Multi-criteria Analysis for Determining Primary Commodities at Jasinga District, Bogor Regency, Indonesia

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Abstract. Multi-criteria analysis is the process of decision making, based on the exploration of many analysis. The use of multi-criteria analysis allows for fair decisions to be made. In this research, the multi-criteria analysis combines quantitative and qualitative data that can be used to determine primary commodities in a region. Besides, the commodities analyzed are only food crops and horticulture. The research aims to analyze primary commodities of village, land suitability and make a recommendation of primary commodities development in the Jasinga District. The methods used multi-criteria analysis with five parameters. They are Location Quotient (LQ) and Differential Shift (DS), land suitability, land rent, commodity economic analysis, and analytical hierarchy process. Furthermore, the results of the analysis are obtained through weighted index scoring methods, and then analyzed availability land and recommendation of primary commodities development. There are five primary commodities in every village at the Jasinga District likes chili, corn, rice, cucumber, and sweet potato. Existing land for primary commodities development is 10,634.3 ha. The direction of primary commodities development included existing, and new areas are 6,036.4 ha, especially for paddy field is 62.5 ha in Kalongsawah village.

Keywords: land rent, location quotient, primary commodities, scoring index,

1. Introduction

In most developing countries, economic performance is associated with developments in the commodity sector. The linkages between commodity markets, economic growth, and development are both strong and complex [1] in encouraging regional development. The role of developing agricultural commodities is very important in regional planning. The primary commodity approach must be based on local potential. According to [2], defining local potencies such as primary agricultural commodities is a basic capital in developing regional economic. The primary commodity is a commodity that has strategic value, based on physical considerations (land and climate conditions) as well as social, economic, and institutional, to be developed in an area [3]. The development of agricultural areas is done a lot without prior research such as comparative and competitive advantages and the potential of land resources in producing superior products [4]. However, perceiving and positioning criteria and instruments for primary commodities is not the same. As a result, the development of these commodities has become mismanaged, even counterproductive to increasing primary commodity production [5]. Approaches to determining primary commodities are very diverse; one of them is multi-criteria analysis [2].

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Multi-criteria analysis is a way of making decisions from various alternatives based on many criteria. The purpose of this analysis is to guide fair decision making. In the analysis of this study combines quantitative and qualitative data [6], including multi-criteria analysis in determining primary commodities. Besides, according to [7], determining the direction of agricultural development programs, such as primary commodities, should be based on the suitability, potential, and availability of land. This is to obtain optimal and quality results with relatively low inputs so that the resulting product has a high competitiveness value.

The rural development can be built through the use of local potentials to fostering economic growth and creating jobs for the local community [8], including the Jasinga District. Jasinga is a sub-district in Bogor Regency with an area of 111.04 km2 and is a border area between Bogor Regency (West Java Province) and Banten Province. This area has an important role in the regional economic flow, especially in Bogor Regency [9]. This region does not yet have a focus on commodity development, based on interviews with the Regional Technical Implementation Unit (UPTD) of Agriculture and the Agricultural Extension Agency, Jasinga District. Besides, based on the Spatial Planning (RTRW) pattern of Bogor Regency in 2016-2036, the Jasinga District has a complete agricultural area (cultivation), including wetland agriculture, dryland agriculture, and plantations. The area of agricultural land is quite extensive, and this can be seen in the field, there is still a lot of lands that have not been planted. The purpose of this study is: (i) analyzing primary commodities per village in the Jasinga District using multi-criteria analysis, and (ii). analyze the availability of land and formulate directions for developing primary commodities in the Jasinga District.

2. Methodology
The research locations are Jasinga District, Bogor Regency, West Java Province (figure 1). Jasinga District is geographically located at coordinates 06°38'0"-06°55'0" South Latitude and 106°50'15"-106°40'0" East Longitude, with hilly topography. Administratively, Jasinga District, bordering directly with Tenjo sub-district in the north, Curugbitung sub-district and Cipanas in the west, Cigudeg sub-district in the east, and Sukajaya sub-district in the south.

![Figure 1. The study area (Jasinga District, Bogor Regency, Indonesia)](image)

This research was conducted in several stages, namely: (i) preparation. This stage includes the collection of literature studies and secondary data (data on harvested agricultural land area of Jasinga District in 2011 and 2016, land unit maps of Jasinga District, RBI maps, climate, and rainfall data, BPN land use maps in 2012, and RTRW maps Bogor Regency in 2016-2036); (ii) Field observations. This stage is to obtain primary data such as land characteristics by conducting field surveys and data on inputs, outputs, and management of selected commodities by conducting interviews with farmers and related parties, 3) Data analysis. This stage is processing various existing data.

The data used in this study consisted of primary data and secondary data. Primary data obtained in the form of data from the field survey and interview respondents. Secondary data obtained from the internet and related agencies such as the Central Statistics Agency (BPS), Geospatial Information Agency (BIG), Meteorological, Climatology, and Geophysics Agency (BMKG), Regional Development Planning Agency (BAPPEDA), Center for Agricultural Land Resources (BBSDLP), and the National
Land Agency (BPN). The materials used in this study are BPS data on the area of harvested crops in Jasinga District in 2011 and 2016, map of land units (SPL) of Jasinga District scale of 1: 50 000, Rupa Bumi Indonesia (RBI) map scale of 1: 25 000, climate data and Jasinga District rainfall, the 2012 BPN land use map, and the 2016-2036 Bogor Regency Spatial Plan (RTRW) map. The equipment used in this study are computers with ArcGIS 10.3 software, STATISTICA 7.0, Microsoft Office, Global Positioning System (GPS), drill bits, field knives, geological compasses, meters, questionnaires, field forms, stationery, and cameras for field observations.

