AGRITROPICA
Journal of Agricultural Sciences

Content is available at :
https://ejournal.unib.ac.id/jagritropica
ISSN: (Print) 2621-217X, (Online) 2621-699X
Agritropica. J. Agr. Sci. 7 (2): 137-142, November 2024

Clustering of Food Security Areas in Bengkulu Province Using Biplot Analysis Approach

Hariz Eko Wibowo[1*], Ridha Rizki Novanda[1], Rihan Ifebri[1], and Ariffatchur Fauzi[2]

[1]Departement of Socio-Economic Agriculture, Faculty of Agriculture, Bengkulu University, Indonesia
[2]Departement of Plant Protection, Faculty of Agriculture, Bengkulu University, Indonesia
***Corresponding author: hariz.ekowibowo@unib.ac.id**
Article info: Submitted: 2024-12-07, Accepted: 2024-12-12, Publish: 2024-12-29

ABSTRACT. Food security is one of the crucial issues in developing countries. The Food and Agriculture Organization (FAO) identifies four food security components: availability, affordability, utilization, and stability. Bengkulu Province, until 2023, is the second poorest province on the island of Sumatra. This has an impact on food affordability, which is a component of food security. There needs to be mapping or grouping in each region in Bengkulu Province so that the policies formed and implemented can be more optimal. This study aims to group and map areas or districts in Bengkulu Province that have similar characteristics based on aspects of food availability, food affordability or physical access to food, and aspects of food utilization. Biplot analysis describes regional characteristics and variable correlations in a two-dimensional graph. The results of grouping food security areas based on the characteristics of the three aspects are three clusters. The first cluster consists of Kaur, South Bengkulu, and Lebong. The second cluster consists of Central Bengkulu, Mukomuko, and North Bengkulu. The third cluster consists of Rejang Lebong, Seluma, and Kepahiang. The first cluster tends to have good food security because its characteristics are relatively close to the food availability and utilisation indicators. The second cluster has strong attributes as an indicator of food affordability. The third cluster has characteristics that describe indicators of lack of electricity, clean water, poverty rate, and life expectancy.

Keywords: Biplot Analysis, Clustering, Food Security

Reference to this paper should be made as follows:
Wibowo, H. E., R. R. Novanda, R. Ifebri, and A. Fauzi. 2024. Clustering of Food Security Areas in Bengkulu Province Using Biplot Analysis Approach. Agritropica. J. Agr. Sci. 7 (2):137-142. Doi: https://doi.org/10.31186/J.agritropica.7.2.137-142.

INTRODUCTION

Food security is one of the important issues in developing countries. The strategy to maintain food security is generally carried out by increasing the availability of domestic food supplies either by increasing the productivity of harvest results or through import policies. Food self-sufficiency is a government commitment, especially in developing countries. The government makes various efforts to plan and implement policies through programs to meet staple food production targets.

Talking about food security is not only about the area of food cropland and food availability but also several aspects. The Food and Agriculture Organization (FAO, 2006) and the National Food Agency from the Indonesian Government or Badan Pangan Nasional (BPN) in Bahasa Indonesia identify three aspects: availability, accessibility, and food utilisation. These aspects contain nine indicators. There are four aspects, but the fourth aspect, namely stability, is temporarily put aside because it is related to food distribution and other details over a certain period.

As the name suggests, food availability explains how to meet the community's food needs. This is related to several things such as population, area of food cropland, amount of food production, more specifically, the type of food crop produced, and consumption level. In this case, the indicator used is the per capita

consumption level ratio to the amount of food crop production (Wibowo et al., 2024).

Accessibility of food, or something some people say is the affordability of food, talks about people's purchasing power. It would be useless if food were available, but the price would be very high, and people would not be able to buy it. So, this aspect talks about food prices and people's economic capabilities. Three indicators are used in this aspect: the percentage of the population below the poverty line, the percentage of households with food expenditures above 65 per cent, and the percentage of the population without access to electricity.

