

## Research article

# Assessing the Suitability of Land in South Malang for Conversion to Oil Palm Plantations and the Possible Environmental Impacts

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**Abstract.**

Malang Regency is located in East Java Province with an area of 3,530.65 km<sup>2</sup>. Its altitude ranges from 0 to 2000 meters above sea level with varying conditions, from lowland to mountainous. The southern part of Malang has various natural resources that need to be preserved. Unfortunately, the Malang Regency Government recently decided to convert a forest area of 50,000 hectares to an oil palm plantation. This plan has both pros and cons. Although oil palm has been cultivated before in South Malang, opening a wider oil plantation area requires further research. Assessing the suitability of land for oil palm farming is necessary to avoid severe environmental damages. In addition, it is essential to take into account insights from the community for economic analysis purposes before and after the implementation of the plan.

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**Keywords:** oil palm, land suitability, South Malang

## 1. Introduction

Oil palm plantations rapidly expand, as seen from the total area of forests converted into oil palm plantations in Indonesia. Oil palm is an important commodity in local, regional, and global markets because its derivative products, such as cooking oil, raw material for margarine, and raw material for the cosmetic industry, are in high demand. The apparent market demand for palm oil products requires conversion from green open lands to oil palm plantations. However, this conversion brings economic, environmental, and developmental impacts on the Crude Palm Oil (CPO) industry. The palm oil-based industry contributes much to economic growth, poverty alleviation, and income distribution [11] [12]. Oil palm development positively affects economic growth, as indicated by the increase in investment, output, and foreign exchange.

Malang Regency is the second-largest regency after Banyuwangi, with a total area of 3,530.65 km<sup>2</sup>. It is located at 112°17'11" to 112°57'00" East Longitude and 7°44'55" to 8°26'35" South Latitude. Its altitude ranges from 0 to 2000 meters above sea level with

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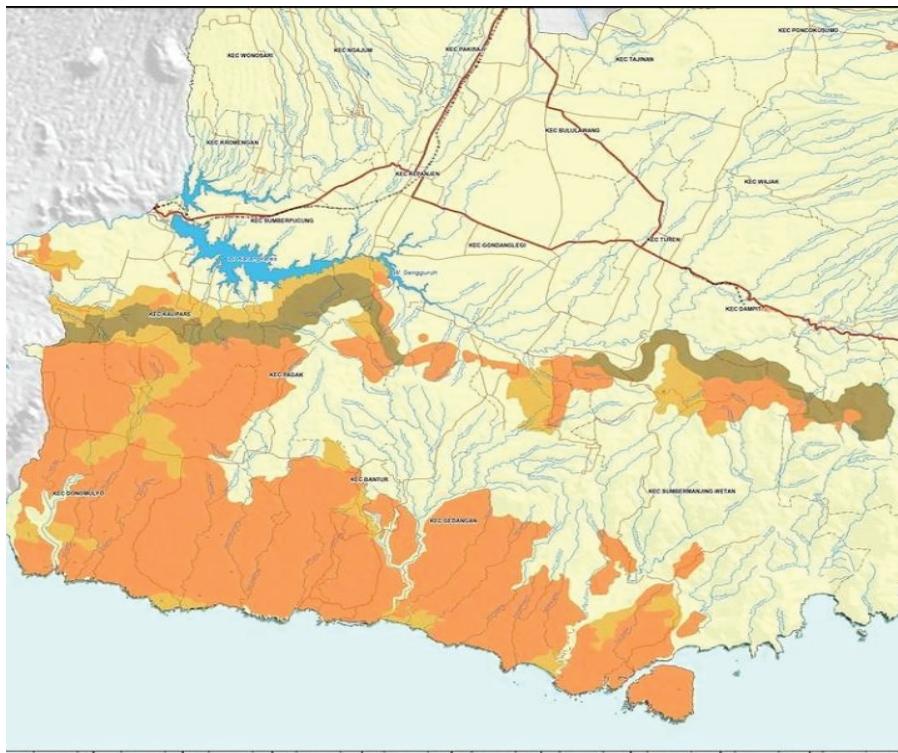
**Figure 1:** Oil Palm Plantation.

varying conditions, from lowland to mountainous. Its geological conditions are formed mainly by young volcano activities (44.25%), old quarter volcanic products (12.47%), limestone facies Miocene (27.15%), Miocene sedimentary facies (3.83%), and alluvium (11.99%) of the total area of the regency. The types of soil in Malang Regency also vary from alluvial, regosol, brown forest, andosol, latosol, Mediterranean, and litosol [1] [2].

