Puccinia meibomiae (Uredinales) of Erythrina crista-galli in Indonesia

Dono Wahyuno

Indonesian Medicinal and Aromatic Crops Research Institute
Indonesian Agency for Agricultural Research and Development (IAARD)
Jl. Tentara Pelajar No.3, Bogor, 16111 INDONESIA
Corresponding email: dwahyuno@yahoo.ca

Poster paper prepared for
The First International Conference of Indonesian Forestry Researchers (INAFOR)
Bogor, 5 – 7 December 2011

INAFOR SECRETARIAT
Sub Division of Dissemination, Publication and Library
FORESTRY RESEARCH AND DEVELOPMENT AGENCY
Jl. Gunung Batu 5, Bogor 16610
**Puccinia meibomiae** (Uredinales) of *Erythrina crista-galli* in Indonesia

Dono Wahyuno

Indonesian Medicinal and Aromatic Crops Research Institute
Indonesian Agency for Agricultural Research and Development (IAARD)
Jl. Tentara Pelajar No.3, Bogor, 16111 INDONESIA
Corresponding email: dwahyuno@yahoo.ca

**ABSTRACT**

*Erythrina crista-galli* is South American original tree. The tree is fast growing type and adapted to various agroecological zone. In Indonesia, the tree commonly planted in yard or along the high way as ornamental tree due to its beautiful shape and color of the flower. Recently leaf spot disease was found from leaves of *E. crista-galli* collected from various areas in Indonesia, and there is no report the occurrence of the rust species of this tree in Indonesia. The present study aimed to identify the rust species based on its morphological characteristics. Thin section of the sample of diseased leaf placed in glass slide with a drop of lactophenol solution for observation under light microscope. Shape, size, color, surface structure of the spores and the fruiting bodies were recorded. The obtained data was compared with references and other rust species of *Erythrina* of Indonesian origin for identification. The results indicated that the rust of *E. crista-galli* is *Phakopsora meibomiae*, and the uredinial state only exists in Indonesia. *P. meibomiae* was found from the leaf samples of *E. crista-galli* collected from West Java, East Kalimantan, North Sulawesi and Bengkulu.

**Keywords**: *Erythrina crista-galli, Phakopsora meibomiae*, rust fungus, uredinales

1. **INTRODUCTION**

*Erythrina* spp. (Coral tree) are light-weight hard wood tree, grow perennially and distributed widely from South America, Asia, Africa and Australia. Among 110 species of *Erythrina*, 70 species have been reported in South America and six to eight species are Malesia origin (Yusuf 1998). that present in Indonesia. In Indonesia, farmers do not use the timber of the *Erythrina* tree for commercial purposes, but they use this plant as shading tree due its botanical nature of the plant, i.e. relatively drought resistant and growing quickly. Two species of Erythrina, *Erythrina fusca* L. and *E. variegata* K&V are common trees that planted in black pepper garden as live post, especially in areas where black pepper is source of income of farmers in Lampung and Bangka-Belitung and Province. While in other areas the plant are used as shading tree for coffee, *piper betle*, *piper retrofractum* and others. Leaves of *E. fusca* also reported to be used against varicella and pruritus (EISAI, 1986); to heal cough, toothache, or relief fever of children (Yusuf, 1998).

In Indonesia, there are no serious pests and diseases has been reported attacking *E. fusca* except the occurrence of wasp (Hymenoptera) which caused gall on young shouts and defoliated wide areas of *Erythrina* spp in Lampung in 2006 (Mardiningisih and Wahyuno, 2006). Two fungal species of rust fungi, *Ravenelia erythrinae* Gåum and *Phakopsora pachyrhizi* H. Sydow and Sydow (*Phakopsora erythrinae* Gåum) had been reported on *Erythrina* spp. In Indonesia (Boedijn 1960; Semangun 1992).

Recently, an introduced *Erythrina crista-galli* L. has been planted widely in Indonesia as shading tree or ornamental, from garden to side road of highway, due its exotic ornamental flower. However, some samples of *E. crista-galli* collected from several areas in Indonesia show...
consistency the presence of rust disease on its abaxial surface. The aims of the present paper are to identify the rust species on *E. crista-galli* and discussing the identity of the rust species on other *Erythrina* species in Indonesia based on its morphological characteristics.

2. MATERIAL AND METHODS

The observation was conducted in plant pathology laboratory of Indonesian Medicinal and Aromatic Crops Research Institute (IMACRI) in Bogor from March to October 2011. The observed samples were the rust fungi naturally infected leaves of *E. crista-galli* and the rust of *Erythrina* spp. (Table 1). The samples of *E. crista-galli* collected from various areas of Indonesia. The samples were preserved as dry material (herbarium) prior observed, and the specimens were deposited in Herbaria of IMACRI (HBI-Bal).

### Table 1. List of observed specimens

<table>
<thead>
<tr>
<th>No.</th>
<th>Code</th>
<th>Host</th>
<th>Location</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>HBI-Bal 513</td>
<td><em>E. crista-galli</em></td>
<td>Bogor, West Java</td>
<td>Dec 7, 2010</td>
</tr>
<tr>
<td>2</td>
<td>HBI-Bal 518</td>
<td><em>E. crista-galli</em></td>
<td>Lembang, West Java</td>
<td>Nov 28, 2010</td>
</tr>
<tr>
<td>3</td>
<td>HBI-Bal 520</td>
<td><em>E. crista-galli</em></td>
<td>Bogor, West Java</td>
<td>Nov 28, 2010</td>
</tr>
<tr>
<td>4</td>
<td>HBI-Bal 523</td>
<td><em>E. crista-galli</em></td>
<td>Cibinong, West Java</td>
<td>Oct 26, 2010</td>
</tr>
<tr>
<td>5</td>
<td>HBI-Bal 525</td>
<td><em>E. crista-galli</em></td>
<td>Samarinda, E. Kalimatan</td>
<td>Feb 22, 2011</td>
</tr>
<tr>
<td>6</td>
<td>HBI-Bal 526</td>
<td><em>E. crista-galli</em></td>
<td>Samarinda, E. Kalimatan</td>
<td>Feb 22, 2011</td>
</tr>
<tr>
<td>7</td>
<td>HBI-Bal 527</td>
<td><em>E. crista-galli</em></td>
<td>Manado, North Sulawesi</td>
<td>March 23, 2011</td>
</tr>
<tr>
<td>8</td>
<td>HBI-Bal 529</td>
<td><em>E. crista-galli</em></td>
<td>Jambi, Sumatera</td>
<td>March 25, 2011</td>
</tr>
<tr>
<td>9</td>
<td>HBI-Bal 530</td>
<td><em>E. crista-galli</em></td>
<td>Bandung, West Java</td>
<td>April 13, 2011</td>
</tr>
<tr>
<td>10</td>
<td>HBI-Bal 531</td>
<td><em>E. crista-galli</em></td>
<td>Cigombong, Sukabumi, West Java</td>
<td>March 15, 2011</td>
</tr>
<tr>
<td>11</td>
<td>HBI-Bal 532</td>
<td><em>E. crista-galli</em></td>
<td>Pakuwon, Sukabumi, West Java</td>
<td>March 9, 2011</td>
</tr>
<tr>
<td>12</td>
<td>HBI-Bal 533</td>
<td><em>E. crista-galli</em></td>
<td>Semarang-Central Java</td>
<td>July 28, 2011</td>
</tr>
<tr>
<td>13</td>
<td>HBI-Bal 534</td>
<td><em>E. crista-galli</em></td>
<td>TMII, Jakarta</td>
<td>Oct 9, 2011</td>
</tr>
<tr>
<td>14</td>
<td>HBI-Bal 514</td>
<td><em>E. variegata</em></td>
<td>Cahaya Negeri, Lampung</td>
<td>Nov 28, 2010</td>
</tr>
<tr>
<td>15</td>
<td>HBI-Bal 515</td>
<td><em>E. fusca</em></td>
<td>Cahaya Negeri, Lampung</td>
<td>Nov 28, 2010</td>
</tr>
<tr>
<td>16</td>
<td>HBI-Bal 516</td>
<td><em>E. fusca</em></td>
<td>Cahaya Negeri, Lampung</td>
<td>Nov 28, 2010</td>
</tr>
</tbody>
</table>

Observation was carried out by scraping the fungal structures from the leaf surface and providing hand free section of the fruiting body of the respective samples. The obtained sections were put in slide glass and mounted in a drop of lactophenol solution, then observed under compound light microscopes (Nikon AFX 2A). The existing morphological characteristic i.e. fungal stage of life cycle, spore size, wall thickness, germ-pore number and its distribution patterns, the presence of paraphysis and its length were measured. The germ pore number and distribution pattern was observed by applying an aniline blue squash technique (Jennings et al., 1989). The existing rust fungal state was named following ontogenic systems of Cummins and Hiratsuka (2003). The surface structure pattern was named based on categories as proposed by Cummins and Hiratsuka (2003) and Lee et al. (1999)

3. RESULTS

In the field, at the infected leaves minute yellow spots uredinia sori of the rust noticed on abaxial, and no uredinia on adaxial surface (Figure 1B and 1C). The infected leaves mostly leaves that present at the lower part of the plant, either young and mature leaves. The uredinia are not seen on leaves of petiole nor stem. In general, the infected leaves vary from 0 up to less than 10%. The infected leaves fall prematurely and the uredinia of the fungus still persist on fallen leaves.
Microscopic observation revealed that the uredinia globose to subglobe, 73-(112)-153 µm in diameter, the cell wall dark to light brown in color and consist 3 to several layers, and ostiolet (Figure 1D).

Urediniospores pedicellate, oblong, obovoid to globose to ellipsoid, light brown to hyaline, echinulate, 18-(23)-29 x 16-(19)-24 µm, cell wall uniform and 0,8-(1)-1,3 µm thick (Figure 1D). Germ pore obscure, 4-(6)-8 and distributed randomly (scattered) or close to equatorial zone (Figure 1E). Paraphysis exists, hyaline, clavate to and 23-(29)-38 x 5-(7)-10 µm (Figure 1D).

The uredinial state only exists and no telial state and other states were found from all the observed samples. Based on the obtained morphological data, especially the germ pore number, distribution pattern and the existing the life cycle. The rust fungus on *E. crista-galli* in Indonesia was identified as *Phakopsora meibomiae* (Arthur) Arthur.

Figure 1: *P. meibomiae* of *E. crista-galli*. (A) Flower of *E. crista-galli*, (B) Infected leaf with the uredinial mass (→) on abaxial, (C) Mass of uredinia (→) (HBI-Bal 530), (D) Uredinia, urediniospores and paraphyses of *P. meibomiae* (HBI-Bal 530), and (E) Germ pore distribution pattern of urediniospore *P. meibomiae* (HBI-Bal 530).
4. DISCUSSION

Ravenalia and Phakopsora are two common fungi attacking of many species Erythraeae world wide. These two genera of rust fungus clearly distinguished from the morphological characteristics of their teliospore. In tropical areas the uredinal state only present. Therefore, the identification of the fungus really on the characteristics of uredinia and urediniospore and supplied by the host range, and their geographic distribution and symptom appearance. Ravenalia platensis Spag has been reported attacking E. crista-galli in Argentina (Lindquist 1982; Deschamps and Wright, 2001; Hernandez and Hennen, 2002). Hypertrophied area often seen on the infected leaves, petioles and young stem. The spermogonial and aecial state often seen on the hypertrophied areas (Hernandez and Hennen, 2002; 2003). Therefore, the Ravenalia is excluded form the suspect as agent of rust disease of E. crista-galli in Indonesia.

Two species of Phakopsora, namely P. pachyrizi and P. meibomiae are the rust species of Erythrina spp. (Ono et al., 1992). These two species of Phakopsora are different in their host ranges, beside its telial morphological characteristic and geographic distribution (Ono et al., 1992). The observation of the specimens show that urediniospore germ pore pattern of P. meibomiae of E. crista-galli is different with those of P. pachyrizi of Erythrina spp.; The germ pore of P. meibomiae is randomly distributed (scattered) and close to equatorial zone; and equatorial zone distributed for P. pachyrizi. P. pachyrizi is well known rust fungus that attacking many species of legumes in South East Asia. Thaug (2005) reported that uredinal state only of P. pachyrizi presents on Erythrina spp., Pachyrhizus angulatus Rich. and Glycine max Merrill in Burma. Coomaraswamy (1979) also reported that only uredinal state of P. pachyrizi (Uredo erythrinae P. Henn) attacking Erythrina spp. velutina in Sri Lanka.

Phakopsora is heteroecious rust fungi. Up to present there is no any record considering the alternate host of the P. meibomiae in Indonesia and this is the first record of the fungus in Indonesia. The future study is needed to confirm the host specificity of the fungus with other Erythrina spp. of Indonesian origin.

5. CONCLUSION

Phakopsora meibomiae is the causal agent of rust disease in Indonesia and the fungus is widely distribute already in Indonesia.

REFERENCES

Boedijn, K B (1960): The Uredinales of Indonesia. Nova Hedwigia 1(3,4); 463-495.


Optimization of Somatic Embryos Formation of *Shorea pinanga* Scheff. Through Suspension Culture

Yelnititis

The Center for Research on Biotechnology and Tree Improvement
Jl. Tentara Pelajar Km.15 Purwobinangun, Pakem, Sleman, Yogyakarta 55582, INDONESIA

Poster paper prepared for
The First International Conference of Indonesian Forestry Researchers (INAFOR)
Bogor, 5 – 7 December 2011

INAFOREC 2011
Bogor, 5 – 7 December 2011
INAFOREC 2011
Bogor, 5 – 7 December 2011
Optimization of Somatic Embryos Formation of *Shorea pinanga* Scheff. Through Suspension Culture

Yelnititis

The Center for Research on Biotechnology and Tree Improvement
Jl. Tentara Pelajar Km.15 Purwobinangun, Pakem, Sleman, Yogyakarta 55582, INDONESIA

ABSTRACT

*Shorea pinanga* (Scheff.) is a member of Dipterocarpaceae, that has an important role as a timber product source and tengkawang. Plant multiplication through suspension culture to mass produced of somatic embryo was conducted. The friable callus was used as explant. Murashige and Skoog (MS) medium supplemented with vitamin of B group, 30 gr/l sucrose and 8 gr/l agar, was used as basal medium. The experiment was conducted in two stages i.e embryogenic callus induction and somatic embryos induction. The embryogenic calli was initiated by the treatment of 4.0 – 5.0 mg/l 2,4-D. For induction of somatic embryo, the embryogenic callus was cultured on the medium supplemented with 1.0 – 3.0 mg/l kinetin. The observation was made on period of embryogenic induction, percentage of embryogenic callus, texture and colour of embryogenic calli resulted, number and performance of somatic embryos resulted. The experimental Designed used was Complete Randomized (CRD) with ten replicates. The results showed that the medium supplemented with 2,4-D 5.0 mg/l was the best for embryogenic callus induce. The embryogenic callus induced was 100% on 10 weeks cultured, friable on performance and yellowish and whitish on colour. The medium supplemented with 1.5 mg/l kinetin was the best treatment to induce somatic embryo and embryo somatic is normal.

Keywords: Embryogenic callus, *Shorea pinanga* Scheff., somatic embryo

1. INTRODUCTION

Dipterocarps are predominant species in major tropical forest in Indonesia, that have a high export value. As it is know already the problem of biodiversity lost in Indonesia, Dipterocarps forest has reached on alarming stage. Therefore, the establishment forest Dipterocarps in Indonesia needed to reach. *Shorea* spp. is one of the most important Dipterocarps genera. The genus *Shorea* has a large number of species, with more than 180 species identified, most of which are indigenous species that are very important to be conserved as well as needed to support of the rehabilitation programme in their natural habitats.

*Shorea pinanga* Scheff. is one of the species belonging to Dipterocarpaceae family that has an important role as timber product source and also non forest timber product (tengkawang). The wood can be used for various purpose such as pulp materials, construction, plywood, furniture, joinering and flooring. This species is also called as red meranti or “meranti merah” and categorized as fast growing species. The increase of wood demand every year cause the decrease of production of natural forest, since there was no sufficient effort to balance between harvesting/logging and regeneration. Considering some aspects mentioned above this species is highly recommended for industrial forest plantation, reforestation and other plantation program. The industrial forest plantation (HTI) program using meranti has not showed consirable success for various reasons, and mainly because there has not enough and continuous provision of planting stocks especially when genetically improved planting stocks are required. Artificial regeneration of this species pose many problems such as: (a) it's seed characteristic that is recalcitrant or can not to be stored for a long period, and (b) the irregularity period of fruiting every four or five year.
Tissue culture as a relatively new technique offering possibility in tackling some problems in plant propagation to supply of planting stocks. Plant propagation by tissue culture can be done in three ways namely: adventive shoot formation, lateral shoot formation and somatic embryogenesis. Somatic embryogenesis is one of the tissue culture techniques that has advantage compare to other two techniques such as planting stocks obtained originated from single cell, have bipolar structure that are one polar in this structure into shoot and the other polar into root. And so planting stocks obtained through somatic embryogenesis will be more than the other two techniques because from one cell of callus will be somatic embryo and the end can be planting stoks. Suspension culture is somatic embryogenesis technique that conducted with use liquid medium. The purpose of this study is to obtain the most appropriate somatic embryos proliferation methode of *Shorea pinanga* Scheff. through suspension culture, that can be useful for further application.

