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Assessing the potential and determinants of food crop sub-sector production in East Java, Indonesia

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ABSTRACT

Purpose — *This study aims to identify the base and non-base areas within the food crop sub-sector and examine the relationship between agricultural land area, labor (farmers), and the Human Development Index in the production zones of the food crop sub-sector.*

Method — *The research utilized Location Quotient analysis and logit regression analysis, employing the SPSS application as the analytical tool. The study sample consisted of 38 regencies/cities from East Java Province.*

Result — *The results of this research reveal the specific areas encompassed within the food crops sub-sector base in East Java Province, namely: Pamekasan Regency, Blitar Regency, Madiun Regency, Nganjuk Regency, Probolinggo Regency, Trenggalek Regency, Jombang Regency, Kediri Regency, Magetan Regency, Ngawi Regency, Tuban Regency, Ponorogo Regency, Bangkalan Regency, Bondowoso Regency, Lamongan Regency, Sampang Regency, Situbondo Regency, Tulungagung Regency, and Pacitan Regency. Furthermore, the research outcomes highlight a significant correlation between the agricultural labor force (farmers) and production levels, encompassing both the base and non-base sectors of the food crop sub-sector within East Java Province. Conversely, the study reveals that the Human Development Index (HDI) and land area do not exert a statistically significant influence on production.*

Contribution — *This study contributes by determining the regencies/cities in East Java Province classified as base and non-base areas of the food crops sub-sector. It explores the factors leading to such classifications. Unlike previous research focusing solely on base and non-base areas, this study comprehensively analyzes both categories within the food crops sub-sector.*

Keywords: *food crops sub-sector, location quotient analysis, logit regression*

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INTRODUCTION

Regional economic development is a process wherein local governments and communities collaborate to manage existing resources and establish a partnership model between local government and the private sector. The primary goal of every regional economic development endeavor is to enhance the quantity and diversity of job opportunities and foster competitiveness within local communities. To achieve these objectives, local governments and their communities must collectively embark on regional development initiatives aimed at harnessing potential and bolstering competitiveness for building a robust regional economy (Hutapea, Koleangan, & Rorong, 2020).

In order to expedite regional economic development through prioritized infrastructure development, investment is crucial in areas with economic potential. Addressing the issue of inequality in regional development implementation is inherently linked to historical challenges faced by every country. Enhancing the dominant sectors in each region serves as a means to accelerate growth and achieve equitable development through intensified regional development efforts (Faza, Susilowati, & Arifin, 2023).

The expansion of the agricultural sector remains a pivotal objective, aiming to bolster production, achieve food self-sufficiency, elevate farmers' income, create more job opportunities, meet industrial raw material requirements, and enhance export capacity. To strike a balance between industry and agriculture in the national economic structure, continuous emphasis will be placed on the development of the industrial sector, particularly agro-industry. The encouragement of private participation in development activities will be fostered by creating a conducive business climate through the dissemination of information and facilitating ease of engagement (Ramlawati, 2020).

The agricultural sector serves as a source of livelihood for a significant portion of the population in Indonesia and plays a vital role in contributing to the regional economy. The development of this sector centers on regional superior commodities, enabling the effective utilization of the region's potential (Martauli & Astuti, 2021).

In recent years, there has been a notable global increase in agricultural sector development. The key steps to foster such development involve assessing the agricultural sector's potential in each country and optimizing it for income generation. The agricultural sector is further categorized into five subsectors: plantation, food crops, horticulture, livestock, and hunting. Among these, the food crop subsector emerges as the most significant income contributor, particularly in rural areas, propelling progress and development. Moreover, the

food crop sub-sector constitutes a commodity vital for fulfilling basic human needs (Setiani, Unang, & Rofatin, 2021).

Based on data from the Badan Pusat Statistik Provinsi Jawa Timur (2020), the food crop subsector emerges as a significant player in Indonesia's economic development. The primary aim of enhancing this subsector is to augment the production of food crop commodities within the country. In the context of Indonesia's development, food crops have gained paramount importance, especially concerning food supply strengthening efforts during 2014-2019. The government's strategic positioning of the food crop subsector in development can be attributed to the escalating demand for food crops.

