Multicriteria land index for determining primary commodity in agricultural landuse planning

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Abstract. Regional development usually start with identifying regional potencys. Defining a local potencies such as primary agricultural commodities is a basic capital in developing regional economic. The concept of determination is pointed by Barlowe (1986), which include bio-physically suitable, economically feasible and institutionally acceptable. The approach (analysis) used in this research is Geographic Information System (GIS), commodity base analysis (LQ), differential shift (SSA), gross margin (GM), distance to market location, process hierarchy analysis (AHP), and multicriteria land index. This research is located in transmigration area of Rawa Pitu Sub District, Tulang Bawang Regency, Indonesia. This research aims to identify basic commodities for each village. The results shows that several land parameters which include land suitability and accessibility, commodity parameters which include LQ and SSA as well as economic parameters which include GM can be used to determine primary commodity in a region. They composed what we call as multicriteria land index. There were some basic commodities identified using such index, which include paddy, maize, rubber, and oil-palm. Paddy is a primary commodities in certain villages. Whereas maize and oil palm is a primary commodities in another villages. Rubber is not a primary commodities in any village.

1. Introduction
The development of rural areas is one of the government's programs in order to support the development of prosperous in Indonesia. The results of the 2010 population census [1] show that the population of Indonesia is 237,641,326 people, and 119,321,070 people or 50.21% live in rural areas. With this proportion, rural development is important in efforts to improve the welfare of the community. Most Indonesians live in rural areas, their lives very depend on the agricultural sector. Based on data from the Central Bureau of Statistics [2], labor in the agricultural sector are as many as 41.20 million people, or 43.4% of the total population of Indonesia. Thus, the agricultural sector in Indonesia is very strategic to improve the standard of living of the population, besides it’s importance of providing food. In fact, the average income per month for agricultural households is very low, only 2.2 million rupiah [3]. However, nationally reviewed until 2013 the contribution of the agricultural sector was second after the processing industry, although when compared to 2003 the share of this sector decreased from 15.2 percent to 14.4 percent [4]. This condition shows the transformation of
Indonesia where the contribution of the primary sectors is replaced by an increase in the secondary and tertiary sectors including housing and infrastructure.

At present, Indonesia's agricultural agribusiness development has a challenge in the form of increasingly competitive market competition in the international sphere. Ratification of various international agreements forces each country to open various trade and investment barriers and open the export-import opportunities as wide as possible. This will encourage increasingly intense market competition, as a result of regional and international market integration on the domestic market. Agricultural land is decreasing due to land conversion to other uses with higher economic value, such as settlements, industries and so on. Topographic farmland is flat and has good liability, it has a large potential to be converted into other uses. According to [5], flat topographic land is generally suitable for the construction of housing and factories, especially those not far from city centers and major transportation routes. For that, the development of each commodity on each land must be efficient. Advanced rural agribusiness development requires natural resource support and the selection of the right commodities. Thus, selecting the right commodity in each part of the region that has different characteristics is an important issue. Commodities that have the advantage to be cultivated in an area called primary commodities.

According to [6], the definition of primary commodities is a mainstay commodity that has a strategic position, based on technical considerations (soil and climate conditions) as well as socio-economic and institutional (technological mastery, human resource capacity, infrastructure, and local socio-cultural conditions) worthy to be developed in an area. Determination of primary commodities in an area needs to be done, with the consideration that commodities that are able to compete sustainably with the same commodities produced by other regions. In addition, these commodities are managed efficiently in terms of technology and socio-economics and have comparative and competitive advantages. The ability of the region to produce and market all commodities in accordance with the conditions of land and climate in certain regions is also limited.

Primary commodity needs to have advantages, both comparative and competitive advantages, so that they are able to compete with competing commodities. The comparative advantage of agricultural commodities is the ability of commodities to produce optimally. For this reason, it needs to be developed on land which has suitable biophysically, it means that it can grow and provide high yields. Such compatibility can be predicted with a land suitability analysis [7], or from the fact that it has been widely cultivated in the region, with an analysis of base commodities [8]. Competitive advantage, means that it has high convenience to be marketed, for example in terms of accessibility. It is seen that many parameters need to be considered so that a commodity becomes a primary commodity. Integrating various comparative and competitive advantages of an area in an analysis will be very helpful in regional development planning. According to [9], the growth of several leading sectors (bases) will determine the development and whole development of the region, while the non-base sector is only the consequences of regional development. Goods and services from the exported base sector will generate revenue for the region and increase consumption and investment. Increased income not only causes an increase in demand for the base sector, but also increases demand for the non-base sector so that it also encourages an increase in non-base sector investment.

This research was conducted to integrate various aspects of determining primary commodities, both physical, economic, productivity and accessibility aspects. As a case study, the Rawapitu area, Lampung Province was taken. In this region which is an agrarian transmigration area, the government developed an agribusiness-based regional development model called “Kota Terpadu Mandiri (KTM)” [10-12]. In its concept, the development of the KTM region is based on the development of agribusiness primary commodities. This area is one of the transmigration areas in Lampung Province which has a lot of potential natural resource, but it is less developed. This can be seen from the lack of infrastructure and post-harvest processing. One way to develop this region is through the development of primary commodities. The purpose of this study was to identify primary commodities in the Rawapitu transmigration area, by integrating several parameters.
2. Methodology
This research was conducted in Rawapitu Sub District, Lampung Province. The study area is located at 04°12’ - 04°22’ S and 105°30’ - 105°45’ E (Figure 1). The research area is a sub-district that included 9 (nine) villages. The climate in the study area is wet tropical, with an average annual rainfall (based on data from the 2 (two) nearest climate stations) of 1,712 (Wirala station) and 2,372 mm (Menggala station). Based on the Oldeman climate classification system, the study area included the C2 climate type which is the type of climate with a wet month of 5 - 6 months, and dry months 2 - 3 months.