Primary data collection is done by field observations, in the form of field surveys to obtain land characteristics data by taking 23 observation points representing each SPL and interviews to obtain data on input, output, and management of selected commodities. Interviews were conducted with farmers, the Agricultural Technical Implementation Unit (UPTD), the Agricultural Extension Agency, and the Jasinga District Civil Servants. Based on the data, there are 9 selected commodities, namely irrigated paddy field, non-irrigated paddy field, corn, cassava, sweet potato, peanut, chili, cucumber, and long beans.

Data analysis included: (i) determining primary commodities of each village; (ii) availability of land to find out available land (has the potential to be planned) for commodities suitable for development; (iii) direction of primary commodity development.

2.1. Determination of Primary Commodity with multi-criteria analysis

2.1.1. Basic commodity analysis and commodity growth rate. The first stage is through the analysis of comparative advantage (LQ) and competitive (DS). Both of these analyses are carried out first to get the commodity studied. The data used is BPS harvest area data for crops, namely food crops and horticultural crops (vegetables) in 2011 and 2016. The data for that year was chosen because of the limited data available (there is no recent year data). The LQ equation in this research is:

\[ LQ_{ij} = \frac{X_{ij}}{X_i} \]

with:

- \( LQ_{ij} \) = Location Quotient the j-commodity in the i-village
- \( i \) = villages in Jasinga District
- \( j \) = commodities in Jasinga District
- \( X_{ij} \) = the j-commodity in the i-village
- \( X_i \) = the sum of all commodities in the i-village
- \( X_j \) = the number of j-commodities in all villages
- \( X.. \) = total value of all commodities in all villages

An activity j is concluded concentrated in region i, if \( LQ_{ij} > 1 \). So that the commodities chosen to be developed in the study area are commodities that have a value of \( LQ_{ij} > 1 \) and are commodities with the largest LQ value. The equation of DS analysis in this study is:

\[ DS_{ij} = \frac{X_{ij}(t1)}{X_{ij}(t0)} - \frac{X_j(t1)}{X_j(t0)} \]

with:

- \( DS_{ij} \) = Differential Shift the j-commodity in the i-village
- \( i \) = villages in Jasinga District
- \( j \) = commodities in Jasinga District
- \( X_{ij} \) = the j-commodity in the i-village
- \( X.. \) = total value of all commodities in all villages
- \( X_j \) = the number of j-commodities in all villages

2.1.2. Land suitability analysis of 9 commodities. Land suitability analysis is carried out by matching land characteristics with plant growth requirements [10]. Stages of land suitability analysis carried out are the preparation of SPL maps, ground checks in the field, secondary data collection, analysis, and
map-making. The data used include SPL maps (BBSDLP), RBI maps (BIG), climate data (BMKG), and field observations. The land characteristics evaluated, only the physical characteristics of the land that are difficult to change, but affect plant growth such as temperature (tc), water availability (wa), oxygen availability (oa), rooting media (rc), erosion (er), land preparation (lp).

2.1.3. Analysis of Land rent (LR) (economic rent). Land rent analysis (LR) used is economic rent in agricultural land use. Land rent data obtained through interview respondents. Interviews were conducted by giving questions to farmers (respondents) regarding inputs, outputs, and management. Selected farmers are the leaders of farmer groups, members of farmer groups, and farmers who develop and market selected commodities. The material used in the questionnaire. The tools used are stationery and camera. The value of land rent (units of Rp m$^{-2}$ year$^{-1}$) in this study was calculated using the formula:

\[
LR = \frac{Total\ Revenue\ (TR) - Total\ Expenditure\ (TE)}{land\ area\ (m^2)} \tag{3}
\]

2.1.4. Analysis financial feasibility of farming. Analysis of farming is carried out to obtain information on the financial feasibility of farming and study and predict the amount of income and profits of farming based on the allocation of available resources. Data on farming is obtained through interviews with farmers (questionnaire). The selection of respondents is the same as land rent respondents. The analysis of farming used is Revenue Cost Ratio (R/C ratio) and Benefit-Cost Ratio (B/C ratio). Revenue Cost Ratio (R/C ratio), which is a comparison between the total income earned, and the total costs used in farming activities. R/C ratio of a farming business shows the ratio between the value of production (revenue), with the total cost of farming [11]. The results of the R/C ratio analysis can give an idea of whether a commodity is feasible or not. The formula for calculating the R/C ratio is as follows

\[
R/C\ ratio = \frac{Total\ Receipts\ (TR)}{Total\ Expenditure\ (TE)} \tag{4}
\]

There are three possibilities of the implications of R/C ratio [11], namely:

1) If the R/C ratio is > 1, then farming activities are feasible
2) If the R/C ratio = 1, then farming activities break even
3) If the R/C ratio < 1, then farming activities are not feasible

Benefit Cost Ratio (B/C ratio) is the present value (PV) in divided by the present value (PV) out. B/C ratio analysis is used to analyze the comparison between benefits and costs. The B/C ratio is in principle the same as the R/C ratio, the difference is that in the analysis of the B/C ratio the benefit is considered while the R/C ratio considered is acceptance [12]. Systematically the equation can be written:

\[
B/C\ ratio = \frac{\sum_{t=1}^{n} \frac{B_t}{(1+i)^t}}{\sum_{t=1}^{n} \frac{C_t}{(1+i)^t}} = \frac{\Delta\ benefit}{\Delta\ cost} \tag{5}
\]

with:

\[
\begin{align*}
B/C &= Benefit\ Cost\ Ratio \\
B_t &= the\ benefits\ of\ farming\ until\ the\ year\ t \\
C_t &= farming\ costs\ up\ to\ year\ t
\end{align*}
\]

\[
i = interest\ rates \\
t = year
\]

There are three possibilities of the implications of the B/C ratio [11], namely:

1) If the B/C ratio is > 1, the farming activities are profitable (the additional benefits are greater than the additional costs)
2) If the B/C ratio = 1, then farming activities break even (additional benefits equal to additional costs)
3) If the B/C ratio < 1, then farming activities loss (additional benefits equal to additional costs)
R/C ratio and B/C ratio values are calculated based on the highest production value of each commodity on the land with a suitability class S1. Each field is assumed to produce maximum concerning [13], where production in the suitability class S1 ≥ 80% of optimal production, S2 land between 60% - 80%, S3 land between 40% - 60%, and N land producing <40%.

2.1.5. Analysis of community preferences using the Analytical Hierarchy Process (AHP). Data obtained through interviews with farmers and related parties such as representatives of the UPTD Agriculture, Agricultural Extension Agency, and Jasinga District Civil Servants. This analysis is used to determine the weight of each parameter. The criteria used in determining primary commodities include LQ and DS results, land suitability, land rent, and farming. The sum of all variables is the weight (w') in the calculation of determining primary commodities. But it should be noted, the value of a Consistent Ratio (CR). If the pair-wise comparison matrix with CR <0.1, then the inconsistency of opinion from the decision-maker can be accepted [14].

2.1.6. Determine the primary commodity by scoring each parameter. Determination of primary commodities was obtained based on the results of the previous analysis, namely: (i) the LQ and DS values of the area of food crop and horticultural crops (vegetables) in 2011 and 2016; (ii) land area class S (suitable) (ha); (iii) results of land rent analysis in units (Rp / m² / year); and (iv) results of analysis of farming. Then tabulate the data per commodity per village. For each data, the index value is calculated so that ∑Xij has a value of 1.00, then the data are normalized using the mathematical formula as follows:

\[
|i| = \frac{X_{ij}}{\sum_{i=1}^{n} X_{i}}.
\]

with:

- \(i\) = village area = 1,2,...,n; n = 16
- \(j\) = variable to-1,2,...,7
- \(X_{ij}\) = the value of the j-variable in i-region
- \(X_{i}\) = DS value
- \(X_{j}\) = land rent
- \(X_{i1}\) = LQ value in 2011
- \(X_{i2}\) = R/C ratio value
- \(X_{i3}\) = B/C ratio value

After obtaining the index value of each variable, the next step is to multiply each index variable value by the weight (w'), then add up each index variable value which has been multiplied by weight (w'), so that the total score is obtained. The highest number of commodity scores is determined as the village’s primary commodity. Mathematically, the index sum can be written as follows:

\[
Xi = \sum_{i=1}^{n} X_{ij} * w'.
\]

with:

- \(Xi\) = total commodity scores in the i-region
- \(X_{ij}\) = the value of the j-variable in i-region
- \(w'\) = AHP weight

2.1.7. Land availability. Land availability analysis uses data in the form of the 2016-2036 Bogor Regency RTRW map and the 2012 BPN land use map. Both maps are then overlaid, the overlay results from these maps produce land information available for primary commodity development. Land available for development is legally suitable for agricultural cultivation activities (table 1). Besides, the type of land use chosen is the type of land use that has not been productive.
Table 1. Land availability criteria for agricultural development based on the RTRW map and land use (LU) map attributes

| RTRW | CF | EFH | PPF | WA | DL | PA | RS | US |
|------|----|-----|-----|----|----|----|----|----|
| FR   | A  | A   | A   | A  | A  | A  | NA | NA |
| MG   | NA | NA  | NA  | NA | A  | NA | NA | NA |
| VG   | NA | NA  | NA  | NA | A  | NA | NA | NA |
| PF   | NA | NA  | NA  | NA | NA | A  | NA | NA |
| PF   | NA | NA  | NA  | NA | NA | A  | NA | NA |
| BS   | NA | NA  | NA  | NA | NA | NA | A  | NA |
| RV   | NA | NA  | NA  | NA | NA | NA | NA | NA |
| MR   | NA | NA  | NA  | A  | A  | NA | NA | NA |

Note:
CF = Conservation forest
EFH = Enclave forest area
PPF = Permanent production forest area
WA = Wetland area
DL = Dry land area
PA = Plantation area
RS = Rural settlement area
US = Urban settlement area
FR = Forest
MG = Mixgarden
RV = River
MR = Moor
PF = Paddy fields
VG = Vegetables garden
PA = Poultry farms
A = Available
NA = Not-available

2.2. Primary Commodity Development Direction
The direction of commodity development in each village is based on the results of primary commodity determination, land availability analysis, and the results of land suitability at the research location. The development in this research is to determine the allocation of existing and new development for primary commodities.