According to the Badan Pusat Statistik Provinsi Jawa Timur (2023), East Java Province is renowned as one of the national food reserves, evident through the development of rice, corn, and soybean commodities, vital for achieving food security. The food crop production in East Java Province has witnessed growth from 2018 to 2022. However, it is noteworthy that the land area allocated to the food crop subsector in East Java Province has experienced a decline, primarily due to rapid housing development in the region.

In previous studies, Zuhdi (2021) finds that Kampar Regency in Riau Province significantly contributes to the regional economy, showing consistent GRDP growth and potential as an economic growth source. The study highlights the dominant and rapidly advancing agricultural sector in Kampar Regency based on Klassen Typology and Location Quotient (LQ) analyses. The agricultural sector serves as the growth basis for Kampar Regency, meeting the needs of other regions and exhibiting high competitiveness through Yield Shift Share analysis.

Additionally, Pratama (2020) reveals that Corn, Cassava, Sweet Potatoes, Peanuts, and Soybeans have LQ values > 1, making them base commodities with specialized production parameters in the province. Sweet Potatoes and Corn exhibit the highest LQ values, signifying their potential as regional superior products for Kebumen Regency. These commodities also meet other regional demands. Conversely, Rice and Green Beans have lower LQ values and are not considered non-base sectors, lacking the potential to become regional superior products or supply other regions. Products like Sweet Potatoes, Lowland Rice, Corn, Soybeans, and Green Beans, with positive LQ values > 1, experience faster growth in Kebumen Regency compared to Sweet Potatoes and Peanuts in Central Java Province.

The novelty of this study lies in its comprehensive analysis of the base and non-base areas within the food crop sub-sector in East Java Province. Unlike previous research that concentrated solely on these classifications, this study explores the

relationship between agricultural land area, labor (farmers), and the Human Development Index (HDI) in the production zones of the food crop sub-sector. By utilizing Location Quotient analysis and logit regression analysis, the study offers a robust examination of the factors influencing production levels in both base and non-base sectors. Moreover, the identification of specific regencies/cities as part of the food crops sub-sector base in East Java Province provides valuable insights for policymakers and stakeholders seeking to enhance agricultural development in the region. Overall, the comprehensive and multi-dimensional approach of this study contributes to a deeper understanding of the dynamics and implications of regional agricultural development, setting it apart from previous research efforts.

Based on the research background provided above, the purpose of this study is to determine which regions in East Java Province constitute the base and non-base areas of the food crop sub-sector. Additionally, the study aims to investigate the factors that influence food crop sub-sector production in East Java Province.

METHOD

This research adopts a quantitative research design with a descriptive approach. As stated by Neuman (2013), quantitative research methods involve statistical analysis of data to test predetermined hypotheses and derive conclusions. The descriptive approach used in this study aims to provide a comprehensive description of the research object. Sugiyono (2012) further clarifies that a descriptive approach entails presenting a detailed account of the object under study based on data.

In this study, several key variables are operationally defined to facilitate research replication and precision of findings. Base sector regions are those with potential for superior sector production, contributing to economic improvement. Food crop land area is measured in hectares and represents designated land for food crop cultivation. Labor is quantified as the number of farmers involved in managing food crop sub-sector commodities. The Human Development Index (HDI) is an index that measures education, life expectancy, and income, offering a composite indicator for assessing regional well-being and development. These operational definitions enable researchers to effectively study and compare the identified variables within the context of the study.

The research utilizes secondary data, which refers to data obtained from existing sources. Specifically, the data for this study were sourced from the Central Bureau of Statistics of East Java Province. The dataset encompasses various variables, including district/city food crop subsector GRDP, district/city total

GRDP, provincial food crop subsector GRDP, provincial total GRDP, district/city food crop subsector GRDP growth rate, provincial food crop subsector growth rate, food crop subsector land area, food crop subsector labor, and Human Development Index. The study spans a period of five years, from 2017 to 2022. All data used in this research were obtained from the Central Statistics Agency, ensuring the reliability and credibility of the information employed in the analysis.