The spatial data used is the Indonesian Rupabumi Digital Map (RBI) on a scale of 1:50,000 [13]. Primary data was acquired using a questionnaire. Field surveys for soil sampling for laboratory analysis were carried out in 2010, while commodity prices used for regional economic calculations were prices in 2013.

The regional analysis in this study was to obtained the parameters of regional development, in the village analysis unit. The village analyzed consist of: Sumber Agung, Batang Hari, Panggung Mulyo, Andalas Cermin, Duta Yoso Mulyo, Gedung Jaya, Rawa Ragil, Bumi Sari and Mulyo Dadi. The analysis includes: (i) analysis of base commodities, in terms of planting area and production value, (ii) shift share analysis, (iii) land suitability analysis, and (iv) economic analysis. These parameters are then synthesized through Analytical Hierarchy Process and normalization for the analysis of the determination of primary commodities. A summary of the research matrix is presented in Table 1.

![Figure 1. Map of the study area.](image)

2.1 Determination of Base Commodities
Base commodities are analyzed using Location Quotient (LQ) analysis. This method was adopted from [14-15]. LQ measures relative concentration or degree of specialization of economic activities through a comparative approach. In practice, LQ analysis is not limited to economic use, but extends to various fields related to planning including commodities [16; 6]. In this study, the analysis was carried out with 2 bases: (i) harvest area, and (ii) production value (production x price). The assumptions used in this analysis are (i) relatively uniform geographical conditions, (ii) activity patterns are uniform, and (iii) each activity produces the same product. LQ values are calculated using the following formula:

\[
LQ_{ij} = \frac{X_{ij}/X_i}{X_{j}/X_c}
\]

where: LQij = Location Quotient Value (LQ for activities to j in the i region; Xij = planting area (ha)/income value (Rp) for commodities to j in the village to i; Xi. = Planting area (ha)/income value total (Rp) in the village to i; Xj = planting area (ha)/income value (Rp) commodity to j
in the total area; \( X_{..} \) = planting area (ha)/income value (Rp) all commodities in the study area; 
\( i \) = the village studied, \( j \) = commodity.

### Table 1. Purpose matrix and research analysis.

| Objectives | Data Source | Type of Data | Data Analysis Technical |
|------------|-------------|--------------|-------------------------|
| (i) Determination of base commodities | Tabular statistical data [2] | Secondary data | ▪ LQ analysis, based on planting area  
▪ LQ analysis, based on production value |
| (ii) Determination of shifts in commodity production | Tabular statistical data [2] | Secondary data | Shiftshare analysis |
| (iii) Determination of commodity land suitability | Soil analysis in the Land Map Unit | Primary data | Land suitability analysis |
| (iv) Economic feasibility | Interview with community (price) | Primary data | Calculation of Gross Margin |
| (v) Accessibility | Spatial data (road track) | Primary and secondary data (spatial) | Calculation on map |
| (vi) Weighting | Analysis results (i), (ii), (iii) dan (iv) | - | Analytical Hierarchy Process |
| (vii) Multi-criteria land index | Analysis results (i), (ii), (iii), (iv) dan (v) | - | Normalization and index calculation |

The interpretation of the results of the analysis is as follows:

(i) If the value is \( > 1 \), the commodity \( i \) has a comparative advantage to be developed in an area (village).

(ii) If the value is \( < 1 \), the commodity \( i \) does not have a comparative advantage to be developed in an area (village).

In this study, LQ analysis was carried out using the data of the planting area of 4 (four) selected commodities in 2013 and the value of income by multiplying the number of production and prices. Planting and production area data were obtained from Rawapitu in 2012 figures [2]. Prices are obtained from the results of field observations, with details of the prices of each commodity as follows: rice Rp. 2,000, -/kg, corn Rp. 1,000, -/kg, oil palm Rp. 950, -/kg, and rubber Rp. 8,000, -/kg. While the production data per kilogram obtained from field observations for rice and corn varies relatively in each village, ranging from 4,000 - 9,000 kg for rice and 3,000 - 4,000 kg for corn. For oil palm and rubber, the price is relatively the same in all villages, namely Rp. 1,250 kg for palm oil and Rp. 1,150 kg for rubber.

2.2 Shifting Commodity Structure

Shift Share Analysis is a technique used to understand the shift in activity structure in a particular location compared to a reference (with a wider area) in two time points [17]. Literature survey shows that shift-share analysis is one of the methods most often used by planners, geographers and regional scientists [18]. Shift share analysis can be used to set targets/sectors and analyze economic impacts. The shift-share analysis equation can be written as follows:

\[
SSA = \left( \frac{X_{i(1)} - X_{i(0)}}{X_{..(0)}} - 1 \right) + \left( \frac{X_{i(0)} - X_{..(0)}}{X_{..(0)}} \right) + \left( \frac{X_{..(1)} - X_{..(0)}}{X_{..(0)}} \right)
\]

\( a \) \( b \) \( c \)
where: \( a \) = component share; \( b \) = proportional shift component; \( c \) = differential shift component, and 
\[ X_{...} \] = area of agricultural land; \( X_i \) = total land area for commodity farming to \( i \); \( X_{ij} \) = land area for the fifth commodity in the village area to \( i \); \( t_1 \) = final year point; and \( t_0 \) = starting year point.

In this study, shift share analysis was carried out based on the Rawa Pitu Sub District harvest area data relative to Tulang Bawang Regency. Ideally, the shift share analysis is carried out using harvest area data per village, so the unit of analysis is the same as other analyzes. However, due to limited data with two points a year, the data analysis used per-commodity data (not per village). This needs to be noted, considering that in most areas of analysis in Indonesia, data on village units are generally more difficult to obtain compared to sub-district level data, let alone districts, where data is relatively more available because it becomes an official observation unit of institutions such as the Central Statistics Agency.