3. Results and Discussion

3.1. Commodity Base and Commodity Growth Rate
Commodity base analysis and commodity growth rate is obtained through LQ and DS analysis. The results of LQ and DS analysis in determining primary commodities based on the value. If the LQ value obtained is 1.1 and 1.3, then the LQ value is 1.3, potentially as a primary commodity. The presentation of the results of the analysis is made in graphical form. The results of the 2016 LQ analysis and DS indicate that the commodity was selected for further analysis. If the LQ value > 1 (base commodity) and the DS value are positive (growing). Villages that have primary commodities will be in quadrant I (top right) with a value of LQ > 1 and DS > 0.

Based on the results of the analysis, food crops that have the highest LQ > 1 and DS > 0 values are irrigated paddy fields (figure 2a), found in six villages namely Pangradin, Kalongsawah, Sipak, Tegalwangi, Jasinga, and Neglasari villages. This commodity shows that irrigated paddy field has the best growth, and is comparative and competitive superior compared to other food crop commodities. Based on available data, the six villages have the widest irrigated paddy field harvest area in Jasinga District. Meanwhile, vegetable commodities that had the highest LQ > 1 and DS > 0 values were long beans (Figure 2i), found in five villages namely Pamagersari, Tegalwangi, Jasinga, Cikopomayak, and Neglasari Villages. These results also show that long beans have the best growth and are comparative and competitive superior compared to other vegetable crop commodities. Based on available data, the five villages have the widest harvest area for long beans in the Jasinga District. This is by [15] research, a high LQ value and positive DS means the highest amount of production, greater area of land use of these commodities, and a lot of labor, and absorbed in the development of these commodities.
Figure 2. LQ values (2016) and commodity DS (a) irrigated paddy field, (b) non irrigated paddy field, (c) corn, (d) cassava, (e) sweet potato, (f) peanut, (g) chili, (h) cucumbers, (i) long beans in Jasinga District
3.2. Land Suitability
Land suitability analysis is carried out to determine the land that has the potential for commodity development. Evaluation of land suitability in this study is an evaluation of actual land suitability based on the characteristics of existing land. Land suitability evaluation is carried out based on the land unit approach (SPL). The land characteristics obtained are then compared with the land suitability criteria of each commodity. The irrigated paddy field commodity land suitability class (figure 3a) is in the form of S1 class (suitable) covering 2,702.61 ha, S2 (quite suitable) covering 4,771.72 ha, S3 (marginal appropriate) covering 619.7 ha, and N (not suitable) covering 5,823.5 ha. The non irrigated paddy field land suitability class (figure 3b) is in the form of an S1 class covering 4,821.4 ha, S2 covering 2,745.4 ha, S3 covering 527.3 ha, and N covering 5,823.5 ha. Land suitability classes for corn, cassava, sweet potato, peanuts, chili, cucumber, and long beans (figure 3c) are S3 class of 8,001.6 ha and N of 5,915.9 ha.

Table 2 shows the area of land suitability of each commodity analyzed in each village. These results indicate that Pangradin Village has the most primary commodity potential in Jasinga District. This is obtained based on the area of land suitability class S (suitable) widest, where Pangradin Village has the widest S class land area for all commodities. Based on field observations, the slope is a dominant obstacle, indicating a high level of erosion hazard. Clay-dominated soil texture increases the chance of erosion in the study area. Improvements to the limiting factor with the expectation of the actual land suitability class can be a potential suitability class. Efforts to improve land erosion limiting factors include efforts to reduce the rate of erosion, making terraces, planting parallel contours, and planting cover crops [16].

3.3. Land Rent
Land rent analysis to determine the net income of land, per square meter per year for the development of selected commodities. Based on field observations, no farmers have planted paddy fields in the last one to two years, so non-irrigated paddy field data were not obtained. This applies also to the analysis of farming. The results of the analysis (table 3) show the highest value of land rent, is the corn of Rp 15,648 m\(^{-2}\) in Cikopomayak Village. Maize varieties grown in Cikopomayak Village are hybrid corn. This is consistent with Bahau's (2008) research, that hybrid maize farming is relatively better developed in dry land than other varieties of maize (composite). Besides, maize in Cikopomayak Village has the highest land rent value compared to other villages, with the dominant land suitability class S3. Based on

![Figure 3](image-url)
interviews, Cikopomayak Village hybrid corn ("jagung hibrida") commodity was sold to large companies such as Pokpan in Tangerang at a price of Rp 4,500 kg⁻¹.

