i>	<i>Authors Response</i>
1	<p>Abstract – The abstract could be more informative by providing results. I prefer to see some results in the abstract. - Abstract needs to be clarified in a sense to differentiate this study from other published work in this field. The objectives of this work are given in the abstract, but the sentence could be modified to provide more clarity. - The abstract is looking weak owing to the unavailability of background knowledge of this study. Add a comprehensive line at the start of the abstract about the background history of the work. The ending of this section is quite abrupt. Complete the abstract with a conclusion on this work and its findings.</p>	<p>The authors have revised the abstract as per the editor's comment.</p>
2	<p>Introduction -The introduction lacks sufficient background information, which cannot give the reader detailed background knowledge and possible wide application of this study.</p> <p>-The literature review is a little poor. For readers to quickly catch your contribution, it would be better to highlight major difficulties and challenges and your original achievements to overcome them in a clearer way in the abstract and introduction.</p> <p>- Please add a sentence or two to clearly recap how your study differs from what has</p>	<p>The authors have revised the introduction as per the editor's comment.</p>

1

	<p>already been done in the literature to ascertain the contributions more strongly.</p> <p>-The introduction needs to emphasize the research work more with a detailed explanation of the whole process considering past, present, and future scope.</p> <p>- How the present study gives more accurate results than previous studies? It needs to be strengthened regarding recent research in this area with possible research gaps. It is strongly recommended to add recent literature. Research gaps should be highlighted more clearly, and future applications of this study should be added.</p> <p>- Selected references are quite old, which from one point of view, is good since the authors cited necessary references to define a research problem, while on the other hand, the lack of recent references may indicate an insufficiently performed literature review.</p> <p>Try to refer to some recent and up-to-date research papers, especially 2021 and 2022.</p> <p>Please include relevant references from the GEOMATE journal to assist readers of this journal in connecting to the paper.</p> <p>Please add a (last) paragraph in the introduction in which the content of the subsequent sections of the article is described.</p>	
3	<p>Add Research Significance section- The significance of the study is basically the importance of your research. The significance of your study must be stated in this section of your research paper. The size of the research significance should be between 70 to 100 words. It should identify the significance and potential impact of the reported work on the state of the art or state of practice. The novelty of the research needs to be clearly brought out in this section.</p>	<p>The authors have revised the Research Significance section as per the editor's comment.</p>
4	<p>Results and Discussion - Please compare your results with some papers in the related field and explain the similarity and differences between your results and theirs.</p> <p>- The discussion of the comparison results</p>	<p>The authors have revised the Results and Discussion as per the editor's comment.</p>

	may be strongly extended by providing proper considerations to each plotted graph	
5	Conclusions - The conclusion should be an objective summary of the most important findings in response to the specific research question or hypothesis. A good conclusion states the principle topic, key arguments, and counterpoint and might suggest future research.	The authors have revised the conclusions as per the editor's comment.
6	Figures - Please do not compress the figure (images of 600 dpi resolution or more are preferable). Draw figures clearly and embed text in the image properly. Do not cut and paste from another text and ensure the pictures look useful and readable after printing. Do not use outer boundaries. Figures should be auto-fit to a single column or the whole width over two columns. Font size in all figures must be 10 font sizes times new roman or similar (Not too big and not too small). Do not use outer borders, italics, and bold. One good example and 4 bad examples have been given in the template for your reference. Please follow all the instructions strictly.	The authors have revised the figures as per the editor's comment.
7	References - Follow the template referencing style. The authors are advised to revise references, including the latest references. Try to refer to some recent and up-to-date research papers, especially 2021 and 2022. Please include relevant references from the GEOMATE journal to assist readers of this journal in connecting to the paper. Book references need the page number, publisher's name, place of publication, Year, pp, etc. If a book contains a total of 500 pages, then it will be written as pp.1-500. pp.??-?? missing in many references. Follow the template referencing style.	The authors have revised the references as per the editor's comment.

