Conservation efforts for Geronggang Trees (Cratoxylum arborescens (Vahl.) Blume) as a function of peatland restoration and protection in Bengkalis Regency

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Abstract. Bengkalis is the region that has the largest peatland in Riau Province. However, 57 percent of the peatland conditions in Bengkalis have been degraded due to careless land clearing for plantation land, resulting in land drying, surface subsidence, and flammability. Efforts to restore peatlands in Bengkalis are being carried out by utilizing local plants whose presence is increasingly depleting, namely Geronggang tree (Cratoxylum arborescens (Vahl.) Blume). This research provides information regarding the conservation efforts of Geronggang trees by the Bengkalis local community in supporting peatland restoration by making observations and collecting secondary data. Observation results show that Geronggang tree has ecological, social, and economic benefits for the local Bengkalis community. Bengkalis people have their way of cultivating Geronggang trees; Geronggang seeds are planted using a mixed planting system, and Geronggang harvesting is carried out using thinning cutting, alley cutting (lane), and embroidery cutting systems. This stage is carried out to maintain the humidity of the peat land in each passage and to maintain the continuity of peat growth. Thus, conservation carried out by the Bengkalis local community must be able to keep the ecological and environmental functions of degraded peat areas. The research concludes that the Geronggang tree is a habitat and plant that grows and lives on peatlands in the Bengkalis area.

1 Introduction

In 2019, the peatland ecosystem in Indonesia was ranked the second largest in the world at 22.5 million ha. Papua is a province with a peatland area of 6.3 million ha. Central Kalimantan Province reached 2.7 million ha, South Sumatra (1.7 million ha), Riau (2.2

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million ha), and West Kalimantan (1.8 million ha). Furthermore, West Papua has a peatland area of 1.3 million ha, East Kalimantan has an area of 0.9 million ha, and North Sumatra, North Kalimantan, and South Kalimantan each have an area of 0.6 million ha. [1]. Riau's peatland area is 2.2 million ha of Indonesia's total peat area and is equivalent to 56.1 percent of the total peatland in Sumatra [2-5], stated that one of the main peat areas in Riau is Bengkalis, with an area of 856,385 hectares. Peat has a role in regulating climate, as a water supplier, and supports high biodiversity. However, peat becomes a source of carbon pollution when a fire occurs. Around 243 tons/ha are released, causing economic, social, and ecological damage and losses, reaching 16.1 billion USD in 2015 [6]. Peatlands are used for non-forestry purposes. Fire is a tool for preparing plantation land by palm oil companies and industries after logging. A report from the Riau Province Plantation Service, 2009, stated that 102,858.5 ha of plantation area is in the peat area of Bengkalis Regency.

The uniqueness of the peat ecosystem is that it is partly wetland and partly terrestrial. Forests function ecologically as a place to store natural resources like germplasm and timber products, create habitats for fish, and serve as a carbon source. Warehouse that serves as a climate balancer. The Ministry of Environment explains that Law Number 32 of 2009 concerning Environmental Protection and Management asserts the significance of preserving and effectively managing the peat ecosystem as an integral part of the environment [7]. His research explains that the peat ecosystem is a fragile unit processed over thousands of years by accumulating solid and wet plant material. Peatlands have a direct life support function and provide land for increasing food security and benefits for controlling floods and global climate [8].

From 1982 to 2007, 57 percent of Riau's peatlands were lost from the total area owned, leaving 1.8 million ha remaining [3,9]. Clearing peat land by cutting down forests (land clearing) will result in subsidence, irreversible drying, and flammability. The occurrence of fires causes the diversity of flora and fauna to decrease because they cannot survive. Meanwhile, fire consumes organic material in the ground and plants seeds [10]. Improving the ecology of peatlands is an effort to restore nature to ecosystem functions.

Bengkalis Island is a peat area on the outer side of Riau Province, Indonesia. At a coordination meeting at the Coordinating Ministry for Maritime Affairs in July 2019, it was stated that the outer islands, including Bengkalis Island, were threatened due to abrasion. The abrasion process that occurs is a peat slide. This process was triggered by deforestation, land use change in peat areas, and massive canalization as drainage in the opening of plantations and Industrial Plantation Forests (HTI). Existing canals slice through peat domes and damage the integrity of peatlands. The impact is that the peat will slide and be sedimented towards the sea when heavy rain falls. Apart from the rainy season, the worst disasters occur during the dry season. The burning of forests and peat during this season is a disaster and has a huge impact. In 2019, land fires still occurred in Bengkalis Regency, burning hundreds of hectares of peat land. The existence of empty and abandoned land is the cause and impact of these land fires. Therefore, efforts are needed to make these abandoned lands productive.