### Tabel 2. Land suitability for all commodities in each village in Jasinga District

| Village      | Irrigated Paddy Field | Non Irrigated Paddy Field | Other Commodities (*) |
|--------------|-----------------------|---------------------------|-----------------------|
|              | Land area (ha)        |                           |                       |
|              | Class S | Class N  | Class S | Class N  | Class S | Class N  |
| Pangradin    | 1,173.4 | 442.9   | 1,173.4 | 442.9   | 1,173.4 | 442.9   |
| Kalongsawah  | 410.6    | 6.6     | 410.6   | 6.6     | 318.2   | 99.1    |
| Sipak        | 622.9    | 0.0     | 622.9   | 0.0     | 622.9   | 0.0     |
| Pamagersari  | 306.1    | 3.4     | 306.1   | 3.4     | 306.1   | 3.4     |
| Jugalajaya   | 668.8    | 1,199.2 | 668.8   | 1,199.2 | 668.8   | 1,199.2 |
| Curug        | 713.5    | 941.2   | 713.5   | 941.2   | 713.5   | 941.2   |
| Tegalwangi   | 101.8    | 540.3   | 101.8   | 540.3   | 101.8   | 540.3   |
| Koleang      | 93.1     | 439.9   | 93.1    | 439.9   | 93.1    | 439.9   |
| Jasinga      | 306.6    | 360.9   | 306.6   | 360.9   | 306.6   | 360.9   |
| Setu         | 224.5    | 88.9    | 224.5   | 88.9    | 224.5   | 88.9    |
| Cikopomayak  | 481.1    | 123.2   | 481.1   | 123.2   | 481.1   | 123.2   |
| Neglasari    | 142.6    | 196.6   | 142.6   | 196.6   | 142.6   | 196.6   |
| Bagoang      | 165.1    | 254.3   | 165.1   | 254.3   | 165.1   | 254.3   |
| Barengkok    | 1,134.2  | 477.6   | 1,134.2 | 477.6   | 1,134.2 | 477.6   |
| Pangaur      | 852.5    | 198.7   | 852.5   | 198.7   | 852.5   | 198.7   |
| Wirajaya     | 697.3    | 549.8   | 697.3   | 549.8   | 697.3   | 549.8   |
| **Total**    | **8,094.0** | **5,823.5** | **8,094.0** | **5,823.5** | **8,001.6** | **5,915.9** |

*Commodities of corn, cassava, sweet potatoes, peanuts, chili, cucumber, long beans; S = suitable, N = not suitable

Aside from corn, the highest land rent for vegetables is chili at Rp 15,628.8 m⁻² and cucumber at Rp 15,500 m⁻² in Pamagersari Village. The results show that the land rent of vegetable crops, especially chili and cucumber, has a higher land rent value compared to food crops. This is due to the high cost of receiving these two commodities by farmers in Pamagersari Village, amounting to Rp 25,000 kg⁻¹ and Rp 6,000 kg⁻¹, compared to other villages, so profits are higher. Based on these results, corn, chili, and cucumber are economically more profitable compared to other commodities. Unlike the irrigated paddy field results, the average land rent is lower than the average land rent of other commodities. This is because the costs incurred to produce irrigated paddy fields are relatively higher compared to other commodities. Besides, the area of land used is relatively higher, ranging between 2,000-10,500 m². The lowest average land rent is cassava at Rp 546.8 m⁻². This is due to the relatively low income received by farmers, ranging from Rp 500-2,000 kg⁻¹.

### 3.4. Financial feasibility of farming

This analysis is for the financial feasibility of farming, studying, and predicting farm profit, based on the allocation of available resources. The feasibility of farming is obtained through the R/C ratio analysis, while the B/C ratio is used to see the benefits. The results of the analysis showed that the most feasible plants developed and provided benefits and advantages in Pangradin Village were irrigated paddy fields, in Kalongsawah Village were peanuts, in Sipak Village were irrigated paddy fields, in Pamagersari Village were cucumbers, in Setu Village were irrigated paddy fields, in Cikopomayak Village is corn, in Bagoang Village is sweet potato, in Pangaur Village is irrigated paddy field, in Wirajaya Village is corn. This is in accordance with Figure 4, where if the value of R/C ratio and B/C ratio > 1, then the farming business is feasible or profitable, the value of R/C ratio and B/C ratio = 1 then the farm business is equal, and R/C ratio and B/C ratio < 1, then farming is not feasible to be developed or lost. The villages of Jugalajaya, Curug, Tegalwangi, Koleang, Jasinga, Neglasari, and
Barengkok do not have profitable commodities (feasible) because there are no commodities that have a value of R/C ratio and B/C ratio > 1.