<p>English -Please kindly revise the language of the paper presentation. There are still some minor typos and grammatical errors.</p> <p>Please send it to professional English proofreading services. Usually, they will issue a certificate of English checking, including the track change version of the corrected paper. After the English correction by the professional organization, please upload both the track change paper and the copy of the certificate (electronic version)</p> <p>Example: Certificate program Nature Research Editing Service (springernature.com)</p>	<p>The authors have provide the certificate of professional English proofreading services as per the editor's comment.</p>
<p>Spaces in the pages – Fill all the pages with text and figures appropriately. Avoid spaces at the bottom or top of each page.</p>	<p>The authors have revised the pages as per the editor's comment.</p>
<p>Paragraphs – In a research manuscript writing, most paragraphs should include at least three sentences, though rarely more than ten.</p>	<p>The authors have revised the paragraphs as per the editor's comment.</p>

8	Last page: Both columns should be the same height.	The authors have revised the format accordingly.
9	English: There are many grammatical errors. Please correct it using an English professional editor.	The authors have used the free version of grammar correction to help check the paper. Most of the grammatical error is because of the foreign word, such as <i>gelam</i> , and latin word such as <i>melaleuca cajuputi</i> .

The authors appreciate the valuable comments from the Reviewers.

KUTIPAN NASKAH REVISI Ke-2 OLEH AUTHOR

International Journal of GEOMATE, Month, Year Vol.00, Issue 00, pp.000-000
ISSN: 2186-2982 (P), 2186-2990 (O), Japan, DOI: <https://doi.org/10.21660/2022.000.0000>
Geotechnique, Construction Materials and Environment

UTILIZATION PATTERN AND POTENTIAL OF GELAM WOOD (*MELALEUCA CAJUPUTI* POWELL) AS A FOUNDATION STRUCTURE

* Muhammad Afief Ma'ruf^{1,3}, Yudi Firmanul Arifin², Mufidah Asy'ari¹ and Rusdiansyah³

¹Doctoral Program of Agricultural Science, Postgraduate Program, University of Lambung Mangkurat, Banjarbaru, Indonesia; ²Faculty of Forestry, University of Lambung Mangkurat, Banjarbaru, Indonesia; ³Faculty of Engineering, University of Lambung Mangkurat, Banjarbaru, Indonesia

*Corresponding Author, Received: 00 Oct. 2018, Revised: 00 Nov. 2018, Accepted: 00 Dec. 2018

ABSTRACT: Gelam wood (*Melaleuca cajuputi* Powell) is one of the raw materials for traditional foundations in Kalimantan, which is widely available along the wetlands of Kalimantan. Gelam wood is very important in wetlands supporting the construction of houses and other infrastructure in Indonesia. The need for gelam wood in Kalimantan is huge and continuous. To date, the use of gelam is used not only in the development of wetland stilt housing, but also in the production of planks and beams for the interior of the house, as well as debris and scraps used as firewood. The purpose of this study is to identify the pattern of using gelam wood as a foundation structure and its potential. The method used in this research is qualitative research that using an interview survey and literature review. The result shows that the pattern of using gelam wood as a foundation are 3-6 m length for simple buildings or 1-storey houses, 7-10 m length for 2-storey buildings or high-rise buildings, and 3-4 m length for road construction. The diameter of gelam wood used is vary between 8-15 cm. The potential use and utilization of gelam wood as a foundation structure is very large, where the need for gelam wood for residential foundations in Banjarmasin City reaches the range of 13500 m³ in 1 year and an average of 14000-20000 gelam logs are needed for 1 road construction project, not including those used for other structures.

Keywords: Gelam, Foundation, Utilization, Structure, Potential

1. INTRODUCTION

Gelam (or galam in colloquial speech) wood (*Melaleuca cajuputi* Powell) is one of the raw materials for traditional foundations in Kalimantan, which is widely available along the wetlands of Kalimantan. Gelam wood which belongs to the *Melaleuca* genus of the *Myrtaceae* family is a plant that grows naturally in the peatlands of South Kalimantan, Central Kalimantan, and other areas. Seven types of *Melaleuca* are common throughout the world, namely *Melaleuca cajuputi*, *Melaleuca dealbata*, *Melaleuca leucadendra*, *Melaleuca nervosa*, *Melaleuca quinquenervia*, *Melaleuca stenostachya*, and *Melaleuca viridiflora* [1, 2]. Gelam wood in South Kalimantan generally comes from Batola Subdistrict, Tanah Laut Regency, Tapin Regency, South Hulu Sungai Regency, and partly from Central Kalimantan, especially Dadahup Village in Kapuas Regency. Batola subdistrict as the center of gelam wood production in South Kalimantan has the potential for gelam wood between 2.9 to 7.1 m³/ha and tends to decrease every year [3, 4].

