The potential of Lampung province as the area for producing mineral fertilizer

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Abstract. Lampung Province has the potential as a producer of mineral fertilizers. The availability of mineral and rock resources in the area has the potential to be processed into mineral fertilizers. Rocks and minerals have been shown to increase productivity and maintain fertility of agricultural land. Rocks and minerals such as zeolite, basalt, pumice, limestone, phosphate and perlite, its availability in Lampung Province makes it possible to become an agro-mineral industry raw material. For this reason, there is a need for good cooperation between related agencies to create processing of rocks and minerals into effective, efficient mineral as fertilizers.

Keywords: Rocks, minerals, fertilizers, agro-mineral, agricultural

1. Introduction

The availability of food is necessary to compensate for the increase of the population. The impact of increasing population land use has shifted. The total of agricultural land continues to decrease because the function of land is transformed into residential land. The decreasing of soil quality in agricultural land causes the decreasing in productivity. To overcome this problem, there are two things. First, control the conversion of agricultural land. Second, improve the quality of critical land to function as agricultural land [1]. To maintain and increase the productivity of the soil, it is necessary to add nutrients by fertilizing. Unfortunately, the chemical fertilization process will damage the soil structure itself. Adding minerals into the soil that a good technique to restore the soil fertility [2]. Fertilizers are materials that contain one or more nutrients needed by plants including C, H, O, N, P, K, Ca, Mg, S, Fe, Mn, U, Zn, L, Mo, and B.

The important production factor for the agricultural sector is fertilizer. Fertilizers contribute to the success of increasing agricultural production by 20 percent [3]. The most essential plant nutrients are nitrogen (N), phosphorus (P) and potassium (K). Except for some special nitrogen fertilizers, almost all artificial fertilizers from rocks which chemically processed, i.e. rocks that have been chemically modified, plus some micronutrients that are often needed by plants, such as calcium (Ca), magnesium (Mg), sulfur (S), copper (Cu), cobalt (Co), iron (Fe), and etc. Generally, only modified physically, for example by crushing. However, modifications is needed for rocks and minerals (derivative), which has a number of specific chemical substances combined with an aggregator, but only simple techniques consumption that can be optimized.Therefore, agro-mineral is expected to be an alternative substitute for fertilizer that is cheaper and easier to obtain to increase plant nutrition and improve soil structure, by utilizing the geological resources found around the agricultural land [4].

Natural minerals contain many macro and micro elements which can be used as nutrients for plants. The macro and micro elements in natural minerals depend on the building blocks of rocks. The application of
natural minerals as a source of nutrients is a natural process that utilization for fertilizer will be safe for the
environment [3].
Lampung Province has the potential of natural resources in the form of metallic, industrial, energy and
construction minerals. Nevertheless, the findings related to mineral deposits in the area of Lampung has not
been found, both in quantity and quality. In this paper, the authors try to explain the potential of mineral
deposits in Lampung province which can be used to build the mineral fertilizer industry.

2. Description of Lampung Province
Lampung province is an area with average high around 300-500 m of the sea. It is located between 103°
40' and 105°50' east longitude, 6°45', and 3°45' South latitude. Lampung province area is shaped by
34,623.80 km². In terms of geographic position has Lampung province boundaries as follows: North-South
Sumatra province and Bengkulu province; South-Sunda Strait; West- Java Ocean. Lampung province has 13
regency and 2 municipality, include; West Lampung, Tanggamus, East Lampung, South Lampung, North Lampung, Way Kanan, Tulang Bawang, Pesawaran, Mesuji, Pringsewu, East Tulang Bawang, The West Coast regency, Bandar Lampung, and Metro municipality [33].

2.1 Geology Lampung Province
Lampung province has a total area of 35288.35 Km² including the islands located at the most south-eastern
part of Sumatera Island. Lampung province is bordered by the province of South Sumatra and Bengkulu to
the North, The Sunda Strait to the South, the Java Sea to the East, the Indonesian Ocean to the West.
Western ridge of Lampung is part of the Bukit Barisan mountain range of the which is Geanticlinal and
Synclinal to the east. This part of the mountains from the Cretaceous age, underwent deformation process
during the tertiary age to form a fault. This process generates a geological phenomenon like long-cal
Watermelon fault along the river of Way Watermelon and gulf of Watermelon and oval-shaped volcanoes
(Tanggamus, chills, Rebang surround it). Tectonic depressions such as the valleys of Suoh, Gedong
Surinam, and Way Lima roommates were covered by Volcanic sedimentation from the fisuves eruption.
Sukadana Basalt, a plateau, was the result of an eruption that is happened in the Holazin age. This plateau
was not sediment like volcanic sand resulted from volcanic dust. Data on the mineral deposits in Lampung
are not available yet so that the potential of mineral deposits is not much known [33].