Location quotient analysis

The study employs Location Quotient (LQ) analysis to assess the level of economic sector specialization within a region and identify the base sectors. Base sectors are capable of producing food crop subsectors for their region and exporting to other regions. The LQ calculation is performed using the formula:

$$LQ_{ik} = \frac{P_{ik}/P_k}{P_{ip}/P_p} \quad \text{.....(1)}$$

Where,

LQ_{ik} : LQ value of food crop subsector in district/city k
P_{ik} : GRDP of food crop subsector of district/city k (billion rupiah)
P_k : Total GRDP of district/city k (billion rupiah)
P_{ip} : Provincial food crop subsector GRDP (billion rupiah)
P_p : Province's total GRDP (billion rupiah)

From the LQ calculation, it can be seen that:

$LQ_{ik} > 1$: Food crop subsector becomes the base sector in the district/city with higher specialisation of food crops in the district/city compared to the Province.

$LQ_{ik} < 1$: Food crop subsector is non-basic in the district/city with food crop specialisation in the district/city lower than the provincial level.

$LQ_{ik} = 1$: The level of specialisation of food crops in the district/municipality is the same as the provincial level (Endi, 2015).

Logistic regression analysis

The logistic regression is a statistical approach utilized to model categorical response variables based on one or more predictor variables, which can be either categorical or continuous. When dealing with a response variable comprising

two categories, namely "base sector" and "non-base sector," the appropriate logistic method to apply is the binary logistic regression. Logistic regression can handle response variables that are either binary (having two categories) or polycotomous (ordinal or nominal). The probability in logistic regression is essential for determining the likelihood of an event or outcome occurring based on the predictor variables and their coefficients.

$$\pi(x_1) = \frac{\exp(\beta_0+\beta_1 x_1)}{1+\exp(\beta_0+\beta_1 x_1}\text{.....(2)}$$

In this context, the two categories are represented as "success" or "failure," with the probability of success denoted as P(Y=1) = π, and the probability of failure as P(Y=0) = 1 - π. Consequently, the variable Y for each observation adheres to the Bernoulli distribution (Nirwana, 2015).

Binary logistic regression

Binary logistic regression was chosen as the suitable analytical tool for this study since the dependent variable is dichotomous, presenting two distinct categories. Given the non-linear nature of the generated model, the equation used to depict the results is somewhat more intricate compared to multiple regression. The general equation for binary logistic regression, as expressed by Kuncoro (2017), is as follows:

$$Y_i = \frac{eu}{u+eu}\text{.....(3)}$$

In the binary logistic regression model, the estimated probability, denoted as Yi, is computed for each case (i=1,...n). The variable "u" represents the ordinary regression equation utilized in the model.

$$u: A + b_1 X_2 + b_2 X_2 + \text{..... } b_k X_k \text{.....(4)}$$

The general formula for food availability (Y) as the dependent variable is influenced by three independent variables: land area (X1), labor force (X2), and Human Development Index (X3).

$$Y = f(X_1 + X_2 + X_3)\text{.....(5)}$$

Meanwhile, the econometric model can be written as follows:

$Y = \beta o + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + + \mu_i$ .....(6)

Description:
Y = The production area of the base sector and the non-base sector of the food crops sub-sector in East Java Province
X_1 = Land area
X_2 = Labour
X_3 = Human Development Index (HDI)
$\beta_1, \beta_2, \beta_3$ = regression coefficient
μ_i = error terms

In the Binary Logistic Regression (BLR) model, the dependent variable Y is categorized into two classes: 1 = if the region is classified as a food crop subsector base region, and 0 = if the region is classified as a food crop subsector non-base region.

Binary logistic analysis was employed to analyze the econometric model, and data processing and analysis were conducted using the SPSS application. The parameter estimation test can be conducted through the following steps:

Wald test

The Wald test is utilized to ascertain whether there is a significant influence between the dependent variable and the independent variables included in the model. To calculate the Wald value, the following procedure can be followed (Wardhono, and Indrawati, 2011).