The plantation sector has been the leading sector in Malang Regency, consisting of dry land and rice fields, producing basic food commodities. The plant heterogeneity and ecological condition in this area need to be maintained. A rumor has been spreading regarding the plan for developing oil palm plantations in South Malang. The soil types in Malang Regency include the Mediterranean, lithosol, regosol, and latosol, which are relatively fertile soil for plantations yet easily eroded. Latosol and regosol soil are suitable for oil palm plantations. The plan to open oil palm plantations in the southern Malang Regency will positively and negatively impact the social economy and the surrounding environment.

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Regency will positively and negatively impact the social economy and the surrounding environment.



**Figure 2:** A Map of South Malang.

The development of oil palm plantations has been mainly carried out by entrepreneurs, in which natural forests or industrial plantation forests are converted into oil palm plantations [3] [4]. The expansion of oil palm plantations brings impacts to forest areas in Indonesia. Law Number 41 on Forestry categorized the functions of forests into three: protection forests, conservation forests, and production forests. Government policies are the benchmark for the development of oil palm plantations [5]. Changes in land use might lead to weaker functions of forests in soil and water conservation. In addition, improper land conversion using fire decreases the productivity of the land in the long term. Land conversion will result in lower land quality. Slash and burn leaves wastes that accelerate soil washing and impoverishing [5] [6] [9]. Degradation in soil organic matter contents will worsen soil physical and chemical properties [1].

In developing areas, most development plans are profit-oriented than sustainability-oriented, so it often neglects environmental factors. The industrial sector, which highly depends on environmental resources, contributes to massive pollution, especially in developing countries [6]. The development of oil palm plantations should be first reviewed in in-depth studies to evaluate the land suitability and land capability

to avoid degradation in soil quality in the future. In addition, the Environmental Impact Assessment (*Analisis Mengenai Dampak Lingkungan – AMDAL*) resulted in a recommendation to limit the expansion of oil palm plantations to avoid damages to the ecosystem, and material, social, and environmental losses.

## 2. Method

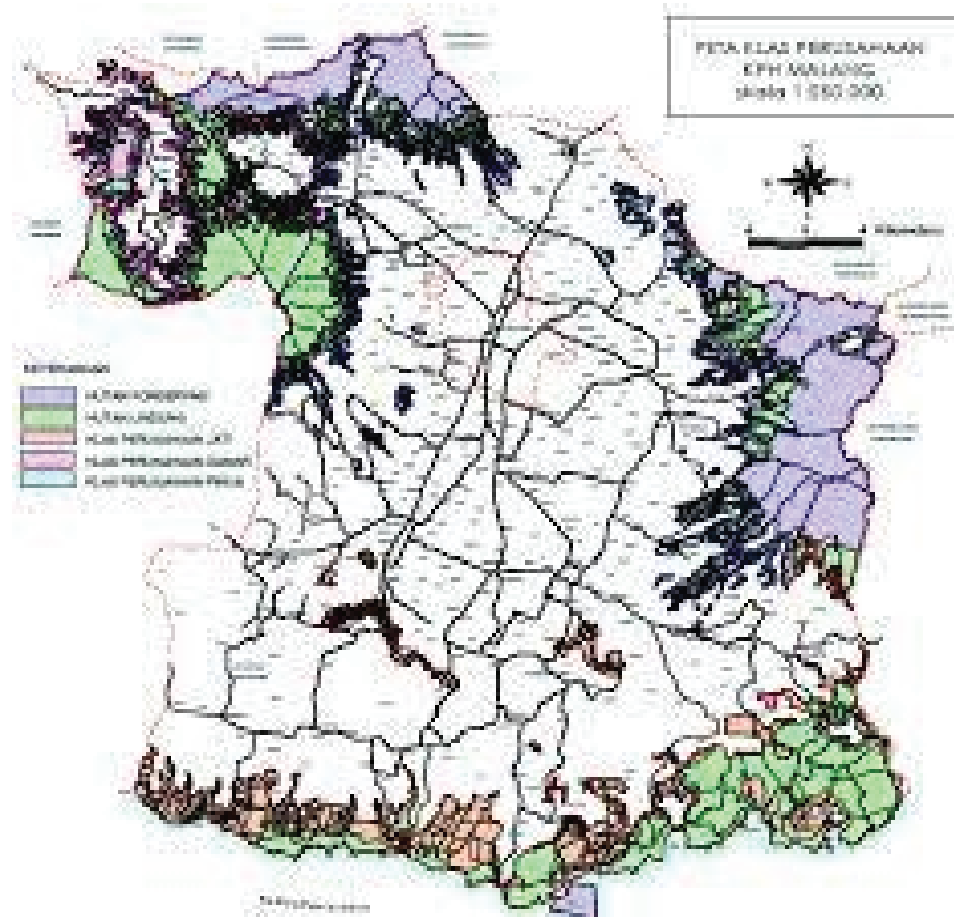
This study took place in Donomulyo District, Malang Regency, East Java Province. Primary data were obtained from respondents through observations and interviews. Secondary data came from library materials, including research-based books, research reports, scientific publications, regional regulations, and government agency data. This present qualitative research focused on the process and meaning or perceptions to present a variety of qualitative information with a detailed and meaningful analysis that at the same time did not neglect quantitative data in the forms of numbers or amounts. Logics, irregularities, and behavioral displays and their integration will be revealed in the genetic case study [8].