Food utilisation is an aspect that refers to the body's ability to use the nutrients in food and includes how food is prepared, stored, and processed. It can also refer to how food is distributed within a household. There are five indicators, which are (Wibowo et al., 2024)

1. The average length of schooling of girls aged 15 years over
2. The percentage of households without clean water access
3. The ratio of the number of residents per health professional to the population density level
4. The percentage of stunting
5. The rate of life expectancy

Food insecurity is frequently linked to the development of several issues. Children under five who do not have access to wholesome food will suffer from nutritional issues such as malnutrition (Hackett et al., 2009; Motbainor et al., 2015). Food insecurity is also linked to chronic diseases (Seligman et al., 2010; Gowda et al., 2012) and obesity in women (Franklin et al., 2011; Pan et al., 2012). Additionally, hazardous sexual behaviour (Vogenthaler et al., 2013), anxiety, sadness, risky coping mechanisms, and poor pregnancy outcomes in women are all associated with food insecurity (Ivers & Cullen, 2011). Further societal effects of food insecurity include children's delayed mental development (Rose-Jacobs et al., 2008; Slopen et al., 2010).

Bengkulu Province, until 2023, has the second-highest poverty rate on the island of Sumatra. The poverty rate is one of the important indicators of food security, especially the accessibility aspect. There needs to be mapping or grouping in each region in Bengkulu Province so that the policies formed and implemented can be more optimal.

This study aims to group and map districts in Bengkulu Province with similar characteristics based on aspects of food security. The hypothesis is that several districts have similar characteristics and then become a group, with several groups with similar characteristics.

MATERIALS AND METHODS

Biplot analysis describes regional characteristics and variable correlations in a two-dimensional graph. This analysis uses Food Security and Vulnerable Atlas (FSVA) data from the National Food Agency (BPN). Biplot Analysis is an explanatory graph method used in statistics with two-dimensional charts that represent a multidimensional dataset (Wulandary, 2019)

1. Angle degrees between two variables represents the positive/negative correlation
2. Vector line length represents the level of variance
3. The distance between the object and the variable line represents the value of the variable on the object

RESULTS AND DISCUSSION

The results of the biplot analysis illustrate three groups of food security areas based on the characteristics of the three aspects. Referring to Figure 1, the first cluster consists of Kaur, South Bengkulu, and Lebong Regencies. Central Bengkulu, Mukomuko, and North Bengkulu districts have contiguous characteristics and are the second cluster. Moreover, the remaining districts, such as Rejang Lebong, Seluma, and Kepahiang, form the third cluster. The first cluster tends to have good food security because its characteristics are relatively adjacent to the indicators of food availability and food utilisation. Rice is Indonesia's most widely eaten energy source (Yudaningrum, 2011).

Food utilisation subsystem indicators include the proportion of households without access to clean water, the average years of education for women aged 15 and over, the population-to-health worker ratio, life expectancy,

and the proportion of stunted toddlers (Yuliantini et al., 2022).

The coordinates of the second cluster members are close to food accessibility. Consumption tends to diversify as income increases, which increases the consumption of nutritious food (Yudaningrum, 2011). Their income influences the amount of community consumption at a time. According to Pujoharso (2013), consumption tends to increase or decrease along with changes in income. Social welfare increases when the proportion of income spent on food decreases (Ariani et al., 2007).

The third cluster has characteristics that describe indicators of lack of electricity, clean water, poverty rates, and life expectancy. It could be due to the area. Sukiyono et al. (2015) state that the needs of farmers and fishermen in coastal areas also restrict food security.