Wald test $= \left(\frac{\beta_i}{S_e . \beta_1}\right)^2$ .....(7)

Description:
β_i : regression coefficient
$S_e \ \beta_1$: standard error βi

If the Wald count is less than the Wald table value at a significance level of α = 5%, or if the calculated probability exceeds the critical value at α = 5%, then the null hypothesis (H0) is accepted. This suggests that the independent variable has no statistically significant effect on the dependent variable.

If the calculated Wald value exceeds the Wald table value at a significance level of α = 5%, or if the calculated probability is smaller than the critical value at α = 5%, then the null hypothesis (H0) is rejected. This implies that the independent variable significantly influences the dependent variable.

Nagelkarke test (R^2)

To assess the individual level of influence of the independent variable on the dependent variable, the coefficient of determination is utilized. The coefficient of determination represents the square of the correlation coefficient, signifying the explanatory power of each variable used. In this study, the Nagelkerke test (R^2) is employed because, as stated by (Ghozali, 2005), the Nagelkerke value (R^2) can be interpreted similarly to R^2 in multiple regression.

Goodness of fit test

The Goodness of Fit test is a statistical hypothesis test utilized to ascertain whether a given set of expected frequencies is equivalent to the frequencies observed in a specific distribution (e.g., binomial distribution, Poisson distribution, or normal distribution).

Hypothesis development

Land area and production

According to a study by Gultom, & Harianto (2022), the conversion of agricultural land in urban areas results in cities relying on rural and peripheral regions for their food supply. Urban areas heavily depend on food yields from these rural and peripheral regions to meet their food needs.

H1: Land area has an impact on production of the food crops sub-sectors

Labour and production

According to the research conducted by Belmondo & Triani (2020), employment is identified as a crucial variable in achieving economic growth in Indonesia. The study highlights that a higher number of employed workers correlates with an increased potential for production growth in the country, consequently contributing to overall economic growth.

H2: Labour has an impact on production of the food crops sub-sectors

Human Development Index and production

The study conducted by Pambudi & Bendesa (2020) reveals that a farmer's level of education, without relevant farming experience, may not lead to optimal production results. The income of salt farmers is significantly influenced by their

work experience, as it reflects real-life experiences gained while working. Longer or more extensive work experience enhances a person's skills and efficiency in completing their responsibilities, thus positively impacting their productivity in farming tasks.

H3: Human Development Index has an impact on production of the food crops sub-sectors

RESULT AND DISCUSSION

Based on the findings derived from the Location Quotient calculation, the districts/municipalities can be categorized into base sectors and non-base sectors within the food crop subsector. Base sectors pertain to those capable of locally producing food crop subsectors to cater to their regions' needs and simultaneously engage in exports to other regions. In contrast, non-base sectors comprise areas that lack the ability to internally produce food crop subsectors, leading them to rely on imports from other regions.

Among the regencies/municipalities, notable food crop bases include Pamekasan Regency with an LQ index value of 2.35, Blitar Regency with an LQ index value of 2.00, Madiun Regency with an LQ index value of 4.36, Nganjuk Regency with an LQ index value of 3.26, Probolinggo Regency with an LQ index value of 2.77, Trenggalek Regency with an LQ index value of 2.20, Jombang Regency with an LQ index value of 1.97, Kediri Regency with an LQ index value of 1.70, Magetan Regency with an LQ index value of 3.16, Ngawi Regency with an LQ index value of 5.59, Tuban Regency with an LQ index value of 1.85, Ponorogo Regency with an LQ index value of 4.15, Bangkalan Regency with an LQ index value of 2.02, Bondowoso Regency with an LQ index value of 3.43, Lamongan Regency with an LQ index value of 3.49, Sampang Regency with an LQ index value of 2.76, Situbondo Regency with an LQ index value of 2.57, Tulungagung Regency with an LQ index value of 1.66, and Pacitan Regency with an LQ index value of 2.62.