2. MATERIAL AND METHODS

The experiment was conducted at Biotechnology of Tissue Culture Laboratory, Centre for Forest Biotechnology and Tree Improvement, Yogyakarta, Indonesia. Materials used for this study are friable callus-derived immature embryo from young fruit which collected from The Forest Research Arboretum, Forestry Department, Darmaga, Bogor, West Java. Murashige and Skoog (MS) medium supplemented with vitamin of B groups and 30 gr/l sucrose was used as basal medium. Aspects in somatic embryogenesis to be included in this study are: callus multiplication, embryogenic callus induction and somatic embryos induction or maturation of embryogenic callus. MS medium with 8.0 gr/l agar supplemented with 4.0 – 5.0 mg/l 2,4-D was used for callus multiplication, embryogenic callus induction. For maturation of embryogenic callus to somatic embryo formation or that can be converted into plantlet was used MS liquid medium supplemented with 1.0 – 3.0 mg/l kinetin. The observation was made on period of embryogenic induction, percentage of embryogenic callus, texture and color of embryogenic callus, number and performance of somatic embryos resulted. The experimental Designed used was Complete Randomized (CRD) with ten replicates.

3. RESULT AND DISCUSSION

The results showed that friable callus (Figure 1) can be propagated on the medium supplemented with 2,4-D and can develop to nodular callus. Plant growth regulator 2,4-D was necessary for callus initiation, callus proliferation and or embryogenic callus formation. According to George and Sherrington (1987) and Nagasawa and Finer (1988) 2,4-D is one of the auxins that very effective used for callus proliferation. Different with the experiment of Zhou *et al.*, (1994) describing for callus proliferation were used two kinds of plant growth regulator.

![Image](image.png)

Figure 1. The friable callus

In this study, proliferation of friable callus used 4.0 – 5.0 mg/l 2,4-D treatment. Callus friable was observed from all the treatment. The best treatment for callus proliferation was 5.0
mg/l 2,4-D and callus develop to nodular callus. Friable nodular callus was induce at high frequency 95% for 12 weeks without subculture or subculture was conducted three times 4 weeks intervals. Nodular callus obtained was friable and white in color. Nodular callus formation normally used single plant growth regulator and sometime needed two or more plant growth regulator that acted synergistically. Te-chato and Lim (1990) and Yelnitivity and Bermawie (2000) reported that for nodular callus formation used BA and thidiazuron most effective.

3.1 Induction Embryogenic Callus

The treatment of 5.0 mg/l 2,4-D is the best to induction of embryogenic callus. The embryogenic callus obtained was friable for eight weeks after inoculation. Similar to Yelnitivity studies (2007) describe the embryogenic callus inducted after two times subculture four weeks intervals.

![Figure 2: The embryogenic callus from different 2,4-D treatment](image)

According to Guohua (1998) 2,4-D is auxin that very effective to embryogenic callus induction than NAA or IBA. Furthermore, Massabo and Ruffoni (1993), Gastaldo et al., (1994) and Rao and Bapat (1995) describing for embryogenic callus induction required of 2,4-D alone. In this study 100 % of callus embryogenic were produced.
The embryogenic callus obtained was friable in texture (Fig.2) and yellowish and whitish in color. Similar to studies of Shimizu et al. (1997) and Ortiz et al. (2000) that obtain yellowish embryogenic callus of *Iris germanica* plant. And this callus can develop to follow somatic embryogenesis design.

### 3.2 Induction of Somatic Embryo

In this stages, the embryogenic callus cultured on the liquid medium regeneration supplemented with plant growth regulator 1.0 – 3.0 mg/l kinetin. The result showed that development of the embryogenic callus to somatic embryo induction showed. For the first time this callus to be proliferated and greenish and than somatic embryos formation will start. Friable embryogenic callus will be compact and globular. The color change of callus showed after subculture.

Figure 3: Development of embryogenic callus to somatic embryos through suspension culture

Figure 4: Stages of somatic embryos
4. CONCLUSION

The treatment supplemented with 3.0 mg/l kinetin is the best treatment to somatic embryos induction. Number of somatic embryos produce was 160 for five weeks. Kirby (1997) describing that using of sitokinin alone effective to somatic embryos induction. This result the best than Yelnititis studies (2007) that obtain 110 somatic embryos at the same species. On the other hand, Nanda and Rout (2003) obtain 72.6 somatic embryo on the treatment BA and 2,4-D from Abies fraseri plant. Cotyledon stage of somatic embryos obtained in this study has two cotyledone and somatic embryo is normal.

REFERENCES


Landslide Hazard Mapping to Support the Handling of Landslide Hazard in the Upstream Deli Watershed

Rahmawaty¹, Bejo Slamet¹, Abdul Rauf² and Anita Naomi¹

¹Department of Forestry, Faculty of Agriculture, Sumatera Utara University, Jl. Tri Dharma Ujung No. 1, Kampus USU, Medan, North Sumatra, 20155, INDONESIA
 Corresponding email: rahmawaty@usu.ac.id

²Department of Soil Science, Faculty of Agriculture, Sumatera Utara University, Jl. Tri Dharma Ujung No. 1, Kampus USU, Medan, North Sumatra, 20155, INDONESIA

Poster paper prepared for
The First International Conference of Indonesian Forestry Researchers (INAFOR)
Bogor, 5 – 7 December 2011
ABSTRACT

Natural disasters landslides as one natural phenomenon is one of the environmental problems that often occur in the province of North Sumatra, Indonesia. Landslides usually occur in the watershed upstream. The upstream of Deli Watershed is located in Karo Regency. Karo Regency is an area that has the potential for landslides; this region is mostly located in the highlands. This research aimed to identifying and mapping of landslide prone areas in Karo Regency and provided advice to the government in an effort to support the handling of dangerous landslides. This research used data such as: earth feature of Indonesia map/Peta Rupa Bumi Indonesia (RBI) or what is called as basic map with scale 1:50000, slope map, geological map and land cover/land use map. Processing was done with overlaid each parameter to determine landslide hazard using Geographic Information System. The results showed that in the upstream region DAS Deli, landslide hazard was dominated by high-class, followed by a very high grade, medium, low and very low. The Class which very high landslide hazard contained in the Sub-district of Tiga Binanga, there was a high grade in the Sub-district Mardinding, while other classes (medium, low and very low) spread over several districts in Karo Regency. The main causes of landslides in this area mainly due to the slope factor, type of rock, soil, and land use.

Keywords: Landslide, mapping, Deli watershed, environmental, Karo Regency

1. INTRODUCTION

1.1 Background

Landslides usually occur in the watershed upstream. Natural disasters landslides as one natural phenomenon are also one of the environmental problems that often occur in the province of North Sumatra, Indonesia. The upstream watershed Deli is located in Karo Regency. Karo Regency is an area that has the potential for landslides; this region is mostly located in the highlands. Many factors can affect the stability of slopes that lead to the occurrence of landslides. These factors include: geological and hydrological conditions, topography, climate and weather changes. According to Priyono et al. (2006), the potential for soil erosion can be minimized by empowering communities to identify typologies of landslide prone slope lands, the early symptoms of the slope will move, and efforts should be done early anticipation. Effective early warning system should be made based on predictions, when and where landslides will occur also actions that should be done when disaster strikes.

Geographic information systems can be used in determining the priority areas for disaster relief. According to Burrough (1986), a geographic information system (GIS) is a powerful set of tools for collecting, storing, retrieving, transforming and displaying spatial data from the real world for a particular set of purpose. GIS technology integrates common database operations such as query and statistical analysis with the unique visualization and geographic analysis benefits.
An area most vulnerable to disasters is a main priority in conducting mitigation measures. By this research, it is known that areas prone to landslides, so early prevention can be done. If the anticipation is not immediately done, losses due to landslides would not be inevitable.

1.2 Objective

This study generally aimed to identifying and mapping of landslide prone areas in Karo Regency and provided advice to the government in an effort to support the handling of dangerous landslides.

2. MATERIAL AND METHODS

2.1 Description of the Study Area

The research was conducted in Karo Regency (the upstream of Deli Watershed). Geographically, it is located between 2°50’ - 3°19’ LU dan 97°55’ - 98°38’ BT (Figure 1). This research was conducted during January to July 2010. Data analysis and processing were performed at the Laboratory of Integrated Forest Management, Department of Forestry, University of Sumatera Utara.

![Map of study area](image1.png)

Figure 1: Map of study area

2.2 Data Collection

This research used data such as: earth feature of Indonesia map/Peta Rupa Bumi Indonesia (RBI) or what is called as basic map with scale 1:50,000, slope map, geological map and land cover/land use map. Processing was done with overlaid each parameter to determine landslide hazard using Geographic Information System.

3. RESULT AND DISCUSSION

Based on the district in Karo Regency, the distribution of landslide prone consists of five classes, namely: very low, low, medium, high, and very high. Distribution of landslide hazard based on the district was not evenly distributed in each sub-district as is presented in Figure 2. (based on analysis on the map and checking in the field). Each class of landslide hazards was marked with different colors.
Characteristics of landslides are most commonly found in Indonesia is the type of landslide translational and rotational (KESDM, 2008). There are characteristics of landslides was found in the area, namely: translational landslides, landslides of rotation, and movement of the block. Characteristics of landslides in areas of research have different extents in each sub-district (Table 1). Based on Table 1, the characteristics of landslides were most commonly found, namely: the Sub-district of Tiga Binanga (very high), Sub-district Mardingding (high, low, and very low).

Table 1. Landslide hazard class based on sub-district in Karo Regency

<table>
<thead>
<tr>
<th>Sub-district</th>
<th>Very low</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
<th>Very High</th>
<th>Total Ha</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barusjahe</td>
<td>-</td>
<td>-</td>
<td>857.79</td>
<td>-</td>
<td>241.76</td>
<td>1,099.55</td>
<td>5.45</td>
</tr>
<tr>
<td>Berastagi</td>
<td>69.53</td>
<td>2.03</td>
<td>2.40</td>
<td>169.00</td>
<td>32.74</td>
<td>275.72</td>
<td>1.37</td>
</tr>
<tr>
<td>Juhar</td>
<td>38.05</td>
<td>4.84</td>
<td>167.39</td>
<td>1,661.15</td>
<td>160.79</td>
<td>2,032.24</td>
<td>10.08</td>
</tr>
<tr>
<td>Kabanjahe</td>
<td>101.87</td>
<td>-</td>
<td>153.52</td>
<td>144.36</td>
<td>-</td>
<td>399.76</td>
<td>1.98</td>
</tr>
<tr>
<td>Kutabuluh</td>
<td>-</td>
<td>-</td>
<td>12.30</td>
<td>1,841.40</td>
<td>324.77</td>
<td>2,178.48</td>
<td>10.80</td>
</tr>
<tr>
<td>Laubaleng</td>
<td>263.96</td>
<td>89.21</td>
<td>26.73</td>
<td>1,218.39</td>
<td>21.75</td>
<td>1,620.06</td>
<td>8.03</td>
</tr>
<tr>
<td>Mardingding</td>
<td>543.37</td>
<td>131.79</td>
<td>28.21</td>
<td>2,476.73</td>
<td>23.96</td>
<td>3,203.82</td>
<td>15.89</td>
</tr>
</tbody>
</table>

Figure 2: Map of landslide hazard class in Karo Regency

Source: Analysis result (2010)
Tiga Binanga Sub-district has the very high landslide in Karo District with an area of 477.27 ha, because of the soil was dominated by Dystropepts, Tropudults, Humitropepts, land cover was agricultural land, dry slopes above 45%, and the type of rock is a Mixed-Sediment (silt/mudstone). The most influential in the level of landslide hazard in the Tiga Binanga Sub-District was slope.

Mardingding Sub-district, an administrative district that has the greatest area when compared with other Sub-districts in Karo Regency. The extent of 3.203,82 hectares and is a district that has a high level of landslide hazard in the Karo district with an area of 2.476,73 ha. The types of soil were Tropudults and Dystropepts, land cover was dominated by secondary forest of dry land, the type of rock was a sediment-mixture, and the slope was above 45%. Landslide conditions are depicted in Figure 3.

According to Marwanto et al. (2007), an area determined to have potential for landslides if it meets three requirements, namely: the slope is quite steep, has a glide plane of the surface soil layer beneath the semi-permeable and soft and there is enough ground water to meet the above fields the sliding. With a high percent slope, then the incidence of landslides are only waiting for the trigger factor is rainfall or earthquakes. Based on the results, the higher the percent slope of the land, the greater the potential for landslide. It is also clarified by Wahyunto et al. (2003) and Arsyad (2006). Soil type is one of the parameters determining the level of erosion. According Haifani (2008), the occurrence of landslides is generally caused by the presence of a large thickness of loose soil. With the rain, the rate of erosion will be higher. Furthermore, according Budiono (2003), soil texture also affects the absorptive capacity of a soil.
4. CONCLUSION

The class which very high landslide hazard contained in the Sub-district of Tiga Binanga, there was a high class in the Sub-district Mardinding, while other classes (medium, low and very low) spread over several Sub-districts in Karo Regency. The main causes of landslides in this area mainly due to the slope factor, type of rock, soil, and land use.

REFERENCES


Study of Traditional Agroforestry System in West Nusa Tenggara: Finding the Alternative of DA REDD Site Based on Carbon Stock

Ryke Nandini

Forestry Research Institute of Mataram
Jl. Dharma Bhakti 7, Lombok Barat, NTB 83371, INDONESIA
Corresponding email: rykenand@yahoo.com

Poster paper prepared for
The First International Conference of Indonesian Forestry Researchers (INAFOR)
Bogor, 5 – 7 December 2011
Study of Traditional Agroforestry System in West Nusa Tenggara: Finding the Alternative of DA REDD Site Based on Carbon Stock

Ryke Nandini
Forestry Research Institute of Mataram
Jl. Dharma Bhakti 7, Lombok Barat, NTB 83371, INDONESIA
Corresponding email: rykenand@yahoo.com

ABSTRACT

West Nusa Tenggara (NTB) has limited forest land cover. It causes NTB being a target of Reducing Emission from Degradation and Deforestation Demonstration Activity (DA REDD). One of important requirements for being a DA REDD is the status certainty of management area. Beside of forest area, a potential DA REDD is the traditional agroforestry system that has been managed by community for centuries from generation to generation. Counting of carbon stock in existing traditional agroforestry systems is one way to choose an alternative location of the DA REDD. This research aimed to study the existed traditional agroforestry system in NTB, and to analyze its carbon stock on four carbon pools. Field survey was used to study traditional agroforestry system. The plot sampling method was used for inventory of vegetation and soil sampling in every agroforestry system. Carbon stock was analyzed using Vademicum Kehutanan allometric method, Hairiah et al. method and MacDicken equation (1997). Comparative method was used to determine the best traditional agroforestry system in terms of carbon stock. The result showed that the existed traditional agroforestry system in NTB were silvopasture, Sesbania glandiflora fallow land, alley cropping, “Rau”, “Kebon”, and “Forest Kebon”. Kebon was the best system on carbon stock with average total carbon stock of 401.89 ton/ha. The carbon pool which had the largest carbon stock was vegetation carbon of “Rau” system (191.09 ton/ha). Based on the result, “Kebon” and “Rau” could be an alternative of DA REDD site.

Keywords: Traditional agroforestry, carbon, DA REDD

1. INTRODUCTION

Forest land cover in West Nusa Tenggara (NTB) decrease year by year. According to the land cover map for 2006-2009 periods, its declining was approximately 14.3%. On the other hand, there are many succesful community forest (HKm) and increasing of forest people in NTB. There were at least 14 HKm until year of 2009 and 32,659.13 ha forest people during 2004-2008 in NTB (Dinas Kehutanan Propinsi NTB, 2011). It cause NTB being a target of Reducing Emission from Degradation and Deforestation Demonstration Activity (DA REDD).

Target of REDD site is not only inside of forest area but also outside of forest area, as long as it has a certain management status. In NTB, there are many agroforestry traditional system outside of forest area that might be a site of DA REDD. It has been managed by community for centuries from generation to generation. According to Roshetko and Mulawarman (2001, in Iskandar, 2008), at least there were eight traditional agroforestry systems in NTB, such as “Rau”, Sesbania glandiflora fallow land, alley cropping, “Kebon”, “Ngerau”, “Forest kebon”, and silvopastura.

