Utilization and cultivation opportunities of pelawan (Tristaniopsis merguensis Griff.) as a biomass energy source in Southern Sumatera

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Abstract. Pelawan (Tristaniopsis merguensis Griff.) has been used for many purposes in Southern Sumatera including for energy, food and medicine but effort to cultivate the species is not yet tried properly. The wide utilization resulting overexploitation and degraded its natural habitats. Research on pelawan utilization and cultivation was conducted with survey and field experimental method. Survey conducted on its natural habitats and related home industry and the field experimental is conducted on the Forest Area for Specific Purpose (KHDTK) of Kemampo to promote cultivation of the species. Result showed that pelawan was mostly used for energy purpose in the form of small timber both used directly as firewood or after being converted into charcoal. Utilization of pelawan as firewood is mostly done by household and several restaurants to get food with distinctive taste but pelawan charcoal is managed as an export commodity product by home industry. Pelawan has strong ability to sprout and stump sprouting became the main regeneration mechanism, however, generative reproduction is an important mechanism to increase its stand productivity. Cultivation trials showed that pelawan can be cultivated in generative reproduction with diameter growth of 4.5 cm and height of 457 cm in the age of 3 years old.

1. Introduction

Pelawan (Tristaniopsis merguensis Griff., Myrtaceae) is a well-known species in Southern Sumatera especially in Bangka Belitung and South Sumatera Province because of its extensive benefits in meeting human needs, both economically and ecologically. Pelawan occur in many different types of lowland to lower montane forest up to 1300 m altitude, often along rivers or near the coast. Geographic distribution occurs from Burma and Thailand throughout the Malesian (Sumatera and Java) to eastern Australia and New Caledonia [1]. In Southern Sumatera, pelawan grows well in lowland that have high humidity and often occurs adjacent to watercourse [2].

Pelawan has been used for many purposes including as sawn timber, high-quality firewood, food and medicines but its utilization is specific to community where the species found. The people in Bangka Island used the wood of pelawan as house buildings, boat buildings, stakes for pepper support and firewood [3]. In South Sumatera (Muara Enim and Ogan Ilir Regency) the utilization is limited for charcoal making and high-quality firewood. In line with the development of knowledge and research, utilization of pelawan is increasingly widespread. The leaves of pelawan processed into tea powder for healthy dan refreshing drinks and base on phytochemical analysis showed that leaves of pelawan...
contain flavonoid, tannin, saponin, steroid and triterpenoid compounds [4]. It is indicated that leaves of pelawan has a high potential to be used as botanical pesticides and medicines. On the other hand, ecologically, pelawan plant has important role in its natural habitat. The flowers of pelawan produce nectar as the main food source of honey bee (Apis dorsata) so that pelawan stand play important role in honey production [5]. Furthermore, the rooting system area of pelawan serves as a host of edible mushrooms (Heimioporus sp). Pelawan honey and pelawan mushrooms are the important product of pelawan stand that can increase the income of the community around the forest [6, 7].

Utilization of pelawan timber as material for making charcoal has been going on many years in South Sumatera. Material fulfillment of making the charcoal is carry out by extensive exploitation of pelawan timber from the nature. The extensive exploitation without being followed by cultivation activities have resulted in overexploitation that impacts on sustainability management of the species. Information about the magnitude of pelawan timber needed by the charcoal industry and the ability of the nature to provide it is very important in achieving the sustainability of timber supply to pelawan charcoal industry.

Stump of pelawan has strong ability to sprouting and until now, stump sprouting is the only one mechanism to supply raw material for related industrial sector. However, many of the natural spread area of pelawan found on conservation area and community land that tend to be converted into agricultural land, so establishing pelawan plantation on specific area to supply raw material for related industry become important thing to do. Utilization of biomass as a source of energy is expected to reduce dependence on fossil energy source and at the same time reduce the impact on the environmental, especially greenhouse gas emissions [8, 9]. This paper presents the utilization of pelawan in South Sumatera, especially for firewood and making charcoal and the growth performance of pelawan in plantation trial.

2. Materials and Methods

2.1. Time and Location
Survey on utilization and ecology of pelawan was conducted in September 2015 until May 2018. Survey on Ecology performed in Muaraenim District, South Sumatera Province and Bangka Barat District, Bangka Belitung Islands Province. Survey on utilization of pelawan timber as charcoal making material conducted on charcoal industry factory in Ogan Ilir District, South Sumatera.