Logit regression analysis

This study seeks to assess the influence of land area, workforce, and the Human Development Index on the production areas of both the base and non-base sectors within the food crops sub-sector in East Java Province. The research employs Binary Logistic Regression as the analytical tool. The outcomes of the logit method, revealing the relationship between the dependent variables (production areas of base and non-base sectors in the food crops sub-sector) and

the independent variables (land area, workforce, and Human Development Index), are presented in Table 1.

Table 1. Results of logit regression analysis

	B	S.E.	Wald	df	Sig	Exp(B)	95% C.I.for EXP (B)	
							Lower	Upper
LL	0.000	0.000	0.680	1	0.409	1.000	1.000	1.000
TK	0.000	0.000	7.371	1	0.007	1.000	1.000	1.000
HDI	0.042	0.342	0.015	1	0.903	1.042	0.534	2.037
Constant	-1.810	11.202	0.026	1	0.872	0.164		

Source: processed data (2023)

The obtained logistic regression analysis equation is as follows:

$$\text{Ln}\left(\frac{p}{1-p}\right) = -1.810+0\ \text{LL} +0.000\ \text{TK} + 0{,}042\ \text{HDI}$$

The findings from the multivariate analysis of the land area variable, conducted through the logistic regression test, reveal a p-value of 0.409. This implies that the land area variable exhibits no statistically significant effect on the production areas of both the base sector and the non-base sector within the food crops sub-sector.

On the other hand, the analysis of the labor variable using the logistic regression test yields a p-value of 0.007. This suggests that the labor variable demonstrates a statistically significant impact on the production areas of the base sector and the non-base sector of the food crops sub-sector at a significance level of α = 5%.

Additionally, the HDI variable's logistic regression test results in a p-value of 0.903, indicating that the Human Development Index variable does not exert a statistically significant influence on the production areas of the base sector and the non-base sector of the food crops sub-sector.

Wald test

The Wald test /Z test serves to assess the partial effect of the independent variable on the dependent variable. In this context, the parameter utilized in the Wald test /Z test involves comparing the significance value with the predetermined significance level of 5%. Upon analyzing the data presented in Table 2, the following observations can be made:

Table 2. Wald test results

	B	S.E.	Wald	df	Sig	Exp(B)
Step 0 Constant	0.105	0.145	0.526	1	0.468	1.111

Source: processed data (2023)

The obtained results indicate that the slope value or beta coefficient (B) for the Constant is 0.105, and its corresponding Odds Ratio or Exp(B) is 1.111. The Significance value or p value obtained from the Wald test is 0.468. It is important to note that the beta coefficient (B) is analogous to the beta coefficient in Ordinary Least Square (OLS) or linear regression. Similarly, the Wald test serves as the counterpart to the partial t in OLS. Additionally, the Exp(B) represents the exponentiation of the beta coefficient (B), and in this case, Exp(0.105) yields a value of 1.111.

Nagelkerke test (R^2)

The Nagelkarke test is employed to assess the extent of influence exerted by the independent variable on the dependent variable partially. With reference to the data processing outcomes presented in Table 3, conclusive statements can be made as follows:

Table 3. Nagelkerke test result

-2 Log likehood	Cox & Snell R Square	Nagelkerke R Square
249.653	0.067	0.090

Source: processed data (2023)

Based on the Nagelkerke R Square value of 0.090 and the Cox & Snell R Square value of 0.067, it can be deduced that the independent variables collectively account for 9% (0.090) of the variance in the dependent variable. This implies that approximately 91% of the variance remains unexplained by the included independent variables, suggesting that there are other factors outside the model that contribute to the explanation of the dependent variable.

Goodness of fit test

The objective of the Goodness of Fit Test is to assess the precision of the estimated data in relation to the observed data. Drawing insights from the data processing outcomes documented in Table 4, it is possible to assert the following:

Table 4. Goodness of fit test result

Chi-Square	df	Sig
19.022	0	0.015

Source: processed data (2023)

The Hosmer and Lemeshow Test, serving as a Goodness of Fit test (GoF), plays a pivotal role in assessing the accuracy of a formed model. Its primary objective is to ascertain whether the model aligns appropriately with the observed data. A significance value of 0.015 (<0.05) was obtained, leading to the rejection of the null hypothesis (Ho). This rejection indicates that the model cannot be deemed acceptable, and hypothesis testing cannot be conducted due to a significant disparity between the model and its corresponding observed values. Consequently, further refinement or investigation may be warranted to improve the model's conformity to the observed data.