Counting of carbon stock of existing traditional agroforestry systems is important as consideration to choose an alternative location of the DA REDD. Carbon stock in existing traditional agroforestry systems could be a baseline for counting of carbon stock in the next periode of carbon stock counting.
This research aimed to study the existed traditional agroforestry system in NTB, and to analyze its carbon stock on four carbon pools.

2. EXPERIMENTAL METHOD

This research was conducted in NTB, including Lombok Island and Sumbawa Island (Figure 1). Six districts were selected as sample area, such as West Lombok, Central Lombok, North Lombok, East Lombok, Sumbawa and West Sumbawa. Field survey was used to identify and study the existing traditional agroforestry system.

Figure 1. West Nusa Tenggara Map

Carbon stock was analyzed from 4 carbon pool (vegetation, soil, necromass and understorey). Sample location was determined using purpossive sampling for every traditional agroforestry system. Nested plot sampling was used for inventory of vegetation, soil sampling, necromass and understorey measurement (Figure 2).

Figure 2: Nested plot sampling layout used in the research

Carbon stock analysis used Vademicum Kehutanan allometric method (1976), Hairiah et al. method (2001) and MacDicken equation (1997). Comparative method was used to determine the best traditional agroforestry system in terms of carbon stock.

3. RESULT AND DISCUSSION

According to Nandini et al. (2009), physiography of the research area are volcanic and fluvial landform with volcanic igneous such as basalt, andesite and breccia; and sedimentary rock
such as alluvium, colluvium and alluvial fan deposit as well. Average Annual rainfall of the research area for 1985-2008 periods is 475-1980.7 mm/year. There were six traditional agroforestry systems in NTB that still existed when the research was conducted (Table 1).

Table 1. The existing traditional agroforestry systems in NTB

<table>
<thead>
<tr>
<th>No</th>
<th>Traditional Agroforestry System</th>
<th>Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kebon</td>
<td>Mix planting system between wood, multi purpose tree species (MPTS), and food production crops. It locates around resettlement. Area of 0,25 – 2 hectares Income from fruits Rp 3-4 million/year</td>
</tr>
<tr>
<td>2</td>
<td>Forest kebon</td>
<td>Mix planting system between wood, MPTS, annual crop as food production and animal feed on land owned. It is far from home and near forest area. Area of 0,5 – 3 hectares. Uncertain and incontinuous income except from fruits, food and animal feed</td>
</tr>
<tr>
<td>3</td>
<td>Silvopastura</td>
<td>Combination of trees and animal feed plant such as <em>Gliricidia sepium</em> and <em>Pennisetum purpureum</em> Area of 0,25 – 2 hectares</td>
</tr>
<tr>
<td>4</td>
<td>Alley cropping</td>
<td>Using variety of legume as alley crop for nitrogen fixing and annual crops and fruits in between. Area of 0,25 – 2 hectares</td>
</tr>
<tr>
<td>5</td>
<td>Rau</td>
<td>Land use system on sloping land for annual crops (Gora paddy, corn, and bean) Using terrace and cover crops for retaining rain water. Area of 0,25 – 2 hectares Plantation production on one planting season are 3-4 ton/ha dry grain equivalent.</td>
</tr>
<tr>
<td>6</td>
<td><em>Sesbania glandiflora</em> fallow land</td>
<td>Most of them are in arid area <em>Sesbania glandiflora</em> as boundary annual crop land. <em>Sesbania glandiflora</em> is utilized for nitrogen fixing, animal feed, vegetable and firewood. Area of 0,5 – 2 ha</td>
</tr>
</tbody>
</table>

The highest carbon stock of the existed traditional agroforestry system was “Kebon” (401.89 ton/hectare). Base on the research, Kebon was dominated by vegetation such as jackfruit (*Artocarpus heterophyllus*), coconut (*Cocos nucifera*), mahagony (*Swietenia mahagoni*), rambutan (*Nepheleium lappaceum*) coffee (*Coffea arabica*), cashew (*Anacardium occidentale*), acid (*Tamarindus indica*) and teak (*Tectona grandis*) with average diameter of 10.9-54 m and height of 6.49-14.3 m. The result of each carbon stock is presented in Figure 4.
Remarks: KH = forest kebon, BL = alley cropping, WP = silvopastura, K = kebon, R = rau, PT = *Sesbania glandiflora* fallow land

Figure 4: The result of carbon stock counting

The highest carbon pool was vegetation of “Rau” (191.09 ton/ha). Rau was dominated by coconut (*Cocos nucifera*), mahagony (*Swietenia mahagoni*), dadap (*Erythrina lithosperma*), cashew (*Anacardium occidentale*) and cottonwoods (*Ceiba petandra*) with average diameter of 10.5-35.1 m and height of 4.33-21.95 m. Carbon stock of carbon pools in the existed traditional agroforestry system is showed in Figure 5.

![Figure 5: Carbon stock of four carbon pools in each traditional agroforestry system](image)

<table>
<thead>
<tr>
<th></th>
<th>Total carbon; KH</th>
<th>Total carbon; BL</th>
<th>Total carbon; WP</th>
<th>Total carbon; R</th>
<th>Total carbon; PT</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-veg</td>
<td>125.89</td>
<td>108.90</td>
<td>108.07</td>
<td>110.41</td>
<td>191.09</td>
</tr>
<tr>
<td>C-so</td>
<td>123.71</td>
<td>110.40</td>
<td>99.86</td>
<td>146.15</td>
<td>92.35</td>
</tr>
<tr>
<td>C-nec</td>
<td>78.39</td>
<td>61.22</td>
<td>83.48</td>
<td>102.76</td>
<td>29.03</td>
</tr>
<tr>
<td>C-und</td>
<td>36.99</td>
<td>45.73</td>
<td>44.91</td>
<td>42.58</td>
<td>47.16</td>
</tr>
</tbody>
</table>

Remarks: KH = forest kebon, BL = alley cropping, WP = silvopastura, K = kebon, R = rau, PT = *Sesbania glandiflora* fallow land, C-veg = carbon from vegetation, C-so = carbon from soil, C-nec = carbon from necromass, C-und = carbon from understorey

Figure 5: Carbon stock of four carbon pools in each traditional agroforestry system
4. CONCLUSION

Carbon stock is the one of parameter that can be a consideration to determine DA REDD site. Base on stock carbon analysis, “Kebon” and “Rau” could be an alternative of DA REDD site.

REFERENCES


Four Types of New Record for Diospyros in Tangkoko Nature Reserve in North Sulawesi

Julianus Kinho

Forestry Research Institute of Manado
JL. Raya Adipura, Kel. Kima Atas, Kec. Mapanget, Manado, 95119, INDONESIA

Poster paper prepared for
The First International Conference of Indonesian Forestry Researchers (INAFOR)
Bogor, 5 – 7 December 2011
Four Types of New Record for Diospyros in Tangkoko Nature Reserve in North Sulawesi

Julianus Kinho

Forestry Research Institute of Manado
JL. Raya Adipura, Kel. Kima Atas, Kec.Mapanget, Manado, 95119, INDONESIA

ABSTRACT

Ebony trees were from Diospyros have been known as the trees of high economic value. The trees of Diospyros can be found in virgin forest generally, especially in lowland forest to mountain in 900 asl and sometimes in the slope area. It is rarely growth in secondary forest, exactly planted by human. Some of them can be found in the mountain to 1700 asl, swamp forest, kerangas forest, and ultrabasic area. Tangkoko Nature Reserve is one of conservation area in North Sulawesi. This is one of tourist destination in North Sulawesi with many flora potential but less known. Research about Diospyros diversity is important to support bioecology data. This research aim to know Diospyros types which growth naturally in Tangkoko. Exploration method were used to collect data, and literature study to know the types of Diospyros which not recorded by Tangkoko Nature Reserve. The result show that four new records of Diospyros were found in Tangkoko Nature reserve. The species namely Diospyros ebenum Koenig., D.pilosanthera Blanco., D.bebecarpa A.Cunn., dan D. malabarica (Desr.) Kostel. The number of list Tangkoko plants has added by fourth new records of Diospyros in Ebenaceae. Eight types have been reported before consist of 7 species were reported by Lee et al. (2001) and 1 species reported by Wirdateti et al., (2006). Nowadays 12 species of Diospyros has been known from Tangkoko Nature Reserve in North Sulawesi.

Keywords: Diospyros, conservation, bioecology, diversity, marga

1. INTRODUCTION

Diospyros is a genus of family Ebenaceae and has more than 300 species spread throughout tropical forests in Asia, Australia, Pacific Islands and Africa. In Malesia was found about 170 species and especially in Indonesia there are about 100 species of trees from the Highways Diospyros L. (Hiern, 1873 in Bakhuizen van den Brink, 1936; Riswan, 2002). The types of the genus Diospyros commonly found in natural forests or primary lowland until height of 900 m in hilly areas and tropical rain. They are rarely found in secondary forests. Several types of Diospyros may grow in the forests of the mountains in altitude of 1700 m asl, peat swamp forest, heath forest, and forests on limestone soil and ultra-alkaline soil (Riswan, 2002).

Ebony tree derived from the genus Diospyros has long been recognized as a type of tree that produces high quality wood. Tree species which is known as a tree of genus Diospyros namely ebony are Diospyros celebica Bakh., D.ebenum Koenig., D.jarvis Bakh., D.lolin Bakh., D.macrophylla Bl., D.pilosanthera Blanco., And D.rumphii Bakh. The types of ebony trees are most important and least known among the seven types of tree namely Diospyros celebica because this type have brown striped wooden and D.rumphii with black color and not striped while in world market known as Makassar ebony (Soenaryo, 2002; Riswan, 2002).

Sulawesi Island is known to have a unique flora, because the island is located in Wallacea lines, which is the convention centre spread of plants from Asia and Australia, and is thought to have a very high diversity of plants (Steenis, 1950 in Sulistiarini, et al., 2007). Tangkoko Nature Reserve is one of area conservation in Sulawesi, which is located in the Bitung regency in North Sulawesi, and the area approximately 3,196 Ha. Geographically located in 125°3’ CA.Tangkoko-
125°15' and 1°3'-1°34' BT LU. The area has mountainous topography sloping up from the coastal forest to mossy forest with the highest mountain 1,109 m above sea level (BKSDA Sult, 2009).

There are many research was conduct in Tangkoko Nature Reserve. It is mostly done by domestic researchers and foreign researchers. Most of the research was done about animals such as Sulawesi black monkey (Macaca nigra), tangkasi (Tarsius spectrum) and hornbills (Aceros cassidix), whereas information about the diversity of flora is still very lacking. Therefore, the study aims to collect data and information of plant species diversity in Tangkoko nature reserve. This article is a part of the research results in Tangkoko Nature Reserve. This article focused on four types of new records for genus Diospyros in Tangkoko Nature Reserve.

2. MATERIAL AND METHODS

Collection was conducted in June and August of 2010. Exploration and collection of samples was done in July while in the beginning of flowering and fruiting. Data collection was done in altitude of 000-200 m above sea level. Exploration and collection of samples plants are continue in August 2010 for the types of the genus Diospyros is detected or will flower and bear fruit for the month. Vegetation sampling methods follow Balgooy (1987); Rugayah et al., (2004); Ward et al., (2004), namely as a collection of higher plants in general. Each plant has collected cultivated flowers or fruit. Collection of plant samples from the genus Diospyros in the subsequent identification of the Herbarium Research and Development Center (Research) of Forest and Nature Conservation, Bogor. Based on the collection and identification of fresh herbs and a description of the types of Diospyros collected and supported by the literature.

3. RESULT AND DISCUSSION

Infrafamili classification for Ebenaceae was introduced first by de Candolle (1844) which classified the family Ebenaceae into eight genera, namely: Cargillia, Diospyros, Euclea, Gunisanthus, Maba, Macnightia, Rospidios and Royena. Then Hiern (1873) classify 249 species into five genera, namely: Diospyros, Euclea, Maba, Royena, and Tetradis. Furthermore Bakhuizen (1936-1955) in the revision of regional Malayensium Maba was combine with Diospyros and breaks it into four genera, namely: Diospyros, Euclea, Royena and Tetradis. White (1980; 1983) combines Royena and Tetradis synonymous with Diospyros and only classified into two genera, namely: Diospyros and Euclea. Duangjai, et al., (2006) make a classified based on the results of a study supported by the results of data analysis from the separation from six DNA regions, and they classifies Ebenaceae into four genera, namely: Lissocarpa, Euclea, Royena, and Diospyros. Nowadays, we know that family Ebenaceae consist of four genera.

According to Whittemore, et al., (1989), the number of species from genus Diospyros in Sulawesi approximately 26 species. Five types of which species are endemic to Sulawesi, namely: Diospyros celebica Bakh., D.eburnea Bakh., D.greshoffiana Kds.ex.Bakh., D.polita Bakh., and D.revenusa Bakh. The spread of Diospyros species endemic Sulawesi is not explained further, is only mentioned a place to grow in lowland forest or mountains. According to Keββler et al., (2002) were data collected from various sources mentioned that the number of species for genus Diospyros in Sulawesi, approximately 19 species. This amount is more or less 7 types bellow when we compared to those previously reported by Whittemore et al., (1989), does this mean there has been a reduction in the type of the genus Diospyros in Sulawesi, given the number of reported or recorded according to Keββler et al., (2002) is the result of recording data 13 years later after Whittemore et al., (1989).

The result showed that based on field data collection by exploration, specimen herbarium identification and supporting by the literature on genera Diospyros in Sulawesi (Whitemore et al., 1989; Keββler et al., 2002; Lee, et al., 2001). Four types of the genus Diospyros has identified as new recordings in Tangkoko Nature Reserve, namely; Diospyros ebenum Koenig., D.pilosantha Blanco.,
D. hebecarpa A.Cunn., and D. malabarica (Desr.) Kostel. Those types has added list of plant species in Tangkoko Nature Reserve, specifically list of family Ebenaceae. The list plants previously of the genus *Diospyros* in some conservation areas in North Sulawesi (Lee, *et al*., 2001), shown in Table 1.

Table 1. The number of list plants for Diospyros in North Sulawesi

<table>
<thead>
<tr>
<th>No</th>
<th>Name of type</th>
<th>Vernacular name</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Tk</td>
</tr>
<tr>
<td>1</td>
<td><em>Diospyros buxifolia</em> (Blume)</td>
<td>Pamaapegun, Kujangran</td>
<td>*</td>
</tr>
<tr>
<td>2</td>
<td><em>D. celebica</em> Bakh.</td>
<td>Heade, Ameade</td>
<td>*</td>
</tr>
<tr>
<td>3</td>
<td><em>D. hebecarpa</em> Cunn ex Benth.</td>
<td>Oloitoma</td>
<td>*</td>
</tr>
<tr>
<td>4</td>
<td><em>D. javanica</em></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>5</td>
<td><em>D. korthalsiana</em> Hiern.</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>6</td>
<td><em>D. macrophylla</em> Bl.</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>7</td>
<td><em>D. maritima</em> Bl.</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>8</td>
<td><em>D. minahassae</em> Bakh.</td>
<td>Bengkoal, Pambesian, Pombasian</td>
<td>*</td>
</tr>
<tr>
<td>9</td>
<td><em>D. rumphi</em> Bakh.</td>
<td>Hitam (Peremp), K,Mojodin, K,Mojondi, Mojodi</td>
<td>*</td>
</tr>
<tr>
<td>10</td>
<td><em>Diospyros</em> sp.</td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

Number of list plants: 7 4 3 8 3 1 0 2


Remark:
- Tk: CA.Tangkoko (Tangkoko Nature Reserve)
- Mb: SM.Manembonembo (Manembonembo Nature Reserve)
- Ga: CA.Gunung Ambang (Gunung Ambang Nature Reserve)
- Bn: TN. Bogani Nani Wartabone (Bogani Nani National Park)
- Pn: CA.Panua (Panna Nature Reserve)
- Pym: Paguyaman (Paguyaman Nature Reserve)
- Bk: Bunaken (Bunaken National Park)
- Kk: SM.Karakelang (Karakelang Nature Reserve)

Table 1 shows that list of plant species in Tangkoko Nature Reserve made by Lee, *et al*., (2001) based on data compilation from various sources (Lee, *et al*., 1999; Kinnaird and O’Brien, 1996; WWF, 1980) mentioned that in Tangkoko Nature Reserve there are seven types of genus *Diospyros* whereas in this study found eight species of genus *Diospyros*. Three types of which have been previously reported by Lee, *et al*. (2001), namely; *Diospyros minahassae* Bakh., *D. korthalsiana* and *D. maritima* Bl. Then, in five years later (2001-2006) the addition of the number of species plant in Tangkoko Nature Reserve about one type is *Diospyros cauliflora* Bl., reported by Wirdateti *et al*. (2006). Furthermore, in four years later (2006-2010) the addition of four types of the genus *Diospyros* in this study. List of plants for genus *Diospyros* in Tangkoko Nature Reserve were found in this study, shown in Table 2.
The results showed that *Diospyros* species contained in Tangkoko NR more dominant in lowland forest on altitude 0-500 m asl. Two main characteristics distinguish lowland forest with other terrestrial biomes is the high density of trees and vegetation conservation status of most of categorized rare locally (Clark *et al.*, 1999 *in* Kurniawan, *et al*., 2008). Species composition and diversity of plants in the forest depends on several environmental factors such as moisture, nutrients, sunlight, topography, parent rock, soil characteristics, canopy structure and history of land use (Hutchinson *et al*., 1999 *in* Kurniawan, 2008). Description four types of new records for *Diospyros* in Tangkoko NR as follows:

### 3.1 *Diospyros pilosanthera* Blanco.


**Distribution:** Naturally *Diospyros pilosanthera* Blanco., has a fairly wide distribution area ranging from Indonesia to the central part of eastern Indonesia. *Diospyros* species can be found naturally in Borneo (Kutai, Bulungan, Berau, Tarakan, Tidung), Sulawesi (Poso, Bolaang Mongondow, Gorontalo in Minahasa, Banggai, Muna), Moluccas (Morotai, Buru, Timbunta, Halmahera) and Irian Jaya (Alrasid, 2002)

**Morphology:** Trees with a height of 30 meters, diameter of 73.2 cm. Stem smooth, pared bark, black, trunk does not buttress. Single leaf, seated alternating leaves, leaf base rounded, tapered tip of the leaf, the leaf surface is not shiny slippery. Leaf length 20.1 cm, and width 9.4 cm, petiole length of 1.5 cm. Average new leaf edges branching out from the armpit leaves. Tangkoko Nature Reserve, Bitung, North Sulawesi. 10°33'55"N / 125°09'53" E, Alt: 34 m asl. Collection on July 8, 2010. (Kinho, J. 346).

