Adaptability of Ganimtri (*Elaeocarpus ganitrus*) on degraded land of community forests in Tasikmalaya Distric, West Jawa Province

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**Abstract.** *Elaeocarpus ganitrus* is one of the prospective Non-Timber Forest Product (NTFP) species in the community forest. The wood can be used for building and music tool raw material. Specific products in the form of seeds are used as medicine, handicrafts, and traditional ceremonies. The aim of the research was to study the adaptability of *A. ganitrus* on degraded land of community forests in Tasikmalaya. Plot establishment was conducted in Gunungtandala Village, Kawalu Sub District and Tasikmalaya District, West Java Province. The spacing of this trial is $3 \times 3$ m with 2300 number of seedlings. The research showed that the survival of *A. ganitrus* in the total area reached 70.6%. The percentage of *A. ganitrus* life starting from the largest is 98% on flat land, 96% on slope land and 18% on steep land. Survival and growth prove that *A. ganitrus* are able to grow in this site. The slope factor greatly affects the vegetative and generative growth of *E. ganitrus*. There is a tendency that he stressed vegetative growth of *E. ganitrus* on steep land encourages generative growth with the appearance of flowers. Most of the *E. ganitrus* plants start flowering at the age of 3.5 years. The recommendation of this study is the use of *A. ganitrus* species in NTFP development on marginal lands in community forests. This species is also used in the restoration of the conservation area.

1. Introduction

*Elaeocarpus ganitrus* is a type of multipurpose tree species plant. In general, the use of *A. ganitrus* is a producer of seeds/fruit and some of that are used as carpentry wood [1]. Wood can be used as raw material for woodworking and materials for making musical instruments/guitars. *A. ganitrus* fruit has a hard petrified endocarp and attractive ornaments. The unique shape and size of *A. ganitrus* seeds can produce various jewelry products (bracelets, necklaces, beads) and seeds used for religious ceremonies and funeral ceremonies in India [2,3]. Hindus believe *A. ganitrus* seeds as Gods tears that drip into the earth then grow into trees. *A. ganitrus* seeds good for body health to overcome stress, control blood pressure and various mental illnesses, and affect the brain system when spreading bioelectronic stimulation. The marketing of *A. ganitrus* seed products has a specific route. It was exported to India and China [5].

*A. ganitrus* in Tasikmalaya community forest begins to bear fruit at the beginning of the dry season to the beginning of the rainy season. According Fitriani [6] the spread of *A. ganitrus* plants in Indonesia covers Central Java, Kalimantan, Bali, and Timor. The growth of wood is relatively straight with many branches and evergreens. *A. ganitrus* is relatively easy to grow on various types of regosol, andosol,
podsollic, brown, latosol in the lowlands to highlands (0 to 1300 masl) and can be more than 1200 masl, with rainfall 3500-4500 mm/year [1,3,7].

The location of the research site is the degraded land of community forests. Land overgrown with reeds (Imperata cylindrica Raeschu) with a slope starting flat, sloping, and steep. The soil conditions overgrown with reeds (Imperata cylindrica Raeschu) are a reflection of degraded conditions. One of the government programs is to rehabilitate degraded land to return to its original function. Another benefit of the rehabilitation of degraded land is to restore the function of land, both economically and environmentally. Environmental functions are characterized by returning soil fertility, good land cover, and increasing land productivity. This can be carried out by vegetatively conserving land by planting species that can adapt to degraded land. A. ganitrus is a fast-growing type that is naturally easy to find and does not need a specific place of life [8] Trials of planting A. ganitrus at various levels of relative slope is rarely carried out. Moreover, the use of A. ganitrus for Forest Rehabilitation and Degraded Land has not been widely recommended. This is caused by a lack of information about the adaptation of A. ganitrus on degraded land. The purpose of this study was to test the adaptation ability of A. ganitrus plants to the level of the slope of the land in the Tasikmalaya community forest.

2. Materials and Methods

2.1. Location

The research was carried out on the degraded land of Imperata cylindrica which administratively is in Gunungtandala Village, Kavalu Sub District, Tasikmalaya District of West Java Province. The study was conducted for 3 years 8 months from October 2015 to July 2019. Place height is 260 meters above sea level, with 18.8°C of minimum temperature and 28.2°C of maximum temperature. The humidity of air is between 19.7-26.4%. The average rainfall per month is around 302.67 mm [9].