2.2 Agricultural conditions
Wetland paddy production in Lampung province Reached 4.09 million tons during 2017 Increased by 6.75
percent, the highest production generated by the Central Lampung Regency, roommates Reached 733.03
thousand tons. The highest productivity of rice crops in Bandar Lampung City is 59.86 quintal/hectare.
Horticultural type of plant for vegetable crops, the Reviews largest production produced by the plant petsai
roommates Reached 10 684 tonnes, where 53.04 percent is produced from West Lampung Regency. While
for the type of fruit plants produced the Reviews largest production of banana fruit roommates Reached
1462.42 thousand tonnes with 32.98 percent produced from Central Lampung Regency. Lampung province
is famous for the production of coconut, rubber, and coffee, it is supported by both kinds of production of
Reviews These plants. In 2017, Lampung is Able to produce 170.475 tonnes of oil palm and 114 214 tons
of coffee. The production of palm oil produced by Central Lampung Regency roommates Reached 25.38
percent of the total production, while coffee production ranks third after rubber production. The largest
coffee produced from West Lampung area Reaches production of 50.35 percent [33].

3. Discussion
In Lampung province, various mineral resources are founded. There are several minerals and rocks that
have the potential to be used as raw materials for the mineral fertilizer industry including:
3.1. Zeolite

Lampung has abundant natural zeolite resources, spread in several districts in Lampung province. Data from the Directorate of Regional Potential Development, in 2012, Lampung had a source of natural zeolite of 31.173.505 tons [5]. Meanwhile, according to Kusdarto, the availability of zeolite in Lampungas much as 200.000 tons in Kalianda District, and 2.000.000 tons in Katibung District both in South Lampung Regency. While in Tanggamus District, Cukuh Balah Sub-district there are 41.600.000 tons of natural zeolite. Zeolite rocks in the Southern District are white tufa, fine-grained to coarse. Mineral consists of clinoptilolite and mordenite with a mineral association of plagioclase, montmorillonite, cristobalite, and quartz. Even though zeolite from Tanggamus is greenish white, hard, and massive [6]. Research and application of zeolite in agriculture has developed. Zeolite has been proven to help the process of increasing production in agriculture, improving the nature of the soil which is physically and chemically damaged.

The function of zeolite in this case as a soil conditioner, carrier of fertilizer, controlling the release of ions NH4+ and K+ (as a slow release fertilizer) and maintaining moisture of soil. Natural zeolite has a good ability to absorb and exchange cations [6-7]. Zeolite is not acidic, so it can support the acidity of the soil and reduce the dose of lime [8]. Five types of zeolite which have been beneficial for agriculture such as clinoptilolite, mordenite, erionite, kabasit, and philipsit. The result analysis of soil showed that zeolite was increased the content of K, Na, Ca, and Mg soil. It was also increase the Cation Exchange Capacity (CEC) and soil pH because the cations in zeolite were pushed out by H+ and the cation was released into the soil solution which may cause the nutrient supply [7]. The application of zeolite has been carried out in various types of soil with various types of plants and showed a positive result to increased productivity and soil structure [9-13].

3.2. Pumice

In Lampung province, data related to pumice resources has not been widely published. However, based on a map of the potential of non-metallic mineral resources in Lampung province, issued by the Directorate Inventory of Mineral Resources, there is potential resources of pumice in South Lampung, Kalianda district. Pumice is a volcanic rock with light colored, chemically and physically unobtrusive, like perlite. These rocks are formed as the result of a great expansion of the gases that are dissolved in a silica-rich lavas such as rhyolite or riodasit thick. Like perlite, pumice has pores, so it can float on water. For horticulture, pumice was took from loose sediment with splitting and sorting. For the environment, the production of pumice more friendly than perlite or vermiculite because it does not require high energy for thermal expansion. The difference with perlite mainly related to pore size, particle shape, and size [4]. Pumice has the physicochemical properties that are similar to perlite so it can be used to replace perlite which is not expensive in greenhouse plant maintenance [4].

3.3. Limestone

Everywhere the soil acidity is a common problem due to the decreasing in agricultural products, including developed countries. High solubility rates, unsuitable rock, and some things are rare such as continuous chemical acidification and the addition of large amounts of ammonium sulfate. The main problem in the highly acidic farming area is insufficient high H+ ions, the addition of highly toxic Al3+ concentrations at low pH, and low levels of Ca2+ ion exchange. These issues are generally handled by liming. All materials containing Ca and Mg compounds can be used as liming materials to neutralize the acidity of the soil, increasing the pH of soil with adding of Ca and decrease of Al.

Limestone and dolomite are materials that have been used for liming for centuries, and it still used in some countries [4]. The acidity of soil have physical and chemical constraints that inhibit the growth of plants. Fertilizing and liming of acid soils can make the land productive. Lime is a group carbonates such as calcite (CaCO3) and dolomite (CaMg(CO3)2), commonly used to increase the pH of soil because it will dissociate into Ca2+ and Mg2+ ions in the soil [32].