2.3 Land Suitability
Land suitability evaluation is an assessment of land suitability for certain uses [19], for example cultivation of rice, corn, and so on. Several methods can be done for land evaluation, one of the most popular is the minimum limiting method [20]. With this method, evaluation is done by matching the characteristics of the land from a land unit with plant growth requirements or criteria. In this study, evaluations were carried out using minimum constraints, used criteria from the Agricultural Research and Development Agency [21]. In this study, the assessment was carried out on the actual land suitability, namely the current land suitability, without the input.

2.4 Gross Margin
Economic analysis is carried out to obtain information about the financial feasibility of farming, including the amount of income and farm profits. Economic analysis conducted is Gross Margin (GM), Benefit Cost Ratio (BCR/BC Ratio, Net Present Value (NPV)), and Internal Rate of Return (IRR). The selected commodities analyzed are based on field survey data and primary commodities analysis. Identification of commodity choices can be seen from the many/least of these commodities being cultivated by farmers, in addition to the physical potential of the land. The commodities include rice, corn, rubber, and oil palm.

In this study, the parameters of economic analysis, only Gross Margin. Gross Margin (GM) value or economic benefit, is calculated from the average amount of income minus the average amount of all costs incurred in a certain area of land (for example per hectare) within a certain period (for example per year). Gross Margin is agricultural income (production x price) less costs. Mathematically can be written:

\[
Gross Margin = \sum_{ki} production\; ki \times product\; price\; ki - \sum_{ji} input\; ji \times input\; price\; ji
\]

where: \( ki \) : type of production unit to \( i \); and \( ji \) : input type to \( i \).

Calculations for economic parameters need to refer to the concept of differences in economic output on land with different suitability [19]. The assumptions used can refer to [22]. Production on land with S1 suitability class \( \geq 80\%\) of optimal production, on land with S2 suitability is 60 - 80% of optimal production, on land with S3 suitability classes 40 - 60% of optimal production, and on land with N suitability < 40% of optimal production.

In the final stage, primary commodities were identified for each village. Primary commodities are determined through a multicriteria land index, by determining the 6 (six) analysis results variables used, namely: (i) LQ based on planting area, (ii) production-based LQ, (iii) Shift Share Analysis, (iv) land suitability, (v) economy (gross margin), and (vi) accessibility. In the calculation, the weight of each variable is determined using analytical hierarchy process (AHP) analysis.
2.5 Analytical Hierarchy Process (AHP)
AHP is one method to develop a priority from various choices using several criteria (multi criteria). Because of its multi-criteria, AHP is widely used in prioritizing [23]. AHP in this study is used to determine the weight of each of the selected primary commodity variables. Consensus factors for variable weight of primary commodities are determined by experts. In this research, experts consist of 6 agricultural experts of Bogor Agricultural University and Ministry of Agriculture. The simple AHP structure used in this study can be presented in figure 2.

![AHP hierarchical structure of determination of primary commodity.](image)

2.6 Multicriteria Land Index
The primary commodity determination of each village was carried out using the multicriteria land index. The criteria used are 6 (six) variables according to the results of the previous analysis, namely the results of the LQ analysis (planting area and production value), SSA, land suitability, economy, and accessibility. The weight of each variable is obtained from the results of AHP analysis. The variable with the highest weight based on AHP means that the variable is considered the most influential based on community preferences, and opposite. In determining this primary commodity, accessibility variables were added, represented by the distance from the village center to the marketing location of each commodity calculated from the spatial length of the road.

Because the units of the 7 variables are different, it is necessary to normalize through the preparation of an index. Thus, each variable is multiplied by the weight of each variable and then the index value is calculated, the mathematical formula can be written:

\[
I_{ij} = \frac{B_{j} \times X_{ij}}{\sum_{j=1}^{6} B_{j} \times X_{ij}}
\]

where:
- \(B_{j}\) = variable weight to j;
- i = village area = 1, 2, ..., n; n = 9;
- \(X_{ij}\) = variable value to j in region i;
- \(J = 1, 2, ..., 6; X1 = LQ planting area; X2 = LQ production value; X3 = SSA value; X4 = land suitability; X5 = Gross Margin; X6 = accessibility.

Especially for accessibility variables, the value needs to be inverted first, from the distance value. This is based on logical criteria, the closer the village location is to the marketing location, the better it can be assumed (the potential to be a primary commodity in the context of this research), and opposite. The logical consideration is that the closer the distance is, the easier it is for farmers to market their agricultural products, thus spurring the increasing number of farmers to plant these commodities (selected commodities) and with a short distance marketing costs will be small, so that these commodities have great added value for farmers. Thus, the accessibility index value is obtained from the inverse of the city center distance to the marketing location. Mathematically, this can be written as follows:

\[
X_{6} = \frac{1}{B_{j6} \times X_{16}}
\]

where:
- \(X_{6}\) = accessibility index;
- \(B_{j6}\) = Weight of accessibility variables;
- \(X_{16}\) = Accessibility variable value in region i.

Furthermore, so that \(\sum X_{ij}\) values 1.00, then data normalization is carried out, accordingly is presented in equation (4). After obtaining the indexs value of each variable, then the sum of each value
of the indexs variable is obtained so that the total score is obtained. The largest number of commodity scores is determined as the main commodity of the village. Mathematically the addition of indexs (scoring) can be written as follows:

$$Xi = \sum_{j=1}^{P} Xij$$

where : $Xi$ = total area score to $i$; $Xij$ = variable value to $j$ in region $i$; $J = 1, ..., 6$

3. Results And Discussion

Rawapitu Sub District has natural resource potential in the plantation, fisheries and food crop agriculture sectors, infrastructure support and authority in natural resource management. The potential of existing land resources has not been used optimally for the development of agricultural commodities.

