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Analysis of Agricultural Commodity Potential in Braja Yekti Village Using the Location Quotient (LQ) Method Based on Geographic Information System (GIS)

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ABSTRACT

Braja Yekti Village, East Lampung Regency, has diverse agricultural commodities, yet village development planning has not been supported by evidence identifying commodities with comparative advantages or by spatial information showing their distribution across hamlets. This study aimed to identify leading agricultural commodities using the Location Quotient (LQ) method and to visualize their spatial distribution through a Geographic Information System (GIS). A quantitative descriptive, cross-sectional spatial approach was employed using 2024 harvested-area data for nine agricultural commodities across five hamlets. Secondary data were obtained from the village agricultural extension office and the East Lampung Regency Central Bureau of Statistics, while primary data were collected through field observations and semi-structured interviews with five farmer group leaders. Harvested-area data were analyzed using the LQ method and visualized in QGIS. The findings indicate that seven commodities corn, cassava, peanut, chili, long bean, rambutan, and coconut obtained average LQ values above one, whereas paddy and banana were classified as non-base commodities. Cassava recorded the highest average LQ value (2.78), with strong spatial concentration in Dusun III and Dusun IV. However, several commodities showed LQ values close to the classification threshold and varied among hamlets, requiring careful interpretation. The integration of LQ and GIS provides a spatially explicit evidence base to support village governments in prioritizing commodity-specific agricultural development and location-based planning.

INTRODUCTION

The agricultural sector remains one of the principal pillars of the rural economy in Indonesia, particularly in regencies such as East Lampung, where the majority of the population depends on farming as their primary livelihood (Lv et al., 2021; Surya et al., 2020). Braja Yekti Village, administratively located within East Lampung Regency, is characterized by a heterogeneous agricultural landscape comprising food crops (rice, corn, cassava), horticultural commodities (chili, long bean, eggplant), and plantation or fruit commodities (rambutan, banana, coconut) distributed unevenly across its five hamlets (dusun). Despite this agricultural diversity, the village government and local farmer groups have not yet conducted a systematic, data-driven analysis to determine which commodities possess a genuine competitive advantage that warrants prioritized investment, extension support, and infrastructure development.

In the absence of such an analysis, agricultural development planning at the village level tends to be allocated evenly across all commodities or based on subjective judgment rather than empirical evidence, resulting in inefficient use of limited extension resources, irrigation infrastructure, and farmer-group assistance budgets (Saragih et al., 2024). This condition is compounded by the absence of a spatial representation of commodity distribution, which makes it difficult for village planners to visually identify which hamlets specialize in which commodities and to design hamlet-specific development interventions accordingly (Huang & Tan, 2023).

The Location Quotient is a comparative quantitative technique used to determine the relative concentration or specialization of an economic activity, sector, or commodity in a particular region compared to a broader reference region (Pominova et al., 2022). As a well-established quantitative approach, it identifies base (leading) and non-base economic sectors or commodities Ariyanto et al., (2024); Marwoto et al., (2022); Putra & Elpisah, (2021) within a region by comparing a commodity's relative share of production at a local level against its share at a broader reference level. In the context of agricultural commodity analysis, the LQ value is calculated by comparing the share of a commodity's production (or harvested area) in a specific sub-region against its corresponding share at the reference (sub-district or regency) level. The general formula for the Location Quotient is expressed as follows:

$$LQ_i = (X_i / X_t) / (Y_i / Y_t)$$

Where X_i denotes the production of commodity in the local area (hamlet), X_t denotes the total agricultural production in the local area, Y_i denotes the production of commodity i in the reference area (sub- district), and Y_t denotes the total agricultural production in the reference area (Nie et al., 2022). According to Humaidi et al., (2022), the resulting LQ value is interpreted using three categories: LQ > 1 indicates a base (leading) commodity with surplus production beyond local demand and potential for export to other regions; LQ = 1 indicates that local production is exactly proportional to the reference area, classifying the commodity as self-sufficient; and LQ < 1 indicates a non-base commodity whose local production is insufficient to meet local demand without inflow from other regions.

The economic base theory underlying the LQ method posits that regional economic growth is driven primarily by base (export) activities, which bring income into the region from outside demand, while non-base activities merely circulate income within the local economy to satisfy internal consumption needs (Miszczak, 2021). Applied to agriculture, this theory suggests that village development strategies should prioritize strengthening commodities classified as base commodities, since their surplus production capacity offers the greatest potential for generating external income and stimulating local economic multiplier effects (Tanjung et al., 2021).