### Table 3. Land rent value of each commodity in Jasinga District

| Village     | Irrigated Paddy Field | Non Irrigated Paddy Field | Corn | Cassava | Sweet potatoes | Peanuts | Chili | Cucumber | Long beans |
|-------------|-----------------------|---------------------------|------|---------|----------------|---------|-------|----------|------------|
| Pangradin   | 617                   | 0                         | 0    | 575     | 0              | 0       | 2,916 | 476      | 118        |
| Kalongsawah | 1,444                 | 0                         | 1,530| 375     | 0              | 5,098.8 | 0     | 11,12.5  | 750        |
| Sipak       | 12,245                | 0                         | 1,693.5| 833.3 | 896.7          | 0       | 826.7 | 17,192   | 610        |
| Pamagersari | 342.7                 | 0                         | 0    | 0       | 0              | 0       | 15,628.8| 15,500    | 7,894.7    |
| Jugalajaya  | 471.5                 | 0                         | 0    | 0       | 0              | 0       | 471.5 | 0        | 212.5      |
| Curug       | 802.5                 | 0                         | 894  | 0       | 2,500          | 800     | 624   | 755      | 340        |
| Tegalwangi  | 510                   | 0                         | 780  | 400     | 150            | 640     | 400   | 0        | 465        |
| Koleang     | 1,176                 | 0                         | 499.7| 0       | 0              | 1,555   | 547   | 4,509    | 1,167      |
| Jasinga     | 890                   | 0                         | 1,000| 0       | 0              | 0       | 693   | 568      |            |
| Setu        | 936                   | 0                         | 0    | 0       | 0              | 0       | 0     | 0        |            |
| Cikopomayak | 1,720.8               | 0                         | 15,648| 950   | 602            | 0       | 0     | 0        |            |
| Neglasari   | 1,278.8               | 0                         | 1,530| 250     | 250            | 450     | 0     | 735      | 215        |
| Bagoang     | 652                   | 0                         | 0    | 0       | 1,000          | 0       | 2,205 | 1,257    | 227        |
| Barengkok   | 975                   | 0                         | 0    | 550     | 0              | 0       | 975   | 0        | 0          |
| Pangaur     | 1,137.9               | 0                         | 720.25| 1,000 | 1,169          | 281     | 2,886.7| 1,500    | 2,040      |
| Wirajaya    | 234                   | 0                         | 645  | 150     | 250            | 222     | 3,846.7| 1,780    | 0          |
| **Average** | **900.8**             | **0**                     | 2,494.0| 564.8 | 852.2          | 1,209.0 | 2,847.9| 2,730.6  | 1,217.3    |

*Value 0, because there are no farmers who planted paddy fields in the last one to two years

### 3.5. Multi-criteria analysis

Multi-criteria analysis is used in the final stage of determining the primary commodity. The parameters used are the results of the LQ and DS analysis, the area of land suitability of the S class (suitable) per village, the value of land rent, the value of farming (R/C ratio and B/C ratio). After that, the total index value is equal to 1.00. Then the index value is multiplied by the weight (w'). Weights obtained through analysis of stakeholder perceptions (AHP analysis), to determine the proportion of factors that influence the development of primary commodities in Jasinga District. The weights of each variable accordingly are presented in Table 4.

Table 4 shows that the area of harvested land is the most important indicator in determining leading commodities analyzed through LQ and DS analysis with a value of 0.564. Furthermore, the suitability of land with a value of 0.222, land rent with a value of 0.116, and the feasibility of farming with a value of 0.097. This is by the research of [17], that the area of harvested land and yields are the most important factors in determining primary commodities. These values are weighted in the calculation of multi-criteria analysis (weighted index scoring).

Based on the results of the multicultural analysis, seven commodities are dominant in each village in Jasinga District (Figure 6), namely chili, corn, long beans, peanuts, irrigated paddy field, cucumber, and cassava. This result was obtained based on the highest score of all commodities in each village. Chili is in Jugalajaya Village (0.323) and Jasinga Village (1.043), Corn is in Kalongsawah Village (3.326), Sipak Village (0.908), Cikopomayak Village (0.797), Neglasari Village (0.641), Bagoang Village (0.477), and Desa Sipak (0.908) Barengkok (0.779), while Long beans are found in Pangradin Village (1.122). Meanwhile, Peanuts are in Tegalwangi Village (0.748) and Koleang Village (2.104), Irrigated paddy fields are in Pamagersari Village (0.485) and Setu Village (0.578), Cucumbers are in Pangaur Village (1.034) and Cassava is in Desa Curug (0.349) and Wirajaya Village (0.590) (figure 5 and table 5). The results were obtained from a multi-criteria analysis. The parameter with the highest value potentially has the highest score.
(Note: RC = R/C Ratio, BC = B/C Ratio, pd = paddy, jg = corn, uk = cassava, uj = sweet potatoes, kt = peanuts, cb = chili, ti = cucumber, kp = long beans)

**Figure 4.** R/C value and B/C ratio for each commodity in Jasinga Sub District

**Table 4.** Weight of each parameter based on AHP results

| Parameter                | Weight (w’) | Sequence |
|--------------------------|-------------|----------|
| Analysis of LQ and DS    | 0.56        | 1        |
| Land suitability         | 0.22        | 2        |
| Land rent                | 0.11        | 3        |
| Feasibility of farming   | 0.09        | 4        |