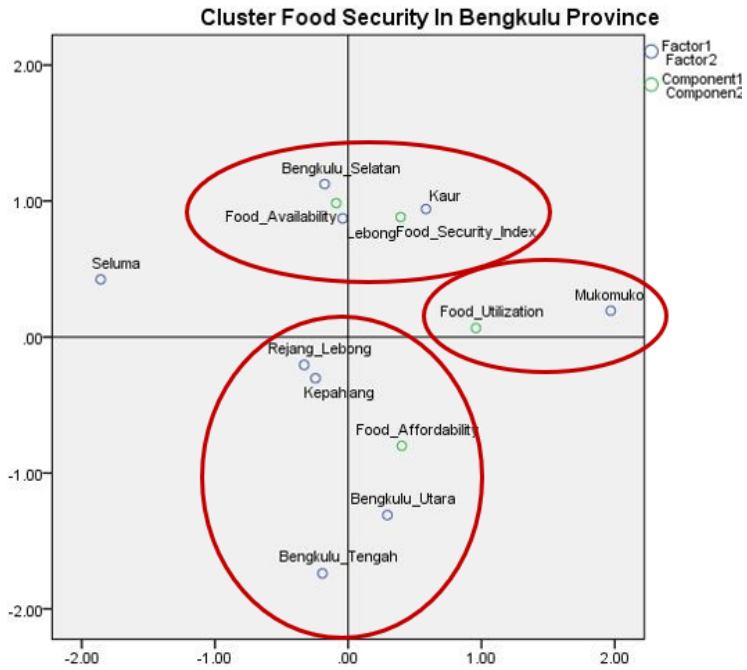

Figure 1. Cluster with Biplot Approach

This result is relatively different from another result with the descriptive analysis approach. Wibowo et al. (2024) argue that in certain districts, the food security index rose steadily throughout the period, whereas in others, it varied. Districts like Rejang Lebong, Seluma, and Mukomuko are among those that are changing. Bengkulu City and other districts' Food Security Indexes tend to rise. Kepahiang and Bengkulu Central's Food Security Index are the only districts with a propensity to decline.

The pandemic effect could cause this condition. The pandemic has significantly impacted food security, especially in Bengkulu Province (Wibowo et al., 2023). Several factors relate to the food security index and are affected by the pandemic, such as home ownership status, type of lighting, PKH program status, and adequate sanitation (Asriani et al., 2024).

Food security in Indonesia can be considered in both rural and urban settings. Urban-dwelling Indonesians report feeling unsafe, and the percentage has gone up as a result of the epidemic (Kharisma & Abe, 2020). According to Greenville et al. (2020), food exports must be halted in a non-self-sufficient nation like Indonesia so that attention can be focused on meeting domestic food demand. Dietary awareness can increase immunity, and the BULOG can release food stock as efficiently as possible (Rozaki, 2020). Dependency on imports raises the possibility of future issues. Another problem arises when rice is overemphasised as the primary ingredient to attain food security.

More rules and initiatives are required to advance the food diversification program (Rozaki, 2021).

Food security policy should also consider food price volatility. Changes in food prices may significantly impact the growth and development of the economy. More price risk tends to skew production patterns and discourage private investment, especially in developing countries—deficiencies in agricultural production and inadequate agricultural investment. At the same time, it was demonstrated that food price shocks significantly changed human capital composition, with particularly detrimental effects on education and nutrition. They were also connected to civil wars and social unrest in general. The impact of fluctuating food prices on long-term growth seems severe. (Wibowo et. al., 2023)

CONCLUSION

The results of the biplot analysis illustrate three groups of food security areas based on the characteristics of the three aspects. The first cluster consists of Kaur, Bengkulu Selatan, and Lebong Regencies. Rejang Lebong, Kepahiang, Bengkulu Utara, and Bengkulu Tengah districts have contiguous characteristics and are the second cluster. The remaining districts, namely Seluma and Mukomuko, have different characteristics. However, the distance between Mukomuko Regency and food utilisation is close, illustrating that Mukomuko and food utilisation have a high correlation. This can be called the third cluster. The first cluster tends to have good food security because its characteristics are relatively adjacent to the indicators of food availability and the overall food security index. Coordinates of the second cluster member are close to the food accessibility or affordability. Seluma Regency has a reasonably considerable distance from other districts and other indicators, and it can be interpreted that the correlation between Seluma Regency and other districts is weak. Seluma has characteristics that describe the lack of 9 indicators, such as electricity, clean water, poverty rates, life expectancy, etc.

