

The Effect of Ecological and Physiological Adaptation of Food Crops on Food Security in the Banyumas Highlands Region

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Received: February 19, 2024

Revised: June 13, 2024

Accepted: July 25, 2024

Published: July 31, 2024

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DOI: [10.29303/jppipa.v10i7.8090](https://doi.org/10.29303/jppipa.v10i7.8090)

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Abstract: This study aims to analyze the influence of ecological and physiological adaptations of food crops on food security in the highland area of Banyumas Regency. The research area includes Baturaden, Kedungbanteng, and Cilongok Districts, which are known to have a surplus of rice food reserves. Ecological adaptation includes how food crops adapt to specific environmental conditions at high altitudes, while physiological adaptation includes plant responses to factors such as temperature, humidity, and soil type. The data used in this study came from the Central Statistics Agency of Banyumas Regency in 2021. The results show that food accessibility, measured through physical and social access, has a significant correlation with food security. Physical and social access were significantly correlated with food security, with significance values of 0.046 and 0.017, respectively. The study concluded that the ecological and physiological adaptations of food crops play an important role in supporting food security in the Banyumas highlands, and that increased physical and social accessibility can improve food security stability in the region. Local governments need to focus on providing facilities and infrastructure that support food accessibility to ensure sustainable food security in the highlands.

Keywords: Ecological adaptation; Food accessibility; Food security; Highlands; Physiological adaptation

Introduction

The ecological and physiological adaptation of food crops plays an important role in food security, especially in highland areas such as Banyumas Regency. Ecological adaptation includes the ability of plants to adapt to specific environmental conditions, such as temperature, humidity, and soil type. Physiological adaptation includes plant responses to these environmental factors, including physiological mechanisms that allow plants to survive in less than optimal conditions. In the highlands, environmental conditions are often more extreme and

varied compared to the lowlands (Benitez-Alfonso et al., 2023; Massawe et al., 2015; Tabe-Ojong et al., 2023).

Food crops must have good adaptability to be able to grow and produce optimally. Crops such as rice, corn, and vegetables require special adaptations to survive in lower temperatures and different soil conditions. Research shows that the ecological and physiological adaptations of food crops have a significant impact on food security in highland areas. Plants that are able to adapt well tend to produce more stable and quality harvests, which in turn improves the food security of local communities. In Banyumas Regency, sub-districts such as Baturaden, Cilongok, and Kedungbanteng show

How to Cite:

Wijayanti, K. E., Mulyani, A., Sukmaya, S. G., Wicaksari, S. A., & Saputro, W. A. (2024). The Effect of Ecological and Physiological Adaptation of Food Crops on Food Security in the Banyumas Highlands Region. *Jurnal Penelitian Pendidikan IPA*, 10(7), 3920-3931. <https://doi.org/10.29303/jppipa.v10i7.8090>

good adaptability, which is reflected in better food security compared to other regions. Banyumas Regency has several sub-districts in the highlands such as Baturaden, Cilongok, and Kedungbanteng. Based on this description, this study aims to determine the influence of ecological and physiological adaptation of food crops on food security in the highland area of Banyumas Regency.

The integration of biological and economic aspects of agriculture in government policies is expected to improve food security and community welfare in the region (Hadley et al., 2023; Leisner, 2020; Vermeulen et al., 2012). Poverty alleviation policies and discussions on food security are not new problems. Agricultural policies must support efforts to address food security. Proper agricultural policies have a correlation with poverty alleviation (Salasa, 2021). The decrease in poverty rate shows that people are starting to be able to meet their household food needs. This comprehensive effort must be supported by the government through policies that target poverty alleviation and overcoming food security problems. The problem of food security has not been solved properly until now (Rusliyadi et al., 2019).

The development of food security is a challenge related to the number of populations. Ecological and physiological factors of food crops are important factors because they can affect the availability and productivity of crops. The limited natural resources in fulfilling food and the many land use changes cause its own problems. Limited food production causes food problems for households (Kerr et al., 2019; Feizizadeh et al., 2023; Subedi et al., 2023). The infrastructure of the food sector must also be improved, especially in rural areas which are the main source of food products. Competition with imported food products and households that are on the poverty line is an additional problem (Paasch et al., 2015). The demand for food needs increases as the capita increases, driving an increase in demand for food products. Differences in income levels, health awareness, and diet lead to differences in the level of food security at the household scale. Different community activities also contribute to this difference. Food-insecure areas in Indonesia are often correlated with the poverty level of the population (Rusliyadi, 2021).