---

**Table 2. Number of list plants for *Diospyros* were found in Tangkoko Nature Reserve**

<table>
<thead>
<tr>
<th>No</th>
<th>Name of Type</th>
<th>Tangkoko Nature Reserve</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><em>Diospyros ebenum</em> Koenig.</td>
<td>(♀)</td>
</tr>
<tr>
<td>2</td>
<td><em>Diospyros cauliflora</em> Bl.</td>
<td>*</td>
</tr>
<tr>
<td>3</td>
<td><em>Diospyros pilosanthera</em> Blanco.</td>
<td>(♀)</td>
</tr>
<tr>
<td>4</td>
<td><em>Diospyros hebecarpa</em> A.Cunn. ex Benth.</td>
<td>(♀)</td>
</tr>
<tr>
<td>5</td>
<td><em>Diospyros korthalsiana</em> Hiern.</td>
<td>*</td>
</tr>
<tr>
<td>6</td>
<td><em>Diospyros minabassae</em> Bakh.</td>
<td>*</td>
</tr>
<tr>
<td>7</td>
<td><em>Diospyros malabarica</em> (Desr.) Kostel.</td>
<td>(♀)</td>
</tr>
<tr>
<td>8</td>
<td><em>Diospyros maritima</em> Bl.</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td><strong>Number</strong></td>
<td>8</td>
</tr>
</tbody>
</table>

Remark: (♀) New record of *Diospyros* in Tangkoko Nature Reserve
3.2 *Diospyros ebenum* Koenig.

**Synonym:** -

**Distribution:** India and Sri Lanka. Spread in Indonesia is naturally found in Sulawesi (Minahasa, Poso, Buton), Moluccas (Halmahera, Tanimbar, Aru,) and Nusa Tenggara (Sumbawa and Flores).

**Morphology:** Trees with a height of 15 m, 25 cm diameter. Branching centralized (circular), stratified. Trunk cylindrical, not pared or exfoliate, smooth skin texture, dark brown somewhat sunny, coastal forest. Single leaf, leaf length of 20.5 cm, 10.3 cm wide leaves, 1 cm long petiole, leaf surface smooth, glossy dark green, beneath light green leaves behind bright. Flat base of the leaves, rounded leaf tips, leaf edges flat, seated alternating leaves. Fruit is round, smooth, sheath 1.95 cm diameter, hugging the base of the petals of fruit, single fruit, fruit located in the armpit leaves, fruit have two locus. Tangkoko Nature Reserve, White Stone Park, Bitung Regency. Coordinat 01° 33 ' 56 "N / 125° 10 ' 13" E, Alt: 2 m asl, Collected on July 7, 2010. (Kinho, J. 336).
3.3 *Diospyros hebecarpa* A.Cunn ex Benth.

**Synonym:** -

**Distribution:** India, Sri Lanka, Australia, Papua New Guinea

**Morphology:** Trees, height 8 m and 63 cm diameter. Bark black, circular branching pattern in intervals of 2 meters. Black stem smooth, grooved shallow, small buttress, not gummy. Wood is shiny white. Leaf is single, seated in alternating arrange, length 12.1 cm, width 3.4 cm. Petiole 0.4 cm long, small size, pointed leaf tips. Surface slick glossy leaves, beneath of leaves pale green, young stems leaf out in the armpit. Young green fruit, the fruit surface slick, smooth, fluffy, Peduncle 0.76 cm length and 1.3 cm diameter. Tangkoko Nature Reserve, White Stone Park Area, in Bitung Regency, North Sulawesi. Coordinat 01°33'45"N /125°09'55" E, Alt: 45 m asl. Collected on July 8, 2010 (Kinho, J. 349).

![Image](image1.jpg)

**Figure 3: Diospyros hebecarpa** A.Cunn ex Benth.

3.4 *Diospyros malabarica* (Desr.) Kostel.


**Vernacular name:** River ebony, Indian persimmon, Mountain ebony, Malabar ebony (E), Komoi, Kumun (Mal.), Culiket, Klega, Kleca, Toyokuku, Tako suan (Thai). Makusi (Ind.), Klicung (Nusa Tenggara Barat).

**Distribution:** From India and Sri Lanka through Southeast Asia. In Southeast Asia have been reported in Myanmar, Thailand, Cambodia, Malaysia (Peninsular) and Indonesia (Java, Sulawesi).

**Morphology:** Trees with a height of 90-10 m, diameter 10-12 cm. Growth in flat area and sandy soil as the habitat. The trunk silindris with smooth black. Leaf single in alternating arrange, leaf base rounded, pointed leaf tips, leaf edges flat, length 18 cm and width 6 cm, petiole length 1 cm. Fruits oval, brown with 4.7 cm diameter, clearly gum, somewhat sticky. The fruits have soft hairs on surface, feed by Sulawesi monkeys (*Macaca nigra*). Tangkoko Nature Reserve, Coordinat 01°33'56"N / 125°09'51" E, Alt: 57 m, August 28, 2010. (Kinho, J. 393)
The trees including of slow growing species, but the wood is a luxury wood with striped pattern and black mottled with brown combined. *Diospyros malabarica* tree can reach up to 25 m high, leafy green rather thick and stiff, branch-free height of about 10-20 m, with 30-45 cm diameter. It is generally straight-trunked tree, and round the outer skin color is black, rough and scaly. Flesh-colored leather in a little red. The texture of the trunk smooth to some what smooth. Fiber direction straight or some what integrated, shiny wood surface slippery. Wood brown reddish color and has a gradation with a wooden terrace. Wood patio colored mottled black, has a specific gravity of 1.05. This type of wood is widely used as furniture, carvings and household appliances. In Tangkoko Nature Preserve, the fruits has been feeding by Sulawei monkey (*Macaca nigra*) and fruit bats (*Pteropus indicus*). Flowering season is expected around January to February and ripe in July to September. The seeds including recalsytrant so its can not be stored in long time. Fruit obtained should be planted. The longer kepts could make less of the viability. These species was reported to grow in altitude 300-650 m asl, in range temperate regions C and D with rainfall aproximately 1300 to 2750 mm /year (MoF, 2007).

4. CONCLUSION AND RECOMMENDATION

The number of plant species in Tangkoko Nature Reserve be increased by the addition of four new species of the genus *Diospyros* recordings that were previously known that only have 8 types, and nowadays by this research they are 12 types. Four kinds are new records, namely; *Diospyros ebenum* Koenig., *D. pilosanthera* Blanco., *D. bebecarpa* A. Cunn., and *D. malabarica* (Desr.) Kostel. Further research is needed in potency and distribution analysis of Diospyros species, especially those included in Ebony group as wood timber which high economic value.

REFERENCES


Utilization of Palm Plants (*Arenga Pinnata* Merr.) by People Around The Forest in a National Park Halimun-Salak Mountain

Yelin Adalina

Poster paper prepared for
The First International Conference of Indonesian Forestry Researchers (INAFOR)
Bogor, 5 – 7 December 2011
Utilization of Palm Plants (*Arenga Pinnata* Merr.) by People Around The Forest in a National Park Halimun-Salak Mountain

Yelin Adalina

ABSTRACT

National Park Halimun-Salak Mountain (NPHSM) defined as an effort to maintain the function of the region while enhancing the benefits to the communities in and around forest. Socioeconomic improvement around the park will have a positive impact on the environment that supports the preservation of national park ecosystem. To improve the socioeconomic conditions surrounding forest plants including through utilization of various plants products palm plants. Purpose of this study was to determine the types of utilizations of palm plants by people around the forest. Research sites were in Majasari Village, Sobang sub-district, Lebak Regency, Banten province. Research approached was carried out by surveys and in-depth interviews with respondents. Data were analyzed descriptively. Result of research are: a) the number of trees that are tapped by farmers varied, ranging from 2-8 trees per day depending on the ability of farmers to conduct wiretaps; b) the production of palm sugar 30-180/konjor/month/farmer with a selling price of Rp 15,000/konjor. Palm sugar production per farmer varies depending on the number of trees being tapped, the characteristics of trees, and tapping technique. Net income of farmers in the utilization of palm trees Rp 260,000 - Rp 2,390,000 million. Number of farmers’ income varies greatly depending on the ability of farmers in maximizing the utilization of palm plants.

Keywords: Utilization, palm plants (*Arenga Pinnata* Merr), Halimun Salak Mountain

1. INTRODUCTION

Utilization of forest resources on the basis of national park is expected to further ensure the preservation of natural resources and can increase welfare benefits to local communities with more real. Existence of National Park Halimun Salak Mountain can not be separated from the community within and around the area that has a high degree of dependence on natural resources that exist in the region (Sudarmadji, 2001).

National Park Halimun Salak Mountain designated as a National Park by a Forestry Ministerial Decree number 175/Kpts-II/200, situated in the Province of West Java and Banten Province include Sukabumi Regency, Bogor and Lebak with an area of ± 113,357 Ha. Seen from the destination management is one of the efforts to preserve the function of the region while enhancing its benefits to society. Expected by society around forest will increase welfare, while the integrity and preservation of natural resources in the parks maintained so that a balance between conservation efforts with efforts to increase the welfare of forest communities (Suhaeri, 1994).

To improve the economics of forest communities, among other things through the utilization of various palm plant products, namely palm juice is processed into palm sugar. Palm sugar commodity has long been recognized and highly prospective Indonesian people as a commodity export. Palm plants grow and spread almost all over Indonesia, among others in Banten Province. Palm crop acreage in the Province of Banten in 2003 reached 1,633 hectares (ha) or 11 % of the total area of palm plants in the island of Java which reached 15,025 ha. Largest centers of palm plants in the province of Banten, namely in the Lebak Regency with an area of 1,348 ha (Directorate General of Plantations (2003) *in* Burhanudin (2005).
Palm tree is a plant that contains many benefits for society, because all parts of the plant can be used. The majority of people around the area of NPHSM precisely in Majasari village, Lebak Regency uses palm tree as a raw material processing sugar obtained from the result of tapping sap from the tree. Majasari Village is one of the villages in the Lebak Regency as palm sugar production center. But until now have not pursued the development of palm utilization optimally, due to various technical and non-technical constraints. In addition to the limited knowledge of the community in the development of sugar plant products. Public knowledge of the utilization and processing of palm was traditionally a hereditary nature, so that as the development of the knowledge era will lead to crisis. People also still rely on palm which grows naturally, through the role of weasel/ferrets (*Paradoxurus Hermaphroditus*) and have not thought about planting seeds directly or selection. When the plant is giving high enough economic contribution when used optimally in-sufficient household. Therefore the use of palm research by community around the area of NPHSM needs to be done, so hopefully people can better optimize the utilization of palm. Purpose of this study was to determine the type of plant utilization of palm products on the surrounding community around National Park of Halimun Salak Mountain.

**2. METHODOLOGY**

**2.1 Place and Time of Research**

Research was conducted in Majasari Village, Sobang District, Lebak Regency, Banten Province. Site selection study is based on the people in this village generally utilize palm tree, palm juice is processed into plam sugar. Majasari village is one of the village as the center of palm sugar production from three other villages in the Sobang District, Lebak Regency, Banten. Research was conducted in October 2011. Lebak Regency known as one of the largest palm sugar producing area in Indonesia. Production capacity reached 2,249.4 tons per year spread over 44 production centers. (Department of Industry and Trade Lebak Regency, 2005).

**2.2 Material and Methods**

Material needed in this study are palm trees growing on private land and palm trees that grow on the forest area NPHSM, namely the Endut Mountain. Necessary equipment consist of: Thermometer, Thermohigrometer, meter, raffia and other materials supporting research.

Done with descriptive method of research through a survey approach, observations and interviews using questionnaires or in-depth interviews with selected respondents, namely palm sugar producers. Data collection techniques using field observation techniques, which is by direct observation on the palm sugar producers. Necessary data in this study are:

1. Potential of palm plants.
2. The types of utilization of palm trees by people around NPHSM.
3. Level of palm sugar production and palm sugar producers income.
4. Permanent ways of harvesting of palm trees and sap processing into palm sugar.

**3. RESULTS AND DISCUSSION**

Palm (*Arenga pinnata* Merril) or synonyms *Arenga saccarifera* Labill, family Arecaceae is one type of potential palm plants and can grow well in the tropics, including Indonesia. Palm in Indonesia were given different names among regions, among others, palm tree called tangkal kawung in Sunda language, Bakjuk (aceh), Onau (Toraja, Sulawesi/Celebes), Anau or neluluk or anggong (Java), Mana or Nawa-nawa (Ambon, Maluku) and Hanau (Dayak, Borneo) (Hastuti, 2000).
Palm or palm plant (*Arenga pinnata*) can reach heights of up to 20 meters with trunk diameters reaching 65 Cm. Palm tree can grow at an altitude of about 500-800 meters above sea level (asl). This tree can grow in any soil conditions such as clay, calcareous soil and sandy soil, but not resistant to the soil with too acidic conditions with rainfall about 1,200 Mm per year with moderate-to-wet climate. Depth of 1-3 meters of water needed by an average temperature of 25°C.

Palm plants that grow in the region of NPHSM especially Endut mountain and grown on land owned by villagers in the Majasari Village is a plant that’s not cultivated, in other words wild plant with the spread of growth by raccoons or badgers (*Paradoxurus Hermaphroditus*). Undigested sugar palm fruit seeds are discharged through the ‘back door’ and then germinate and grow become palm tree with an irregular distribution. Palm tree that grows in the region NPHSM (G. Endut) as well as on private land tends to spread and irregular.

Based on field observation conducted in the region of NPHSM precisely in the Endut mountain Cimangkok block, which lies about 3 Km from the Majasari village, suggesting that the spread pattern of palm trees are not regular, as well as palm trees growing on private land. Potential measurements palm plants that exist around the foot of Mount Endut with area 400 M² (measuring 20 x 20 meters) showed that the palm tree that grows as much as seven trees, and the number of palm trees that can be tapped as many as three trees. Potential measurements palm plant at the foot of the mountain Endut amounted to 29 trees, and plants that could be tapped had totaled five trees. This suggest that at least the potential of palm plants are ready to be tapped by communities around the forest for which the sap can be utilized that can be made palm sugar. Besides many palm trees growing around the cliff so that people can use it less because of a very high risk if fallen from the tree while climbing palm trees.