## 3. Result and Discussion

Regarding the land conversion issue in Malang Regency, the Regent, Sanusi, said that the Malang Regency Government would develop oil palm plantations. It would provide production and processing land of 50,000 hectares, and investors would establish a biofuel factory. The southern part of Malang Regency has the Mediterranean, lithosol, regosol, and latosol soil types—they are fertile soil suitable for plantations yet easily eroded. Latosol and regosol soils are known to be ideal for oil palm plantations. However, this area also has a range of karst hills (especially those close to the south coast) that potentially accelerate the rate of water infiltration. The success of oil palm cultivation is determined by three factors: resources, characteristics of farmers, and market demand. Land suitability for oil palm plantations is very site-specific, and the geographical conditions greatly determine the plant productivity.

The data released by *Dinas Kehutanan Jawa Timur* or East Java Provincial Forestry Service showed that the total forest area in Malang was 41,203.40 hectares for protected forests, 44,866.40 hectares for production forests, and 23,856.96 hectares for conservation forests. The total area of protected forests has decreased from the previous year (in 2017) due to conversion to production land and built-up land [4]. The conversion of protected forests into production forests is possible through political movements by the

local government to obtain support from the central government. The production and processing of palm oil will take place in South Malang. Thus, these activities should focus on improving the welfare of the local community. This productive activity might bring economic benefit for the local community, yet its impacts on the environment should be anticipated.



**Figure 3:** A Clas Map of Forest Management Unit Companies in Malang (Source: IG Sahabat Alam).

Oil palm plantations consume a high amount of water—they will reduce the quantity of groundwater. Consequently, drought might occur in the dry season. The gluttony level of water is reflected in water consumption, and it can be measured based on evapotranspiration value. Studies reported that the range of evapotranspiration values in oil palm plants is between 1100 and 1700 mm per year [10], in their three-year study at the sub-unit of Plantation Research Center Kalianta Kabun Riau (*Pusat Penelitian Perkebunan – PPKS*) found the average evapotranspiration value in oil palm plantations was 1,104.5 mm per year. Evapotranspiration at the oil palm plantation in Landak Kapuas sub-watershed was at 4.39 mm per day, or equivalent to 1580 mm per year. Compared to the evapotranspiration value in other plantation crops cultivated in relatively dry



climates, the value range is equal or even more significant. Sugarcane plantations show evapotranspiration within 1,000-1,500 mm per year, while banana plants range between 700-1,700 mm per year [12]. The evapotranspiration value of coconut plants is 1980 mm per year. As a comparison, the evapotranspiration values of other food crops such as rice, corn, and soybeans range from 1,200 – 2,850 mm per year within three planting seasons (equivalent to 1 year). Small leaf forestry plants, such as *lamtoro* or white leadtree (*Leucaena leucocephala*), acacia, and *segon* or Chinese Albizia (*Albizia chinensis*) even have much higher annual evapotranspiration values than oil palm of 3,000 mm per year, 2,400 mm per year, and 2,300 mm per year, respectively.