2.2. Methods

Planting is carried out on 3 different slope conditions, namely (1) flat land/0% of slope, (2) slope land/10-20% of slope, and (3) steep land/>45% of slope. The total plants planted are 2300 seedlings. Planting of A. ganitrus is carried out during the rainy season (October, 2015). The spacing of the research location is 3 x 3 m with 2300 plants. Planting holes size are 40 x 40 x 30 cm. Basic fertilizer at the time of planting is 2 kg cow manure/planting hole. At the age of 8 months, weeding and fertilizing with 150 grams/planting holes of Urea + TSP + KCL (3:1:1) and 2.5 ounces/plant of furadan were carried out. At the age of 1.5 years, it’s only weeding/cleaning of weeds that grow were applied.

2.3. Data and analysis

Data collection was carried out at the age 3 years 8 months of A. ganitrus. The collected data covers life percentage, flowering/ fruit percentage, growth in height and diameter of the A. ganitrus plant. The data of the research were analyzed by analysis of variance and if it was significantly different, it would be continued by Duncan’s further test at 95% of test level. The SPSS 18 was used for data analysis.

3. Results and Discussion

3.1. Results

Based on the analysis of variance, it was shown that the influence of land slope was significant different from height growth and the diameter of A. ganitrus at 44 months old as shown in Table 1. To find out the average difference among treatments the Duncan test was carried out.

Table 1. The variance analysis on land slope effect on growth of height and diameter of 44 months old A. ganitrus

| Parameter          | FCal   | signification |
|--------------------|--------|---------------|
| Height             | 44.616 | 0.000*        |
| Diameter           | 16.355 | 0.000*        |
The results showed that the average value of *A. ganitrus* growth in succession starting from the best was on flat land, the slope land (10-20%) and the steep land (>45%). The average growth rate of *A. ganitrus* diameter from the highest to the lowest is on the slope land (10-20%), flat and steep land (>45%). The best percentage of flowering *A. ganitrus* obtained on the slope land (10-20%) is equal to the steep land (>45%) and higher than flat land. The highest percentage of the life of the *A. ganitrus* trees is obtained on flat land, the slope land (10-20%) and the steep land (>45%). The value of growth in height, diameter, percentage of life, and percentage of flowering *A. ganitrus* can be seen in Table 2.

**Table 2.** The average growth rate of height, diameter, life percentage and flowering percentage of 44 months old *A. ganitrus*

| Treatments (Slope of Land) | Height (cm) | Standard Deviation | Diameter (cm) | Standard Deviation | Life percentage (%) | Flowering percentage (%) |
|----------------------------|-------------|-------------------|---------------|-------------------|---------------------|-------------------------|
| Flat (0%)                  | 10.25 a     | 2.63              | 9.73 a        | 2.57              | 98                  | 10                      |
| Sloping (10-20%)           | 9.48 a      | 2.06              | 10.79 a       | 2.92              | 96                  | 16                      |
| Steep (>45%)               | 6.19 b      | 2.12              | 7.69 b        | 2.75              | 18                  | 16                      |

Remark: different letter shows significant different of 95% of level

Based on the Duncan test, the growth of *A. Ganitrus* had a significant difference. On the flat land the highest value was significantly different from the steep land (>45%). The growth of *A. Ganitrus* from the Duncan test results obtained the lowest value on the steep land (>45%) was significant different from the flat land and the slope land (10-20%). Based on Duncan Test, the lowest diameter growth was 6.19 cm on steep slope (>45%). It was significantly different to the flat land and the slope land (0% – 20%).

3.2. Discussion

Growth of ganitri tested on land with various slopes shows a significant different in height, diameter, survival and flowering percentage. Plant growth is influenced by growth factors such as stand density (plant spacing), stand age characteristics, climate factors (temperature, precipitation, wind speed and air humidity) and soil factors (physical, chemical composition, and microbiological components soil) [10]. Growth of tree height can be influenced by differences in the speed of leaf formation which is very sensitive to the quality of site. The quality of site can be influenced by differences of land sloping. According Davis and Jhonson [10] there are three environmental factors and one genetic (internal) factor that are very significant in influencing height growth. These are nutrient content of soil minerals, soil moisture, sunlight, and the balance of genetic characteristics between the growth of tree height and diameter. Diameter growth is influenced by factors that influence photosynthesis (photosynthesis results for respiration, leaf replacement, root growth and high growth have been fulfilled).

The growth of ganitri on flat land is better than on sloping and steep land. This is caused by the slope factor of the land which is on the relatively flat land, it is more secure from the run-off. This can minimize nutrient leaching. The slope factor has a direct effect on soil erosion [11]. The higher the slope of the land from the horizontal field, the higher the occurrence of the erosion process (detachment, transportation, and sedimentation) [12]. On steep slopes, the potential for high surface erosion/ run off results in leaching which decreases soil fertility. The hight rainfall in the steep slope can cause damage to the soil [13]. At the same time sloping land with large erosion destroys the ganitri plant so that it is uprooted from its roots. 12-16% of slope caused nutrient availability for plants to decrease, decrease in productivity, decrease in crop quality, decrease infiltration rate and ability of soil to hold water down [14,15].