![Image 1](image1)
![Image 2](image2)
![Image 3](image3)

Figure 1: Measurement of palm trees at the foot of the mountain Endut 2. and 3. Palm trees that grow on private land

Table 1. Measurement of height and diameter of the palm trees in the mountain region Endut, Cimangkok block, Majasari village, subdistrict Sobang

<table>
<thead>
<tr>
<th>No.</th>
<th>Plot 1</th>
<th>Plot 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Height (m)</td>
<td>Diameter (cm)</td>
</tr>
<tr>
<td>1.</td>
<td>6</td>
<td>32</td>
</tr>
<tr>
<td>2.</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>3.</td>
<td>11</td>
<td>25</td>
</tr>
<tr>
<td>4.</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>5.</td>
<td>4</td>
<td>24</td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3.1 The Types of Products Palm Tree Use In Majasari Village

In general community/farmer in the Majasari village utilize palm tree limited to the utilization of sap is then processed into palm sugar. Farmers are not optimizing the utilization of palm plants due to the terms of marketing. Other than that tapping work is generally done by an old farmer, while young people prefer to work outside the village or work in the farm. The average ownership of productive palm plants in the Lebak Regency about 11 trees. Palm plants which include the productive age between 7-23 years, while plants that can be tapped or dideres aged between 7-8 years with intercepts tapping ranging from 7-15 years old (Forestry and plantation office Lebak Regency(2005) in Rachman (2009)).

Number of farmers done palm wire tapping in Majasari village about 45 farmer. Most farmers in conducting wiretaps of palm tree is as a side job, so the number of trees tapped were not many, which is an average of two trees. This is because the wiretapping does not require a considerable outpouring of time, which is about one hour in the morning or late afternoon. In general the main job they worked on farms.

Number of palm trees that are tapped by farmers/penderes which is the main job, which is an average of five to seven trees. Outpouring of their time in doing this work more, i.e. from morning to evening while waiting for cooking palm sugar that they do in the area/region. Palm tree is a plant that has many benefits. When calculated, the tree is able to provide income for their owners to 12 million rupiah over three years. However, not many tapper (penderes) and the owner of the palm tree that can maximize the benefits. The types of utilization of palm trees by farmers/penderes in Majasari Village, include:

- Palm juice to be processed into palm sugar
- Fibers
- Palm fruit as kolang kaling
- Young palm leaves as a tobacco wrapper
- Palm trunk as firewood

Table 2. Types of palm trees utilization in Majasari village

<table>
<thead>
<tr>
<th>No.</th>
<th>Farmer's Name</th>
<th>Number of palm trees on private land/region</th>
<th>Number of palm trees that are tapped</th>
<th>Type of utilization of palm</th>
<th>Location of the utilization of palm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Sadropi</td>
<td>10</td>
<td>2</td>
<td>Palm juice, kolang kaling, young palm leaves, firewood, fibers</td>
<td>In NPHSM area</td>
</tr>
<tr>
<td>2.</td>
<td>Sarbani</td>
<td>30</td>
<td>2</td>
<td>Palm juice, kolang kaling</td>
<td>In NPHSM area</td>
</tr>
<tr>
<td>3.</td>
<td>Adik</td>
<td>100</td>
<td>8</td>
<td>Palm juice, kolang kaling firewood, fibers</td>
<td>Private land</td>
</tr>
<tr>
<td>4.</td>
<td>Jumadi</td>
<td>50</td>
<td>6</td>
<td>Palm juice, fibers</td>
<td>Private land</td>
</tr>
<tr>
<td>5.</td>
<td>Hasan</td>
<td>10</td>
<td>7</td>
<td>Palm juice, kolang kaling</td>
<td>In NPHSM area</td>
</tr>
<tr>
<td>6.</td>
<td>Komarudin</td>
<td>20</td>
<td>4</td>
<td>Palm juice, fibers, kolang kaling</td>
<td>In NPHSM area</td>
</tr>
<tr>
<td>7.</td>
<td>Sapri</td>
<td>15</td>
<td>4</td>
<td>Palm juice</td>
<td>In NPHSM area</td>
</tr>
</tbody>
</table>

3.2 Palm Juice

Palm trees produce sap or palm juice that can be made into palm sugar, beverages (labang) and also can be made into ethanol (ethyl alcohol), which is an alternative fuel to replace kerosene, LPG, and gasoline. Besides palm juice can be used for drugs such as constipation, irregular
menstruation, dysentery, pneumonia and inhibits absorption of cholesterol. Economically, palm trees serves as a source of income for most people, especially in Majasari village, Lebak regency of Banten. In general people in this village take advantage by taking the palm trees juice to serve as a printed palm sugar. Manufacture of palm sugar made by penderes/farmer in the Majasari village are still traditionally and process of manufacture/production done in the private land or in the forest area. Raw material for making palm sugar derived from sugar juice or called sap, the male flower stalks that can be tapped when the palm was five years old with peak production at the age of 15-20 years. Characteristic of each palm trees different, and tapping technique every penderes/farmer on generally different, so not all tapper succeed in tapping palm juice. Results of tapping palm juice is usually only processed into printed palm sugar.

3.3 Palm Fruit

Palm fruits can be processed into food called kolang kaling. Farmers generally do not use palm fruit by process them into kolang kaling by itself, because the manufacturing process is rather difficult, to perseverance, need perseverance and prudence in the processing process because the palm fruit sap causing itching on the skin. Therefore, farmers prefer to sell the palm fruit is still on the tree to the kolang kaling craftsmen with an average price of IDR 20,000.00-IDR 25,000.00 per hand. Number of hands in a single tree varied, ranging from two to six hands palm fruit.

![Palm fruit as an ingredient of kolang kaling](image)

Figure 4: Palm fruit as an ingredient of kolang kaling

3.4 Palm Leaves

In general, farmers in the Majasari village exploit the young palm leaves to be rolled cigarette which is then filled by tobacco. Some residents in the Majasari village used old palm leaves as a house roof or gazebo.

![Palm leaves as roof](image)

Figure 5: Palm leaves as roof

3.5 Palm Fibers

Farmers in the majasari village generally less utilize palm fibers. This was due to marketing problems that do not exist so they are less interested in making fibers. As for the use of palm fibers are actually immigrants from Sukabumi who had come to the Majasari village every three months. Fibers that they get can reach two or three trucks each retrieval. This they do because the fibers marketing in the area of Sukabumi very prospect. Almost all the buildings store along the road between Ciawi until Sukabumi sell fibers, which was the source of the fiber mostly from Majasari village areas. Farmers who have palm trees on private land only rewarded minimally
entrants collector of fibers. Whereas when farmers in the Majasari village itself utilize this palm fibers, it can increase household income, there should be no entrants in the decision-palm fibers into this region.

![Figure 6: Palm fibers](image)

3.6 Palm Sugar Production

Average number of palm trees that are tapped by farmers/penderes in Majasari village varied, that is two to four trees per day. Tapping sap was done by the farmer in the morning and afternoon. This depends on the ability of farmers in the wiretapping, because in general the tapping done by old farmers, while young farmers generally less interested in doing this work. This is because the risk is too high in a climbing palm trees with an average height of trees reach 8-12 feet.

Average production of printed palm sugar that produced by penderes in Majasari village as much as two konjor/day from two to four palm trees are tapped. Farmers produce printed palm sugar into two types/qualities. Low sugar quality/quality number two which are sold to middlemen at a price IDR 7,500.00/konjor or IDR 15,000.00/head, while the good quality sugar/number one, the farmers sell directly to the people around/direct buyers at a price of IDR 15,000.00/konjor or Rp 3,000.00/head. One konjor sugar consists of five printed sugar head that arranged and wrapped in banana leaves or bark that has been dried. Middlemen sell printed palm sugar to the shop/market price of IDR 10,000.00-IDR 12,500.00/konjor or IDR 2,000.00-IDR 2,500.00/head to quality printed palm sugar quality number two, while the price sold in the shop/market IDR 15,000.00 – IDR 20,000.00/konjor or IDR 3,000.00 – IDR 4,000.00/head. Selling price of printed palm sugar quality level number one in market/shops in Lebak Regency, the average IDR 22,500.00- IDR 25,000.00/konjor or IDR 4,500.00- IDR 5,000.00/head. Middleman profits earned an average of IDR 2,500.00- IDR 5,000.00/konjor, while the rate of profit in the shop or on the market an average of IDR 5,000.00- IDR 7,500.00/konjor. Benefits for farmers are very small, and in general they do not take into account the energy that they have sacrificed/are doing. If their wages labor is taken into account in the process of tapping the sap until it becomes printed palm sugar does not match with what they’ve done/sacrificed with a very high risk if it falls from a tree while wiretapping.

Palm sugar become a source of live hood for farmers in the production centers of palm sugar. One palm sugar production centers in Indonesia are in the Lebak regency. Lebak regency as one of the largest palm sugar producing area in Indonesia. Palm sugar industry in these regency absorb the workforce 5,406 through 2,982 micro and small units. Production capacity reaches 2,249 tons per year spread over 44 production centers (Department of Industry and Commerce, Lebak Regency, 2005).
Income of each farmer in the use of palm products vary widely, ranging from IDR 260,000.00 – IDR 2,390,000.00/month. This depends on the ability of farmers in optimizing the utilization of palm trees. Revenues are spread in the utilization of palm, from palm juice products are processed into printed palm sugar. Size of the income of farmers from the number of trees being tapped, but it depends on the technique of tapping palm sap. Other products such as sugar palm fruit and palm fiber selling prices are very cheap, not as good as the selling price of printed palm sugar and tend to be seasonal.

Table 3. Sugar palm farmers’ income in Majasari village, Sobang Regency

<table>
<thead>
<tr>
<th>Name</th>
<th>sadrap</th>
<th>Sarban</th>
<th>Adik</th>
<th>Jumadi</th>
<th>Hasan</th>
<th>Komarudin</th>
<th>Sapri</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of trees that are tapped</td>
<td>2</td>
<td>2</td>
<td>8</td>
<td>6</td>
<td>7</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Palm sugar production (konjor/3 months)</td>
<td>90</td>
<td>90</td>
<td>450</td>
<td>540</td>
<td>360</td>
<td>180</td>
<td>360</td>
</tr>
<tr>
<td>Palm sugar income/3 months (IDR x 1,000)</td>
<td>1,350</td>
<td>1,350</td>
<td>6,750</td>
<td>8,100</td>
<td>5,400</td>
<td>2,700</td>
<td>5,400</td>
</tr>
<tr>
<td>Palm fruit (hand)</td>
<td>2</td>
<td>1</td>
<td>5</td>
<td>-</td>
<td>6</td>
<td>200 liter kaling</td>
<td>-</td>
</tr>
<tr>
<td>Palm fruit income/3 months (IDR x 1,000)</td>
<td>50</td>
<td>25</td>
<td>100</td>
<td>-</td>
<td>300</td>
<td>600</td>
<td>-</td>
</tr>
<tr>
<td>Fibers (thread)</td>
<td>5</td>
<td>-</td>
<td>24</td>
<td>9</td>
<td>-</td>
<td>15</td>
<td>-</td>
</tr>
<tr>
<td>Fibers income/3 months (IDR x 1,000)</td>
<td>5</td>
<td>-</td>
<td>72</td>
<td>9</td>
<td>-</td>
<td>15</td>
<td>-</td>
</tr>
<tr>
<td>Gross Income/3 months (IDR x 1,000)</td>
<td>1,405</td>
<td>1,375</td>
<td>6,922</td>
<td>8,109</td>
<td>5,700</td>
<td>3,315</td>
<td>5,400</td>
</tr>
<tr>
<td>Gross Income/year (IDR x 1,000)</td>
<td>2,810</td>
<td>2,750</td>
<td>13,844</td>
<td>16,218</td>
<td>11,400</td>
<td>6,630</td>
<td>1,800</td>
</tr>
<tr>
<td>Production costs/year (IDR x 1,000)</td>
<td>1,175</td>
<td>1,175.5</td>
<td>1,827.5</td>
<td>1,863.5</td>
<td>1,366.5</td>
<td>1,211</td>
<td>949</td>
</tr>
<tr>
<td>Net income/year (IDR x 1,000)</td>
<td>1,635</td>
<td>1,574.5</td>
<td>12,016.5</td>
<td>14,354.5</td>
<td>10,033.5</td>
<td>5,419</td>
<td>9,851</td>
</tr>
<tr>
<td>Net Income/month (IDR x 1,000)</td>
<td>270</td>
<td>260</td>
<td>2,000</td>
<td>2,390</td>
<td>1,670</td>
<td>900</td>
<td>1,640</td>
</tr>
</tbody>
</table>

Caption: Palm sugar price IDR 15,000.00/konjor, Palm fruit price IDR 20,000.00- IDR 25,000.00/hand, Kolang kaling price IDR 3,000.00/liter, Fiber price IDR 1,000.00- IDR 3,000.00/thread. Palm sugar production in a year counted for 6 months.
3.7 Processing of Palm Juice Into Printed Palm Sugar

Palm sugar production process at the farm level is done using very simple equipment. Equipment needed in the production process of palm sugar consists of: lodong or bamboo to hold the sap, pot, stirrer, stove, firewood, sieve sap, tapper’s machetes, bats (paninggar), konjor or palm sugar molds made of wood. Production process starting from tapping palm sugar sap, sap cooking, stirring and printing of palm sugar. Sap tapping done in the morning and afternoon. Before doing the tapping, lodong or bamboo cleaned using fibers and water. If lodong bamboo less clean then sap will ferment quickly and the resulting printed sugar taste a bit sour because of the fermentation.

Sap is collected in bamboo rod with a length of one meter and storage process can take up to three months continuously without stopping. Each tree can produce 10-15 liters of juice per day by tapping twice on the morning of the day and evening. The morning leads sap filtered, and poured into the pot and cooked until done in order to half-finished printed sugar then stored. Result leads sap should be cooked as soon as possible because the palm juice only stand for about three hours. If not immediately processed into sugar it will turn into a palm wine to drink or vinegar with ethanol content of up to 4% (Burhanudin, 2005).

The lead late sap is mixed with the sap in the morning leads that has been cooked, then the mixture is cooked again. On the ripening process sap added a little cooking oil or coconut oil as much as 10 grams for 25 liters of sap. Cooking is done until the liquid sap becomes concentrated and must often be stirring. Scum and dirt are washed away. Then the concentrated sugar liquid is printed in the mold made of wood, and cooled. Before use, the mold wood is cleaned by using lime water and soak them with water to facilitate the release of palm sugar. The cooking of palm juice or sap until the liquid become concentrated until ready to be molded into printed palm sugar approximately 4-6 hours, depending on the amount of sap is cooked.

Figure 9: Location of printed palm sugar manufacture
3.8 The Process Stages of Making Print Palm Sugar

Pictures caption:
1. Lodong bamboo cleaning
2. Lodong fumigation
3. Lodong storage in palm tree
4. Beating the palm tree with paninggar
5. Finished climbing lodong storage
6. The result of tapping palm juice to be processed
7. Ripening process of sap
8. Thick palm sugar which is ready to be printed
9. Palm sugar that has been printed
10. Production of palm sugar
11. Palm sugar ready for market

4. CONCLUSION

- Palm plants that grow in the NPHSM region, especially in mountain Endut and growing on private land in the Majasari village is a plant that is not cultivated/wild plants growing spread by raccoons or badgers (Paradoxurus hermaphroditus).
- Farmer/penderes in Majasari Village utilize of use palm tree limited on utilization of sap which then processed into palm sugar, not to optimize the utilization of palm trees yet.
- Printed palm sugar production produced by penderes in Majasari Village on average 2 konjor/day from 2-4 palm trees are tapped.
- Size of the income of farmers depend on the ability of farmers from the amount of trees that are tapped and sap tapping technique.

REFERENCES


[1]
Structure and Composition of Vegetation in Northern Part of Mount Gede and Their Implication for Conservation

Sudarmono

Centre for Plant Conservation, Bogor Botanical Garden, Indonesian Institute of Sciences
Jl. Ir. H. Juanda No. 13 Bogor, 16122, INDONESIA
Corresponding email: s_darmono@yahoo.com

Poster paper prepared for
The First International Conference of Indonesian Forestry Researchers (INAFOR)
Bogor, 5 – 7 December 2011
Structure and Composition of Vegetation in Northern Part of Mount Gede and Their Implication for Conservation

Sudarmono
Centre for Plant Conservation, Bogor Botanical Garden, Indonesian Institute of Sciences
Jl. Ir. H. Juanda No. 13 Bogor, 16122, INDONESIA
Corresponding email: s_darmono@yahoo.com

ABSTRACT

Mount Gede-Pangrango National Park (MGPNP) is located in Cianjur regency, West Java. It lies on Northern Part of Mt. Gede and is close to Cibodas village and tea plantation. This forest as water catchment and has floral species richness which has a role to sustain the function of such a national park. The objective of this study was to explore the plant species structure and composition in Northern Part of Mount Gede and their implication for conservation. Data were collected from the plots established on study site and analyzed descriptively – quantitatively using Important Value Index (IVI). The results showed that, Villebrunea rubescens was dominant (IVI=45.15%) in the tree stage with the diameter of 16-20 cm, followed by Altingia excelsa (39.77%) and Schima wallichii (21.92%). Altingia excelsa was the dominant species in tree stage. Seedling stage was dominated by Villebrunea rubescens. Plant species richness in the sapling stage could guarantee the sustainability of forest in the future of Northern Part of Mt. Gede, including flora and fauna conservation in the ecosystem of Mt. Gede.

