Land Suitability Evaluation of Jati Plus Perhutani: Study Case in Ngawi and Surakarta Forest Management Unit

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Abstract. Soil is one of the land resources that serves as a medium for plant growth, habitat for soil organisms, recycling systems for nutrient and organic matter and water supply mechanism. Soil qualities and characteristics will determine their ability as a land resource that could change at any time. Soil suitability evaluation conducted by soil survey, aimed to assess the characteristics of the soil, determine the limitation factors of land suitability, and alternatives cultivation to improve its productivity. This research aimed to determine land characteristics, land suitability classification, limitation factors of land suitability, and providing strategic directives for JPP teak cultivation on the research location at Ngawi and Surakarta FMU. The result of land evaluations are clay land texture, relief: flat (<3-8%) to mountainous (30-40%). Low soil infiltration rate, high water restrain ability, difficult to cultivate and high run-off potential in slope area. Soil acidity: slightly acid (6.11) to alkaline (7.81), C-organic: low (0.58) to high (3.49), N-Total: very low (0.07) to moderate (0.22), P_2O_5: very low (3.78) to very high (32.0), K_2O: moderate (0.58) to very high (1.40), which were formed from 2,039.71 – 2,072.01 mm year^{-1} rainfall rate with isohypothermic soil temperature and ustic soil humidity regime. Current Land Suitability on sites is not suitable permanently (N2) due to rooting condition as limiting factor (soil effective depth). The potential land suitability to be improved is disassembling the land mechanically, application of organic substances and soil conservation implementation.

1. Introduction
Soil is one of the land resources that serves as a medium for plant growth, to give benefit specially to human life, that could serves its best accordingly to its maintainance. Perum Perhutani have gain superior teak clones named JPP-teak, from a long series of plant breeding that has been developed as teak production plantation in most of area managed by Perum Perhutani. Land screening for JPP-teak planting in large scale considered not always suitable for the clones growth. These can be seen from the JPP-teak evaluation report which is developed as routine plantation, have shown its productivity are still below standard.

Production improvement of teak log commodity in Perum Perhutani required sufficient and relevant data and information of land resources, including geology data, topography, soil, climate and others. In order to fulfill such data to improve teak log production and JPP-teak plantation quality can be obtain by conducting an overall research concerning teak plantation land suitability. Land evaluation is a process to presume land potential from time to time based on its utilization, agriculture or non agriculture [1]. Land suitability is land compatibility for certain cultivation (including JPP-teak), because cultivation of crop commodity must suitable to its soil and environmental traits, to fulfill its growth requirement to gain its optimum productivity. The principal aim of agricultural and forestry land suitability evaluation is to presume the soil potency and limitation in order to gain crop
production [2]. Land limitation in JPP-teak plantation in Pemalang and Ngawi FMU that inhibit the productivity of JPP-teak was soil consistence [3]. Soil consistence and structure determined root density and spread range. Heavy soil consistence may cause low root density and limited spread range, as the result is a low ability of root to absorb moist and nutrient [4]. In this research, land suitability evaluation was conducted in Ngawi and Surakarta FMU.

2. Method
The research locations are in Ngawi FMU, BKPH Watutinatah, plot 98 within planting year 2011 and Surakarta FMU BKPH Tangen plot 7b within planting year 2013, observations was conducted in 2016. The main field survey steps were to make mini-pith and soil profile on site, cross section 2 x 1 m size and 1.5 m depth or until reach out its main rocks [5]. Soil morphology observations consisted of soil color, structure, consistency, solum thickness, rooting, rock status and drainage. Land morphology observations consist of slope status, relief, elevation, rock outcrop, erosion status and land use. Soil samples were collected from the profile, as much as 1 kg for physical and chemical analysis, soil sample were placed in a clear plastic bag 15 x 25 cm size.

Soil analysis was conducted in the laboratory to obtain data on soil physical and chemical properties. Climate data was collected from a 10 year data series (2004-2013 for Ngawi region and 2006-2015 for Surakarta region), to determine annual average temperature, amount of wet and dry month, maximum and minimum temperature and annual rainfall. Current land suitability from each soil map unit on the research location was determined using matching method between land-quality with the plant growth criteria without enhancing land limiting factor. Land suitability criteria were based on Simple Limitation LPT Bogor (1983) in Djaenudin et.al [6], potential land suitability determine by considering input and management acts to be applied in the research site.

3. Result and Discussion
The current land suitability on the research site based on PPT (2003) in Hardjowiegeno and Widiatmoko [7] showed N2 value as “r” as its limiting factor, which indicate the land used for JPP teak plantations are unsuitable permanent, which also indicating a very heavy limiting factor that are unable to use sustainably. Limiting factor “r” are rooting media consist of soil drainage, soil texture and root effective depth. On this research site limiting factor specially is N2 which is root effective depth only 10-15 cm, meanwhile the suitable effective depth for teak is >150 cms.

| Table 1. Current Land Suitability on The Research Sites |
|-----------------------------------------------|
| Land Quality and Characteristic               | Ngawi | Surakarta |
| Temperature (t)                               |
| Average Temperature (C˚)                      | S1     | S1         |
| Water availability (w)                        |
| Dry months                                    | S1     | S1         |
| Annual Rainfall (mm)                          | S2     | S2         |
| Rooting medias (r)                            |
| Drainage                                      | S3     | S3         |
| Texture                                       | S1     | S1         |
| Effective depth (cm)                          | N2     | N2         |
| Nutrient retention (n)                        |
| pH                                            | S3     | S3         |
| P₂O₅ (ppm)                                    | S1     | S1         |
| Soil preparation (p)                          |
| Surface rock (%)                              | S1     | S1         |
| Outcrop (%)                                   | S1     | S1         |
| Consistency                                   | -      | -          |


| Land Quality and Characteristic | Ngawi | Research Sites | Surakarta |
|--------------------------------|-------|----------------|-----------|
| **Erosion risk (e)**           |       |                |           |
| Erosion                        | S3    |                | S1        |
| Slope (%)                      | S3    |                | S1        |
| **Flood risk (b)**             |       |                |           |
| Flood                          | S1    |                | S1        |
| **Current land suitability**   |       |                |           |
| N2r                            | N2r   |                | N2r       |

The restoration of current land suitability characteristic to become potential land suitability on the research locations which is claypan (high-level soil maintanance) is by mechanic soil plowing, and also application of organic matter as soil enhancer and implementation of soil conservation.

4. Conclusion
Land suitability characteristics and classifications on JPP teak clonal plantation in research area is N2r, which is permanently unsuitable, it is defining that the land has a heavy limiting factor to grow teak. The limiting factor in the research location is “r”, which determined as rooting media that consist of soil drainage, soil texture and effective depth for teak root development. The N2 limitation factor is pointing to effective depth which is only 10-15 cm in depth, wherein teak suitability for effective depth is ≥ 150 cms.

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