3.1 Base Commodities

Location Quotient (LQ) analysis based on planting area and production (table 2) shows that, the basis of annual crop activity in this region is rice because of the 9 villages analyzed, 7 villages including LQ planting area and production value are greater than 1 ($LQ > 1$). For annual crops, oil palm and rubber are the base commodities in 3 villages because of the LQ value $> 1$ in the 3 villages. Calculation of LQ values based on planted area and LQ based on production values shows somewhat different results. More details show the differences in the LQ of corn and rubber commodities. In LQ based on production value, Panggung Mulya village has $LQ > 1$ for corn and rubber, whereas on LQ based on planting area, $LQ < 1$. This difference indicates that both bases of analysis are needed, given the high planting area does not always have implications for high production. In all cases, several factors can influence, including crop failure, especially in rice, in areas that are often flooded.

Table 2. LQ value based on area of planting and production in each village.

| No | Village             | LQ planted area | LQ production value |
|----|---------------------|-----------------|---------------------|
|    |                     | Paddy | Corn | Palm oil | Rubber | Paddy | Corn | Palm oil | Rubber |
| 1  | Sumber Agung        | 1.01   | 0.49 | 0.98     | 1.72   | 1.00   | 0.46 | 0.87     | 1.52   |
| 2  | Batang Hari         | 0.25   | 4.50 | 3.25     | 3.88   | 0.34   | 13.22| 9.08     | 10.82  |
| 3  | Panggung Mulya      | 0.97   | 0.85 | 1.47     | 0.97   | 0.99   | 1.06 | 1.74     | 1.15   |
| 4  | Andalas Cermin      | 1.03   | 1.18 | 0.74     | 0.56   | 1.01   | 1.06 | 0.84     | 0.64   |
| 5  | Duta Yoso Mulyo     | 1.19   | 0.00 | 0.56     | 0.31   | 1.05   | -    | 0.50     | 0.28   |
| 6  | Gedung Jaya         | 1.26   | 0.00 | 0.03     | 0.04   | 1.06   | -    | 0.03     | 0.03   |
| 7  | Rawa Ragil          | 1.22   | 0.35 | 0.09     | 0.05   | 1.05   | 0.29 | 0.07     | 0.04   |
| 8  | Bumi Sari           | 1.25   | 0.00 | 0.13     | 0.00   | 1.06   | -    | 0.10     | -      |
| 9  | Mulyo Dadi          | 1.10   | 0    | 1.47     | 0.11   | 1.05   | -    | 1.42     | 0.11   |

3.2 Shifting Growth

Area of Commodity Planting. Based on the results of SSA analysis (table 3), the results of the growth rate of planting area in Tulang Bawang Regency were obtained at -0.27. This shows that the rice commodity in the Rawapitu Sub District has a lower growth rate of planting area compared to the total growth rate in Tulang Bawang Regency. The growth rate of planting area was 0.26 lower than the growth rate of planting area in Tulang Bawang Regency. Other commodities such as corn, oil palm and rubber have a growth rate of planting area greater than the total growth rate in Tulang Bawang Regency. This fact shows that the exploitation of annual crops is generally more attractive to people in this region. Most likely this is related to annual crops income potential that is greater than seasonal crops.
The results of the analysis showed that for corn plants, the land suitability class at the study location was S3 (marginally suitable) and N (not suitable). Land with S3 land suitability class (marginally suitable in the middle of the research location, while land with N land suitability class (not suitable) is located along the Pidada River and Tulang Bawang River. The dominant limiting factor is

### Table 3. Decomposition value of growth shifts.

| No | Commodity   | Componen          | SSA  |
|----|-------------|-------------------|------|
|    |             | Regional Share    | Proporsional | Differensial |
| 1  | Paddy       | -0.27             | -0.26        | 1.640        | 1.11 |
| 2  | Corn        | -0.27             | 0.37         | -0.097       | 0.00 |
| 3  | Palm oil    | -0.27             | 0.28         | -0.088       | -0.08|
| 4  | Rubber      | -0.27             | 0.26         | 0.003        | -0.01|

Note: SSA = Shift Share Analysis

In the analysis of the decomposition of shifts in the growth of planted area, the components used in multicriteria matrices determining primary commodities are components of differential shifts, because they can explain in the scope of activities and smaller areas. Meanwhile, component share and components of proportional shift explain in more general scope (aggregate). Differential shift components can explain the dynamics of a certain level of competitiveness in certain sub-regions of the activity in other sub-regions.

### 3.3 Land Suitability of Commodity

In this study the types of commodities analyzed for land suitability were corn, paddy rice, rubber and oil palm. The selection of the evaluated commodity is based on the facts in the field, the plant area of these commodities is dominant. In addition, the village monograph data in 2011 also shows that there are only 4 data (commodities) that have sufficient data. The recapitulation of the results of the land suitability analysis at the research location is presented in table 4 and figure 3.