Keywords: Dominant species, flora, sustainability, Mt. Gede

1. INTRODUCTION

Mount Gede or Gunung Gede is a stratovolcano in West Java, Indonesia. The volcano contains two peaks with Mount Gede as one peak and Mount Pangrango for the other one. Historical volcanic activity has been recorded since the 16th century. Gunung Gede and Pangrango are the first five parks that had distinction of launching Indonesias National Park Program. Located on Bogor, Cianjur and Sukabumi districts with cover area around 15,196 ha. It is the most accessible mountain to climb from Jakarta. By only 2 hours drive south of Jakarta and 5 " 6 hours trekking, you will find a tranquil rainforest, self guided trail and a spectacular view of West Java from the peak.

The national park consists of twin volcanoes: Gede 2,958 m above sea level (asl) and Pangrango 3,019 asl. The two summits are connected by a high saddle known as Kandang Badak, 2,400 m asl. The mountain slopes are very steep and are cut info rapidly flowing stream, which carve deep valleys and long ridges. For those fortunate enough to stand on the summit of Mount Gede in clear conditions the view is spectacular. The sub-montane ecosystem is characterized by many large, tall trees like jamuju (Dacrycarpus imbricatus) and puspa (Schima wallichii). The sub-alpine ecosystem, meanwhile, is characterized by grassy meadows of Isachne pangerangensis, edelweiss flower (Anaphalis javanica), violet (Viola pilosa), and sentigi (Vaccinium varingiaeolatum). The objective of this study was to explore the plant species structure and composition in Northern Part of Mount Gede and their implication for conservation.
2. MATERIAL AND METHOD

2.1 Location and Time

Ecological research will be carried out in the National Park of Mount Gede Pangrango, West Java. Research was carried out in the resort for Cibodas. Research carried out for a month, i.e. in June 2011.

2.2 Data Collection Research

The Plot is made to six lanes within the forested buffer around the Lake. The spread of the population in some areas in West Java, according to data dissemination of observations at the Herbarium Bogoriense herbarium sheets that had been done before (activities 2009). In every region, conducted sampling by making observations based on the difference in height of plot where appropriate divisions of the riparian vegetation. Steenis (1972), that is under 1000 m above sea level, 1000-1500 m above sea level, 1500-2500 m above sea level and above 2500 m above sea level. At any height made sampling data retrieval with vegetation sampling methods for the parallel systematic (Cropper, 1993) which fitted cut contours, in a number of plots that are built with rectilinear plot nesting along transect technique. For the seedling stage plot that was built for, size 2 x 2 m, sapling stage of 5 x 5 m, pole stage 10 x 10 m, and the tree of 20 x 20 m. The Data collected is the number of individuals, species, and the diameter of the breast for tall trees, poles and sapling stages (Indriyanto, 2006). High stem and the diameter of a heading is also measured. Plant vegetation down or are stuck in the trunk (liana, herbaceous, fern, orchids, palms, pandanus, and others) observed qualitatively. All identified specimens in the Herbarium Bogoriense carefully, Biology Research Center, Cibinong, LIPI.

3. MATERIAL AND METHODS

The material and the tools used that is Global Positioning System (GPS), hygrometer, the altimeter, the meter (50 metre), the meter (especially the diameter gauge), the pH metre, cutting scissors, big plastic, the field book, the label, the pencil, newsprint, alcohol, the rope and the digital camera.

3.1 Data Analysis

Descriptive data took the form of the name of plants, it was identified the scientific name et cetera then was processed to get the important value index (IVI). This important value index was the number of the relative densities (RDs), the relative dominance (RD) and the relative frequency (RF) cited from Soerianegara and Indrawan (1978) formula:

\[
IVI = RF + RDs + RD.
\]

Where:
- \(RF\) = the number of plot was filled up by a species : the total number of all plot x 100 %
- \(RDs\) = the number of individuals of a species: the density of all the species x 100 %
- \(RD\) = the domination of a species : the domination of all the species

Especially the level of the seedling of IVI = RF + RDs. Furthermore this important value index was made the basic in determining the level of the domination of a tree species in Mount Gede.

3. RESULT AND DISCUSSION

3.1 Tree Structure and Composition

At the northern part of Mount Gede location, stands the most widely encountered and the dominant species is Villebrunea rubescens with the largest diameter class 20 cm and less. In this plot, the area is rather open because the stands are already much diminished, especially in the 30-
50 cm diameter class. In general, fallen trees, and the succession has not reached a climax, especially with invasive plant *Passiflora suberosa* disorders. In the plot transect an area of 4 hectares with a size of 200x200 m² recorded 9,394 trees or 2,348 trees/ha. Wijaya (1999) observed in the same area that on 1999 recorded 787 trees or density 394 trees/ha in area of 2 hectares with a size 20 x 1000 m². So for 10 years (1999-2011) in the north slope of the Gede Mountain had the density twice the fold and his diversity were also high with increasingly the width of the observation plot (Table 1).

Table 1. Comparative tree density in southern part and northern part of Mount Gede

<table>
<thead>
<tr>
<th>No.</th>
<th>Location</th>
<th>Altitude (m asl)</th>
<th>Plot size (m²)</th>
<th>Wide (ha)</th>
<th>Tree density</th>
<th>Species number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Southern part Mt. Gede</td>
<td>1,700.</td>
<td>100x100</td>
<td>1</td>
<td>553</td>
<td>43</td>
</tr>
<tr>
<td>2</td>
<td>Southern part Mt. Gede</td>
<td>1,350</td>
<td>100x100</td>
<td>1</td>
<td>655</td>
<td>43</td>
</tr>
<tr>
<td>3</td>
<td>Northern part Mt. Gede</td>
<td>1,500</td>
<td>20x1000</td>
<td>2</td>
<td>394</td>
<td>106</td>
</tr>
<tr>
<td>4</td>
<td>Northern part Mt. Gede (recent studied 2011)</td>
<td>1393 = 1450</td>
<td>200x200</td>
<td>4</td>
<td>2,348</td>
<td>232</td>
</tr>
</tbody>
</table>

Stands that have important value index (IVI) high on the Northern part Mount Gede for the tree level, ie *Villebrunea rubescens* (45.15%), *Altingia excelsa* (39.77%), *Schima walichii* (21, 92%), and others are presented in Table 2. It appears from the common plant species on the northern slope is composed of trees having a diameter below 30 cm, while the trees that have a diameter greater than 51 cm is dominated by *Altingia excelsa* and *Schima walichii* (Tabel 3).

Table 2. Results of vegetation analysis of tree category at Northern part of Mount Gede

<table>
<thead>
<tr>
<th>No.</th>
<th>Scientific name</th>
<th>RDs (%)</th>
<th>RF (%)</th>
<th>RD (%)</th>
<th>IVI (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><em>Villebrunea rubescens</em></td>
<td>16.81</td>
<td>19.5</td>
<td>8.85</td>
<td>45.15</td>
</tr>
<tr>
<td>2.</td>
<td><em>Altingia excelsa</em></td>
<td>9.05</td>
<td>10.50</td>
<td>20.22</td>
<td>39.77</td>
</tr>
<tr>
<td>3.</td>
<td><em>Schima walichii</em></td>
<td>6.03</td>
<td>7</td>
<td>8.89</td>
<td>21.92</td>
</tr>
<tr>
<td>4.</td>
<td><em>Macropanax dispermum</em></td>
<td>7.33</td>
<td>8.5</td>
<td>5.09</td>
<td>20.92</td>
</tr>
<tr>
<td>5.</td>
<td><em>Saurauia blumeriana</em></td>
<td>7.33</td>
<td>8.5</td>
<td>4.82</td>
<td>20.64</td>
</tr>
<tr>
<td>6.</td>
<td><em>Pteria rimosa</em></td>
<td>5.60</td>
<td>6.5</td>
<td>5.33</td>
<td>17.44</td>
</tr>
<tr>
<td>7.</td>
<td><em>Castanopsis argentea</em></td>
<td>4.31</td>
<td>5</td>
<td>5.34</td>
<td>14.65</td>
</tr>
<tr>
<td>8.</td>
<td><em>Saurauia pendula</em></td>
<td>4.74</td>
<td>5.5</td>
<td>3.30</td>
<td>13.54</td>
</tr>
<tr>
<td>9.</td>
<td><em>Ficus rubus</em></td>
<td>4.74</td>
<td>5.5</td>
<td>2.71</td>
<td>12.96</td>
</tr>
<tr>
<td>10.</td>
<td><em>Laportea stimulans</em></td>
<td>3.02</td>
<td>3.50</td>
<td>1.49</td>
<td>8.01</td>
</tr>
</tbody>
</table>

Notes: RDs = Relatives Density; RD = Relatives Dominant; RF = Relatives Frequency; IVI = Important Value Index

Table 3. Species dispersal based on diameter class of Mount Gede, West Java

<table>
<thead>
<tr>
<th>No.</th>
<th>Tree species</th>
<th>Diameter class (cm)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>16-20</td>
<td>21-30</td>
</tr>
<tr>
<td>1</td>
<td><em>Villebrunea rubescens</em></td>
<td>20</td>
<td>17</td>
</tr>
<tr>
<td>2</td>
<td><em>Altingia excelsa</em></td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td><em>Schima walichii</em></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td><em>Macropanax dispermum</em></td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td><em>Saurauia blumeriana</em></td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>34</td>
<td>32</td>
</tr>
</tbody>
</table>
3.2 Conservation Implication

The tree with the diameter below 30 cm in five main tree species in the north part of the Gede Mountain totalling 61.7% (66 trees) showed the process of the succession of proceeding vegetation well (the Table 1). However the existence of the old tree or trees with diameter more than 50 cm totalling 26% (28 trees) that was dominated by two species, there are *Altingia excelsa* and *Schima walichii* then was worried when the strong wind happening then fell and died like that happened during 2006. The pattern of conservation could be done by protecting the seedling from to two big trees and when must be carried out by the distance away to the seedling from *Altingia excelsa* and *Schima walichii* as well as monitored his growth.

4. CONCLUSION

Seedling stage was dominated by *Villebrunea rubescens*. Plant species richness in the sapling stage could guarantee the sustainability of forest in the future of Northern Part of Mt. Gede, including flora and fauna conservation in the ecosystem of Mt. Gede.

REFERENCES


The Establishment of Nyamplung (*Calophyllum inophyllum*) Based Forest Plantation in Coastal Areas as Source of Potential Biofuel Energy to Support Sustainable Forest Management

M.Yamin Mile and Encep Rahman

Agroforestry Technology Research Institute

Poster paper prepared for
The First International Conference of Indonesian Forestry Researchers (INAFOR)
Bogor, 5 – 7 December 2011
The Establishment of Nyamplung (*Calophyllum inophyllum*) Based Forest Plantation in Coastal Areas as Source of Potential Biofuel Energy to Support Sustainable Forest Management

M.Yamin Mile and Encep Rahman

Agroforestry Technology Research Institute

1. INTRODUCTION

Nyamplung (*Calophyllum inophyllum*) is one of tree species of gutterscae, growth in low land especially in coastal region. The geographical distributions are South India, Malaysia, Indonesia and Australia. Nyamplung have a high tolerant to the extremum conditions such sandy and degradation areas (Stiven, 1998). The tree has 15-30 meter high and have a great number of branches with 25 cm size of flower. Fruiting available almost along the year consist of two fruiting period of April- August and October- March.

Nyamplung produce a hard wood for furniture. The most interesting is the used of nyamplung to produce potential energy biofuel besides other use such as medical for a certain diseases. (Dirk HR, 2008;Yindjo et al., 2005; Mataka et al., 2004). Research activities on nyamplung In Indonesia just recently started but still in limit number. This is the reason of still limitation in using nyamplung for biofuel energy.

2. NYAMPLUNG AS GREEN ENERGY POTENTIAL

Nyamplung recognized is one of the most possible alternatif to replace other biofuel energy plant because of a number of advantages such as:

- no competition with food
- High adaptation to grow even in marginal soil condition
- easy in regeneration
- produce a great number of fruit in almost the whole year
- -have other used such as medical for a certain diseases
- the stand can be used as winbreak and filter for a high saline waque pavour from the sea
- Have a high oil rendamen (73 %) compare with other biofuel energy plant such as jarak 50 %, sawit 50 %
- oil produced suitable for the international biodiesel standard quality
- double flameable ability compare with petroleum

Based on above advantages, nyamplung will be the ultimate choice for renewable source of energy. However this ultimate choice will never have positif impact if no supporting from the National policy in supporting nyamplung as source of biofuel energy. The government play an importen role in arranging, rule making and marketing the biofuel oil from nyamplung.
3. RESEARCH ON FRUIT PRODUCTION POTENTIAL AND PLANTATION PROJECTION OF NYAMPLUNG

3.1 Nyamplung Fruit Production at Batukaras

Figure 1: Nyamplung in natural condition of coastal forest
Figure 2: Observation on fruit production of nyamplung in Batukaras on May- August 2010 in different diameter class. The chart shows that fruit production of nyamplung vary based on diameter class.

3.2 Total Fruit Production

Total nyamplung fruit production during flowering period April-August in Batukaras, Ciamis

Figure 3: Research on potential fruit production
Figure 4: The Total Fruit Production in fruiting period of April-Agustus in Batukaras

Both chart show the total fruit production from every sample of trees. The chart show that the more diameter the more fruit production. Nyamplung with >40 cm diameter produce 160-200 kg seeds per years. Based on this observation can be estimated for one ha nyamplung with 400 trees may produce 64 ton seeds.. From these estimation it can be predicted the total production from a certain farm areas.

Based on biofuel demand proyecion, the nasional demand of biofuel arround 2.5 % from nasional fuel cosumption have been planned by the Indonesian government. The biofuel need in 2012 estemeted about 720 kiloliter. If all of the biofuel demand will be supplied by nyamplung (assumption 2.5 kg nyamplung seeds for one liter biofuel). Information abaut production potential of nyamplung is usefull to improve silvicultural techniques. Plantation nyamplung in coastal region some time facing some silvicultural problems. By improving silvakultural techniques will support the plantation nyamplung in larger areas especially in improving environmental condition in coastal regions.
4. CURRENT SILVICULTURAL RESEARCH ON NYAMPLUNG

4.1 Nursery Techniques

The treatment using media consist of top soil and manure (1:1) become the best, germinate average 13 day after planted with the growth reach 97%.

![Nyamplung seedling in nursery](image1)

![Nyamplung seedling in nursery](image2)

Figure 5: Nyamplung seedling in nursery

4.2 Growth Ability

The treatment using media top soil with manure (1:1) after 3 month growth reach 28.42 cm will be the best performance compare other treatments.

4.3 Plantation

Plantation nyamplung in coastal areas need a certain techniques because of extreme condition of both sandy soil and other environment condition such as temperature, humidity and wind with high content of salt. One of the successful technique is using bronjong made by bamboo 1.5 cm high and 60 cm of diameter to protect from an extreme wind blowing, temperature and humidity.
Figure 5: Treatments on nyamplung plantation techniques in Batukaras using bronjong

Figure 6: Mix plantation of nyamplung in coastal areas of Batukaras Ciamis
5. NYAMPLUNG BASED SUSTAINABLE COASTAL FOREST MANAGEMENT

Currently around three million nyamplung seddling have been planted in various places in Indonesia. The plantation will cover 400,000 ha in different location. Ministry of forestry get that task as significant of standard materials of biofuel energy. This step is part of national energy policy which put the target in 2025, biofuel used of 5% of the total national energy needed. The development of nyamplung plantation in coastal area will support sustainable forest management with some advantage such as:

- play important role on reducing emission of carbon
- protected coastal areas from tsunami disaster, abrasion and other environmental destruction
- create favorable microclimate
- increased farmer income
Medicinal Plants of Pangelekan Coastal Forest, Ciamis, West Java, Indonesia

Marfuah Wardani and Titik Setyawati

The Center for Research and Development on Forest Conservation and Rehabilitation
Jl. Gunung Batu 5, Bogor 16610, INDONESIA
Corresponding email: marfuah58@yahoo.co.id; titiek29@yahoo.com

Poster paper prepared for
The First International Conference of Indonesian Forestry Researchers (INAFOR)
Bogor, 5 – 7 December 2011
Medicinal Plants of Pangelekan Coastal Forest, Ciamis, West Java, Indonesia

Marfuah Wardani and Titik Setyawati

The Center for Research and Development on Forest Conservation and Rehabilitation
Jl. Gunung Batu 5, Bogor 16610, INDONESIA
Corresponding email: marfuah58@yahoo.co.id; titiek29@yahoo.com

ABSTRACT


Keywords: Medicinal plants, uses, coastal forest

1. INTRODUCTION

Natural forest in Indonesia have a diversity plant species is relatively high. It is estimated that there are 250,000 to 400,000 species of flowering plants, including species of plants important in medicinal. Zuhud (2009) estimated that there are 2,039 species of medicinal plants occurring in Indonesia forest areas, and 65 species of them grown in coastal forest ecosystems.