Gelam wood is very important in wetlands supporting the construction of houses and other infrastructure in Indonesia. The need for gelam

wood in Kalimantan is huge and continuous. To date, the use of gelam is used not only in the development of wetland stilt housing, but also in the production of planks and beams for the interior of the house, as well as debris and scraps used as firewood. [3]. Gelam wood (Fig. 1) has special properties so it is very suitable to be used as part of the foundation of house buildings along the riverbank. The nature of gelam wood is that the more it is submerged the more strength becomes durable. Gelam wood submerged in mud continuously has strength for decades. Research conducted on peat swamps in Central Kalimantan states that the gelam wood foundation used in Central Kalimantan peat swamp soil can last up to 35 years. The gelam wood foundation used on peat swamp soil for 10-38 years in Central Kalimantan experienced an increase in wood dry density by 28.13%, hardness by 12.83%; and silica content of 1.25% [5].

The potential use and utilization of gelam wood in the City of Banjarmasin and the Province of South Kalimantan is quite large. The gelam wood foundation has several advantages when compared to precast concrete foundations, both in terms of cost and in terms of adaptability to swamp land. The use of gelam wood is more dominant in the form of

logs such as piles [6, 7], as seen in Fig. 2. The use of gelam wood as a foundation is generally in the form of group piles or rafts because group foundations have a smaller reduction than single piles [8] and provide better stiffness during lateral pushover [9]. Gelam wood is one of the most suitable foundation materials because it was able to adapt to surrounding conditions [1]. This form of adaptation of gelam wood is important, especially in dealing with tidal effects on soil water content and soil temperature, which other studies have shown that changes in soil temperature affect the bearing capacity of the pile foundation [10, 11].



Figure 1. Gelam wood (*Melaleuca cajuputi* Powell)



project, not including those used for other structures. Constraints that may be faced regarding the potential for sustainable use of gelam wood as a foundation are the difficulty of finding the diameter and length of gelam wood that is more than 4-5 m, and the next obstacle is its availability which is dwindling, and even tends to become extinct.

This result is slightly different from the similar research that based on gelam traders as its respondents. Based on the traders, the dimension of gelam wood used for foundation structure is 8-9 cm, and the bigger diameter is used for railway pile and plank [6]. The similarity in both research is that the potential use and utilization of gelam wood is still exist and even continue to increase until the future, although currently its availability in nature is starting to decrease.

5. CONCLUSION

The research on the pattern of utilization and potential of gelam wood as a foundation structure obtained the following results:

1. The pattern of using gelam wood as a foundation are 3-6 m length for simple buildings or 1-storey houses, 7-10 m length For 2-storey buildings or high-rise buildings, and 3-4 m length for road construction. The diameter of gelam wood used is vary between 8-15 cm.
2. The potential use and utilization of gelam wood as a foundation structure is very large, where the

structure and its potential. The expected results of this study are to obtain the information about the dimension of gelam wood mostly used for foundation structure. It is also expected that the necessity of gelam wood in a year for foundation structure can be obtained from this research.