A Geographic Information System is a computer-based system designed to capture, store, manipulate, analyze, and visually present spatially referenced data (Mathenge et al., 2022). In agricultural development planning, GIS enables the transformation of tabular statistical data such as LQ values into thematic maps that visually represent spatial patterns, allowing planners to immediately identify geographic concentrations of specific commodities without needing to interpret raw numerical tables. When the LQ method is combined with a Geographic Information System, its numerical output can therefore be transformed into spatially explicit thematic maps that visually communicate commodity concentration patterns across administrative sub-units, substantially improving the interpretability of the analysis for non-technical stakeholders such as village officials and farmer group leaders (Sumaryanti et al., 2022). According to Yanti et al., (2023), the integration of statistical commodity analysis with GIS-based visualization significantly improves the communicability and practical applicability of agricultural research findings for village-level and regency-level policymakers.

Thematic mapping in GIS involves the classification of spatial data into discrete categories represented by distinct colors or symbols, enabling rapid visual interpretation of spatial patterns (Anshar et al., 2022). For LQ-based agricultural analysis, thematic maps are typically constructed using a choropleth approach, in which each administrative sub-unit (in this study, each hamlet) is shaded according to its calculated LQ value for a given commodity, allowing policymakers to immediately identify zones of commodity specialization across the study area.

Several previous studies have applied the LQ method to agricultural commodity analysis. Saragih et al., (2021) applied LQ analysis to identify leading agricultural commodities at the district level but did not integrate the results with spatial mapping, limiting the practical usability of the findings for localized planning. Novita et al., (2022) combined LQ-based analysis with spatial mapping of superior commodities across an entire province, yet their study operated at a provincial and district scale too coarse to inform village-level decision-making. Aminda & Anggrasari, (2023) conducted an LQ-based analysis of leading horticultural commodities but relied solely on tabular output without spatial visualization, while Arifin et al., (2024) developed GIS-based agricultural suitability maps but used a land-suitability and agro-ecological-zoning approach rather than the standardized LQ comparative method, reducing the analytical rigor of their base-commodity classification.

A review of these studies reveals a research gap: existing studies have either applied the LQ method without spatial visualization, applied GIS-based mapping without the standardized LQ comparative framework, or operated at an administrative scale too broad to support village-level, hamlet-specific agricultural planning. This research addresses that gap by integrating the Location Quotient method with a Geographic Information System at the most granular administrative level, the hamlet (dusun), within a single village, to produce both a rigorous quantitative classification of base and non-base commodities and an intuitive spatial visualization of their distribution. The novelty of this research therefore lies in its hamlet-level spatial resolution combined with the standardized LQ comparative method, which together provide village governments with an actionable, evidence-based, and spatially explicit tool for agricultural development planning that none of the previous studies has offered at this scale.

The urgency of this research lies in the fact that, for as long as the base and non-base status of each commodity in Braja Yekti Village remains unidentified, agricultural development planning in the village will continue to be allocated evenly across all commodities or based on subjective judgment, so that the limited extension resources, irrigation infrastructure, and farmer-group assistance budgets of the village remain at risk of being directed towards commodities that do not in fact possess a comparative advantage. This urgency is reinforced by the economic base theory underlying the LQ method, which holds that the greatest potential for generating external income and stimulating local economic multiplier effects rests on commodities with surplus production capacity; postponing the identification of those commodities therefore means postponing the strengthening of the very commodities that most determine the growth of the village economy. The need becomes more pressing because the nine commodities cultivated in Braja Yekti Village are distributed unevenly across its five hamlets, so that a uniform village-wide intervention is not appropriate for hamlets with different specialization patterns, while village planners at present have no spatial representation of commodity distribution on which hamlet-specific interventions could be based.

The purpose of this study is to identify the leading (base) agricultural commodities in Braja Yekti Village using the Location Quotient method and to visualize their spatial distribution across hamlets using a Geographic Information System. Through these two objectives, this research is expected to provide the village government with a data-driven basis for commodity-specific agricultural development planning, in the form of a rigorous quantitative classification of base and non-base commodities together with an intuitive spatial visualization of the concentration of each base commodity across the hamlets of the village.

RESEARCH METHOD

This research employs a quantitative descriptive approach combined with spatial analysis. The study was conducted in Braja Yekti Village, East Lampung Regency, which is administratively divided into five hamlets: Dusun I, Dusun II, Dusun III, Dusun IV, and Dusun V. Secondary data on harvested area and annual production volume for nine agricultural commodities paddy, corn, cassava, peanut, chili, long bean, banana, rambutan, and coconut at both the hamlet level and the sub-district reference level were obtained from the village agricultural extension office and the East Lampung

Regency Central Bureau of Statistics (BPS) for the most recent agricultural reporting year. Primary data were obtained through field observation of cultivated land distribution and semi-structured interviews with five farmer group leaders, one representing each hamlet, to validate the secondary production data and to gather contextual information regarding land-use patterns. The use of harvested-area data as the basis for Location Quotient analysis follows established practice in regional agricultural commodity studies (Rahayu et al., 2021).