Food problems in Indonesia are shown by differences in household food consumption that are not proportional to production. Based on the ecological and physiological adaptation of food crops in the Banyumas highlands, most Indonesians still consume rice as the main food, with rice intake accounting for up to 60 percent of daily calorie intake (Ayesha et al., 2023; Seppelt et al., 2022; Wollenberg et al., 2016). This dependence causes further problems, demanding that

Indonesia achieve production higher than domestic demand. Indonesia was the third largest rice producer in 2015, with a production of more than 50 million metric tons of rice. However, rice consumption increased faster than production, causing rice imports at a certain time term. Land ownership problems also occur, caused by land conversion and property inheritance (Rusliyadi & Libin, 2018). Indonesians who are still experiencing poverty face difficulties in obtaining food, coupled with health, education, and nutrition problems. Most Indonesian people are in a condition of energy and protein shortage, below 2000 kcal of energy per capita (Badan Pusat Statistik, 2021). More than 53% of Indonesians are in the energy consumption range of 1,322 to 1,988 kcal, below the recommended nutritional adequacy rate (Rusliyadi, 2023). Households with food insecure categories are an additional problem that must be well anticipated. Solving the problem of food-insecure households will help solve food security (Hou et al., 2022; Mirzabaev et al., 2023; Tchonkouang et al., 2024).

The government must take policies that help achieve food security, where every individual must meet their food needs in terms of adequacy, quality, safety, variety, nutrition, equity, and affordability of food. Food security can be assessed from three main pillars: food availability, food access, and food utilization. The provision of staple food is the responsibility of the government, especially for regions on the island of Java that have difficulty accessing food (Negoro et al., 2014). Anticipatory steps need to be taken, especially in the aspects of accessibility and the provision of foodstuffs which are often scarce both ecologically and physiologically. The ecological and physiological adaptation of food crops is an important factor to consider because different environmental conditions in the region can affect the availability and productivity of crops. National food security can be realized by balancing the demand and supply of food at a certain price level and quantity (Mekonnen et al., 2021; Sanga et al., 2021; Tripathi et al., 2016). Access to food is an important benchmark because not all people who work as farmers are able to provide their own food. The three main dimensions of food security, namely availability, accessibility, and affordability, must be met. The integration of government policies with food price stabilization is important for national development. Poverty alleviation is also important for the equitable distribution of the community's economic level.

This research is important because it reveals the significant role of ecological and physiological adaptation of food crops in food security, especially in highland areas such as Banyumas Regency. The extreme and varied environmental conditions in highlands require food crops to have good adaptability to grow

and produce optimally (Gerda et al., 2023; Lefe et al., 2024; Setioningrum & Subiantoro, 2023). This study aims to understand how these adaptation abilities affect the stability and quality of crop yields, which in turn impacts the food security of local communities. By identifying the adaptation factors that support crop productivity in highland environments, this research can provide essential insights for developing more effective agricultural policies and supporting efforts to improve community welfare through better food security. Additionally, this research is relevant in the context of poverty alleviation policies and food security enhancement, which are global challenges, considering the need for agricultural policies that can holistically and sustainably address food security and poverty issues.

Method

An analytical descriptive method was used in this study. This study uses secondary data from the Central Statistics Agency of Banyumas Regency in 2021 by paying attention to ecological and physiological aspects. The research location used is the highlands in Banyumas Regency represented by Baturaden, Kedung banteng, and Cilongok Districts. The selection of this sample is based on purposive sampling that the highlands have different food security diversity if banned the food accessibility variables are divided into two aspects, namely physical access and social access. Ecological and physiological factors of food crops are the main consideration because environmental variations in the area can affect the availability and productivity of crops. The evaluation of physical access was carried out by measuring how much market is available in the study area, while social access was measured by the number of households or heads of families receiving government assistance for their food needs.