2. RESEARCH SIGNIFICANCE

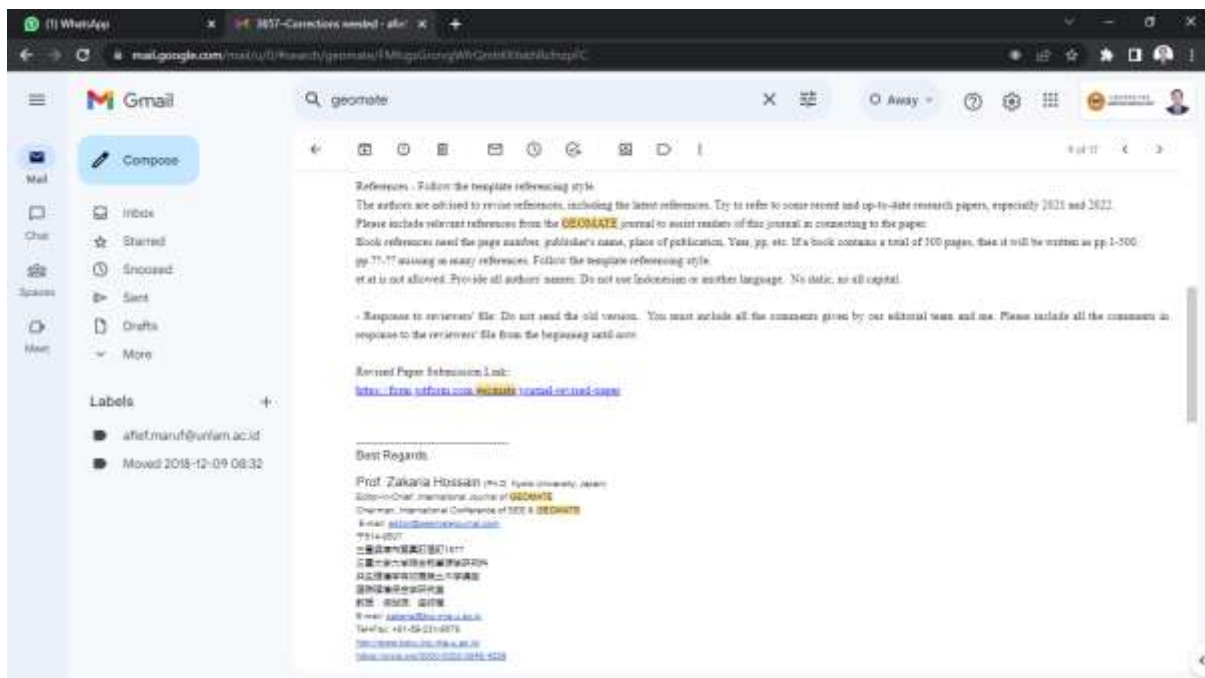
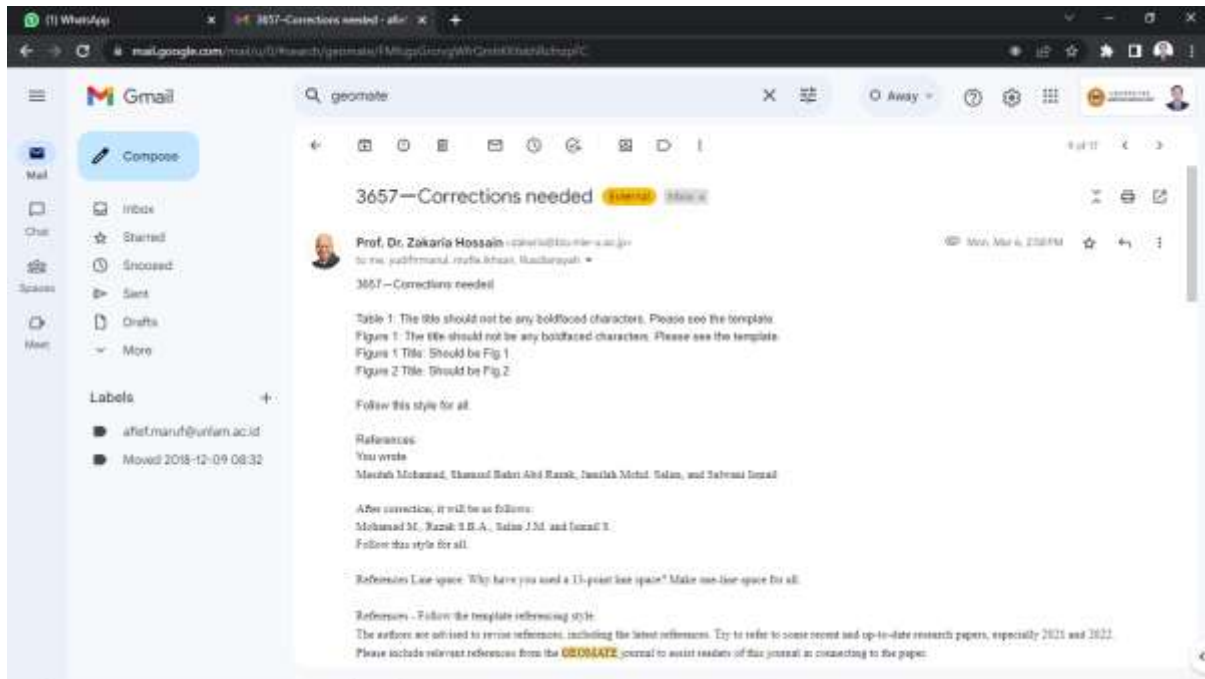
The significant of this study is the identification of gelam wood dimension that used specifically as a foundation structure for a variety of construction type. This study is also the first research that utilize the construction society in Banjarmasin City as the respondent in terms of reason for using of gelam wood as a foundation structure. The necessity of gelam wood as a foundation structure will also obtain from this study, which is not been recorded in any previous study. The result of this study will provide the necessary information for all the stake holder and government for the formulation of the future gelam wood utilization strategy in order to prevent the extinction of gelam wood itself.