The effect of slope on the growth of ganitri diameter on the research plot showed significant results. On steep land, the smallest average diameter is obtained which is significant different from the diameter growth on flat and sloping land. Soekotjo [16] states that the growth of stem diameter depends on the moisture density, crown surface and root system, and the influence of climate and soil conditions. High
air temperature will increase the transpiration rate. In a long time, it will disturb the water balance and it will disturb the plant growth. Growth of ganitri diameter on flat and sloping soil with 3 x 3 m of spacing is quite high and proportional while on steep land growth in height and diameter is smaller even though the light intensity is higher. The cause of the lack of growth of ganitri on steep land is high erosion. This is caused by the processing of land in the research plot so that the land is not covered by litter. It seems that having the ability to control erosion and surface flow instead of closing trees that are not balanced by the formation of litter will increase the rate of erosion because the kinetic energy of raindrops from trees more than meters taller is greater than raindrops which fall freely outside the forest [17]. The land cover factor has an exponential relationship with the contact surface and erosion produced that varies depend on the type of land use [18]. Erosion observation on sloping land with a slope of 50% to 60% during the rainy season in five types of land use obtained the lowest erosion rate on forest observations compared to observations made in coffee plantations with various plant ages [19].

The high erosion causes the land to be degraded. Degraded land is characterized by the presence of reeds which causes disturbed vegetative growth of ganitri. The success of planting on steep land is also relatively low. Agroforestry patterns are efforts for the success of planting on steep land. It can reduce run-off and leaching of nutrients. The presence of lower plants will cover the surface of the soil and reduce run-off. Construction of terraces will able to reduce soil damaged by surface run-off. Managing the minimum tillage land to reduce the disruption to the land can be applied as well. Another thing to applied is the combination of no-tillage and minimum tillage. In various cases, this requires careful processing of the soil to minimize soil damage and leaching of nutrients.

Generative growth on sloping land shows relatively higher results compared to flat areas. The best percentage of flowering starts on steep, sloping, and flat land. On steep land it causes low vegetative growth but encourages flowering. Although vegetative growth and the percentage of life on steep land are relatively lower, flowering works higher. With a low percentage of life, it gives open space. The abundance of sunlight that covers tree canopy due to lower canopy competition allows the flowering of ganitri plants. The abundance of light can reach the entire canopy surface that its gives a positive effect on flowering. As for ganitri, on flat land with a spacing of 3 x 3 m and a percentage of the life of 98%, the canopy is in contact so that the canopy is known to reduce light intensity. Canopy growth on flat land has intersected so that not all canopy surfaces receive sunlight intensity. On the steep land produce lowest vegetative growths but actually encourage generative growth with the appearance of flowers. Vegetative growth was not accompanied by generative growth (in contrast). Generative growth with the appearance of flowers is in fact opposed to vegetative growth. The physical appearance and survival of ganitri on sloping land is lower but produces more flowers. The process of stressing plants on steep land will inhibit vegetation growth but encourage generative growth. This happens because plants with high stressing levels for vegetative growth will encourage plants to grow generatively. Ganitri plants with low vegetative growth on steep land actually encourage generative growth with the appearance of flowers.

The research location at an altitude of 260 m asl, latosol soil, and with 18.8°C of minimum temperature and 28.2°C of maximum temperature and more than 2000 mm/year of rainfall. This is in accordance with the research [1] that the distribution of Ganitri can grow with latosol soil in the lowlands to the highlands (0-1300 masl). The success of ganitri planting which reached 70.6% showed that ganitri could grow on degraded land of Imperata with these biophysical conditions. Degraded land marked by reeds, latosol brown soil and topography varying from sloping, steep, and flat can be rehabilitated with A. ganitrus. The density of growth and the percentage of life on steep land can be anticipated by making frequent terraces and minimal tillage of agroforestry.

4. Conclusion
The slope factor greatly affects the vegetative and generative growth of E. ganitrus. Steep degraded land results in low vegetative growth but encourages generative growth with flowering. A. ganitrus can grow properly on flat and sloping slope levels (0-20%) on ex Imperata cylindrica fields. A slope of 10-20% can produce a higher balance of vegetative and generative growth than other slopes. A. ganitrus should
be planted on flat or sloping land. If it is planted on steep land, a pattern for soil and water conservation should be applied. Planting *A. ganitrus* for the main products of the fruit should be planted with more than 3 x 3m of spacing.

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