Cultivation activities starting with collecting seed and and sapling as planting material conducted in Bangka, Bangka Tengah and Bangka Barat District, Bangka Belitung Island Province. Furthermore nurseries, planting and tendance regimes were carry out in Forest Area for Specific Purpose (KHDTK) Kemampoo, Banyuasin District, South Sumatera Province.

2.2. Methods
Study on pelawan timber utilization is carry out by survey method and interview with the related community as respondents. The respondents consist of two groups of community, both the people who exploit pelawan timber from the natural secondary forest and the people who are employees in charcoal industry. Cultivation activities carry out with experimental method, start with collecting ripe seed and sapling from high quality parent tree on natural habitat of pelawan plant. Both of plants material are treated and maintained in nursery to get high quality seedling for plantation. The duration of both plant materials maintained in nursery until ready for planting are recorded.

Cultivation activities of pelawan was carry out in April 2016 starting with land clearing, making planting holes, and planting activities. Planting performed in randomized block design with three blocks and four different initial spacing of 2 m x 1.5 m; 2 m x 1 m; 1.5 m x 1.5 m; and 1.5 m x 1 m. Each planting plot consist of 49 plants (7 x 7 tree plot). Height and diameter of each plant was recorded as growth parameter every year starting in April 2017 and continued in April 2018 and April 2019. Measurement data were analyzed with descriptive statistics to obtain the average growth of each planting treatment.
3. Results and Discussion

3.1. Utilization of Pelawan Timber as Firewood

Pelawan timber is used for many purposes mainly for high-quality firewood and raw material for making charcoal. Utilization of pelawan as firewood associated with its wood and energy properties. Pelawan timber has high density and calorific value, each of reaching 1.18 gr/cm³ (1,180 kg/m³) and 4296 cal/g [10]. Among of energy properties of pelawan timber that support its use as firewood are that it can produce good flame, less ash, long duration of combustion, and has higher heat (calorific value) than other species.

Utilization of pelawan timber as firewood generally occurs in area where the timber found. However, pelawan timber also traded outside of its distribution area, including to urban areas. In urban area, for example in Palembang city, pelawan timber are sold for some restaurant as firewood to get food with distinctive taste. Pelawan timber for firewood are sold in short lengths in the range of 50-100 cm in length and 2-25 cm in diameter (Figure 1).

![Figure 1. Various sortimen of pelawan timber traded in Palembang City, South Sumatera used for firewood](image)

Pelawan timber used for firewood in Palembang city is obtained from secondary forest in several villages in Muaraenim District, mainly in Kemang and Karang Endah Village. They are exploited and cut down by the people lived in the village and employee as wood exploiter. Cut wood, hereafter collected at the village level collecting point. After being collected by the wood collector, the wood is transported to trader in Palembang City using transport truck. Pelawan wood trade as firewood also found in Bangka Barat District

Pelawan timber trading in South Sumatera is familiar with the timber classification system. This wood classification is made by the wood collector in the village level base on criteria for wood received by the charcoal industry. Base on this classification system, pelawan timber used for firewood is the wood with the second quality class. Wood in this class level has lower quality in stem straightness and the occurrence of knot. The first class quality of pelawan timber is used for making charcoal.

3.2. Utilization of Pelawan Timber for Charcoal Making

Industry of charcoal making from pelawan timber found in Ogan Ilir District, South Sumatera and has been operating since 2015. Source of raw material for making charcoal is obtain from the same location as the source material for firewood, but the industry of charcoal use first class quality of pelawan timber, because it was trade as an export commodity product. The destination countries of pelawan charcoal export include Japan, South Korea and China.

Industry of making pelawan charcoal is a simple industry. The series of manufactories processes begins with drying of raw materials, followed by combustion process and packaging (Figure 2). However, the selection processes are carried out before the combustion and packaging process to get the highquality products of charcoal. Even though pelawan charcoal pose as an export commodity
business, the industry still depends on the availability of raw material in nature or forest, without follow by cultivation activities. Although pelawan plant can sprouting after cutting, the high needs of raw material can cause the industry to experience difficulties in meeting raw materials in the future.