**Figure 5.** Primary commodity for each village with the highest score in Jasinga District

**Table 5.** Score Primary Commodity

| No | Village     | Primary commodities | Score |
|----|-------------|---------------------|-------|
| 1  | Pangradin   | Long beans          | 1.1   |
| 2  | Kalongsawah | Corn                | 3.3   |
| 3  | Spak        | Corn                | 0.9   |
| 4  | Pamagersari | Irrigated Paddy Field | 0.5   |
| 5  | Jugalajaya  | Chili               | 0.3   |
| 6  | Curug       | Cassava             | 0.3   |
| 7  | Tegahwangi  | Peanuts             | 0.7   |
| 8  | Koleang     | Peanuts             | 2.1   |
| 9  | Jasinga     | Chili               | 1.0   |
| 10 | Setu        | Irrigated Paddy Field | 0.6   |
| 11 | Cikopomayak | Corn                | 0.8   |
| 12 | Neglassari  | Corn                | 0.6   |
| 13 | Bagoang     | Corn                | 0.5   |
| 14 | Barengkok   | Corn                | 0.8   |
| 15 | Pangaur     | Cucumber            | 1.0   |
| 16 | Wirajaya    | Cassava             | 0.6   |

3.6. Land Availability and Direction for Primary Commodity Development

In this study, the direction of the development of primary commodities in terms of physical aspects and land availability. Considerations for the preparation of directives for primary commodity development are land availability and land suitability. The available land is land that does not conflict with the direction of the spatial pattern contained in the Bogor Regency RTRW in 2016-2036, and the location
is suitable land for the plant. Determination of the location that becomes the direction of development considers land use maps based on BPN 2012 with a scale of 1: 10,000. The use of the BPN data, to obtain detailed results, to be able to predict the availability of land in detail as well (although in 2012, it will be updated gradually). Based on the results of the analysis of land availability in full according to presented in figure 6a. Land available for the development of commodities covering an area of 10,634.3 ha, while land that is not available is 3,262.7 ha.

This shows that the available land is bigger than the available land. The available land can be used for all commodities analyzed and is expected to increase the productivity of all commodities. Besides, it can add economic value, especially the agricultural sector in Jasinga District. Directives for the development of all analyzed commodities (irrigated paddy fields, non-irrigated paddy fields, corn, cassava, sweet potatoes, peanuts, chilies, cucumbers, and long beans) accordingly are presented in table 6. Area of land used as a direction for development all commodities cover an area of 6,036.4 ha in all villages. Irrigated paddy fields and non-irrigated paddy fields can be developed in Kalongsawah Village with an area of 62.5 ha, in addition to other villages. Spatial distribution of land, the direction of primary commodity development according to figure 6b.

![Figure 6](image)

**Figure 6.** (a) Land availability and (b) the direction of land development for agriculture in Jasinga District

**Table 6.** Land availability and direction for primary commodity development in Jasinga District

| Village    | Land availability (ha) | Directives for commodity development (ha) |
|------------|------------------------|------------------------------------------|
|            | Available | Not available | Ps, Pl, Jg, Uk, Uj, Kt, Ch, Tm, Kp(*) | Ps and Pl |
| Pangradin  | 1,531.9   | 84.4          | 1,089.0                                | 0.0       |
| Kalongsawah| 341.7     | 75.5          | 276.1                                  | 62.5      |
| Sipak      | 439.8     | 183.0         | 439.8                                  | 0.0       |
| Pamaegersari| 221.0    | 88.5          | 221.0                                  | 0.0       |
| Jugalajaya | 1,461.8   | 406.2         | 409.5                                  | 0.0       |
| Curug      | 1,364.0   | 290.8         | 661.1                                  | 0.0       |
| Tegalwangi | 522.5     | 115.9         | 77.0                                   | 0.0       |
| Koleang    | 418.6     | 114.3         | 77.3                                   | 0.0       |
| Jasinga    | 581.6     | 86.0          | 243.7                                  | 0.0       |
4. Conclusion and Suggestion

4.1. Conclusion
There are seven primary commodities in each village in Jasinga District, namely chili, maize, long beans, peanuts, irrigated paddy fields, cucumbers, and cassava. Primary commodities in Pangradin Village are long beans, Kalongsawah Village which is corn, Sipak Village which is corn, Pamagersari Village which is irrigated paddy field, Jugalajaya Village which is chili, Curug Village which is cassava, Tegalwangi Village which is peanut, Koleang Village which is peanut, Village Jasinga namely chili, Setu village which is irrigated paddy field, Cikopomayak Village namely corn, Neglasari Village which is corn rice, Bagoang Village which is corn, Barengkok Village which is corn, Desa Pangaur which is cucumber, Wirajaya Village namely cassava. Land available for the development of leading commodities in an area of 10,634.3 ha. The direction of development of superior commodities in Jasinga District covers existing and new areas for all commodities, covering an area of 6,036.4 ha, specifically the development of irrigated paddy fields and non-irrigated paddy fields which is 64.5 ha in Kalongsawah Village.

4.2. Suggestion
Primary commodity-based area development needs to be implemented in Jasinga District to increase the income of local farmers by taking into account all aspects. Besides, the development of primary commodities needs to be supported with soil analysis data in the laboratory so that the actual physical potential of the land, especially soil fertility, is known.