### Table 4. Land suitability levels in research sites.

| No | Soil Name (USDA. 2010)             | Land suitability for: | Area (Ha) |
|----|-----------------------------------|-----------------------|-----------|
|    | Association of Kanumphuludults.   | Corn                  | 315.93    |
| 1  | Dystrophepts. Tropaquents          | Cassava               |           |
|    | Association of Humaquents.         | Paddy                 |           |
|    | Sulfihemists                      | Palm oil              |           |
| 2  | Assosiasi of Tropaquents.          | Rubber                |           |
|    | Hydraulents. Tropohemists.         |                       |           |
|    | Sulquaments                        |                        |           |
|    | Association of Hydraulents.        |                       |           |
| 3  | Fluvaquents. Tropohemists.         | S3-nr/oa              | 2,517.20  |
|    | Sulquaments.                       |                        |           |
|    | Association of Hydraulents.        | S3-nr/rc              |           |
| 4  | Sulfihemists. Sulfiquents.         |                        |           |
|    | Tropaquents                         |                        |           |
|    | Association of Hydraulents.        |                        |           |
| 5  | Sulfihemists. Sulfiquents.         |                        |           |
|    | Tropaquents                         |                        |           |
| 6  | Association of Hydraulents.        |                        |           |
|    | Tropohemists. Sulfiquents.         |                        |           |
|    | Association of Hydraulents.        |                        |           |
| 7  | Tropahemists. Sulfiquents.         |                        |           |

| Jumlah | 20,710.62 |

where: S1 = suitable, S2 = quite suitable, S3 = marginal suitable, N = not suitable; rc = rooting media, tc = temperature, wa = availability of water, eh = erosion, oa = availability of oxygen; nr = nutrient retention.

The results of the analysis showed that for corn plants, the land suitability class at the study location was S3 (marginally suitable) and N (not suitable). Land with S3 land suitability class (marginally suitable in the middle of the research location, while land with N land suitability class (not suitable) is located along the Pidada River and Tulang Bawang River. The dominant limiting factor is...
nutrient retention (nr). This is because the soil in the research location generally has a pH <5, with soil chemistry that is relatively poor, so it is less suitable for the growth of corn. Based on the criteria of BBSDLP (2011) [24], corn growth will be good in soil conditions with a pH of 5.8-7.8. Improvements or actions that must be taken to land that has a nutrient retention barrier include liming and adding organic matter to improve soil structure. Land suitability maps for corn plants in the study location are presented in figure 3a.

For paddy field, all study locations have a land suitability class S3 (marginally suitable). The dominant limiting factors are nutrient retention (nr) and rooting medium (rc). The results of soil analysis showed that in some places the soils had soil pH ranging from 3 to 5. Land suitability maps for lowland rice crops are presented in figure 3b.

For annual crops, the results of the land suitability analysis of rubber and oil palm plants show the same results. Because both of these commodities have growing characteristics of plants that require the same growing requirements for plants. The land suitability class for rubber and oil palm at the research location is quite varied, from S2 (quite suitable), S3 (marginally suitable) to N (not suitable). Land characteristics that are limiting factors are oxygen availability (oa), nutrient retention (nr) and rooting media (rc). The lands with S2 land suitability class (quite suitable) for the cultivation of rubber and oil palm are extending from the East to the South of the research location. The S3 land suitability class (marginal suitable) are in the middle. Whereas lands with N land suitability class (not suitable) are in the North-Eastern part of the study location. Land suitability maps for rubber and oil palm in the study locations are presented in figure 3c.

**Figure 3.** Map of land suitability for: (a) corn, (b) paddy field, and (c) rubber and palm oil.
3.4 Distance from the Village Center to the Marketing Location
The accessibility is calculated from the village center to the marketing location. The length of the distance is obtained by measuring the length of the road from the village center to the location of the marketing in spatial data. The center of the village (in this case) is the center of government which is generally characterized by the existence of offices and village halls (balai desa). Whereas the marketing location of each commodity varies, both in the form of markets and collectors of agricultural commodities. Based on field observations, it is known that paddy are generally marketed to Rawa Ipil (market), which is included in the administrative area of South Rawapitu Sub District. The location can be reached by land (road) and river. Land routes can go through the Simpang Mesir to the North. Meanwhile, for maize harvests, it is marketed to Unit II, which is quite a distance from the study location, approximately 40-50 kilometers. To go to Unit II can be reached by road to the West of the study location, by passing Penawar Aji Sub District. The oil palm harvest results, most of them are taken to Unit IX or administratively entered into the Penawar Tama Sub District, while rubber is taken to the Penawar Aji Sub District. The distance of the village to the marketing location of each commodity can be presented in table 5.

Table 5. Village distance to the marketing location of each commodity.

| Distance  | Rawa Ipil (rice) | Unit II (corn) | Penawar Aji (rubber) | Unit IX (palm oil) |
|-----------|-----------------|---------------|----------------------|-------------------|
| Sumber Agung | 14              | 40            | 9                    | 13                |
| Batang Hari       | 24              | 40            | 7                    | 24                |
| Panggang Mulyo        | 29              | 36            | 8                    | 27                |
| Andalas Cermin       | 26              | 43            | 12                   | 30                |
| Duta Yoso Mulyo        | 22              | 45            | 16                   | 27                |
| Gedung Jaya            | 13              | 55            | 24                   | 36                |
| Rawa Ragil              | 10              | 58            | 29                   | 40                |
| Bumi Sari               | 15              | 47            | 20                   | 30                |
| Mulyo Dadi              | 17              | 43            | 9                    | 14                |

3.5 Economy Based on Land Suitability
Economic analysis or quantitative analysis of land for annual crops is done to calculate the value of Gross Margin (GM) and BC ratio. While the annual crops of oil palm and rubber carried out a more complete economic assessment, namely calculating the value of Gross Margin (GM), BC ratio, Internal Rate of Return (IRR), and Net Present Value (NPV). The parameters used for calculating the land index are only Gross Margin.

The results of a land suitability-based economic analysis show that the largest Gross Margin (GM) value is Palm Oil on S2 suitability land, which is Rp. 7,288,733.33, /ha/year, then Rubber on S2 suitability land with a Gross Margin value of Rp. 6,751,000.00/ha/year.

Another economic parameter calculated is BC Ratio. The value greater of the BC Ratio, the higher of feasibility level commodity. The largest BC ratio is 3.42 in palm oil commodities in the S2 suitability class. The BC ratio value is 3.42, meaning that each investment of one unit will receive revenue of 3.42 times the initial capital.