![Image of pelawan charcoal production](image1)

**Figure 2.** A series of processes of making pelawan charcoal at a factory in Ogan Ilir District, South Sumatera

### Table 1. Pelawan stem need by some companies in producing pelawan charcoal in Ogan Ilir District, South Sumatera

| No. | Name of company          | Operating year | Location                  | Installed capacity (ton/yr) |
|-----|--------------------------|----------------|----------------------------|-----------------------------|
| 1   | PT. Cipta Kreatif Sejahtera | 2016           | 1. Sukamulya Village, North Indralaya Sub-district | 6,000 – 8,400               |
|     |                          |                | 2. Bakung, village, North Indralaya Sub-district | 10,000 – 12,500             |
| 2   | PT. Ogan Perkasa Sejahtera | 2018           | 1. Bakung village, North Indralaya Sub-district | 13,800 – 15,000             |

Current needs of pelawan timber for making charcoal is estimated at 16,000 to 20,900 ton/year. This amount is in accordance with the needs of a company that has been operating to produce charcoal since 2015 in Ogan Ilir District, South Sumatera. The company has 2 factories each of consist of 53 and 83 combustion chamber and produce 6,000 to 8,400 and 10,000 to 12,500 tons/year of pelawan charcoal. Demand for pelawan timber in the region for making charcoal is estimated will be increase with the establishment of new factory in 2018 with production capacity of 13,500 to 15,000 tons/year of pelawan charcoal (Table 1).

3.3. **Cultivation of Pelawan**

Before cultivation activities of pelawan begins, ecological study of the species is first carried out. This step is necessary to ensure that cultivation activities can be successful. Ecological study is carried out on natural distribution area of the species. The result of ecological study in Muaraenim District, South Sumatera Province and Bangka Tengah and Bangka Barat District, Bangka Belitung Island Province showed that pelawan geographical distribution is on lowland up to 60 meter above sea level (Table 2). Its natural habitat has high humidity and often occurs adjacent to watercourse.

Pelawan plant has two mechanism of regeneration include vegetative and generative mechanism. Vegetative mechanism occurs through stump sprouting if the stump severed in exploitation ativity. Until now, stump sprouting is the main mechanism of pelawan plant to regenerate after many activities of cutting, both for firewood and making charcoal. However, generative mechanism of pelawan also occurs naturally through seed germination on the ground around the parent tree. The germinated seed then grows naturally and known as seedling that can be removed and replanting in another place. Thus, cultivation of pelawan can be conducted using both of ripe seed and removed seedling.
Cultivation of pelawan in KHDTK Kemampo started by making a nursery. Seedling in the nursery is obtain from ripe seed and removed seedling from natural habitat of pelawan tree in Bangka Island. Result showed that seedling from seed takes longer to be ready for planting. Germination of pelawan seed occurs 9-12 months after sowing and the seedling still needs another 6-9 months to be ready for planting, so that total time needed for seeds to be ready for planting reaches 15-21 months. Removed seedling from the natural germination on the ground under parent tree need less time to be ready for planting, which is needs 5-6 months of maintenance in the nursery. Establishing pelawan plantation in KHDTK Kemampo is carried out using removed seedling from natural habitat of pelawan parent tree in Namang Village, Namang Sub-district, Bangka Tengah District under intensive maintenance for 6 months in nursery. The seedling condition after 1 month and 6 months (ready for planting) of maintain in nursery are presented in Figure 3.

**Table 2. Geographical distribution and land characteristic of pelawan plant in South Sumatera and Bangka Belitung Island Provinces**

| Nu. | Geographical Location | Altitude | Land cover | Government area |
|-----|-----------------------|----------|------------|-----------------|
| 1.  | E 0631744 N 9738243   | 30 m asl | Secondary forest | Namang village, Namang sub-district, Bangka Tengah District |
| 2.  | E 0590080 N 9806868   | 24 m asl | Secondary forest | Riding Panjang village, Belinyu sub-district, Bangka Induk District |
| 3.  | E 0553008 N 9799551   | 60 m asl | Dryland agroforestry | Tugang village, Kelapa sub-district, Bangka Barat District |
| 4.  | E 0432853 N 9624909   | 20 m asl | Secondary forest | Kemang village, Lembak sub-district, Muaraenim District |

Remark: asl = above sea level

**Figure 3. Performace of pelawan seedling after 1 month and 6 months of maintenance at nursery in KHDTK Kemampo, South Sumatera**

Planting of pelawan is carried out in close initial spacing of 2 m x 1.5 m; 2 m x 1 m; 1.5 m x 1.5 m and 1.5 m x 1 m. Planting in close spacing are intended to produce more stems in small diameter per unit area. Pelawan timber is used in small diameter size mainly range from 5 - 10 cm, both for making charcoal and firewood. Variation in initial spacing is aimed to find out the most effective spacing in managing pelawan timber planting. However, this information will be fully obtained after several harvesting cycles have been carried out.