In Lampung province, there are 1.900.000 tons of limestone, spread in Pringsewu, Pesawaran, and North Lampung. Limestone is a type of carbonate rock that occurs in nature, also called limestone. The main mineral of limestone is calcite (CaCO3), other minerals are impurity minerals, usually consisting of quartz
(SiO2), carbonate associated with iron minerals and clay minerals, as well as the remaining organic matter of plants [15].

3.4. Perlite
Perlite is a term for volcanic glass material which is not processed and processed. Raw perlates which are not processed are metastable, amorphous, silica-rich volcanic rocks which have a riodytic and riodytic composition. It colored light gray, black glass, and has several concentric fractures resembling the skin of an onion. When heated at a temperature of 1000 °C, the rock will expand to 20 times the volume initially by evaporation of water trapped, white, glass foam forming commercial perlite, porous, lightweight, sterile, physically silicate stable with a good properties heat-retaining (good thermal insulation), and neutral pH.

The expanding perlite has a low bulk density but practically not having cation exchange properties [4]. Perlite may not be directly related to the soil or plants, but widely used as a aggregate of horticulture. The properties of perlite, pH between of 6.5-8.0, and the cell structure causes perlite to absorb the solution many times (can carry herbicides, insecticides, fertilizers, soil regulators and plant roots) [2]. The potential of Perlite in Lampung province was found in West Lampung and North Lampung, with the total mortgage amount of 79 million tons.

3.5. Basalt
The potential of basalt rocks in Lampung province, spread around the mountain from the west side Mt. Tanggamus, through around the semangko bay and continues to the east of Mt. Rajabasa and basalt plains in the Sukadana area. The distribution of basalt divided into two, western volcanic rocks (Oligo to Hulusimpang Miocene formation) and eastern volcanic rocks (from Sukadana to Tamiyang). The difference between eastern and western of basalt in the content of MgO and CaO. Eastern basalt high MgO (7wt%) and low CaO (8wt%), while western basalt low MgO (4wt%) and high CaO (9wt%) [16].

Basalt potential reached 419,071,833 m³ spread over various districts in Lampung province. Some research and application of basalt rocks as mineral fertilizer materials have been carried out [17-22]. The technique of using minerals as soil fertilizer can provide the supply of macronutrients such as nitrogen, phosphorus, potassium, calcium, magnesium, and sulfur, as well as micronutrients such as Fe, Mn, U, Zn and Na on the surface of the ground, this technique also called stone meal fertilizer. Basalt rock can be used as a fertilizer with combined or mixture with other ingredients [21]. In addition, the application of basalt rocks shown an increasing of productivity and growth of plants [23]. Several studies show the benefits of the application of basalt to improve pH, as an alternative to reduce costs and imported raw materials while avoiding negative environmental impacts, improving the Cation Exchange (CEC) of land, and adding K elements to the soil [19] [20] [24-25].

3.6. Phosphate
Natural phosphate (rock phosphate) is the common name used for some types of rocks that contain amounts of phosphate minerals or contains phosphate ions in their chemical structure. Many types of rocks have phosphate-containing components, but rocks containing amount of phosphate that has economic value as mineral or ore is not prevalent [26]. The definition of natural phosphate according to the American Geological Institute is sedimentary rock composed mainly of phosphate minerals [27]. Based on the mineral composition of phosphate sedimentary rock can be distinguished into phosphate-Ca, phosphate Ca-Al-Fe and phosphateFe-Al [28].

Natural phosphate has high solubility in acidic conditions, therefore it is very suitable when used as a source of P fertilizer on dry land such as Ultisol, Oxisol, and some Inceptisol, and less suitable for use in neutral and alkaline soil reaction [26]. Natural phosphate can be used directly as fertilizer and it known as effective as liquid P fertilizer in several countries [29]. The application of natural phosphate from North Carolina and Tunisia in Red Yellow Podzolic soil with P deficiency, pH of 4.5, and saturation aluminum of 78% for four consecutive planting season for upland rice and corn crops showed that the natural phosphate was more effective than TSP [30].
Other studies on podzolic soil from Lampung and Jambi showed that natural phosphate has the same effectiveness and even better than TSP [31]. In Lampung province, phosphate reserves has not been recorded. However, based on the map of Lampung province, the potential of non-metal mineral resources from the Directorate Inventory of Mineral Resources, there is potential for phosphate in North Lampung.

4. Conclusion
The potential of mineral resources in Lampung province needs to be further investigated in terms of quality and quantity. Zeolite, pumice, limestone, pearlite, phosphate, and basalt can be an alternative sources to supply of mineral fertilizers. The good cooperation between the local government and research institutions (Indonesian Institute of Agricultural Technology, Indonesian Institute of Sciences, and University) in Lampung province needs to be developed for agro-mineral industry. The above description about Lampung province provide advantage for developing of mineral fertilizer industry. As the gateway island of Sumatera, and supported by the International class port, Port of Panjang, the mobility of the product will be easy to distribute to the various country in Indonesia. It can be seen the existing of agricultural conditions in Lampung province, it shown the potential market that can be absorbed by producers of mineral fertilizer.

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