SUGGESTION

Food exports must be decreased in a non-self-sufficient nation like Indonesia so that attention can be focused on meeting domestic food demand. Dietary awareness can increase immunity, and the BULOG can release food stock as efficiently as possible. Dependency on imports raises the possibility of future issues. Another problem arises when rice is overemphasised as the primary ingredient to attain food security. Moreover, additional rules and initiatives are required to advance the food diversification program.

Food security policy should also consider food price volatility. Changes in food prices may significantly impact the growth and development of the economy. More price risk tends to skew production patterns and discourage private investment, especially in agricultural production. At the same time, it was demonstrated that food price shocks significantly changed human capital composition, with particularly detrimental effects on education and nutrition.

REFERENCE

Ariani, M., Ariningsih, E., Kariyasa, I. K., & Maulana, M. (2007). Kinerja dan Prospek Pemberdayaan Rumah Tangga Rawan Pangan Dalam Era Desentralisasi. Kerjasama Penelitian Biro Perencanaan, Departemen Pertanian, dan UNESCAP-CAPSA.

Asriani, P. S., Wibowo, H.E., & Sukiyono, K. (2024). Dynamics of household food security pre and post the COVID-19 pandemic in Bengkulu Province, Indonesia. Journal of Socioeconomics and Development, 7(2), 132-143. https://doi.org/10.31328/jsed.v7i2.5138

Food and Agriculture Organization (FAO). (2006). Food Security. [Policy Brief] Rome (IT): Food and Agriculture Organization (FAO). Retrieved from https://reliefweb.int/report/world/policy-brief-food-security-issue-2-june-2006

Franklin, B., Jones, A., Love, D., Puckett, S., Macklin, J., & White-Means, S. (2011). Exploring Mediators of Food Insecurity and Obesity: A Review of Recent Literature. J Community Health, 37(1), 253–264. https://doi.org/10.1126/science.1182768

Gowda, C., Hadley, C., & Aiello, A.E. (2012). The Association Between Food

Insecurity and Inflammation in the US Adult Population. Am J Public Health, 102(8), 1579–1586. https://doi.org/10.2105/AJPH.2011.300551

Greenville, J., Mcgilvray, H., Cao, L.Y., & Fell, J. (2020). Impacts of COVID-19 on Australian agriculture, forestry and fisheries trade. Canberra, Australia. Retrieved from https://www.agriculture.gov.au/abares/research-topics/trade/impacts-of-COVID-19-on-Australian-trade

Hackett, M., Melgar-Quiñonez, H., & Álvarez, M.C. (2009). Household food insecurity associated with stunting and underweight among preschool children in Antioquia, Colombia. Rev Panam Salud Públ, 25, 506-510. https://doi.org/10.1590/s1020-49892009000600006

Ivers, L. C., & Cullen, K. A. (2011). Food insecurity: special considerations for women. The American Journal of Clinical Nutrition, 94(6), 1740S-1744S. https://doi.org/10.3945/ajcn.111.012617

Kharisma, V., & Abe, N. (2020). Food insecurity and associated socioeconomic factors: Application of Rasch and Binary Logistic Models with household survey data in three megacities in Indonesia. Soc. Indic. Res., 148(2), 655–679. https://doi.org/10.1007/s11205-019-02210-z

Motbainor, A., Worku, A., & Kumie, A. (2015). Stunting is associated with food diversity while wasting with food insecurity among under five children in East and West Gojjam Zones of Amhara Region, Ethiopia. PLoS One, 10(8), 1-14. https://doi.org/10.1371/journal.pone.0133542

Pan, L., Sherry, B., Njai, R., & Blanck, H.M. (2012). Food Insecurity Is Associated with Obesity among US Adults in 12 States. J Acad Nutr Diet, 112(9), 1403-1409. https://doi.org/10.1016/j.jand.2012.06.011

Pujoharso, Cahyo. (2013). Aplikasi Teori Konsumsi Keynes Terhadap Pola Konsumsi Makan Masyarakat Indonesia. Artikel Ilmiah. Fakultas Ekonomi dan Bisnis Universitas Brawijaya. Malang. Retrieved from: http://repository.ub.ac.id/id/eprint/106863/