The food security variable is measured from the potential of rice food reserves in each region. The selection of food reserves in the form of rice is because most people still consume rice as a staple food. The first stage is to convert rice into rice by multiplying the conversion value to the net (Purnomo et al., 2021). Rice production that has been converted into rice is then reduced by the community's rice consumption. Rice consumption is sought using the per capita consumption comparison with the number of people in the highlands in Banyumas Regency. All existing components will later be reduced so that the correct rice food reserve figure is obtained (Anggrasari & Saputro, 2021). The following is a mathematical formula to calculate food reserves (Suroso, 2017).

$$PCP = Rnet - Kkr \tag{1}$$

Information:

PCP = Potential Food Reserve

Rnet = Net Rice Production

Kkr = Cumulative Consumption of Rice

Answering the research objectives related to the relationship or correlation between accessibility and food security using the chi-square test. The Chi Square test is useful for testing the relationship or influence of two nominal variables and measuring the strength of the relationship between one variable and another nominal variable (Godde et al., 2021; Kusnadi & Sukmawati, 2023; Novianti et al., 2023; Sukmawati et al., 2022). Mathematically, the calculation of the chi-square test can be seen below (Pasira et al., 2018).

$$X^2 = \sum_{i=1}^n \frac{(O_i - E_i)^2}{E_i} \tag{2}$$

Information:

X^2 = Chi-Square Distribution

O_i = Observation Value

E_i = Expected Value

Decision-making indicators:

- a. If Sig. \geq 0.05, then there is no significant effect
- b. If Sig. $<$ 0.05, then there is a significant influence

For more clarity, the stages of this research can be seen in Figure 1.

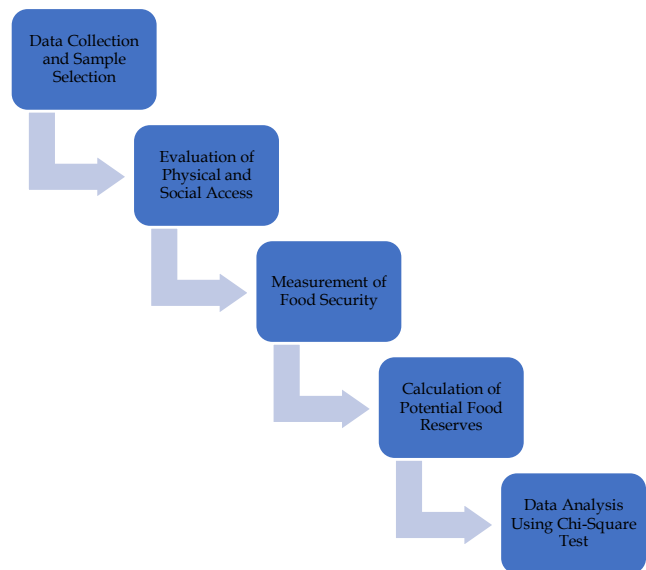


Figure 1. Research procedure

Result and Discussion

Accessibility is an important concern in ensuring household food security, especially for people in the highlands in Banyumas Regency. Accessibility is described based on information on the number of available markets, both markets with permanent, semi-permanent and no buildings. Other discussions related

to the dimension of food accessibility are also reflected in two conditions, namely the availability of minimarkets and restaurants, as well as the availability of food stalls and grocery stores. Ecological access to food is categorized into three scores, namely market availability of less than three kilometers, market availability of more than three kilometers, and the

highest score if there is a market in each village. All available ecological aspects are then compared with the large number of people in each research location so that it can be assumed that the market availability meets or not. The following are the results of research on trade facilities and ecological access found in the highlands of Banyumas Regency.

Table 1. The Number of Trade Facilities in Baturaden District in 2021

Village	Population	Shop Group	Markets with permanent buildings	Markets with Semi-Permanent Buildings	Minimarket / Grocery store / Supermarket	Restaurant	Food stalls	Grocery Store
Purwosari	6,366	1	1		3	4	11	40
Kutasari	6,169	1		1		1	7	32
Pandak	2,951				1	2	10	15
Pamijen	3,038						6	59
Crash	8,780	1	1	1	1	8	26	82
Kebumen	3,784					1	8	16
Karangtengah	8,220				2	5	15	47
Kemutug South	3,325						6	22
Karangsalam	2,706					6	47	37
Kemutug Lor	5,329	1			2	1	16	81
Karangmangu	2,967	4			2	8	30	200
Ketenger	3,312	1				1	10	11
Total	56,947	9	2	2	11	37	192	642