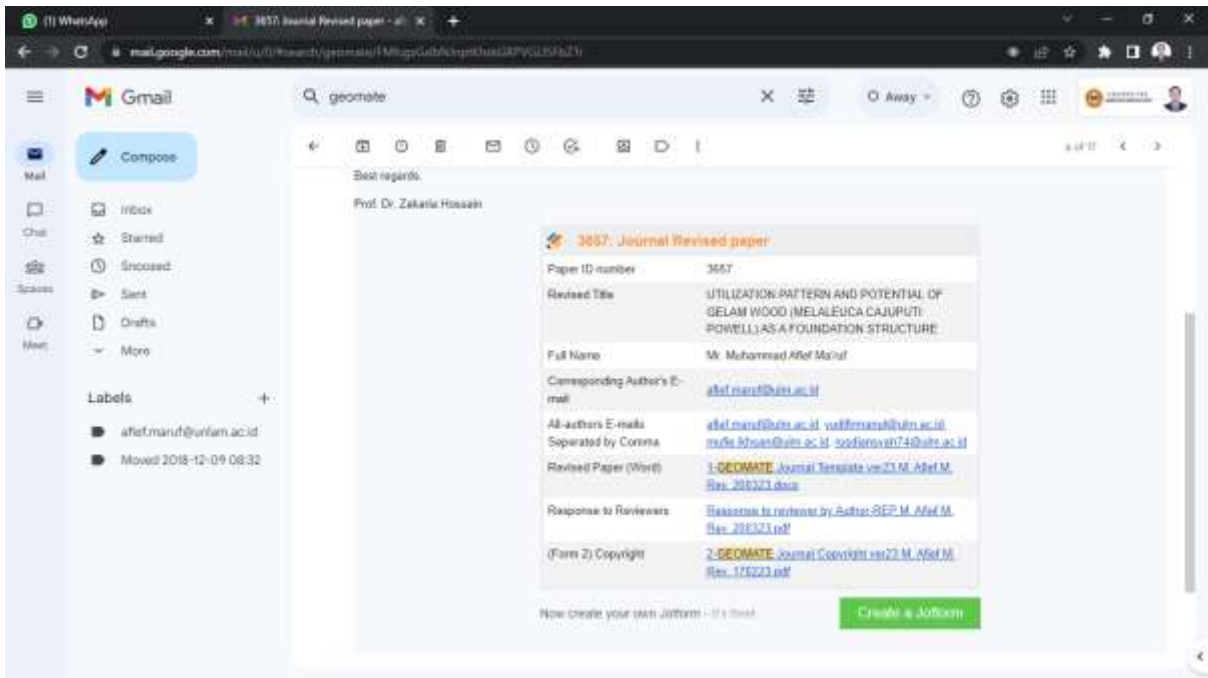
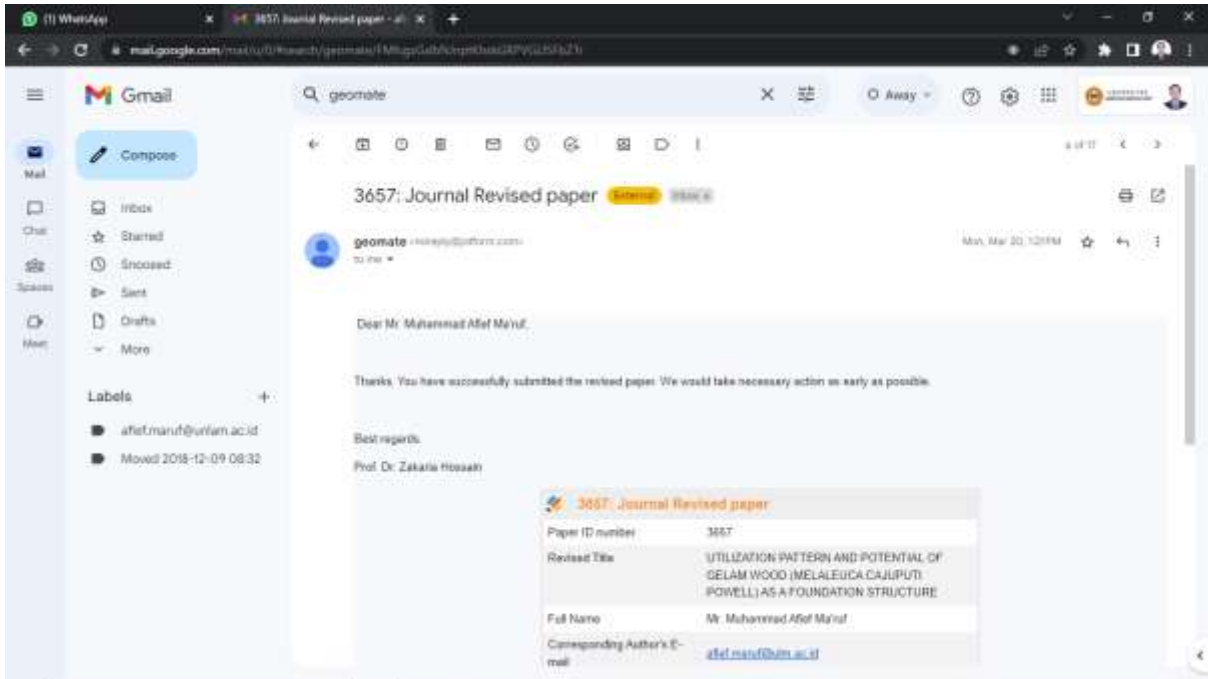
3. METHOD

