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The Potential of Gelam Leaves as Non-timber Product of the Trees for Reforestation of the Degraded Peat land in Central Kalimantan – Indonesia

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ABSTRACT

Gelam (*Melaleuca sp*) is one of the plants that grows naturally in peat land area of Central Kalimantan - Indonesia. The plants is under heavy environmental stress due to the cutting of the trees for uses as a timber which worsen the existing degraded peat land condition. Therefore it is important to explore non-timber products of the gelam trees. The leaves is one of the most potential sources of non-timber products of the trees. Two types of the gelam growing in the degraded peat land of Central Kalimantan is identified, i.e.: *Melaleuca leucadendra* (L.) L. and *Melaleuca cajuputi* Powell. The amount of the leaves that could be harvested is predicted in the order of 12.5 and 7.5 tons per hectare per year with the essential oil that could be produced at 64.8 kg and 86.4 kg for *Melaleuca leucadendra* (L.) L. and *Melaleuca cajuputi* Powell respectively. An analysis on active compound of the essential oil extracted from the leaves by GCMS showed that the oil of *M. leucadendra* (L.) L. contain γ -terpinen, α -terpinolene, caryophyllene, α -humulene and two unknown compound as its major components (5-25%). Whereas oil of *M.cajuputi* Powell contain mostly eucalyptol (1,8-cineol) (52-57 %) with lesser amount (5-13%) of D-limonene, 4-terpineol and caryophyllene. High content of eucalyptol in the leaves of *M.cajuputi* Powell make this species as a potential plant for sustainable reforestation of the degraded peat land. While the gelam trees is maintained standing still, the leaves is allow to be pruned on a regular basis to produce high added value essential oil for feedstock of cosmetics and pharmaceutical industries. This way, the trees for reforestation could also function as a means to provide income generation for local peoples who play important roles in conserving the peat land area in Central Kalimantan, Indonesia.

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INTRODUCTION

In 1995, the Government of Indonesia set an ambitious project to convert the peat land in Central Kalimantan into one million hectares of rice fields. Lack of proper land management has forced to abandon the project and left behind the one million hectares degraded peat land surrounded by local peoples who lost their naturally sources of income they used to have from formerly natural forest in the site. These areas need to be rehabilitated with plants that require minimum preparation of the land. Gelam (tea tree, cajuput) belongs to the family of Myrtaceae that can live in a variety of soil conditions, both arable land and fertile soils. This plant is growing well in the area of peat land which has very different characteristics compared to the mineral soils. In Indonesia, this plant are growing in different islands, namely: Kalimantan, Sumatera, Java, Molluca, Seram, Buru and East Nusa Tenggara. The potential of non-timber products of this plant is an important characteristic of prospective plant for rehabilitation of the degraded peat land in Kalimantan. These plants can synthesize the essential oil in the leaves. Gelam has wide variation in the chemical composition of its oil [1]. This plant contain secondary metabolite with some active compound like Bicyclo[4.2.1]nona-2.4.7-triene-9-yl phenyl selenide, 2-pyrinone, etc [15]. Meanwhile other study report that gelam contain globulol, viridiflorol, and spathulenol [10]. The oil extracted from the leaf contain eucalyptol (1,8-cineole) and it is used traditionally against pain, burns,

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colds, influenza [1] and as a mosquito repellent [9]. The leaves possess antibacterial, anti-inflammatory, and anodyne [11]. Some studies report that this plant could produce the oil about 0,4-1,2% of the harvested fresh leaves [2]. On the most productive sites, 1 ha of cajuput plantation in Central Java, produces about 7,5 t of leaves annually, which gives about 60-65kg of oil [Doran]. In 2013, the price of gelam oil at the distilary gate in Indonesia is between 165.000 to 175.000 Rupiah/kg (16 US \$/kg) while in 1997 that price was much higher ie. 94 US\$/kg [7].

Gelam is native to Kalimantan Island. Gelam plant that also grows naturally in peat land of Kalimantan has two types which have different leaf morphology. Gelam with wider leaf shape is identified as *Melaleuca leucadendra* (L.) L., grows naturally and was exploited by the local peoples since early nineteen by using its trunk as materials for foundation of building construction. Harvesting, logging and processing this type of gelam has degraded the peat land area and hampered reforestration program. While gelam which has a smaller leaf form is identified as *Melaleuca cajuputi* Powell, grows naturally in the area around Palangka Raya of Central Kalimantan. The identity of the plants was confirmed by Herbarium Bogoriensis Plant Museum-Bogor, Indonesian Institute of Science (LIPI). Figure of *M. leucadendra* (L.) L. and *M. cajuputi* Powell are shown in Figure 1-A and Figure 1-B respectively.