To make land productive, it is necessary to plant appropriate vegetation that can prevent landslides and prevent peatland fires. The findings from the study by Mojiol et al. [11] show that the plant that is under conservation objectives and has the highest survival rate is the Geronggang tree (Cratoxylum arborescens (Vahl.) Blume). Geronggang tree shows high litter productivity and the return of nutrients from the litter leaves, which can restore peat nutrients and maintain forest productivity [12]. This tree is native/local vegetation that used to be found in the Bengkalis forest peat area. This Geronggang tree has a robust root system and can store water, so it is suitable for preventing landslides and fire hazards in peatlands. Apart from being easy to grow on peatlands, Geronggang trees can be cultivated and have the potential to be developed as community forest plantations. Chopped wood is widely used as a building material (small-diameter wood for roofs/foundations, and large-diameter wood

is used for pillars, walls, and trusses on building roofs). Another benefit of roasted wood is carpentry wood for making furniture, carts, etc. Using Geronggang trees for their wood must be done through a sustainable planting system. Wood collection must be selective, according to age class, and carried out selectively. A sustainable Geronggang tree cultivation system can be combined (intercropped) with other types of plants, such as rubber, vanilla, and short-term crops, so people can obtain other non-timber products in the short term.

The availability of Geronggang trees provides economic, ecological, and socio-cultural benefits for local communities. Apart from other uses, roasted wood is an alternative raw material for paper and is ideal for planting on peatlands. This has resulted in burned trees becoming an alternative raw material, and many companies are cutting them down. Finding Geronggang trees and their saplings in the field is difficult. IUCN (International Union for Conservation of Nature and Natural Resources), in its report, explains that the Geronggang tree is included as 'Least Concern' or 'Low Risk' on the IUCN red list of species [13-15]. The barking tree is exploited on a large scale by Bengkalis, an economic source for the local community. Apart from that, residents of Bengkalis have their way of conserving Geronggang trees. As Keraf [16] explains, local wisdom is essential for communities to utilize and manage nature and become cultural heritage with existing knowledge and customary norms. The original tribe on Bengkalis Island is the Malay tribe. Malay people must maintain the order of cultural values relating to religious, economic, social, political, artistic, technological, and environmental aspects inherent in local wisdom, which are dynamic and sustainable [17]. Information on Geronggang planting was obtained from research that has been carried out to support the program to save Geronggang plants and restore the function of peatlands.

2 Materials and methods

The potential of this Geronggang has been researched in 2022. It has developed in various elements of society, initiated by the Non-Governmental Organization Malay Youth Concerned with the Environment (IPMPL), which has begun to pursue these activities. The Geronggang cultivation was reviewed directly by the Governor of Riau. This visit significantly impacted the function of Geronggang as an effort to anticipate forest fires in peat areas in Bengkalis Regency.

The method used field observations in the demonstration gardens of the IPMPL NGO, Air Putih Village, Bengkalis District, and several villages supported by the NGO. The towns visited were West Muntai Village and Pasiran Village in Bantan District, Temeran Village, Damai Village, and Sungai Batang Village in Bengkalis District. Apart from these villages, other villages spread across Bengkalis Regency participate in cultivating and cultivating Geronggang plants. The Geronggang commodity preparation pattern was studied during the visit, starting from marketing, land preparation, seeding, planting, maintenance, and harvesting.

3 Results and discussion

The Geronggang tree is a habitat and plant that grows and lives on peatlands in the Bengkalis area. For local communities, using vacant land and natural availability is a supply of food needs that can be exploited for survival. Geronggang cultivation in Bengkalis is driven by its current scarcity. Geronggang is the main plant of Bengkalis, and they have a close relationship. It is a source of income for the people of Bengkalis and functions to maintain ecological damage to peatlands in Bengkalis. Bengkalis forest fires often occur, but in 2014, a significant fire burned several roasted trees. The increase in illegal logging and peatland

fires means that the availability of grove trees is increasingly depleted. The benefits of the Geronggang tree from an economic perspective, such as as a tree for buildings, as a raw material for making furniture, as a raw material for pulp, medicine, and other benefits, have made this tree a target for local communities and wood entrepreneurs.