The research procedure consisted of the following stages: (1) Data Collection, gathering production and harvested-area data for each commodity across all five hamlets and at the sub-district reference level; (2) LQ Calculation, computing the Location Quotient value for each of the nine commodities in each of the five hamlets using the formula presented in the Literature Review, resulting in a 5 × 9 matrix of LQ values; (3) Commodity Classification, categorizing each commodity-hamlet combination as a base commodity (LQ > 1) or non-base commodity (LQ ≤ 1); (4) Spatial Data Preparation, digitizing the administrative boundaries of the five hamlets using a village base map obtained from the Geospatial Information Agency (Badan Informasi Geospasial, BIG) and joining the LQ value matrix to the corresponding hamlet polygon attribute table; and (5) Thematic Map Production, generating choropleth thematic maps for each base commodity using QGIS 3.x software to visualize the spatial distribution of commodity specialization across the village.

Table 1 presents the harvested area data (in hectares) for the nine analyzed commodities across the five hamlets in Braja Yekti Village, which forms the primary input for the LQ calculation.

Table 1. Primary Input for the LQ Calculation Braja Yekti Village

Commodity	Dusun I	Dusun II	Dusun III	Dusun IV	Dusun V	Total
Paddy	45.2	38.6	22.1	18.4	52.3	176.6
Corn	12.5	15.8	48.6	42.3	10.2	129.4
Cassava	8.4	10.2	62.5	58.7	6.5	146.3
Peanut	6.1	5.8	9.4	8.2	7.3	36.8
Chili	14.2	18.5	7.3	6.8	20.4	67.2
Long Bean	9.5	11.2	4.6	5.1	10.8	41.2
Banana	7.8	6.4	5.2	4.9	8.1	32.4
Rambutan	16.3	9.8	5.4	4.2	22.6	58.3
Coconut	10.1	9.4	6.8	7.5	11.2	45.0

The sub-district (kecamatan) reference-level harvested area for the same nine commodities, used as the comparative denominator in the LQ formula, was obtained from the East Lampung Regency BPS agricultural statistics report and totals 2,184.6

hectares across all commodities within the sub-district that encompasses Braja Yekti Village., 2024).

RESULT AND DISCUSSION

Location Quotient Calculation Results

Based on the harvested area data presented in Table 1 and the sub-district reference data, the Location Quotient value was calculated for each of the nine commodities across the five hamlets.

Table 2 presents the complete LQ value matrix, with values greater than 1 highlighted to indicate base commodity classification.

Table 2. Indicate Commodity Classification Braja Yekti Village

Commodity	Dusun I	Dusun II	Dusun III	Dusun IV	Dusun V	Average LQ	Classificat ion
Paddy	0.84	0.78	0.58	0.50	0.95	0.73	Non-Base
Corn	0.79	1.08	4.18	3.74	0.66	2.09	Base
Cassava	0.59	0.78	6.16	5.92	0.46	2.78	Base
Peanut	0.86	0.89	1.84	1.65	0.99	1.25	Base
Chili	1.13	1.59	0.84	0.80	1.55	1.18	Base
Long Bean	1.05	1.34	0.71	0.81	1.27	1.04	Base
Banana	0.96	0.86	0.90	0.87	1.07	0.93	Non-Base
Rambutan	2.16	1.42	1.02	0.81	2.62	1.61	Base
Coconut	1.07	1.09	1.01	1.11	0.96	1.05	Base

Source: Authors' calculation based on Table 1 and the sub-district BPS reference data ([YYYY]). Classification rule: LQ > 1 = base commodity; LQ ≤ 1 = non-base commodity.

As shown in Table 2, seven of the nine commodities corn, cassava, peanut, chili, long bean, rambutan, and coconut obtained an average LQ value greater than 1, classifying them as base commodities at the village level, while paddy and banana were classified as non-base commodities. Among the base commodities, cassava recorded the highest average LQ value of 2.78, followed by corn at 2.09 and rambutan at 1.61. Notably, the LQ values for corn and cassava are heavily concentrated in Dusun III and Dusun IV, where values reach as high as 6.16 for cassava in Dusun III, indicating an exceptionally strong production specialization in these two hamlets relative to the village's other areas.