Source: Secondary Data Analysis (2023)

Based on Table 1, it can be known the facilities and infrastructure, especially for trade in Baturaden District. Before discussing the availability of facilities and infrastructure, table 1 explains how many people are in Baturaden District. This sub-district has 12 villages. The largest number of residents is in Rempoah Village with more than eight thousand people, followed by Karangtengah Village and Purwosari Village. The least number of residents is in Karangsalam Village. The total population in Baturaden District reaches 56,947 people. Table 1 informs that there are several villages that have facilities in the form of shop groups. Karangmangu Village is the village that has the most shop groups with a total of 4 shop groups. Not only in Karangmangu Village but also in Purwosari, Kutasari, Rempoah, Kemutug Lor and Ketenger Villages also have shop groups. The market with permanent buildings is also owned by two villages in Baturaden District, namely Purwosari and Rempoah Villages. Table 1 also provides information on the availability of facilities in the form of markets with semi-permanent buildings in Baturaden District. Kutasari Village and Rempoah Village are two villages that have markets with semi-permanent buildings.

Table 1 also informs the availability of minimarkets and supermarkets in Baturaden District. A total of 11 minimarkets and supermarkets spread across 6 villages.

Purwosari Village has the most minimarkets or supermarkets, followed by Karangtengah, Kemutug lor and Karangmangu Villages with 2 minimarkets or supermarkets each. Pandak and Rempoah villages each have one minimarket or supermarket. The total number of restaurants in Baturaden District is 37 units. Rempoah and Karangmangu Villages have the highest number of restaurants compared to other villages with a total of 8 units, while Kemutug Kidul and Pamijen Villages do not have restaurant availability. A total of 192 food stalls are spread across all villages in Baturaden District. Karangsalam Village has the highest number of food stalls with 47 units. The grocery store is also owned by Baturaden District with a total availability of 642 units. Karangmangmu Village has the highest number of grocery stores with 200 units. The availability of facilities in each village shows the ease of food accessibility for households. The more complete and available food provider facilities will increase access to food owned by households. Of course, for villages that do not have facilities, they must be in the village bordering their area to be able to access food. The table below is a mapping of the market distance in each village in Baturaden District.

Based on Table 2, information about market distance based on the area in Baturaden District can be known. This mapping divides into a radius of more than

3 kilometers, less than and the availability of markets in the area. Table 2 shows that the highest score with level 3 is owned by villages that have a market while the lowest score is a village that has no market at all so they have to access the market for more than three kilometers. This allows the villagers to access the market to other nearby villages. Score two is in villages that do not have a market but are side by side with other villages that have a market. The total score with level 1 is 2,706 which

is obtained by multiplying the population and score 1 while the level 2 score of 13,644 is obtained from multiplying the population score 2. The lowest score is in one village in Baturaden District, namely Karangsalam. Therefore, local governments must focus on market procurement and other ecological aspects so that they can support community accessibility in obtaining the food they need.

Table 2. Respondents' Ecological Access to Food Based on Market Distance in Baturaden District in 2021

Information	Score	∑ population	Total Score
There is no market in the village and the distance Nearest Market ≥ 3 km	1	2,706	2,706
There is no market in the village and the distance < Market 3 km	2	6,822	13,644
There is a market in the village	3	47,359	142,077

Source: Secondary Data Analysis (2023)

Based on Table 3, it can be seen that the overall population in Kedungbanteng District is more than 65 thousand residents. Beji Village is the village that has the largest population in Baturaden District with a total of more than 9 thousand residents. Kutaliman Village is in the next position with a population of more than five thousand people. The group of shops owned by Kedungbanteng District consists of four units spread across four villages, namely Kedungbanteng, Karangsalam Kidul, Beji, and Baseh. The number of markets with permanent buildings in Kedungbanteng District is four units divided into four villages, namely Kedungbanteng, Karangsalam Kidul, Beji, and Baseh. Kedungbanteng District does not have a market with semi-permanent buildings but has a minimarket or supermarket as many as 8 units. Karangsalam Village has the largest number of minimarkets or supermarkets with four units while Kedungbanteng and Beji Villages each have two units of minimarkets and supermarkets.