3.1 Cultivation of Geronggang wood

Geronggang in each region has different calls such as Dori, Burunggang, Madangbaro, Gerunggang, Mepa, Mampat, Tamaw, Tumok (Kalimantan). Geronggang's original habitat was tropical rainforests with different types of rainfall, living in swamps or transition zones between swamp land and dry land at an altitude of up to 60 m above sea level. Geronggang can grow to a diameter of more than 60 cm and a height of more than 40 m. Its growth spreads or groups in primary watery forests and shrubs [12]. His research showed that the productivity and nutrient input of Geronggang plants at the age of 2-3 years was slightly higher than that of Krassikarpa (Acacia crassicarpa). Several research results also show that the survival rate in burnt peatlands reaches 69-93 percent.

Geronggang planting is carried out using a mixed planting system. In Bengkalis, most of the land is planted with sago, rubber, and other types of plants. Geronggang becomes a diverse crop on the ground. After that, the people make slash disks so that they are always clean of weeds and harmful vines. Fertilization is only carried out on main crops, while grasslands are rarely given fertilizer. What is unique is that fertilizer will not grow well or even die if fertilizer is applied to the grass. If a Geronggang tree dies, replanting will be carried out to replace the plant immediately. People let some Geronggang trees grow until they are 2-3 years old, intending to encourage growth in trunk circumference. Others will be allowed to grow to large stem diameters. The Geronggang tree harvest system is carried out using a system of thinning felling, alley clear-cutting, and thin-cutting.

The felling system at a distance (thinning) is carried out to reorganize the tree growing space to facilitate the development of trunks and trees in the stand. For fertile trees, thinning is carried out at 3 to 4 years, while for plants with slow growth, thinning is carried out at 5 to 10 years. The aim of thinning felling on Geronggang trees is to allow the best trees to grow optimally until the end of the cycle. The roasting harvest system is carried out using a lane system. Ecologically, Geronggang can absorb ground water like a sponge.

A transparent felling system is implemented. It will not continue to spread to other trees because of the alley partitions. Peatlands have a lot of water, so they don't dry out or catch fire easily. Geronggang is also harvested using the cutting and cutting system. This means that after the grass aisle is cut down, further planting will immediately be carried out on the logged land. The land was replanted with Geronggang tree seedlings whose quality had been maintained. In this way, the Geronggang tree will continue to be preserved. According to the Malay traditional tribe in Bengkalis, the relationship with the environment is significant and has been fostered since the beginning of life. The community developed many local cultural traditions by maintaining local wisdom to protect the sustainability of the environment. So, in preserving the Geronggang tree, it is also found that there is ecological wisdom from the Bengkalis people, namely the prohibition in certain places to damage, let alone cut down, the Geronggang tree that grows naturally there.

Pasiran Village and Air Putih Village are places for conserving grove trees without logging. The barking trees in this area are guarded by Kelulut/Klanceng bees (Trigona sp.), or what the Malay people of Bengkalis usually call nyuan bees. These bees have lived in tree trunks for generations. Nyuan bees will attack and get angry at people who dare to damage the Geronggang tree. With their instincts, they feel disturbed when humans cut down trees in the area. The local community also cultivates yuan bees because, besides helping maintain the beehives, these bees produce honey, which has many benefits if consumed. If some

people act in violation, it can be said that it will be dangerous in their lives. This prohibition is also strengthened by local government legal regulations so that if anyone violates it, they will receive sanctions.

Fig 1. Geronggang wood cultivation in Bengkalis regency.

3.2 Benefits of roasted Geronggang wood

Geronggang can be categorized in durable class IV strong wood class III-IV with a wood-specific gravity of 0.46. Wood can be made for furniture, bridges, and other needs. The wood can be used; this tree can also be used as a pharmacological ingredient, such as an antioxidant, anti-microorganism, anti-cancer, and antidote to free radicals. The use of bark from Geronggang wood has been done since ancient times. Traditionally, Geronggang bark is used for treating itching, boils, fever, cough, diarrhea, and stomach complaints in neighboring countries such as Malaysia and Thailand [18].

Not only as a pharmacological ingredient, another function that is no less important is its benefit in preventing peat fires because it is a peat swamp plant and is resistant to waterlogging. Due to its various benefits on land in Bengkalis, Geronggang has begun to be in great demand, with the sales value "boosted" by market demand. In the past, the potential for Geronggang was very abundant in Bengkalis Regency. Still, with the high rate of exploitation and uncontrolled use of Geronggang wood and burned land, the availability of Geronggang in nature is starting to disappear.