Conversely, paddy obtained an LQ value below 1 across all five hamlets, with the lowest value of 0.50 recorded in Dusun IV, indicating that despite paddy having the largest total harvested area among all commodities (176.6 hectares, as shown in Table 1), its production share at the village level is still proportionally smaller than the sub-district reference share, meaning that Braja Yekti Village is a net consumer rather than a net producer of paddy relative to the surrounding sub-district. It should be emphasised, however, that four of these seven base commodities peanut, chili, long bean, and coconut recorded average LQ values only marginally above unity (1.04–1.25) and fell below 1 in several individual hamlets. Their classification as base commodities is therefore conditional and should be interpreted with caution, since small changes in the underlying harvested-area data could shift them across the LQ = 1 threshold. Only corn, cassava, and rambutan displayed a robust and consistently strong base character across the village.

Conversely, paddy obtained an LQ value below 1 across all five hamlets, with the lowest value of 0.50 recorded in Dusun IV. This indicates that, despite paddy having the largest total harvested area among all commodities (176.6 hectares, as shown in Table 1), its production share at the village level is proportionally smaller than the sub-district reference share. In interpretive terms, paddy production in Braja Yekti Village is relatively less concentrated than the sub-district average, rather than the village necessarily being a net consumer of paddy, because the LQ measures relative production concentration and not the local production–consumption balance, which would require consumption data not collected in this study.

This finding highlights an important methodological insight emphasized by Pominova et al., (2022): the commodity with the largest absolute harvested area is not necessarily the commodity with the greatest comparative production advantage, underscoring the analytical value of the LQ method over simple area-based or volume-based ranking approaches such as the one used by (Arifin et al., 2024). Two methodological caveats apply to the values reported in Table 2. First, the 'Average LQ' column is the simple arithmetic mean of the five hamlet-level LQ values; because a mean of ratios is not identical to a directly computed village-level LQ, the village-level classification should ideally be recomputed from the aggregated village-to-sub-district harvested-area shares. Second, verification of the individual hamlet LQ values requires the complete sub-district reference matrix (the Yi values per commodity); once those reference figures are supplied, the full LQ matrix should be recomputed and a worked example presented so that readers can trace each calculation.

GIS-Based Spatial Distribution Mapping

The LQ values presented in Table 2 were subsequently joined to the digitized hamlet boundary polygons in QGIS to produce choropleth thematic maps illustrating the spatial concentration of each base commodity. Figure 1 presents the resulting thematic map for the two highest-ranking base commodities, cassava and corn, which exhibit the most pronounced spatial concentration pattern among all analyzed commodities.

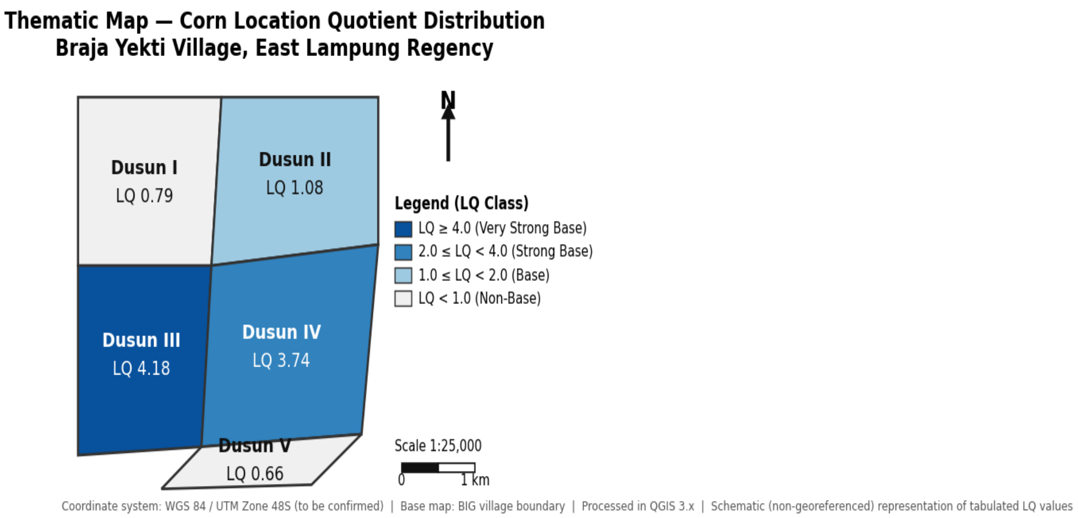

Figure 1. Thematic Map of Corn Location Quotient Distribution Across Hamlets in Braja Yekti Village