Discussion

Land area and production

The probability value of the error is 0.409, indicating that the relationship between land area and the production of the food crops sub-sector is not statistically significant (see Table 1). In other words, the land area does not have a significant effect on the production of food crops in the examined region, East Java Province.

This result suggests that other factors or variables might be more influential in determining the production levels of the food crop sub-sector in the region, and further investigation is required to identify and understand these factors properly. The absence of a significant relationship between land area and production implies that the region's food crop production might be influenced by different variables, such as climate conditions, technological advancements, labor availability, or market demand. Consequently, policymakers and stakeholders need to consider and explore these alternative factors to develop more targeted and effective strategies for enhancing food crop production and achieving sustainable agricultural growth in East Java Province.

Labour and production

The probability error value of 0.007 is smaller than the conventional significance level of 0.05, suggesting that the relationship between labor and food crop production is highly likely to be real and not due to chance (see Table 1).

The positive relationship between labor and food crop production implies that an increase in the labor force will lead to a corresponding increase in the production of food crops in the region. Conversely, a decrease in the availability of labor will result in a reduction in food crop production. These findings highlight the importance of labor in driving agricultural productivity and emphasize the need for effective labor management and workforce development strategies to boost food crop production in East Java Province. Policymakers and stakeholders should consider investing in programs to enhance labor skills, ensure a sufficient workforce, and create a conducive environment for agricultural employment to foster sustainable growth in the food crops sub-sector.

Human Development Index and production

The probability error value is 0.903, which is considerably higher than the conventional significance level of 0.05 (see Table 1). This suggests that the relationship between the Human Development Index (HDI) and the production of the food crops sub-sector in East Java Province is not statistically significant. In other words, the HDI does not have a substantial effect on food crop production in the examined region.

This result implies that other factors or variables might play a more significant role in influencing food crop production in East Java Province. It is essential for researchers and policymakers to explore alternative factors that could have a more pronounced impact on agricultural productivity and development in the region. Factors such as agricultural practices, climate conditions, access to technology, and market dynamics might be crucial drivers of food crop production and deserve further investigation. Understanding these factors in depth can lead to more targeted and effective strategies for promoting sustainable agricultural growth in East Java Province.

CONCLUSION

The study yields significant insights into the food crop sub-sector. Firstly, the analysis identifies several regions as base sectors of the food crop sub-sector, namely Pamekasan Regency, Blitar Regency, Madiun Regency, Nganjuk Regency,

Probolinggo Regency, Trenggalek Regency, Jombang Regency, Kediri Regency, Magetan Regency, Ngawi Regency, Tuban Regency, Ponorogo Regency, Bangkalan Regency, East Java Regency, Bondowoso Regency, Lamongan Regency, Sampang Regency, Situbondo Regency, Tulungagung Regency, and Pacitan Regency.

Secondly, the logit analysis demonstrates the impact of certain variables on the production areas of both the base and non-base sectors. Specifically, the land area exhibits a positive yet insignificant effect on food crop production, while the labor variable shows a positive and significant influence on the production areas of the base and non-base sectors within the food crops sub-sector. On the other hand, the human development index variable has a positive, but insignificant effect on production areas.

These findings underscore the significance of identifying base and non-base sectors within the food crops sub-sector and understanding the factors influencing production levels. This knowledge can aid policymakers and stakeholders in devising effective strategies to enhance food crop production and ensure sustainable agricultural growth in the region. By leveraging the insights gained from this study, informed decisions can be made to promote agricultural development and optimize productivity in the food crop sub-sector.

Further studies could focus on conducting a comprehensive comparative analysis of different regions within East Java Province to identify variations in food crop production and the specific factors influencing these differences. By exploring the unique characteristics and practices in each region, this study could provide valuable insights into regional disparities and highlight best practices for enhancing food crop production in East Java Province.

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