Fig. 1: The Species of Gelam : A. *M. leucadendra* (L.) L. ; B : *M. cajuputi* Powell

Some of industries in other provinces of Indonesia (Java, Maluku, etc) has used *M. cajuputi* Powell leaves to produce the essential oil called cajuput oil. The limited numbers of this type of gelam plants growing in Central Kalimantan which is far from an economic of scale of one essential oil processing units has been hiding the economic potential value of *Melaleuca cajuputi* Powell. Exploring the content of secondary metabolite in leaves of gelam growing in the peat land and evaluate its economic value, can provide basis of income generation from the plants to the communities in Central Kalimantan. By maintaining gelam trees still standing and allow pruning their leaves at regular period, the peatland area cultivated with gelam could be conserved. Based on this results, the economic potential of this plant as income generation for the local people will be further evaluated by valorization of whole biomass in the leaves being pruning by using the bio-refinery concept.

MATERIALS AND METHODS

Study Area:

Study was located in Block C, Pulau Pisau District, Central Kalimantan. Study area designated as Block C was formerly planned as part of One Million Hectare Rice Field Project which abandoned since 1995. Prior to the project, the site was predominantly occupied by Gelam Trees. Tree samples were collected from three sampling sites :

A. Jabiren (02°29'54.8"S-114°11'48.88"E), predominated by *M. leucadendra* (L.) L., characterized by its deep peat land area (depth > 3 m and soil acidity around 4.8). Located in the south of Palangka Raya City. This area had several times get burned (1997, 2002, and 2009) and was heavily damage.

B. Buntoi (02°46'22.26"S-114°12'13.93"E), predominated by *M. leucadendra* (L.) L., characterized by its shallow peat land area (depth around 0.75m and soil acidity around 4.3). This area has also been get burned, which is marked by numerous burnt plant remains.

C. Tunjung Nyaho (02°46'22.26"S-114°12'13.93"E), characterized by its medium depth peat land area (depth around 1,4m, and soil acidity around 2). This area was opened by cut down the trees to be used as educational area (University of Palangka Raya). *M. cajuputi* Powell that grow in this area is only a few plants, with older age and height of the tree reaches 15m.

D. Batu Ampar (02°46'22.26"S- 114°12'13.93"E), where the plant of *M. cajuputi* Powell grows, with a little of stands. This area, characterized by its very shallow peatland area (depth around 0.14m and soil acidity around 6). This area, also had several times get burned since 1997.

flavorings, fragrances, and cosmetics. Eucalyptol also used as an ingredient in many brands of mouthwash, cough suppressant, insecticide, insect repellent [13]. The compound extracted from *M. cajuputi* Powell showed 12,50% mortality in 50ppm and 27% mortality in 125ppm concentration when tested against mosquito *Aedes albopictus* first stage larvae [3].

In plantation of gelam in Indonesia, trees are allowed to grow for 4 years after planting and then pruned about 1m above the ground at the first harvest of leaves. There after, the leaves could harvested each 6-9 month. Based on this practised, leaves of *M. leucadendra* (L.) L. could be harvested at about 12,5 ton/ha/year and could give 64,8 kg of essential oil. This essential oil is a feed stock for pharmaceutical industries. Leaves of *M. cajuputi* Powell could be harvested at about 7,5t/Ha/year and could give gives 86.4 kg of essential oil. The *M. cajuputi* Powell species that contain more than 50% of eucalyptol (1,8-Cineol) in its oil is a potential plant to be used for production of essential oil on industrial scale. At the oil price of 16 US \$ per kg, the potential income of the local people is about 1380 US/ha/ year. This potential income is attractive and prospective to improve the standard of living of the local peoples around the peat land in Central Kalimantan while conserving the peat land as the main sources of their income.

Conclusion:

The essential oil extracted from the leaves of *M. leucadendra* (L.) L. and *M. cajuputi* Powell grows in the peatland contain appreciable amount of γ -terpinene, α -terpinolene, caryophyllene, α -humulene. These compounds has high value and has high demand as feedstock for pharmaceutical and other related industries. The leaves of the two type of gelam is prospective as a main source of the income for the local peoples lives in the near by of the peatland and the use of the gelam for reforestation can benefit conservation of the restoration of the degraded peat land in Central Kalimantan, Indonesia.

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