In rubber and oil palm commodities, the IRR and NPV values were calculated. For both commodities, the IRR value that is greater than the bank's interest at that time is 15%, so it is concluded that it is feasible to cultivate. Based on IRR calculations for the two commodities, almost all of them were greater than 15%, except for palm oil commodities in the N suitability class (IRR = 6.59).

The NPV value is positive (+), indicating that the commodity is suitable to be cultivated, and opposite. The calculation results show that almost all of them are positive, except for rubber commodities on land N (-8,351,619.97). The complete results of the economic calculations are presented in table 6.
Table 6. Components value of GM, BC, IRR and NPV Ratios.

| Commodities | Class of Land Suitability | Gross Margin (Rp/ha/year) | BC Ratio | Internal Rate of Return (IRR) | Net Present Value (NPV) |
|-------------|---------------------------|---------------------------|---------|-------------------------------|-------------------------|
| Paddy       | S3                        | 6,222,241.00              | 1.69    | -                             | -                       |
| Corn        | S3                        | 528,098.00                | 1.00    | -                             | -                       |
|             | N                         | -1,851,902.00             | 0.42    | -                             | -                       |
| Rubber      | S2                        | 6,751,000.00              | 1.78    | 25.22                        | 14,722,911.78           |
|             | S3                        | 4,617,666.67              | 1.34    | 15.08                        | 6,332,172.96            |
|             | N                         | 884,333.33                | 0.56    | -                             | -1,351,619.97           |
| Palm oil    | S2                        | 7,288,733.33              | 3.42    | 47.28                        | 26,954,070.75           |
|             | S3                        | 5,077,133.33              | 2.57    | 42.37                        | 17,432,163.14           |
|             | N                         | 1,206,833.33              | 1.07    | 6.59                         | 768,824.82              |

3.6 Determination of Primary Commodities Based on Multicriteria Land Index

Primary commodity is determined through the addition of the primary commodity index by using data from several analysis results, namely the Location Quotient (LQ) analysis, Shift Share Analysis (SSA), land suitability analysis, production distance aspects to marketing locations and economic analysis.

The first stage of AHP analysis of the variables used. This AHP result shows the weight of each variable used. The highest AHP variable value shows that the variable in the respondent's value (expert) determines the primary commodity. Furthermore, the AHP value is used to calculate the variable value weight. After the AHP value is known, the next is multiplying the AHP value with the value of each variable, so that the weighted value (BxN) is obtained and then the index value is calculated. The weight of the primary commodity determining variables resulting from AHP calculation is presented in Table 7.

Table 7. Components value of GM, BC, IRR and NPV Ratios.

| No | Type of Variable | Value of AHP |
|----|-----------------|--------------|
| 1  | LQ Planting area| 0.34         |
| 2  | LQ Production value| 0.29      |
| 3  | SSA             | 0.15         |
| 4  | Land suitability| 0.11         |
| 5  | Accessibility   | 0.06         |
| 6  | Gross Margin    | 0.05         |
|    | Total           | 1.00         |

The analysis data used is the value of the aspects of comparative and competitive advantage obtained from the results of LQ and SSA analysis. For the aspect of land suitability that is used, it is obtained from the area of class land suitability S1 to S3 in units of hectares. Meanwhile, from the aspect of accessibility is obtained from the results of calculating the distance of the production location to the marketing location with a unit of kilometers (km). Economic aspects are obtained from the proportion index obtained by multiplying the value of Gross Margin (GM) with the suitable land area based on the suitability class with a unit of IDR/ha/year.

Index calculation is done by comparing the value (Xn) with the total value (∑X1-n), so that the sum of the values of each index is 1.00. Accessibility parameters have the opposite meaning, because it is assumed that the closer the distance (small value), the better the condition, and opposite. Furthermore, how to get an accessibility index is done by inverse the value (1/Xn), after that the accessibility index is normalized in the same way and if added up is 1.00. Details of the results of the analysis are presented in table 8, while the scoring of the results of the identification of primary commodities is presented in table 9.
Based on the above stages, it is known that the highest score for the rice crop commodity is Rawa Ragil village with a score of 0.79, while the highest score for corn commodity is in Andalas Cermin village (0.64). This shows that lowland rice is the primary commodity of Rawa Ragil village, while corn is the primary commodity of Andalas Cermin village. Meanwhile, for rubber and oil palm commodities, the highest score was in the same village, namely Sumber Agung village, which were 0.77 (rubber) and 0.83 (oil palm) respectively. This shows that rubber and palm oil are primary commodities in the village of Sumber Agung.

Meanwhile, when viewed based on the village area (table 9), it is known that the rice crop became primary commodity in the Gedung Jaya, Rawa Ragil and Bumi Sari village. While corn became primary commodity in Batang hari, Panggung Mulyo, Andalas Cermin and Duta Yoso Mulyo villages. Palm oil primary commodity in the villages of Sumber Agung and Mulyodadi, and for rubber commodities are not primary commodity in any village.

Rubber commodities do not become primary commodities at the study location, because rubber is an annual crop that rarely cultivated by the local community. Meanwhile, some of the data used are existing commodity data (not potential), such as planting area, production and so forth. So indirectly, the value of rubber commodities is still small. But actually, based on biophysical and economic studies through land suitability analysis and economic analysis of farming, rubber plants are quite suitable for cultivation at the study site, with land suitability class S2 (quite suitable).