Table 3 also informs about the number of restaurants in Kedungbanteng District. This sub-district has a total of 14 restaurants spread across four villages. Beji Village has the highest number of restaurants with 8 units while Karangsalam Kidul Village has five restaurant units. Karangnangka Village has two restaurant units while Melung Village has one restaurant unit. Kedungbanteng District also has a total of 98 food stalls spread across 14 villages. Beji Village has the most food stalls with 22 units, followed by Kedungbanteng Village which has 10 units. Grocery stores are also available in Kedungbanteng District with a total of 400 units. A total of 40 units of grocery stores are owned by Kalikesur Village, followed by Beji Village with 37 units of grocery stores. Ideally, the availability of facilities and infrastructure for food providers must be in each village. Table 4 will map the existing markets in Kedungbanteng District based on distance.

Table 3. The Number of Trade Facilities in Kedungbanteng District in 2021

Village	Population	Shop Group	Markets with permanent buildings	Markets with Semi-Permanent Buildings	Minimarket/ Grocery store/ Supermarket	Restaurant	Food Stalls	Grocery Store
Kedungbanteng	5,354	1	1		2		10	30
Leakage	5,490						9	50
Karangsalam Kidul	4,818	1	1		4	5	6	27
Beji	9,496	1	1		2	6	22	37
Karangnangka	4,755					2	8	31
Clerk	5,243						3	25
Dawuhan Wetan	5,275						6	25
Dawuhan Kulon	3,655						6	35
Baseh	4,456	1	1				8	25
Kalisalak	3,241						5	35
Windujaya	2,859						5	17
Kalikesur	2,834						5	40
Kutaliman	5,565						3	7
Melung	2,444					1	2	16
Total	65,485	4	4		8	14	98	400

Source: Secondary Data Analysis (2023)

Table 4. Respondents' Ecological Access to Food Based on Market Distance in Kedungbanteng District in 2021

Information	Score	∑ population	Total Score
There is no market in the village and the distance Nearest Market ≥ 3 km	1	16,943	16,943
There is no market in the village and the distance < Market 3 km	2	18,928	37,856
There is a market in the village	3	24,124	72,372

Source: Secondary Data Analysis (2023)

Based on Table 4, it can be seen that there are five villages that do not have a market in their village. That way people must access their food to the nearest village that has a market. The five villages in question are Kalisalak, Windujaya, Kalikesur, Kutaliman and Melung Villages. Meanwhile, there are villages that do not have a market but are relatively closer to accessing the market with a radius of less than three kilometers. Villages that access the market with a radius of less than three kilometers are Karangnangka, Keniten, Dawuhan

Wetan, and Dawuhan Kulon. Based on Table 4, it can be seen that the total score with level 1 is 16,943 which is obtained by multiplying the population and score 1 while the level 2 score of 37,856 is obtained from multiplying the population score 2. Local governments must be more aware of the accessibility of food owned by the community. The addition of infrastructure facilities in the form of markets is an important aspect for community food providers.

Table 5. The Number of Trade Facilities in Cilongok District in 2021

Village	Population	Shop Group	Markets with permanent buildings	Markets with Semi-Permanent Buildings/ No Building	Minimarket/ Grocery store/ Supermarket	Restaurant	Food stalls	Grocery Store
Batuanten	5,381						3	30
Kasegeran	5,157						1	68
Jatisaba	5,458						15	26
Anonymous	9,807	1					10	23
Jogger	4,937						7	15
Pageraji	12,020				2		10	67
Sudimara	48,55	1	1				18	22
Cilongok	10,026	2	1		1	1	19	87
Cipete	4,701			1	1		10	80
Cikidang	3,356	1			1		7	26
Permasidi	6,473	1	1		5	1	24	35
Langgongsari	8,512				2	1	15	42
Rancamaya	4,665						3	31
Development	5,578				1		10	31
Karanglo	4,061	1			2		17	32
Kalisari	4,995	1		1			12	35
Karangtengah	10,316	1	1		1	1	28	42
Sambirata	6,019						14	40
Lurah Mountain	8,635		1		5		21	41
Sokawera	8,945	1	1		3		18	86
Total	133,897	10	6	2	24	4	262	859

Source: Secondary Data Analysis (2023)