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Appendix 1. Example of calculating total commodity scores in Pangradin Village

| Sequence | Commodity       | LQ 2011 | Index | w' | skor | LQ 2016 | Index | w' | skor | DS  | Index | w' | skor | Klas | Index | w' | skor |
|----------|----------------|---------|-------|----|------|---------|-------|----|------|-----|-------|----|------|------|-------|----|------|
| 1        | Long beans     | 1.436   | 0.209 | 0.564 | 0.118 | 1.276   | 0.237 | 0.564 | 0.133 | -0.490 | 1.452 | 0.564 | 0.818 | 1 173.387 | 0.111 | 0.222 | 0.025 |
| 2        | Corn           | 0.360   | 0.052 | 0.564 | 0.030 | 0.189   | 0.035 | 0.564 | 0.020 | -0.459 | 1.359 | 0.564 | 0.766 | 1 173.387 | 0.111 | 0.222 | 0.025 |
| 3        | Chili          | 1.085   | 0.158 | 0.564 | 0.089 | 0.000   | 0.000 | 0.564 | 0.000 | -0.333 | 0.987 | 0.564 | 0.557 | 1 173.387 | 0.111 | 0.222 | 0.025 |
| 4        | Timun          | 0.517   | 0.075 | 0.564 | 0.042 | 1.036   | 0.192 | 0.564 | 0.108 | -0.095 | 0.282 | 0.564 | 0.159 | 1 173.387 | 0.111 | 0.222 | 0.025 |
| 5        | Kacang tanah   | 0.000   | 0.000 | 0.564 | 0.000 | 0.322   | 0.060 | 0.564 | 0.034 | 0.000   | 0.000 | 0.564 | 0.000 | 1 173.387 | 0.111 | 0.222 | 0.025 |
| 6        | Ubi jalar      | 0.000   | 0.000 | 0.564 | 0.000 | 0.000   | 0.000 | 0.564 | 0.000 | 0.000   | 0.000 | 0.564 | 0.000 | 1 173.387 | 0.111 | 0.222 | 0.025 |
| 7        | Ubi kayu       | 1.018   | 0.148 | 0.564 | 0.083 | 1.000   | 0.186 | 0.564 | 0.105 | 0.154   | -0.455 | 0.564 | -0.257 | 1 173.387 | 0.111 | 0.222 | 0.025 |
| 8        | Padi sawah     | 0.996   | 0.145 | 0.564 | 0.082 | 1.040   | 0.193 | 0.564 | 0.109 | 0.443   | -1.312 | 0.564 | -0.740 | 1 173.387 | 0.111 | 0.222 | 0.025 |
| 9        | Padi ladang    | 1.465   | 0.213 | 0.564 | 0.120 | 0.527   | 0.099 | 0.564 | 0.055 | 0.443   | -1.312 | 0.564 | -0.740 | 1 173.387 | 0.111 | 0.222 | 0.025 |
| **Total**|                | **6.878**| **1.000**| **5.074**| **0.564**| **5.389**| **1.000**| **5.074**| **0.564**| **-0.338**| **1.000**| **5.074**| **0.564**| **10560.483** | **1.000** | **2.001** | **0.222** |

| Sequence | Commodity     | Land Rent value | Fancial feasability of farming | Total Score |
|----------|---------------|-----------------|-------------------------------|-------------|
| 1        | Kacang panjang| 118.000 | 0.025 | 0.116 | 0.003 | 0.680 | 0.130 | 0.097 | 0.013 | 0.590 | 0.129 | 0.097 | 0.013 | 1.122 |
| 2        | Jagung        | 0.000   | 0.000 | 0.116 | 0.000 | 0.000 | 0.000 | 0.097 | 0.000 | 0.000 | 0.000 | 0.000 | 0.097 | 0.000 | 0.840 |
| 3        | Cabai         | 2,916.000 | 0.620 | 0.116 | 0.072 | 1.100 | 0.210 | 0.097 | 0.020 | 0.060 | 0.211 | 0.097 | 20.020 | 0.783 |
| 4        | Timun         | 476.000  | 0.101 | 0.116 | 0.012 | 0.710 | 0.135 | 0.097 | 0.013 | 0.620 | 0.136 | 0.097 | 0.013 | 0.373 |
| 5        | Kacang tanah  | 0.000   | 0.000 | 0.116 | 0.000 | 0.000 | 0.000 | 0.097 | 0.000 | 0.000 | 0.000 | 0.097 | 0.000 | 0.058 |
| 6        | Ubi jalar     | 0.000   | 0.000 | 0.116 | 0.000 | 0.000 | 0.000 | 0.097 | 0.000 | 0.000 | 0.000 | 0.097 | 0.000 | 0.025 |
| 7        | Ubi kayu      | 575.000  | 0.122 | 0.116 | 0.014 | 1.330 | 0.253 | 0.097 | 0.025 | 1.150 | 0.252 | 0.097 | 0.025 | 0.020 |
| 8        | Padi sawah    | 617.000  | 0.131 | 0.116 | 0.015 | 1.430 | 0.272 | 0.097 | 0.027 | 1.240 | 0.272 | 0.097 | 0.026 | -0.457 |
| 9        | Padi ladang   | 0.000   | 0.000 | 0.116 | 0.000 | 0.000 | 0.000 | 0.097 | 0.000 | 0.000 | 0.000 | 0.097 | 0.000 | -0.540 |
| **Total**|               | 4,702.000 | 1.000 | 1.048 | 0.000 | 0.000 | 0.000 | 0.097 | 0.000 | 0.000 | 0.000 | 0.097 | 0.000 | -0.540 |