According to IUCN, the status of Geronggang in Indonesia, especially Bengkalis Island, is at Lower Risk and Least Concern and is rarely found in natural forests. Meanwhile, its potential on public land is also dwindling. Starting from this problem, one of the institutions became active again and cared. The IPMPL NGO has fostered 40 KTHs with 1495 members on land covering an area of ±2950 hectares in 4 sub-districts. Apart from that, BP2TSTH Kuok has also conducted Geronggang research from several aspects, including the economic part of existing Geronggang community forest exploitation. To illustrate, economically, planting Geronggang with a spacing of 1 x 1 m means that 9215 stems will grow in one ha. Harvested at six years will produce 285 tonnes of wood, then planted again at six years, and the exact yield will be obtained at 285 tonnes. Meanwhile, 744 plants (541 tons) were allowed to be harvested at ten years, with the estimated amount of rejected wood being around 471 plants. The significant market potential makes Geronggang feasible to cultivate in plantation forests.

3.3 Ecological benefits of the Geronggang tree in restoring peatlands

14.93 million ha of peatland in Indonesia in 2016 [19,20]. Based on the latest information in 2021, peatland degradation has occurred in Indonesia, so the remaining peat area is 13.4 million ha [21]. This damage impacts various aspects of life, such as the economy, education, and health. In burnt peat areas, land restoration is carried out with the help of the local community.

Fig 2. Utilization of roasted Geronggang wood in Bengkalis Regency.

Tan is a volume measure commonly used in the timber trade, equivalent to 7200 in3 or 1.6 m3 if converted into metric units. The price obtained from roasted wood currently reaches Rp. 3,500,000,-/ton. It's fantastic how easy it is to grow this plant in Bengkalis. If a minimum period of 10 years is assumed (final cutting only), a nominal value of up to IDR will be obtained. 1,893,500,000,-. In terms of income, the roasted wood business has great potential and has started with the awareness of the local community. Three main assets are the main components in the Geronggang business: edaphic factors and suitable habitat for Geronggang cultivation. Secondly, there is high public interest, and third, communities due to the many existing problems, such as inferior access and low-production land. This restoration aims to enhance the preservation of natural resources and the environment.

Furthermore, the quality can be improved by plant conservation and planting plants with economic value. According to Sanders et al. [22], land-use alterations stem from negotiations among diverse stakeholders concerning utilizing tropical peatlands. This effort is made to restore peat swamp forests after fires and logging by maintaining the ecosystem, including vegetation restoration, hydrological restoration, restoration of ecological and economic functions, and revitalization [23].

The vegetation restoration is divided into two: through planting and natural regeneration [24]. Plant or animal species spontaneously conduct natural reforestation over a very long time after damage occurs. The restoration will increase the quantity and quality of environmental services from peatlands. Vegetation restoration is carried out by replanting grove trees. Based on observations by Suwito [23], the Geronggang species was one of the trees that survived the big fire in 2006. This plant was found living with pioneer ferns after the fire. At the same time, Geronggang performs better regarding growth and seedling growth rates. According to research by Mojiol et al. [11], Geronggang trees are plants suitable for planting in areas affected by peatland fires with the highest survival rate, namely 93.33%. This tree has high growth capacity and better trunk circumference because it has successfully adapted to existing environmental conditions. The Bengkalis Regency area, which often experiences fires yearly, has shown that Geronggang can restore damaged land.

This vegetation can grow on burned land with lateral roots (Figure 3). So, planting Geronggang trees is an effort to prevent forest and land fires. Maintain tree stands with a 2 m x 3 m planting distance, keeping the peat soil moist. This type is suitable for forest rehabilitation and peatland restoration activities according to its nature and growth. Wood that is easy to work with has an attractive wood texture and color and is durable, making it a favorite wood in the Riau region and its surroundings.

Fig 3. Roasted Geronggang tree roots.

Many studies have been carried out regarding the use of peatlands, particularly in endeavors to forestall land fires; most peatlands possess the potential for utilization by local communities, considering the principle of ecological equilibrium [25]. As peatlands develop and become more suitable, the local economy experiences growth, aligning with the population increase in peatland regions. According to Asmit et al., Peatlands can be a revenue source when tourist areas are effectively managed and developed, prioritizing environmental equilibrium. This aligns with Pieter et al.'s research, highlighting that the non-market ecological services provided by peatland resources significantly impact people's willingness to invest in these services. Positive policy development enhances environmental stewardship, and there's a preference for paying for ecosystem benefits [26]. Therefore, peatland management strategies that increase the absorption, storage, and prevention of illegal logging must involve local communities [27].

4 Conclusion

The Geronggang tree is a habitat and plant that grows and lives on peatlands in the Bengkalis area. For local communities, using dormant land and natural availability is a food supply that must be exploited to survive. Conservation carried out by local communities supports peatland restoration in Bengkalis while maintaining local wisdom. The lateral roots of the Geronggang tree absorb more water so that the peat retains moisture and does not burn efficiently.

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