Based on Table 5, it can be known that the number of people in Cilongok District is more than 133 thousand people. The largest number of residents is in Pageraji Village with a total population of more than 12 thousand people, followed by Karangtengah and Cilongok Villages with more than 10 thousand people each. The group of shops is also owned by Cilongok District with a total of 10 units. This group of shops is spread across several villages such as Cilongok Village which has 2 shop units while the rest are in Panusupan, Sudimara, Cikidang, Permasidi, Karanglo, Kalisari, Karangtengah and Sokawera Villages. Markets with permanent

buildings are available in Cilongok District with a total of 6 markets. This market is in six villages, namely Sudimara, Cilongok, Permasidi, Karangtengah, Gunung Lurah and Sokawera. The market with semi-permanent buildings is also owned by Cilongok District as many as two units located in Cipete and Kalisari Villages.

Table 5 also provides information that in Cilongok District there are 24 units of minimarkets or supermarkets. Permasidi and Gununglurah Villages have five units of minimarkets and supermarkets, followed by Sokawera Village with three units, while the rest are spread across several villages in Cilongok

District. The number of restaurants available in Cilongok District is also quite large, around 262 restaurants. Karangtenah Village has the highest number of restaurants with 28 units, followed by Permasidi Village with 24 restaurant ownership. Grocery stores are also owned by Cilongok District as many as 859 units. Cilongok Village has the highest

number of grocery stores with 87 units, followed by Sokawera Village with 86 units. Of course, this facility is a good access for the people in Cilongok District. Some villages that do not have villages can access markets in other villages with a relatively short distance. Ecological access mapping can be seen in the following table.

Table 6. Ecological Access to Food Based on Market Distance in Cilongok District in 2021

Information	Score	∑ population	Total Score
There is no market in the village and the distance Nearest Market ≥ 3 km	1	10,839	10,839
There is no market in the village and the distance < Market 3 km	2	51,743	103,486
There is a market in the village	3	71,315	213,945

Source: Secondary Data Analysis (2023)

Based on Table 6, it can be seen that there are still villages in Cilongok District that have market access more than a radius of three kilometers. The villages in question are Batuanten Village and Jatisaba Village. Cilongok District also still has villages with market access of less than three kilometers, including Kesegeran, Pejogol, Pageraji, Cipete, Langgongsari, Rancamaya, Panembangan, and Sambirata Villages. Based on table 6, it can be seen that the total score with level 1 is 10,839 which is obtained by multiplying the population and score 1 while the level 2 score of 103,486 is obtained from multiplying the population score 2. The completion of ecological access to food that is not yet available can be anticipated by providing a place for the procurement of new markets. In addition to ecological access, the discussion of food accessibility will also discuss psychological access. Psychological access is the accessibility of households in obtaining assistance from the government. Psychological access data for heads of families in the highlands of Banyumas Regency can be seen in the following table.

Table 7. Psychological Access to Food Based on Assistance Activities Received by Heads of Families in the Highlands of Banyumas Regency

	Score	∑ Head of Family	Total Score
Baturaden			
Never received help	1	52,836	52,836
Receive as much assistance as	2	4,111	8,222
Kedungbanteng			
Never received help	1	59,730	59,730
Receive as much assistance as	2	5,755	11,510
Cilongok			
Never received help	1	119,830	119,830
Receive as much assistance as	2	14,067	28,134

Source: Secondary Data Analysis (2023)

Based on Table 7, it can be seen that psychological access exists in three sub-districts representing the

highlands in Banyumas Regency. The acquisition of psychological access is seen from how many heads of families receive assistance that can be used to buy food. Table 7 also provides information that Cilongok District receives the most assistance when compared to Baturaden and Kedungbanteng Districts. Heads of families in Cilongok District received assistance amounting to 14,067 while heads of families in Kedungbanteng received a total of five thousand more heads of families. Baturaden District received assistance for four thousand families. Ecological access and psychological access that have been described are then summarized in the table of food accessibility levels below.