The scope of the research area is the City of Banjarmasin, South Kalimantan. The method used in this research is qualitative research that using an interview survey and literature review with a cultural approach [12, 13]. In this study, the primary data used is the result of a questionnaire given to

- [3] Yudi Firmanul Arifin, Siti Hamidah, and Yulian Firmana Arifin. The Analysis of Management and Timber Trade System of Gelam (*Melaleuca cajuputi*) From Peat Swamp Forest in South Kalimantan. *Journal of Wetlands Environmental Management*, Vol. 2, Issue 2, 2014, pp. 79 – 83.
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- [6] Adnan Ardana, Syaifuddin, and Dewi Alimah. Pola Pemanfaatan dan Pemasaran Kayu Galam di Desa Jejangkit Timur dan Margasari, Kec. Marabahan, Barito Kuala, Kalimantan Selatan. Conference proceedings, in *Proceedings of Seminar Nasional Merawat Asa Restorasi Gambut, Pencegahan Kebakaran dan Peningkatan Kesejahteraan Masyarakat*, 2018,

TAHAP 6 HASIL REVIEW : PERMINTAAN REVISI Ke-3





TAHAP 7 HASIL REVISI Ke-3 OLEH AUTHOR

March 6, 2023

	<i>Editor's Comments</i>	<i>Authors Response</i>
1	<p>Table 1: The title should not be any boldfaced characters. Please see the template.</p> <p>Figure 1: The title should not be any boldfaced characters. Please see the template.</p> <p>Figure 1 Title: Should be Fig.1</p> <p>Figure 2 Title: Should be Fig.2</p> <p>Follow this style for all.</p>	<p>The authors have revised the format as per the editor's comment.</p>
2	<p>References: You wrote Masitah Mohamad, Shamsul Bahri Abd Razak, Jamilah Mohd. Salim, and Salwani Ismail</p> <p>After correction, it will be as follows: Mohamad M., Razak S.B.A., Salim J.M. and Ismail S.</p> <p>Follow this style for all.</p>	<p>The authors have revised the references as per the editor's comment.</p>
3	<p>References Line space: Why have you used a 13-point line space? Make one-line space for all.</p>	<p>The authors have revised the format as per the editor's comment.</p>
4	<p>References - Follow the template referencing style.</p> <p>The authors are advised to revise references, including the latest references. Try to refer to some recent and up-to-date research papers, especially 2021 and 2022.</p> <p>Please include relevant references from the GEOMATE journal to assist readers of this journal in connecting to the paper.</p> <p>Book references need the page number, publisher's name, place of publication, Year, pp, etc. If a book contains a total of 500 pages, then it will be written as pp.1-500.</p> <p>pp.??-?? missing in many references. Follow the template referencing style.</p>	<p>The authors have revised the references as per the editor's comment.</p>