Rose-Jacobs, R., Black, M.M., Casey, P.H., Cook, J.T., Cutts, D.B., Chilton, M., & Frank, D.A. (2008). Household food insecurity: associations with at-risk infant and toddler development. Pediatrics, 121(1), 65-72. https://doi.org/10.1542/peds.2006-3717

Rozaki, Z. (2020). COVID-19, agriculture, and food security in Indonesia. Reviews in Agricultural Science. Gifu University - United Graduate School of Agricultural Science. https://doi.org/10.7831/ras.8.0_243

Rozaki, Z. (2021). Food security challenges and opportunities in indonesia post COVID-19. In Advances in Food Security and Sustainability (Vol. 6, pp. 119–168). Elsevier Ltd. https://doi.org/10.1016/bs.af2s.2021.07.002

Seligman, H.K., Laraia, B.A., & Kushel, M.B. (2010). Food Insecurity Is Associated with Chronic Disease among Low-Income NHANES Participants. J Nutr, 140(2), 304-310. https://doi.org/10.3945/jn.109.112573

Slopen, N., Fitzmaurice, G., Williams, D.R., & Gilman, S.E. (2010). Poverty, Food Insecurity, and the Behavior for Childhood Internalizing and Externalizing Disorders. J Am Acad Child Psy, 49(5), 444-452. https://doi.org/10.1016/j.jaac.2010.01.018

Sukiyono, K., Widiono, S., Cahyadinata, I., & Sriyoto. (2015). Study on Local Concept of Household Food Security: Case of Fishery and Paddy Farming Community in Mukomuko District, Bengkulu Province. International Seminar on Promoting Local

Resources for Food and Health, 12-13 October, 2015, Bengkulu, Indonesia. Proceeding ISEPROLOCAL. ISBN: 9786029071184. P: 333-341

Vogenthaler, N.S., Kushel, M.B., Hadley, C., Frongillo, E.A., Riley, E.D., Bangsberg, D.R., & Weiser, S.D. (2013). Food Insecurity and Risky Sexual Behaviors Among Homeless and Marginally Housed HIV-Infected Individuals in San Francisco. AIDS Behav, 17(5), 1688-1693. https://doi.org/10.1007/s10461-012-0355

Wibowo, H. E., R. R. Novanda, R. Ifebri, and A. Fauzi. (2023). Overview of the Literature on the impact of Food Price Volatility. Agritropica: Journal of Agricultural Science. 6 (1): 22-32. Doi: https://doi.org/10.31186/J.agritropica.6.1.22-32.

Wibowo, H.E., R. Ifebri, A. Fauzi. (2023). Household Food Security Analysis Pre And Post The Covid-19 Pandemic In Bengkulu Province. Journal of Agri Socio Economics and Business. 5(2): 203-214. Doi: https://doi.org/10.31186/jaseb.05.2.203-214.

Wibowo, H. E., R. R. Novanda, R. Ifebri, and A. Fauzi. (2024). Analysis Food Security of Cities in Bengkulu Province Pre and Post Pandemic. Agritropica. J. Agr. Sci. 7 (1): 69-76. Doi: https://doi.org/10.31186/J.agritropica.7.1.69-76.

Wulandary, S. (2019). Implementation of PCA Biplot And K-Medoids Clustering On Country Segmentation Based on Global Food Security Index (GSFI) 2018 Data. Biastatistics: Jurnal Statistika Teori dan Aplikasi: Biomedics, Industry & Business and Social Statistics,13(2), 25-36.

Yudaningrum, A. (2011). Analisis Hubungan Proporsi Pengeluaran dan Konsumsi Pangan Dengan Ketahanan Pangan Rumah Tangga Petani di Kabupaten Kulon Progo. [Bachelor's thesis, Fakultas Pertanian Universitas Sebelas Maret]. https://doi.org/10.20961/sepa.v7i2.48896

Yuliantini, E., Sukiyono, K., Yuliarso, M.Z., & Sulistyo, B. (2022). Food Security and Stunting Incidences in the Coastal Areas of Indonesia. Macedonian Journal of Medical Sciences, 10, 454-461. https://doi.org/10.3889/oamjms.2022.9335