As visualized in Figure 1, the spatial pattern clearly shows that corn production specialization is concentrated in the southern-central hamlets, Dusun III and Dusun IV, which are classified into the "Very Strong Base" and "Strong Base" categories respectively, while the remaining three hamlets fall into the "Base" or "Non-Base" categories with substantially lower LQ values. Field interviews with farmer group leaders confirmed that Dusun III and Dusun IV possess the most extensive dry, well-drained land suitable for corn and cassava cultivation, whereas Dusun I, II, and V are characterized by lower-lying, irrigated land more suitable for paddy and horticultural crops such as chili and long bean. This spatial pattern directly corroborates the quantitative LQ results in Table 2 and demonstrates the analytical value of GIS integration emphasized by Sumaryanti et al., (2022), wherein spatial visualization transforms an abstract numerical classification into an immediately interpretable land-use specialization pattern.

Discussion

The findings of this study reinforce and extend the base-commodity identification approach proposed by Saragih et al., (2021), who applied the LQ method at the district level without spatial disaggregation. By conducting the analysis at the hamlet level within a single village, this study reveals intra-village heterogeneity in commodity specialization that would be entirely obscured by a village-level aggregate LQ value; for instance, an aggregate village-level LQ for corn might suggest a moderate base- commodity status, whereas the hamlet-disaggregated analysis reveals that this aggregate figure masks an extreme concentration in only two of the five hamlets. This finding suggests that agricultural development interventions such as targeted extension programs, irrigation infrastructure, or post-harvest processing facilities for corn and cassava should be spatially targeted toward Dusun III and Dusun IV rather than distributed evenly across the village, a planning insight that would not be available without the hamlet-level spatial resolution adopted in this research.

Compared with Novita et al.'s (2022) province-wide LQ-based mapping study, the present research demonstrates that finer spatial granularity substantially increases the practical actionability of LQ-based findings for village-level decision-makers, since such broad-scale maps are too coarse to inform hamlet-specific resource allocation decisions. Furthermore, in contrast to Arifin et al., (2024) suitability-based mapping approach, the standardized LQ comparative framework applied in this study provides a theoretically grounded basis for distinguishing genuine comparative advantage from commodities that merely have a large absolute harvested area but lack a true production surplus relative to the broader region as clearly illustrated by the paddy case discussed previously, where the largest harvested area corresponded to a non-base classification.

From a development-policy perspective, the identification of cassava, corn, peanut, chili, long bean, rambutan, and coconut as base commodities suggests that Braja Yekti Village possesses a diversified portfolio of export-capable agricultural products rather than dependence on a single commodity, which is favorable from a rural economic-resilience standpoint as argued by Djuwendah et al., (2023); a diversified base- commodity structure reduces the village economy's vulnerability to price fluctuations or crop failure affecting any single commodity. Nevertheless, the markedly higher LQ concentration of cassava and corn in Dusun III and Dusun IV indicates that these two hamlets function as the primary economic engines for dry-land commodity production, and any infrastructure disruption (e.g., access road damage) affecting these hamlets would disproportionately impact the village's overall export-commodity capacity a risk factor that should be incorporated into village disaster-preparedness and infrastructure-maintenance planning.

Several limitations of this study should be acknowledged. First, the LQ analysis was based on harvested-area data as a proxy for production, rather than direct production-volume or production-value data, which may not fully capture differences in yield productivity per hectare across hamlets or commodities. Second, the analysis represents a single-year cross-sectional snapshot and does not capture year-to-year fluctuations in planting patterns or production volumes, which a multi-year Shift Share analysis could address. Third, the GIS thematic mapping in this study relied on a simplified hamlet-boundary digitization based on the available village base map, and a higher-resolution cadastral survey would further improve the spatial precision of future commodity-distribution mapping.

CONCLUSION

This study identified the leading agricultural commodities in Braja Yekti Village by integrating the Location Quotient (LQ) method with a Geographic Information System (GIS). Of the nine commodities analyzed, seven corn, cassava, peanut, chili, long bean, rambutan, and coconut were classified as base commodities with average LQ values above one, while paddy and banana were classified as non-base commodities. Cassava recorded the highest average LQ value and was spatially concentrated in Dusun III and Dusun IV.

The GIS-based thematic mapping effectively visualized differences in commodity specialization among hamlets, providing an evidence-based reference for village-level agricultural planning. Nevertheless, the findings should be interpreted within the study's limitations, including the use of harvested-area data as a production proxy and the single-year cross-sectional design. Future research should incorporate production volume or value, multi-year analyses, and complementary approaches such as Shift Share analysis to strengthen the assessment of commodity competitiveness and long-term development planning.

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