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5	et at is not allowed. Provide all authors' names. Do not use Indonesian or another language. No italic, no all capital.	The authors have revised the references as per the editor's comment. As for the references number [5], [6], [7], [18], [19], [20], [21], [23], [24], [25], [26] and [29], the author has translated the original paper title to English and added (in Indonesian) at the end of the references .
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The authors appreciate the valuable comments from the Reviewers.

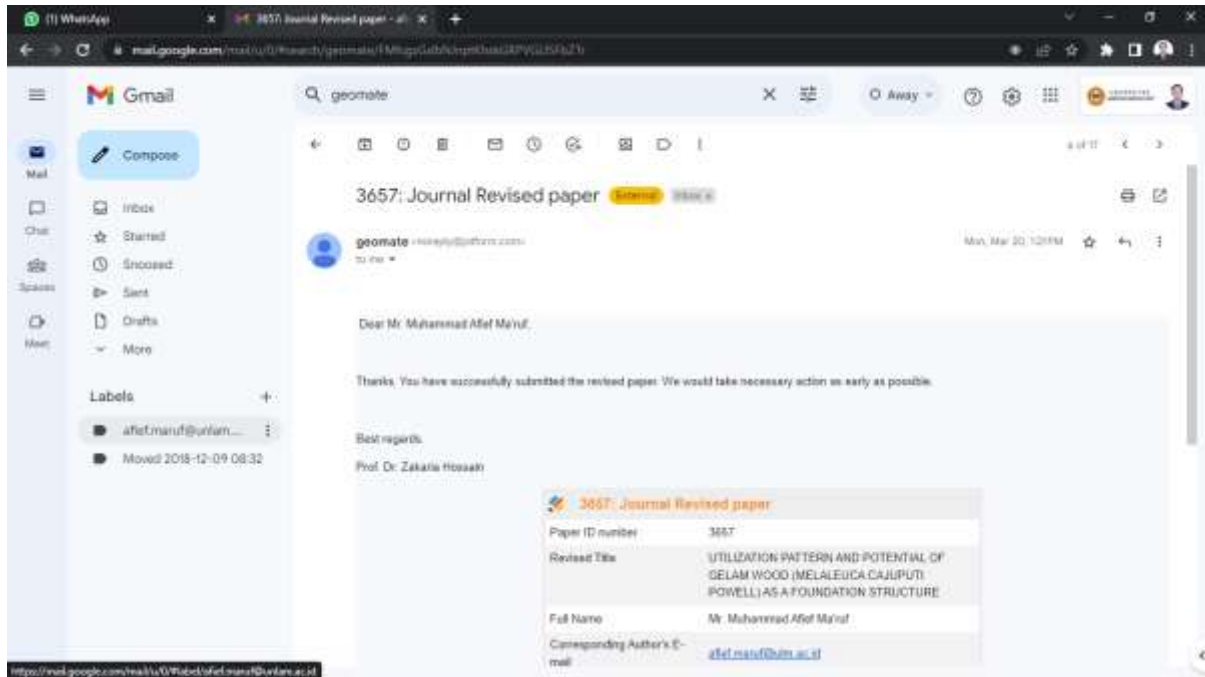
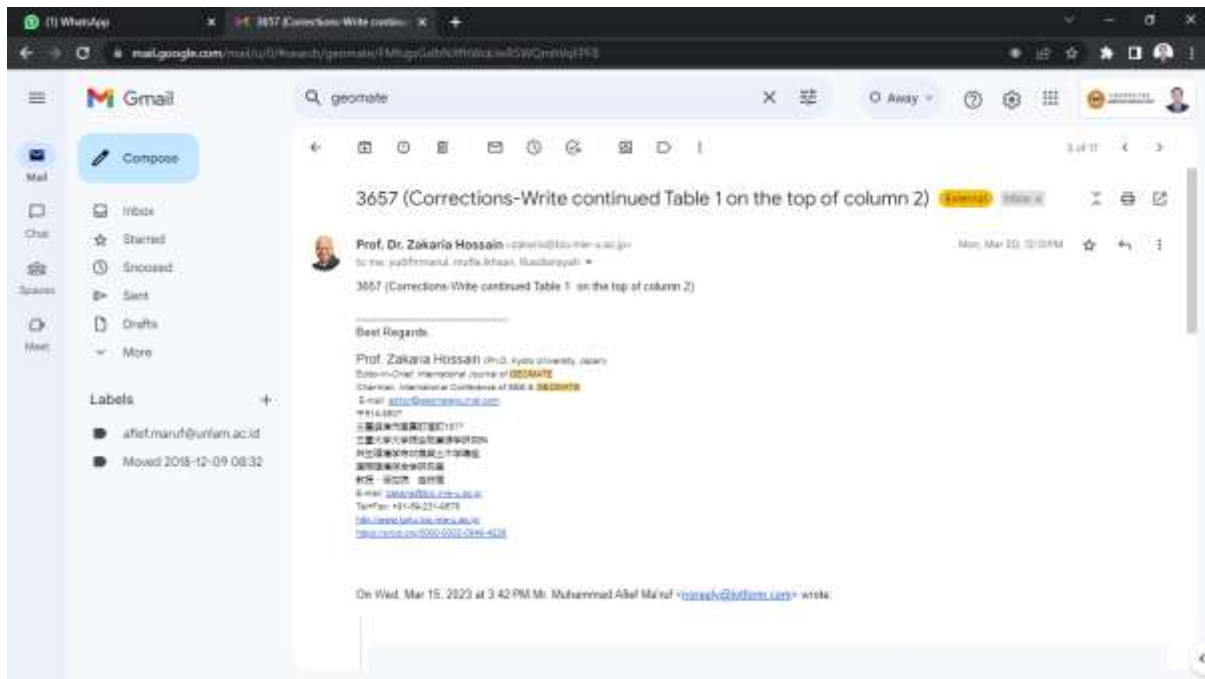
March 20, 2023