Measurements result showed that height and diameter growth of pelawan respectively reach 458 cm and 4.5 cm in the age of three years or mean annual increment of 153 cm/year for height growth and 1.5 cm/year diameter growth. This growth data, especially in diameter growth shows that in the age of three years old, pelawan stump has not yet reached the size that can be harvested. Therefore,
Table 3. Height average of pelawan plant (cm) at the age of three years old in various initial spacing in KHDTK Kemampo, South Sumatera

| Block | Initial spacing (m x m) | Average |
|-------|------------------------|---------|
|       | 2 x 1.5                | 2 x 1   | 1.5 x 1   | 1.5 x 1.5 |
| I     | 467                    | 517     | 455       | 427       | 466       |
| II    | 478                    | 521     | 496       | 427       | 481       |
| III   | 402                    | 473     | 430       | 401       | 427       |
| Average| 449                    | 504     | 460       | 418       | 458       |

Table 4. Diameter average of pelawan plant (cm) at the age of three years old in various initial spacing in KHDTK Kemampo, South Sumatera

| Block | Initial spacing (m x m) | Average |
|-------|------------------------|---------|
|       | 2 x 1.5                | 2 x 1   | 1.5 x 1   | 1.5 x 1.5 |
| I     | 4.9                    | 4.7     | 4.1       | 4.3       | 4.5       |
| II    | 4.8                    | 4.8     | 4.8       | 4.4       | 4.7       |
| III   | 4.1                    | 4.5     | 4.8       | 4.3       | 4.4       |
| Average| 4.6                    | 4.7     | 4.6       | 4.3       | 4.5       |

Growth performance at various initial spacing does not indicate significant difference, both for height and diameter variable. Significant differences are seen in height growth in different planting block, where highest growth occurs in block II and the lowest in block III (Table 3). Condition in block III which are flooded during the rainy season can inhibit the growth of pelawan plants, especially in the early years of growth.

4. Conclusion
Based on the results of the research on utilization and cultivation trials of pelawan tree, several conclusions can be drawn as follows:
1. Pelawan timber has been used for many purposes in Southern Sumatera, mainly for making charcoal and firewood
2. Current needs of pelawan timber for making charcoal is estimated at 16,000 to 20,900 ton/year and estimated to be increase in the future
3. Growth performance of pelawan plant at the age of three years old has reach the average height of 458 cm and diameter of 4.5 cm.
References

[1] Sosef MSM, Hong LT and Prawirohatmodjo S 1998 Timber Trees: Lesser Known Species. Plant Resources of South-East Asia (Leiden: Backhuys Publishers)

[2] Purwanto, Sumadi A and Siahaan H 2018 Seleksi Jenis-jenis kayu yang potensial dikembangkan sebagai sumber energi biomassa di Sumatera Selatan Silvikultur untuk Produksi Hutan Lestari dan Rakyat Sejahtera pp 893–900

[3] Yarli N 2011 Ekologi pohon pelawan (Tristaniopsis merguensis Griff.) sebagai inang jamur pelawan di Kabupaten Bangka Tengah (Bogor: Bogor Agriculture University)

[4] Hadi EE, Muslimin I and Asmaliyah 2018 Potensi pengembangan pelawan (Tristaniopsis spp.) untuk Agroforestry di lahan gambut Silvikultur untuk Produksi Hutan Lestari dan Rakyat Sejahtera pp 791–800.

[5] Akbarini D 2016 Pohon Pelawan (Tristaniopsis merguensis): species kunci keberlanjutan taman keanekaragaman hayati Namang-Bangka Tengah Al-Kauniyah Jurnal Biologi 9(1) 66–73

[6] Henri, Hakim L and Batoro J 2018 Kearifan lokal masyarakat sebagai upaya konservasi hutan pelawan di Kabupaten Bangka Tengah, Bangka Belitung Jurnal Ilmu Lingkungan 16(1) 49–57

[7] Hartanto S, Sulistyaningsih YC, Walujo EB and Article H 2018 Indigenous knowledge degradation of lom community, Bangka Island in identifying and using pelawan padang (Tristaniopsis merguensis) Biosaintifikasi 10(3) 663–670

[8] Change IC 2014 Mitigation of climate change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change 1454

[9] Erikson HM, Hall JP and Helynen S 2002 Bioenergy from Sustainable Forestry Guiding Principles and Practice (New York: Kluwer Academic Publishers)

[10] Siahaan H and Purwanto 2017 Pengembangan dan pemanfaatan energi biomassa sebagai sumber energi ramah lingkungan Prosiding Ekspose Hasil Penelitian: Tata Kelola Hutan Untuk Mewujudkan Pembangunan Hijau Sumatera Selatan pp 48–58.