Table 8. Level of Food Accessibility to Household Food in the Highlands of Banyumas Regency

Information	Total Score	Criterion
Baturaden		
Ecological Access	158,427	Tall
Psychological Access	61,058	Low
Kedungbanteng		
Ecological Access	127,171	Tall
Psychological Access	71,240	Low
Cilongok		
Ecological Access	328,270	Tall
Psychological Access	147,964	Low

Source: Secondary Data Analysis (2023)

Based on Table 8, it is known the level of food accessibility in the highlands. The overall research location showed the same results, namely ecological access to the highlands in Banyumas Regency has high criteria even though there are still some areas where markets are not available in a fairly close distance. Psychological access also showed similar results with low criteria. Thus, it can be concluded that highland areas can have good food accessibility. The measurement of food security in a region is carried out by calculating the potential food reserves available in each region listed in the Table 9.

Table 9. Rice Production and Conversion to Highland Rice in Banyumas Regency in 2021

	Production (Tons)	Netto Conversion	Netto Rice Production	Rice Conversion	Rice Production (Tons)
Baturaden	11,158	0.826	9,217	0.632	5,825
Kedungbanteng	14,646	0.826	12,098	0.632	7,646
Cilongok	27,061	0.826	22,352	0.632	14,127
Average	52,865		43,666		27,597

Source: BPS Data Processed (2023)

Based on Table 9, it can be seen that Cilongok District has the highest rice production compared to the other two regions. Production achievements reached more than 14 thousand tons in 2021. Kedungbanteng has the second largest rice production achievement with more than 7 thousand tons. Baturaden District is in third place with the achievement of rice production reaching

more than 5 thousand tons every year. This production achievement must also be compared with the consumption of people in the highlands to see if the production produced can meet the demand for rice. Therefore, each region must be able to increase its rice production at any time (Saputro et al., 2023a). The table of rice needs can be seen below.

Table 10. Lowland Rice Needs in Banyumas Regency

Year	Total Population (Soul)	Rice Consumption Per Week (kg)	Annual Rice Consumption (Kg)	Banyumas Rice Needs (Tons)
Baturaden	56,947	1,565	81.38	4,635
Kedungbanteng	65,485	1,565	81.38	5,329
Cilongok	133,897	1,565	81.38	10,896
Average	256,329			20,860

Source: BPS Data Processed (2023)

Based on Table 10, it can be seen that the largest population is in Cilongok District reaching more than 133 thousand people, while the second place is in Kedungbanteng District. Individual weekly consumption, especially in consuming rice, reaches 1,565 kilograms, so if calculated on a yearly scale, it requires approximately 81.38 kilograms of rice. The highest rice demand is certainly owned by Cilongok considering that the population is also in the highest position. The rice needs of Cilongok District reached ten thousand tons of rice while the total rice needs from the

four research locations required more than 20 thousand tons of rice. The community's dependence on rice is also in line with research by Saputro et al. (2020) which states that the food intake of most Indonesian people is supplied by rice consumption so that nutritional and nutrient intake is reduced. The dominance of rice as a staple food also requires that each region must be able to produce rice in every season (Saputro et al., 2023b). Food reserves are calculated by reducing the production of each region by rice consumption in that region which can be seen in the Table 11.

Table 11. Highland Food Reserves of Banyumas Regency

	Rice Production (Tons)	Rice Consumption (Tons)	Food Reserves (Tons)	Information
Baturaden	5,825	4,635	1,190	Food Resistant
Kedungbanteng	7,646	5,329	2,317	Food Resistant
Cilongok	14,127	10,896	3,231	Food Resistant
Average	27,597	20,860	6,737	

Source: BPS Data Processed (2023)

Based on Table 11, it can be seen that the food reserves of Baturaden, Kedungbanteng, and Cilongok Districts still have more rice food reserves. The meaning of the statement is that the three regions are on the criteria of food security. The food security category in question where the region has a surplus or surplus of food in the form of rice, considering that the relationship between food security and accessibility is tested using a chi square which can be seen in the table below.