	<i>Editor's Comments</i>	<i>Authors Response</i>
1	Corrections-Write continued Table 1 on the top of column 2	The authors have revised the format as per the editor's comment.

KUTIPAN NASKAH REVISI Ke-3 OLEH AUTHOR

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TAHAP 8 HASIL REVIEW : PERMINTAAN REVISI 4



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Full Name	Mr. Muhammad Afef Ma'rif
Corresponding Author's E-mail	afef.maarif@unim.ac.id
All-authors E-mails	afef.maarif@unim.ac.id , yulianisari@unim.ac.id , rufo.khosan@unim.ac.id , sofiaerovet74@unim.ac.id
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TAHAP 9 HASIL REVISI Ke-4 OLEH AUTHOR

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KUTIPAN NASKAH REVISI Ke-4 OLEH AUTHOR

International Journal of GEOMATE, Month, Year, Vol (Issue), pp. 000-000

Table 1 The volume of gelam wood used in residential houses in Banjarmasin City

Residential Name	Location	Number of Houses	Volume (m ³)
Perdana	Padat		
Mandiri Residence Alamindo	Karya Road	54	346.217
Sejahtera Permai Residence	AMD Blok I Road	51	126.946
Berkat Residence	Sungai Andai Road	14	86.240
Sekumpul Residence	Peradapan Karya Road	331	2829.577
Green Sunny Estate Residence	Tatah Bangkal Luar Road	61	109.277
Villa Sunny Residence	Bangka		
Asman Banua Anyar Residence	Banua Anyar Road	44	331.886
Citra Modern Type 79	Tatah Bangkal	38	628.290

continued Table 1

Green Sunny Living	Peradapan Karya Road	224	5969.920
Griya Permata 5 Type 36 Residence	AMD XII Road	66	379.594
Griya Permata 5 Type 45 Residence	AMD XII Road	9	58.551
IONA LAND Residence Bumi	Kelayan Timur Road	71	464.137
Wahyu Utama the Residence City Type 36 Bumi	AMD XII Road	300	537.429
Wahyu Utama the Residence City Type 45 Bumi	AMD XII Road	75	190.929
Wahyu Utama the	AMD XII	25	392.857

TAHAP 10 ARTIKEL DITERIMA