However, although biophysically and economically sufficiently suitable for rubber commodities, this area should be maintained as a rice producing area in Tulang Bawang District. Besides having the advantage of resources, it can also maintain the availability of food, especially rice in Lampung. The protection of first class land for food crops (rice) is protected by law, one of which is Law Number 41 of 2009 concerning Protection of Sustainable Food Agricultural Land. So that with the existence of this law it is expected that the rice fields in the research location can be maintained and the welfare of the people in the research location in particular and Lampung in general can be achieved. Minimizing the development of rubber cultivation in this region also applies to other annual crops, including oil palm.
| No | Villages            | LQ planting area | LQ Production value | Differential shift (SSA) | Land suitability (area S1, S2 & S3) | Distance from the village center to the marketing location | Gross Margin | Score |
|----|---------------------|------------------|--------------------|--------------------------|----------------------------------|-------------------------------------------------------------|-------------|-------|
|    |                     | BxN I-LT         | BxN I-NP           | BxN I-SSA                | BxN I-K                          | BxN I-Aks Norm-I                                             | BxN I-GM    |       |
| 7  | Rawa Ragil         | 0.41             | 0.13               | 0.31                     | 0.12                             | 0.246                                                       | 0.11        | 0.11  |
| 1  | Sumber Agung       | 0.34             | 0.11               | 0.29                     | 0.12                             | 0.246                                                       | 0.11        | 0.11  |
| 6  | Gedung Jaya        | 0.43             | 0.14               | 0.31                     | 0.12                             | 0.246                                                       | 0.11        | 0.11  |
| 8  | Bumi Sari          | 0.42             | 0.13               | 0.31                     | 0.12                             | 0.246                                                       | 0.11        | 0.11  |
| 4  | Andalas Cermin     | 0.35             | 0.11               | 0.29                     | 0.12                             | 0.246                                                       | 0.11        | 0.11  |
| 9  | Mulyo Dadi         | 0.37             | 0.12               | 0.30                     | 0.12                             | 0.246                                                       | 0.11        | 0.11  |
| 5  | Duta Yoso Mulyo    | 0.40             | 0.13               | 0.30                     | 0.12                             | 0.246                                                       | 0.11        | 0.11  |
| 3  | Panggung Mulyo     | 0.33             | 0.10               | 0.29                     | 0.11                             | 0.246                                                       | 0.11        | 0.11  |
| 2  | Batang Hari        | 0.09             | 0.03               | 0.10                     | 0.04                             | 0.246                                                       | 0.11        | 0.11  |
|    | Sum                 | 3.15             | 1.00               | 2.50                     | 1.00                             | 2.21                                                       | 1.00        |       |
|    |                     | 2.20             | 1.00               | 2.00                     | 1.00                             | 2.278.17                                                   | 1.00        | 8.90  |
|    |                     | 2.00             | 1.00               | 2.10                     | 1.00                             | 2.800,008.45                                               | 1.00        | 6.00  |
| 4  | Andalas Cermin     | 0.35             | 0.11               | 0.29                     | 0.12                             | -0.01455                                                   | 0.11        |       |
| 3  | Panggung Mulyo     | 0.33             | 0.10               | 0.29                     | 0.11                             | -0.01455                                                   | 0.11        |       |
| 5  | Duta Yoso Mulyo    | 0.40             | 0.13               | 0.30                     | 0.12                             | -0.01455                                                   | 0.11        |       |
| 2  | Batang Hari        | 0.09             | 0.03               | 0.10                     | 0.04                             | -0.01455                                                   | 0.11        |       |
|    | Sum                 | 3.15             | 1.00               | 2.50                     | 1.00                             | -0.13                                                      | 1.00        |       |
|    |                     | 2.20             | 1.00               | 2.10                     | 1.00                             | 1.717.26                                                   | 1.00        |       |
|    |                     | 2.00             | 1.00               | 2.10                     | 1.00                             | 2.442                                                      | 3.39        |       |
|    |                     | 2.00             | 1.00               | 2.10                     | 1.00                             | 102,431.71                                                 | 1.00        |       |
| 1  | Sumber Agung       | 0.34             | 0.11               | 0.29                     | 0.12                             | 0.00045                                                    | 0.11        |       |
| 4  | Andalas Cermin     | 0.35             | 0.11               | 0.29                     | 0.12                             | 0.00045                                                    | 0.11        |       |
| 3  | Panggung Mulyo     | 0.33             | 0.10               | 0.29                     | 0.11                             | 0.00045                                                    | 0.11        |       |
| 7  | Rawa Ragil         | 0.41             | 0.13               | 0.31                     | 0.12                             | 0.00045                                                    | 0.11        |       |
| 5  | Duta Yoso Mulyo    | 0.40             | 0.13               | 0.30                     | 0.12                             | 0.00045                                                    | 0.11        |       |
| 2  | Batang Hari        | 0.09             | 0.03               | 0.10                     | 0.04                             | 0.00045                                                    | 0.11        |       |
| 9  | Mulyo Dadi         | 0.37             | 0.12               | 0.30                     | 0.12                             | 0.00045                                                    | 0.11        |       |
| 6  | Gedung Jaya        | 0.43             | 0.14               | 0.31                     | 0.12                             | 0.00045                                                    | 0.11        |       |