Table 12. Recapitulation of the Correlation Between Ecological Access and Psychological Access Factors to Household Food Security in the Highlands of Banyumas Regency

Access	Significance	Criterion
Ecological Access	0.046	Significantly correlated
Psychological Access	0.017	Significantly correlated

Source: Secondary Data Analysis (2023)

Based on Table 12, it can be seen that ecological access is significantly correlated with food security. The

same thing happens with psychological access variables. Therefore, both variables are related to food security. A real correlation was shown from each significance value of less than 0.05. The relationship between the two states the importance of food accessibility in maintaining the value of food security stability. Ecological access and psychological access are correlated in real terms, which means that the higher the food access, the higher the level of food security will also increase or affect food security. Local governments must remain focused on providing food accessibility because this dimension has a real influence on regional food security. In line with this research, the provision of food in the highlands is indeed different from the lowlands. Cultivation practices in the highlands also have their own peculiarities. Cultivation is carried out not only for economic problems but also for the independent supply of food. Labor wages in the highlands also have differences. The abundant availability of labor causes agricultural potential to be quite high in the highlands. People in the highlands also have a different orientation towards money, especially in the agricultural sector which is produced because it focuses on the amount of food needed by households. Therefore, it is not surprising that highlands tend to be more able to be self-sufficient in food (Keleman et al., 2013).

Table 12 shows a clear correlation between accessibility and food security in the highlands of Banyumas Regency. Food accessibility represented by ecological and psychological access variables must be improved. Ecological access can be increased by increasing markets as food providers. The existence of a market will also activate the economy of the surrounding community. The need for ecological access is because the highlands are areas with a higher level of food insecurity compared to the lowlands and middle highlands. This finding is also based on agricultural land in the highlands which is more difficult to control than in the lowlands where the land is more suitable for cultivating agricultural commodities (Yirgu, 2013). Improvements and additional markets in several villages are important to be carried out to increase food access for households in the highlands. Psychological access is also needed to find out how accessible households are in accessing food. The existence of assistance from the government is also considered important to increase the availability of food for underprivileged households. Certain households in the highlands, of course, are still at the poverty line, so psychological access is important for them.

The government also needs efforts to encourage and increase the income of people in the highlands, for example by providing complete production equipment for farmers. Working capital assistance is also needed to improve the welfare of people in the highlands. The

preparation of alternative jobs also needs to take into account that climate change is being faced by highland communities that are not helping so that income is also uncertain and will have an impact on the food security of lowland households. Monitoring and improvement of infrastructure facilities such as markets must also be considered to improve the accessibility of community food. The importance of improving facilities for the sustainability of food accessibility that is well maintained.

Conclusion

Based on the research data, this study investigates the impact of ecological and physiological adaptations of food crops on food security in the highland area of Banyumas Regency, focusing on Baturaden, Kedungbanteng, and Cilongok Districts known for their surplus rice food reserves. Ecological adaptation examines how crops adjust to the specific environmental conditions of high altitudes, while physiological adaptation considers plant responses to factors like temperature, humidity, and soil type. Data sourced from the Central Statistics Agency of Banyumas Regency in 2021 forms the basis of analysis. The findings reveal a significant correlation between food accessibility—assessed through physical and social access—and food security. Both physical and social access exhibit statistically significant correlations with food security, with p-values of 0.046 and 0.017, respectively. This underscores the critical role of ecological and physiological adaptations of food crops in bolstering food security in Banyumas' highlands. Moreover, enhancing physical and social accessibility emerges as a crucial factor in stabilizing food security in the region. To sustain food security in the highlands, local governments should prioritize the development of infrastructure and facilities that enhance food accessibility. These efforts are pivotal in ensuring sustainable food production and availability, thereby fostering resilience against food insecurity in the highland communities of Banyumas Regency.

Acknowledgments

We express our deepest gratitude to the Directorate of Research, Technology, and Community Service of the Ministry of Education, Culture, Research, and Technology for providing funding for the Fundamental Research. We also extend our heartfelt thanks to the Research and Community Service Institute (LPPM) of Universitas Jenderal Soedirman for giving us the opportunity to conduct this research. Special thanks are also extended to many parties who supported this research and cannot be mentioned individually.

Author Contributions

For research articles with several authors, a short paragraph specifying their individual contributions must be provided. The following statements should be used "Conceptualization, K.E.W.; methodology, A.M.; validation, S.G.S.; formal analysis, S.A.W.; writing – review and editing, W.A.S.

Funding

Directorate of Research, Technology, and Community Service of the Ministry of Education, Culture, Research, and Technology for providing funding for the Fundamental Research.

Conflicts of Interest

The authors declare no in every stage of this research, there is no conflict of interest from either the authors or the funders. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

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