Pangelekan coastal forest is one area that predicted to have a diversity of medicinal plants prospected to be developed. It is not only important as a source of timber, but also produce non timber product such as medicinal plants. The communities around the forest area are still utilizing some plants species to treat a disease. A study carried out to get information about the medicinal plants in that coastal forest area. It seems important to take management and to protect them. Data on the medicinal plants is also important for research on pharmacology and the coastal forest management. This paper present the results of a study of the plants in the Pangelekan coastal forest, Ciamis, West Java that are used for medicinal.

2. METODOLOGY

2.1 Location

Pangelekan coastal forest is located at near Batukaras Village, Cijulang District, Ciamis Regency, West Java. This location is between 1080 30' 007" - 1080 30' 143" E and 070 43' 650"- 070 43' 923" N. The area consists of lowland with an undulating topography at 0 to 29 m above sea level. The soils type is Sandy and Alluvial sediments (Institute Soil and Fertilization Research, 1965). According to Schmidt and Ferguson (1951), the climate at the location is type B; with the average annual rainfall is around 3,196 mm per year. Temperatures between 250 C to 300C, and humidity 80% to 90%.

2.2 Data Collection
The observation was carried out during July 2010. We used the explorative method for the inventory of traditional medicinal plants using local people as guide. The identifications were carried out at the Herbarium of Rehabilitation and Conservation Research and Development Centre Bogor.

3. RESULT AND DISCUSSION

3.1 Medicinal Plants

We identified 15 species of medicinal plants belonging to 15 genera’s and 12 families (see Table 1.).

<table>
<thead>
<tr>
<th>No.</th>
<th>Species</th>
<th>Local Name (Javanese)</th>
<th>Family</th>
<th>Habit</th>
<th>Uses for Medicinal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Barringtonia asiatica (L.) Gaertn.</td>
<td>Butun</td>
<td>Lecythidaceae</td>
<td>Tree</td>
<td>Leaves, seed oil</td>
</tr>
<tr>
<td>2.</td>
<td>Cassia fistula Linn.</td>
<td>Bongseng</td>
<td>Leguminosae</td>
<td>Liana</td>
<td>Roots, leaves, seeds</td>
</tr>
<tr>
<td>3.</td>
<td>Caesalpinia implexa L.</td>
<td>Nyamplung</td>
<td>Guttiferae</td>
<td>Tree</td>
<td>Latex, leaves, seeds</td>
</tr>
<tr>
<td>4.</td>
<td>Ceyratia trifolia (L.) Domin</td>
<td>Galing</td>
<td>Vitaceae</td>
<td>Climber</td>
<td>Leaves</td>
</tr>
<tr>
<td>5.</td>
<td>Crateva magusa (Laur.) DC.</td>
<td>Barunday</td>
<td>Capparidaceae</td>
<td>Tree</td>
<td>Roots, barks, leaves</td>
</tr>
<tr>
<td>6.</td>
<td>Desmodium heterophyllum De.</td>
<td>Ki mules</td>
<td>Leguminosae</td>
<td>Slender herb</td>
<td>Roots, twigs, leaves</td>
</tr>
<tr>
<td>7.</td>
<td>Dodonaea viscosa Jacq.</td>
<td>Cantigi pantai</td>
<td>Sapindaceae</td>
<td>Shrub to small tree</td>
<td>Wood charcoal, barks, leaves</td>
</tr>
<tr>
<td>8.</td>
<td>Hernandia nymphaciifolia (Presl.) Kubitzki</td>
<td>Borogondolo</td>
<td>Hernandiaceae</td>
<td>Tree</td>
<td>Roots, leaves, fruits</td>
</tr>
<tr>
<td>9.</td>
<td>Hibiscus tiliaceus L.</td>
<td>Waru limit</td>
<td>Malvaceae</td>
<td>Shrub to tree</td>
<td>Roots, leaves</td>
</tr>
<tr>
<td>10.</td>
<td>Ipomoea pes-caprae (L.) R.Br.</td>
<td>Umbian</td>
<td>Convolvulaceae</td>
<td>Slender herb</td>
<td>Roots, leaves, seeds</td>
</tr>
<tr>
<td>11.</td>
<td>Lantana camara L.</td>
<td>Cente, tai krotok</td>
<td>Verbenaceae</td>
<td>Shrubs, herb</td>
<td>Leaves</td>
</tr>
<tr>
<td>12.</td>
<td>Mallotus philippensis Muell. Arg.</td>
<td>Waru laut, calikangin</td>
<td>Euphorbiaceae</td>
<td>Tree</td>
<td>Leaves</td>
</tr>
<tr>
<td>13.</td>
<td>Pongamia pinnata (L.) Pierre</td>
<td>Binong, k pahang laut</td>
<td>Leguminosae</td>
<td>Tree</td>
<td>Roots, Leaves, barks, seeds</td>
</tr>
<tr>
<td>14.</td>
<td>Terminalia catappa L.</td>
<td>Ketapang</td>
<td>Combretaceae</td>
<td>Tree</td>
<td>Roots, latex of bark, leaves, seeds</td>
</tr>
<tr>
<td>15.</td>
<td>Thepapia papulina (L.) Sol. ex Correa</td>
<td>Waru lot</td>
<td>Malvaceae</td>
<td>Shrub or small tree</td>
<td>Heartwood, leaves, fruits, seed oil</td>
</tr>
</tbody>
</table>
In table 1 shows that there are 12 species of plants have more than one part of an organ that can be used for medicine, and three species can only be used leaves. Seven trees species other than as a drug producer is also useful timber. Two species of medicinal trees which of them are known to produce seed oil as a bioenergy, ie *Calophyllum inophyllum* L. (nyamplung) and *Pongamia pinnata* (L.) Pierre (binong). One species of trees have leaves and bark as a cure for cancer that is *Hernandia nymphaeifolia* (Presl.) Kubitzki (borogondolo). The results of Petit *et al.* (2004), inform about six agents of lignin derived from *H. nymphaeifolia* identified inhibitory activities of cancer cell. The morphology characters of that fifteenth species are presented in the field description.

### 3.2 Field Description

##### 3.2.1 *Barringtonia asiatica* (L.) Gaertn.

**Synonym:** *Barringtonia speciosa* J.R. Foster & J.G. Foster

![Image of Barringtonia asiatica](image)

A tree, 7 to 30 m tall, bole up to 100 cm in diameter. Twig with large leaf scars, 6-10 mm in diameter. Leaves in whorls with petiole very short, simple leaves; blade glabrous, leathery, obovate-oblong or obovate, 15-38(50) cm x 7-18(21) cm, apex emarginatet or mucronet, base cuneate, entire, marginal vein disting. Distribution: Madagascar to Sri Langka, India, Burma to throughout the Malesian region toward northern Australia and into the Pacific, and often planted.

Uses: The leaves are used to treat hernia, heated and externally applied for stomach-ache. The seed oil used to treat scabies, mixed with water and drunk to treat influenza and bronchitis. Young fruits are also consumed as a vegetable (Yalipto, 2001; Floracafe, 2001, Heyne, 1987).
3.2.1 *Caesalpinia crista* Linn.

Synonym: *Caesalpinia nuga* (L.) W.T. Aiton

A Liana up to 15 m long. Leaves paripinnate, rachis 10 – 30 cm long with 2-5 pairs of pinnae, pinna 2-12 cm long, stipules triangular; leaflets opposite, 1-5 pairs, base acute, margin curved, apex acute to obtuse.

Distribution: India, Sri Lanka, throughout South-East Asia to Queensland and New Caledonia. In Indonesia it is not found in East Sumatera and East Borneo.

Uses: The extrack root and leaves are used to externally applied for stomach-ache, menstruation and after childbirth. The root also is considered adiuretic, a tonic and useful in the treatment of bladder stones. The decoction of crushed seed used to treat cough and antidysenteric (Utomo, 2001; Heyne, 1987).

3.2.3 *Calophyllum inophyllum* L.

A medium tree, up to 35 m tall, bole up to 50 cm in diameter. Leaves simple, decussately opposite; blade leathery, entire, glabrous, closely parallel secondary venation with 4-10 veins per 5 mm; leaves elliptic, ovate, obovate or oblong, 5.5 – 23 cm long. Stipules absent.

Distribution: Eastern Africa, from Madagascar to Taiwan, throughout Malesia, northern Australia and the island of the Pacific Ocean; often planted.

Uses: The latex and bark are used internally as a purgative, to treat gonorrhoea and after childbirth. The water soaking of leaves to compresses the eyes. The seed oil is applied externally for rheumatism, scabies, ulcers, boils and itch (Lemmens, 2003; Heyne, 1987).
3.2.4 *Cayratia trifolia* (L.) Domin


A climber, 2-20 m long, stem angular, pubescent when young, ending in adhesive disks, roots tuberous. Leaves 3-foliolate, petiole 2-4 cm long; leaflet oblong-ovate to ovate, 3-8 cm x 2-5 cm, margins toothed, lateral leaflet often lobed, both surfaces pubescent, often becoming sparseluy so when old.

Distribution: From India to southern China, Indo-China, through Malesia (not common in Peninsular Malaysia), and the Pacific Island.

Uses: A decoction of the stem and leaves are used to treat high fever, and a decoction of young leaves can also be eaten with salt to cure fevers. The fresh juice of leaves mixed with the fresh juice of young pineapple are used to treat dandruff (Rahayu, 2001; Heyne, 1987).

3.2.5 *Crataeva magna* (Lour.) DC.


A tree, 8 to 20 m tall, bole up to 30 cm in diameter; branchlets zigzag, yellow-brown. Leaves compound, spirally arranged, 3-foliolate, petiole up to 10 cm long, on top bearing numerous gland like appendages; stipules minute, late caduceus; leaflet lanceolate or oblong, 4-15 (28) cm x 2 – 7 cm, central leaflet broadest about or below the middle, lateral ones more or less symmetrical, apex acuminate, base acute; veins 10 –22 pairs.

Distribution: India, Burma, southern China, Hainan, Indo China, Thailand, Peninsular Malaysia, Sumatera, Java, Kalimantan, cultivated for ornamental tree.

Uses: The juice from root or stem is used to treat fevers and convulsions. It is also used in decoction for stimulating the appetite, and as a febrifuge. The fresh leaves are applied as a tonic and skin irritant against high fever (Schmelzer, 2001; Heyne, 1987).
3.2.6 *Desmodium heterophyllum* DC.

Synonyms: *Desmodium triflorum* (L.) DC. var. majus Wight & Arn., *Hedysarum heterophyllum* Willd.

A terrestrial perennial herb, up to 150 cm long, multi branching, strongly stem, rooting freely from stolons and lower nodes of aerial stem. Stem roundend, solid, reddish, tomentose, with the brown hairs. Stolons become woody, glabrous. Leaves compound, trifoliolate, alternate or spiral, stalked, leaflet obovate or elliptic, glabrous on both sides, margin entire, apex obtuse, emarginated, base rounded.

**Distribution**: Mascarene Islands to India, Southeast Asia, Taiwan, Philippines, widely naturalized in the Pacific Island to Hawaii.

**Uses**: The roots are reportedly are used to tonic and diuretic. The twigs and leaves are used to treat urinary retention and digestive complaints, include diarrhea and dysentery. Liquid extract of the leaves is used for ear drops (Oswalda, 2011, Kham, 2004; Heyne, 1987).

3.2.7 *Dodonaea viscosa* Jacq.


A shrub to small tree, 1.5-8 m tall with up to 20 cm in diameter; branches spreading or erect. Leaves simple, elliptical to obovate, 5-15 cm x 2-5 cm, thin, base decurrent in to petiole, apex rounded, entire, smooth, veins 4-8 mm, ending free; stipules absent.

**Distribution**: Throughout South-East Asia.

**Uses**: The powder of wood charcoal mixed with water is drunk to treat as a remedy for flatulence. A decoction of the leaves or bark is drunk to treat diarrhea or dysentery. The juice from heated leaves is rubbed on nipples of breastfeeding women. The fresh, dried or powdered of leaves are applied as a poultice to treat wounds, swelling, burns, to ripen boils, and sores (van Welzen, 2001; Heyne, 1987).
3.2.8 Hernandia nymphaeifolia (Presl.) Kubitzki

Synonyms: Hernandia peltata Meissn., Hernandia ovigera Auctt.

A tree, up to 30 m tall, bole up to 100 cm in diameter, some time with buttresses. Leaves arranged spirally, simple, entire, glabrous, 15-30 cm x 9-20 cm, palmately veined, base rounded to slightly heart shape, peltate or basifixed, extipulate, petiole 10-25 cm long.

Distribution: From eastern Africa, Madagascar to Sri Lanka, India, Burma to throughout the Malesian region toward Queensland or Australia and into the Pacific Island.

Uses: The leaves are used for cure cancer. The six agents derived from lignin H. nymphaeifolia identified inhibitory activities of cancer cell. An extract of the leaves has also been applied as a painless depilatory. The core root for the drug vomiting blood. The medicinal of purgatives have been made from the leaves and the fruits. In February 2007 for Hernandia nymphaeifolia research presents almost 600 entries and many of them are medically orientated. (Irwanto, 1998; Heyne, 1987).

3.2.9 Hibiscus tiliaceus L.


A shrub to small tree, up to 15-30 m tall. Leaves simple, alternate, blade suborbicular, or the upper ones ovate, 10-15 cm long, base deeply cordate, apex cuspitate, margin finely toothed, beneath 1-5 centra veins with a nectar, upper surface shiny; stipules large, spreading.

Distribution: Throughout the tropics on or near sandy shores.

Uses: The leaves are taken for sore throat, pneumonia, cough, tuberculosis and diarrhea. The leaves are also used as a laxative. The leaves and root are crushed in water and drunk to ease labor. Decoction of root is to cure fever. An extract of the leaves has been applied as a compress boils, and can be used to nourish hair (Dasuki, 2001; Heyne, 1987).

3.2.10 Ipomoea pescaprae (L.) R.Br.

Synonyms: Convolvulus pescaprae L., Ipomoea biloba Forssk., Ipomea maritima (Desr.) R.Br.

A perennial herb, glabrous vine, stem prostate, some times twining, 5-30 m long, often rooting at the nodes, taproot thick. Leaves simple, alternate, often pointing to one side, variable, ovate, elliptical, circular, reniform, 3-10 cm x 3-10 cm, base broadly cuneate to truncate, apex emarginate or deeply 2 lobed, 2 abaxial glands at the base of midrib, blade thick; petiole up to 17 cm long.
Distribution: All tropical beaches, including South East Asia.
Uses: A decoction of the root is considered diminishes the irritation caused by bladder infections. Extract of the leaves is spread on ulcers and then to ripen. The seed is chewed and swallowed as a remedy for cramp and stomach-ache. (Dibiyantoro and Schmelzer, 2001; Heyne, 1987).

3.2.11 Lantana camara L.
Synonym: Lantana aculeata L.

A shrub or herb, up to 2 m long, stem hairy and with spiked, much branches. Leaves simple, opposite, blade ovate, apex acuminate, margins toothed, roughly, upper surface hairy, rarely feels rough to touching the lower surface.

Distribution: India, Srilanka, throughout the Malesian region, United States, South Africa, Mexico, and Australia.

Uses: The extract leaves can be taken to cure vomiting due to food poisoning, and relieve swelling. The leaves are used in a water bath relieve arthritic pain (Wikipedia, 2011; Heyne, 1987).

3.2.12 Mallotus blumeanus Muell. Arg.

A tree, up to 30 m tall, almost completely glabrous. Leaves simple, decussately opposite, blade ovate-oblong, entire, often whitish and with glandular granules below, not peltate; stipule small.

Distribution: Sumatera, Java, Flores (the Lesser Sunda Islands), Sulawesi
Uses: Leaves eaten by women after childbirth and the liquid leaves the collision for eye drops (Lugt, 2003; Heyne, 1987).
3.2.13 Pongamia pinnata (L.) Pierre

Synonyms: Pongamia glabra Ventenat, Millettia novo-guineensis Kanchira & Hatusima, Derris indica (Lamk) JJ Bennett.

A small to large tree, 6-15 m tall, 20-60 cm in diameter. The trunk is generally short with thick branches spreading into a dense hemispherical crown of dark green leaves, branchlets with pale stipule scars. The leaves will fall off when ripe fruit. Leaves compound, imparipinnate, pinkish-red when young, glossy dark green above and dull green with prominent veins beneath when mature; leaflets 5-9, ovate, elliptical or oblong, 5-25 cm x 2.5-15 cm, obtuse-acuminate at apex, rounded to cuneate at base.