Table 8: Identification analysis matrix of village primary commodities.
| No | Villages       | LQ planting area | LQ Production value | Differential shift (SSA) | Land suitability (area S1, S2, & S3) | Distance from the village center to the marketing location | Gross Margin | Score |
|----|----------------|------------------|--------------------|--------------------------|--------------------------------------|-----------------------------------------------------------|--------------|-------|
|    |                | BxN   | I-LT  | BxN   | I-NP  | BxN   | I-SSA | BxN   | I-K   | BxN   | I-Aks | Norm-I | BxN   | I-GM |        |
| 8  | Bumi Sari     | 0.42  | 0.13  | 0.31  | 0.12  | 0.0045 | 0.11  | 121.29 | 0.06  | 1.20  | 0.83  | 0.07   | 145,559.53 | 0.07 | 0.57  |
|    | Sum           | 3.15  | 1.00  | 2.50  | 1.00  | 0.00   | 1.00  | 1866.58 | 1.00  | 8.04  | 12.70 | 1.00   | 2,189,897.57 | 1.00 | 6.00  |
| Commodity 4 – Oil Palm |            |        |       |        |       |        |        |        |       |       |        |        |        |        |        |
| 1  | Sumber Agung  | 0.34  | 0.11  | 0.29  | 0.12  | -0.0132 | 0.11  | 317.46 | 0.17  | 0.75  | 1.33  | 0.21   | 277,773.69 | 0.12 | 0.83  |
| 4  | Andalas Cermin | 0.35  | 0.11  | 0.29  | 0.12  | -0.0132 | 0.11  | 277.97 | 0.15  | 1.80  | 0.56  | 0.09   | 346,284.39 | 0.14 | 0.72  |
| 7  | Rawa Ragil    | 0.41  | 0.13  | 0.31  | 0.12  | -0.0132 | 0.11  | 290.14 | 0.16  | 2.40  | 0.42  | 0.06   | 247,398.13 | 0.10 | 0.69  |
| 9  | Mulyo Dadi    | 0.37  | 0.12  | 0.30  | 0.12  | -0.0132 | 0.11  | 92.32  | 0.05  | 0.84  | 1.19  | 0.18   | 233,163.52 | 0.10 | 0.68  |
| 5  | Duta Yoso Mulyo | 0.40  | 0.13  | 0.30  | 0.12  | -0.0132 | 0.11  | 182.85 | 0.10  | 1.62  | 0.62  | 0.10   | 255,478.83 | 0.11 | 0.66  |
| 3  | Panggung Mulyo | 0.33  | 0.10  | 0.29  | 0.11  | -0.0132 | 0.11  | 150.23 | 0.08  | 1.62  | 0.62  | 0.10   | 318,637.27 | 0.13 | 0.64  |
| 6  | Gedung Jaya   | 0.43  | 0.14  | 0.31  | 0.12  | -0.0132 | 0.11  | 203.80 | 0.11  | 2.16  | 0.46  | 0.07   | 192,189.61 | 0.08 | 0.63  |
| 8  | Bumi Sari     | 0.42  | 0.13  | 0.31  | 0.12  | -0.0132 | 0.11  | 121.29 | 0.06  | 1.80  | 0.56  | 0.09   | 165,402.55 | 0.07 | 0.59  |
| 2  | Batang Hari   | 0.09  | 0.03  | 0.10  | 0.04  | -0.0132 | 0.11  | 230.53 | 0.12  | 1.44  | 0.69  | 0.11   | 364,436.67 | 0.15 | 0.56  |
|    | Sum           | 3.15  | 1.00  | 2.50  | 1.00  | -0.12  | 1.00  | 1866.58 | 1.00  | 14.43 | 6.44  | 1.00   | 2,400,764.64 | 1.00 | 6.00  |
Table 9. Scoring on identification of village-based primary commodities.

| No | Village            | Total score | Primary commodity |
|----|--------------------|-------------|-------------------|
| 1  | Sumber Agung       | 0.78 0.64 0.77 0.83* | Palm oil |
| 2  | Batang Hari        | 0.47 0.69* 0.64 0.56 | Corn |
| 3  | Panggung Mulyo     | 0.57 0.81* 0.71 0.64 | Corn |
| 4  | Andalas Cermin    | 0.65 0.87* 0.74 0.72 | Corn |
| 5  | Duta Yoso Mulyo   | 0.64 0.81* 0.65 0.66 | Corn |
| 6  | Gedung Jaya       | 0.76* 0.58 0.61 0.63 | Paddy |
| 7  | Rawa Ragil        | 0.79* 0.54 0.67 0.69 | Paddy |
| 8  | Bumi Sari         | 0.70* 0.54 0.57 0.59 | Paddy |
| 9  | Mulyo Dadi        | 0.64 0.52 0.64 0.68* | Palm oil |

Jumlah 6.00

where: *village with primary commodity (biggest score).

4. Conclusions and Recommendations

4.1. Conclusion

The base of commodity activity in the Rawaipitu transmigration area is paddy and oil palm or rubber. In addition to the many commodities cultivated in the research location, in terms of land suitability, paddy has the S3-nr, S3-rc, and S3-nr/rc suitability classes, while rubber and palm oil have the same land suitability class, namely S2-nr, S2-nr/oa, S3-nr/oa, S3-rc, and N-oa. So that it is generally suitable for efforts in this region.

The results of economic analysis also show that rice has a Gross Margin value of Rp. 6,222,241.00/-ha/year and the BC Ratio of 1.69 (feasible to cultivate). While rubber plants, on S2 suitability land the Gross Margin value is Rp. 6,751,000.00/-ha/year, BC ratio is 1.78, IRR is 25.22, and NPV is 14,722,911.78 and oil palm on the S2 suitability land the Gross Margin value was Rp. 7,288,733.33/-ha/year, the BC Ratio was 3.42, the IRR was 47.28, and the NPV was 26,954,070.75 (positive, so it's worth working). Economically, rice, oil palm and rubber are profitable if cultivated at the research location.

Rice crop commodities are featured in the building of Gedung Jaya, Rawa Ragil and Bumi Sari. While corn commodities become primary commodities in Batang hari, Panggung Mulyo, Andalas Cermin, and Duta Yoso Mulyo villages. Palm oil is the primary commodity in Sumber Agung and Mulyo Dadi villages, while rubber does not become a primary commodity in any village.

4.2. Suggestion

Based on overall research and field condition, it is better to add other variables that can be used in determining primary commodity, for example the amount of labor, productivity, access to transportation and so on.

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