The labeling of oil palm as a water-consuming plant is logical as it has a fibrous root system that grows in shallow soil that requires a regular watering system and rainfall all year long. Oil palm plants are also prone to drought stress, which refers to an environmental condition where plants could not get adequate water intake, negatively affecting the growth process and production yield. The shallow root system also makes oil palm plants have a relatively lower ability to store water reserves than other plants. This type of root has a weak binding ability to the soil, making it vulnerable to erosion if the plants are planted on slopes or riverbanks. In planting oil palm, it is necessary to compact the soil to reduce the soil pores, thereby reducing the infiltration ability of water into the soil. Based on this explanation, oil palm is not a water-consuming plant, yet its cultivation and yield processing can negatively impact the environment. The 1945 Constitution Article 33 Paragraph 3 concerning the Indonesian Forum for Environment or (*Wahana Lingkungan Hidup Indonesia – WALHI*) states that the earth and water and the natural resources therein are under the control of the state for community purposes. The plan to develop oil palm plantations might violate the 1945 Constitution.

The field observations done in Donomulyo showed that South Malang is still dominated by protected forests, production forests, and plantation lands. Production forests mainly produce teak wood, while the plantation lands produce mostly sugar cane, coconut, rice, and corn plantations. A resident named Tukiman [7] said that palm oil price was relatively low compared to its cultivation effort. Thus, opening up oil palm plantations can lead to economic losses. He planted oil palm once because of the promoted economic benefits [12] [13]. He obtained the oil palm seeds from a factory in Blitar. He concluded that coconut plants offered higher profits than oil palm. Thus, he replaced the oil palm plantations with coconut plants. Farmers were starting to replace oil palm plantations with other crops based on economic considerations.

The oil palm plantations in Donomulyo were first established in the 1990s. The palm oil fruits or Fresh Fruit Bunches (FFB) were distributed and processed in a processing



Figure 4: Google Earth Image.

factory located in Blitar, namely by PT Sawit Arum Madani. The oil palm plantations areas then became a trend from 2000 to 2012. Farmers began to plant oil palm to gain more profit than other crops. Oil palm trees can be first harvested four years after planting with once or twice harvests per year. Oil palm is a plant with shallow fibrous roots that requires regular watering every year. In this study, we found that the soil in the oil palm plantations in Donomulyo started to experience compaction, as shown by vehicle tire grooves and the presence of a runoff pond. Thus, it can be assumed that the soil infiltration rate is low. However, those conditions might also occur because the soil contains lime, allowing water to infiltrate quicker, reducing the plant water intake. The lime content in the soil and short roots of palm oil plants bring another potential disaster, soil erosion in planting areas located on slopes and riverbanks.

The other concern for oil palm plantations is the economic benefit, which is indicated by community welfare. Some residents explained that the production yield of oil palm continued to decline every year. The main cause was drought stress due to lower rainfall. In addition, the price of palm oil keeps decreasing, that planting oil palm can lead to economic losses. Therefore, many farmers have switched to planting other crops and converting their oil palm plantations into livestock farming. Palm oil price is too low at Rp 900 per kilogram and once fell to the lowest price of Rp 400 per kilogram. Because of environmental sustainability and economic reasons, the plan to open up oil palm plantations in South Malang is improper and should be halted.

## 4. Conclusion

The observation and collection of secondary data to review the plan to open up oil palm plantations in South Malang resulted in these conclusions.

1. The soil in South Malang is karst soil that is vulnerable to water erosion.
2. South Malang has low rainfall, making it prone to drought.
3. Continuing the plan will bring economic loss to the community.
4. Regarding those considerations, it can be concluded that South Malang is not a good area for oil palm plantations.

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