Distribution: Along coasts from India to China, Malesia and Pasific islands, Mascaras. It has been introduced in Egypt and Florida and Hawaii.

Uses: The extracts from the leaves, bark and seed are applied as anti-septic against skin diseases and rheumatism. A decoction of root for neutralizing the toxic food. The roots and bark to heal wounds caused by poisonous fish puncture. The seed oil to treat rheumatic drugs, drugs of human and animal skin diseases (Oyen, 2006; Heyne, 1987).

3.2.14 Terminalia catappa L.

Synonyms: Terminalia mauritiana Blanco, Terminalia moluccana Lamk., Terminalia procera Roxb.

A large tree, 15-25 m tall, up to 150 cm in diameter. The trunk is slightly ascending branches spaced 1-2 m apart in tiers, or storeys. Leaves simple, alternate, obovate with short petioles, spirally clustered at the branch tips, 15-36 cm long, 8-24 cm wide, dark green above, paler beneath, leathery and glossy. They turn bright scarlet, dark red, dark purplish-red, or yellow.

Distribution: India, Cambodia, Laos, Vietnam, Thailand, through throughout the Malesian region, Japan, Australia, has been introduced.

Uses: The latex and bark are used internally as a purgative, to treat gonorrhea and after childbirth. The water soaking of leaves to compresses the eyes. The seed oil is applied externally for rheumatism, scabies, ulcers, boils and itch (Valkenburg and Waluyo, 1991; Heyne, 1987).
3.2.15 *Thepesia populnea* (L.) Sol. ex Correa


A shrub to small tree, up to 30 m tall, up to 60 cm in diameter, without buttresses. Leaves simple, alternate, entire or palmately lobed, palmately veined, stipulate. **Distribution:** Along sea coasts, occasionally planted. **Uses:** The heartwood is used to treat pleurisy and cholera. A decoction of wood can be taken to cure fever. Young leaves are eaten as a vegetable. The leaves and fruit are crushed to treat head aches and scabies. The seed oil can be used to kill lice on the head. (Perumal, 1998; Heyne, 1987).

4. CONCLUSION AND SUGGESTION

- There are 15 species, 15 genera and 12 families of traditionally medicinal plants in Pangelekan coastal forest.  
- Research on Pharmacology need to be conducted to examine the chemicals content of medicinal plants.  
- Research collaboration network on medicinal plants should be established to support the development and coastal forest management.

REFERENCES


Schimdt, F H and J H A Ferguson (1951): Rain fall type based on wet and dry period ratios for Indonesia with Western New Guinea. Verb No.42. Direktorat Metereologi dan Geofisika Jakarta.


Application of Seed Encapsulation Technology for Critical Land Reforestation

Harmastini S, Sylvia J R L, Rumella S, Tiwit W, Liseu N and Nuriyanah

Research Center for Biology, Indonesian Institute of Sciences (LIPI), Jl. Raya Jakarta-Bogor, Km.46 Cibinong Science Center, Cibinong 16911, INDONESIA

Poster paper prepared for
The First International Conference of Indonesian Forestry Researchers (INAFOR)
Bogor, 5 – 7 December 2011

INAFOR SECRETARIAT
Sub Division of Dissemination, Publication and Library
FORESTRY RESEARCH AND DEVELOPMENT AGENCY
Jl. Gunung Batu 5, Bogor 16610
Application of Seed Encapsulation Technology for Critical Land Reforestation

Harmastini S, Sylvia J R L, Rumella S, Tiwit W, Liseu N and Nuriyanah

Research Center for Biology, Indonesian Institute of Sciences (LIPI), Jl. Raya Jakarta-Bogor, Km.46 Cibinong Science Center, Cibinong 16911, INDONESIA

ABSTRACT

Recovery efforts and increasing productivity of critical lands require the seed that have adaptation capability and high viability. Seed encapsulation technology is one of effort to improve forestry plant seed germination by physical protection to the seeds. Encapsulation technology is giving potentially nitrogen-fixing and phosphate-solubilizing microbes on encapsulated seed. Providing potential microbial on encapsulation seed give opportunity to improve of quality forest seeds. Microbes that used in encapsulation materials are expected to support growth of plant when the seed is planted on critical land. The purpose of this study was to obtain an encapsulation materials formula that easy, inexpensive and can support microbial growth during encapsulated. In addition, to determine the influence of microbes on the growth and survival rate of plants in the greenhouse. The result of seed encapsulation from various materials showed that agar and YEMA medium are potential to be developed as an encapsulation material. Moreover, the addition of nitrogen-fixing and phosphate-solubilizing microbes influence on growth of sengon plant.

Keywords: Sengon, encapsulation, nitrogen-fixing and phosphate-solubilizing microbes.

1. INTRODUCTION

Critical land is heavily damaged land due to the closure of vegetation loss, so that its function as water and erosion controller, nutrient cycling, microclimate controller and carbon retention to be lost or diminished. This condition is characterized by the availability of water and plant nutrients are very low. More than 15 million hectares of critical tropical forests in Indonesia require revegetation (Betty, 2011).

Reforestation is a program for critical land in Indonesia that is undertaken by the government through the Department of Forestry programs. Implementation of revegetation activities (reforestation) is an effort to reclaim degraded lands. The goal is to improve the unstable and unproductive land and reduce surface erosion. In addition, is expected to improve the microclimate, restore biodiversity and improve the condition of land in order to more productive. The reforestation program is in accordance with increased awareness and knowledge of human about the advantages of environmentally friendly microorganisms. The potential of soil microorganisms can be used as biofertilizer to improve and enhance soil fertility, increase grow capacity and crop productivity and substitute chemical fertilizers.

The effort to restore and improve critical land productivity requires a seed that have adaptation capability and high viability after the planted on the land. The survival of forest seedlings usually are still very low about 30-50%. This is due to many factors including the ability of seedlings to adapt to extreme environments. The unfavorable environmental factors such as availability of water, heat and diseases caused the survival of seedling very low (Anonymous, 1998).

Preparing of high quality forestry seeds in order to realize the revegetation program is a challenge for the forestry farmers. The seed encapsulation technology is one effort to improve forestry seed germination. Target of seed encapsulation activity is to protect the seeds physically
in order to anticipate the influence of various external factors that would interfere with integrity of the seed. The encapsulation materials of seeds is very diverse and the selection of materials is determined by the texture that can keep an encapsulated seed in order to the growth capacity does not lose. The involvement of potential microbes is a prospective opportunities for the provision of high quality forestry seeds. The potential microbes is used to support growth and quality of crops so that plants are able to adapt toward a variety of extreme conditions.

Sengon (Paraserianthes falcataria) is a Leguminosae family. Sengon started to develop as society forest because it can grow on an extensive climate conditions and not require high location to grow. Sengon has many benefits such as building materials, pulp, paper raw materials, containers, and its leaves as fodder. Development of fast-growing Sengon has an impact on the improvement of soil fertility on a fast scale. Besides that, the requirement for Sengon wood that reached 500,000 m³ per year and the prices increased rapidly on the market in recent years led the development of Sengon was needed to support reforestation program. The requirement for this wood is not equal with Sengon production in Indonesia per year. The demand for high quality Sengon seed also increase along with the development of Sengon forest area that planted by the public and private companies (Yayan, 2010). The purpose of this study was to obtain an encapsulation material formula for forestry seeds that easy, inexpensive and can support microbial growth during encapsulated. In addition, to determine the influence of microbes on the growth and survival of plants in the greenhouse.

2. MATERIAL AND METHODS

2.1 Place and Time Research

The study was conducted on March 2011 at Laboratory of Soil Microbiology and Green House, Research Center for Biotechnology, LIPI, Cibinong.

2.2 Material

Materials consist of Sengon seeds, planting media, encapsulation materials and potential microbes. Sengon seed was obtained from Experiment Garden of Haurbentes, Jasinga, Bogor. The planting media consist of soil, sand, soil: sand in the ratio of 1:1, soil: sand: compost in the ratio 1:1:1. The encapsulation materials are rice flour, cassava starch, agar and selective media (YEMA). The potential microbes are nitrogen-fixing and phosphate solubilizing bacteria.

2.3 Methods

The study began with selection of normally seed, followed by germination test to determine the percentage of seeds germination that will be encapsulated. Germination test carried out by soaking the seeds in hot water on temperature ± 80°C, then allowed for 24 hours. The seed were grown in petri dishes containing sterile tissue paper that has been moistened with sterile distilled water. Petri dishes were incubated at room temperature for 3-4 days until all the seeds growth. Percentage of germination was calculated by comparing the number of seeds that grow normally from a total of 100 seeds. Furthermore, produce biomass of nitrogen-fixing bacteria and plant growth hormone-producing bacteria. Production of bacterial cells biomass were made by growing bacteria in liquid medium and incubated shaked for 3 days. Biomass of bacterial cells were used as material is mixed with the encapsulation material.

Preparation of encapsulation materials made by mixing ingredients encapsulate namely cassava starch, rice flour, and agar approximately 0,5 grams in 50 ml of distilled water mixed with 10 ml of nitrogen-fixing and 100 grams of phosphate solubilizing inoculum. After mixed, the materials is used as sengon seed encapsulation. For YEMA material, 50 ml of media was heated to boiling then cooled until the temperature 40°C. After that, the material mixed with nitrogen-fixing and phosphate solubilizing inoculum as sengon encapsulation material.
After encapsulated, the seeds are cultivated in polybags contains ± 250 grams of the planting medium. The planting medium are soil, sand, soil + sand (1:1), soil + compost + sand (1:1:1). As a control, use the seed without encapsulation. Each treatment was made 50 replications. The parameters were observed every month are the germination and plant height.

2.4 Data Analysis

Data of germination percentage calculated based on the number of growing seeds divided by the total number of planting seeds multiplied by 100%, while data of plant height were tested with a variety of one-way analysis of variance.

3. RESULT AND DISCUSSION

3.1 Influenced of Encapsulation Materials

3.1.1 Percentage of Survival

The result of seed germination test (DB) that had been treated with a variety of encapsulation materials and cultivated in the greenhouse can be seen in Table 1.

Table 1. Percentage of Sengon Seed Germination with Encapsulation

<table>
<thead>
<tr>
<th>No.</th>
<th>Treatment of encapsulation materials</th>
<th>Percentage of Germination (%) on Variation of Growing Media</th>
<th>Average of DB</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>soil</td>
<td>sand</td>
</tr>
<tr>
<td>1.</td>
<td>YEMA + microbes</td>
<td>80</td>
<td>88</td>
</tr>
<tr>
<td>2.</td>
<td>Agar + microbes</td>
<td>86</td>
<td>94</td>
</tr>
<tr>
<td>3.</td>
<td>Cassava starch + microbes</td>
<td>84</td>
<td>80</td>
</tr>
<tr>
<td>4.</td>
<td>Rice flour + microbes</td>
<td>86</td>
<td>88</td>
</tr>
<tr>
<td>5.</td>
<td>Control</td>
<td>96</td>
<td>90</td>
</tr>
</tbody>
</table>

Based on the observations showed that the percentage of Sengon seed germination after 3 months planting on each treatment is still high, ranging between 74.5% -92%. Seeds which encapsulated with agar and seeds without encapsulate (control) have germination capability higher than seeds with YEMA, cassava starch and rice flour encapsulate materials. These results indicate that encapsulation treatment did not influence significantly to the growth or viability of seeds. Besides, the seeds with agar encapsulation material show the growth better than control. Because of these plants are still young and the environmental conditions in the greenhouse is not extreme like the field level, so the percentage of survival are still be able to change in the future. According to Sadjad (1980), seed germination is influenced by internal and external factors.

Germination of encapsulation seeds with YEMA, rice flour and cassava starch materials are lower than control. Its caused the materials encapsulation give a little influence to restrain seeds for germination. The encapsulation seeds have many advantages compared with control in improving plant quality such as faster growing, better height and bigger diameter and more resistant to pests and diseases). However, the encapsulation seeds influence to decrease germination although is not very significant.
3.1.2 Height of Plant

After encapsulated treatment, the seeds are cultivated on some of the planting medium in the greenhouse. After 3 months planting, it can be seen that treatment of encapsulation influenced to plants performance. Figure 1 show that growth of Sengon with YEMA treatment after 3 months planting indicate the best result compared with agar, rice flour, cassava starch treatments and control. This is caused YEMA media can maintain seed moisture. According Hendromono (1996), moisture is a factor that influence the growth of plant. The reaction of plant to moisture depends on the type of plant itself. Sengon require moisture about 50-75%. The growth of Sengon seed after 3 months planting with variation of the encapsulation material can be seen in Graph 1.

![Graph 1: The growth of encapsulation sengon seed after 3 months planting in the greenhouse](image)

YEMA medium (Yeast Extract Mannitol Agar) as an encapsulation material has a composition as follows: 0.5 g K$_2$HPO$_4$, 0.2 g MgSO$_4$, 0.1 g NaCl, 3 g CaCO$_3$, 10 g Mannitol, 3 g Yeast Extract, 20 g agar, 1 liter of distilled water (Vincent, 1970). This media consist of nutrients that needed by the nitrogen-fixing microbes. When the seeds are encapsulated by YEMA then planted, nitrogen-fixing microbes will be more active because these microbes have been obtained nutrients from the media. The presence of nitrogen-fixing microbes on the seed that encapsulated by YEMA is estimated much more than the other encapsulation material. It can be indicated by the average height of Sengon is higher than other treatments.

The Sengon seeds that encapsulated by agar also indicate good performance. The agar media can also maintain the seed moisture which one of factors that influence the growth of plant. The agar media is also a good candidate for encapsulation media, it caused by this material is more economic than YEMA materials. Performance of encapsulation Sengon seed after 3 months planting can be seen in Figure 2.
3.2 Influence of Growing Media

Treatment of growing media variations has a purpose to determine the growth capability of encapsulation seed before applying in the critical land. The growth of Sengon on the soil + compost + sand medium showed the best growing, then followed growth of Sengon on the soil, soil + sand and sand media. The growth of encapsulation Sengon seed after 3 months planting on the variation of growing media can be seen in Figure 3.

Based on the research, the mixture media consist of soil + compost + sand is the best medium that used in the nursery before planted on marginal lands or other. The addition of compost to the planting medium has influence significantly on plant growth. Compost is an organic media are derived from plant or organic waste fermentation, such as straw, husk, leaves,
grass and trash. The advantage of using compost as a planting medium is able to restore soil fertility through improvement of soil characteristics as physical, chemical or biological. Besides that, the compost is also a facilitator to absorb nitrogen (N) that is needed by plants.

Based on this study, treatment of planting media variation indicates the growth of Sengon on the sand medium look not good enough. The growth of plant is slower and leaf colours look rather pale compared with the growth of Sengon on the other media. However, Sengon be able to grow on the medium and have the growth capability is good enough at around 88%. The sand and sand + soil medium may represent a condition in the critical land. The results of this study indicate that the encapsulation seed that supplied with potential microbe is still able to grow in unfavourable environmental conditions. According to Hendromono (1996), the size of seed and seedling media affect greatly to the viability of Sengon seeds.

The sand media have a measurement of large pores (macro pores) then it becomes easy to wet and dry quickly by evaporation process. Water evaporates more quickly while water and humidity is a decisive factor of plant growth. Then, the sand media requires irrigation and fertilization more intensive. This causes the sand is rarely used as a single growing media. The sand is often used as an alternative growing media to replace the function of the soil. Because of the sand is considered adequate and appropriate when used as a medium for seedling and growing seeds and rooting of plants stem cutting. Its quick-drying will facilitate the removal process of seedlings that are considered old enough to other media. While the weight of sand is heavy enough to facilitate a stand of stem cuttings. Besides that, the advantage of the sand media is easy to use and can improve aeration and drainage system of the planting medium. Performance of Sengon after 3 months planting on the variation of growing media can be seen in Figure 4.

![Figure 4: The growth of encapsulation Sengon sees after 3 months planting on the variation of growing media](image)

4. CONCLUSION

The results of sengon growth that encapsulated with material variations and cultivated in variations of growing medium, it can be concluded as follows:

1. Percentage of life sengon seed encapsulation generally is good.
2. Materials such as YEMA and agar can be used as an encapsulation candidate for superior seed, especially sengon seed.
3. The advantage of using YEMA is able to maintain the seed moisture that needed to germinate and provide nutrition for nitrogen-fixing microbes. But, the disadvantage of material is more expensive.

4. The advantage of using agar is able to maintain the seed moisture that needed to germinate and material is more economic. But, the disadvantage of material does not provide nutrition for the nitrogen-fixing microbes.

5. The encapsulation seed that provided a potential microbial and cultivated in variations of growing media indicate that is still able to grow in unfavorable environmental conditions.

REFERENCES


