

# Development Strategy for Food Security of Farmer Households in the Keduang Sub Watershed (DAS) in Wonogiri Regency

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**Abstract:** The purpose of this study is to determine the internal and external factors that affect the food security of farmer households, and formulate strategies for developing food security of farmer households. The novelty of this research is to obtain alternative strategies to improve food security of farmer households. The method of determining the research location was carried out purposively, and the determination of the sample research area was carried out purposively, so that 3 sub-districts were selected, namely Jatipurno (upstream), Jatisrono (middle) and Sidoharjo (downstream). Data collection methods were observation, interview, and FGD (Focus Group Discussion). The data analysis method used two stages, including: a) Input Matrix of Internal Factor Evaluation (IFE) and External Factor Evaluation (EFE), and b) analysis using SWOT matrix. The results explained that there were 10 strengths, 11 weaknesses, 4 opportunities, and 5 threats. Based on the SWOT matrix, there are 12 alternative development strategies, namely: 1) increasing food availability of farmer households; 2) assistance by related agencies on food diversification, food safety and health; 3) reducing farming inputs; 4) increasing farmer household income; 5) training and counseling on nutrition; 6) making reservoirs; 7) incentives for millennial farmers; 8) using rice varieties that are low in emissions and resistant to pests and diseases; 9) government regulations on land use change; 10) adjustment of planting times and patterns; 11) selection of drought-resistant food crop commodities and 12) planting of plantation crops.

**Keywords:** Food Security; SWOT; Watershed

## Introduction

Economic development has very complex problems, such as low community income, high unemployment, and slow regional economic development (Mukhlis et al., 2023). Food is a basic human need, therefore the fulfillment of food needs is the responsibility of the state and society. According to Law No. 18/2012, food security is the fulfillment of food for the state to individuals, which is reflected in the availability of sufficient food, both in quantity and quality, safe, diverse, nutritious, equitable, and affordable and does not conflict with religion, beliefs, and community culture, to be able to live healthy, active, and productive lives in a sustainable manner. Food security includes several subsystems, namely food availability, food access and food utilization, and integrates nutrition and food safety in it (Badan, 2020).

The majority of Wonogiri Regency residents work in the agricultural sector (Badan Pusat Statistik

Kabupaten Wonogiri, 2020), cultivating agriculture in paddy fields, gardens, tegal or fields. Food crop commodities include rice, corn, soybeans, peanuts, green beans, cassava and sweet potatoes (BPS Statistics of Wonogiri Regency, 2017). In Wonogiri Regency, there is an artificial reservoir, Gajah Mungkur Reservoir, which dams several river flows such as Keduang, Tirtomoyo, Temon, Solo Hulu, Alang, and several other rivers. Gajah Mungkur Reservoir is included in the Upper Bengawan Solo Watershed (DAS) area. The majority of the Upper Bengawan Solo Watershed is in Wonogiri Regency, while a small part is in Karanganyar, Gunung Kidul and Pacitan. The topography of Wonogiri Regency, including the Keduang Sub-watershed area, is dominated by hills and most of the area is dry land farming (Nugrahanto et al., 2022), of course this affects the socio-economic conditions of farmers which affect the level of welfare of farming families. The problems that occur in the Keduang Sub Watershed area are: (a) erosion and sedimentation that affect the condition of

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land resources; (b) the existence of land conversion from agricultural to non-agricultural land; (c) the topography of the area with different slopes so that the condition of land resources is also different, even the occurrence of drought in some areas, (d) extreme climate change that causes crop failure, a decrease in the cropping index that leads to a decrease in production and productivity, damage to agricultural land resources, an increase in the frequency, extent and intensity of drought, an increase in humidity and an increase in the intensity of Plant Disturbing Organism (OPT) disturbances.

The above conditions will certainly affect the farming of people who live in the Keduang River Sub-watershed area. Changes in these conditions also affect the socio-economy of farmer households, because it will directly affect farmers' income from on-farm sources. Farmer household income consists of on-farm and non-farm income. To survive, farmer households in Wonogiri also seek income other than from the agricultural sector. An increase or decrease in income will affect the expenditure or consumption patterns of farming households. Household consumption patterns affect household food security. The relationship between income and food security can be explained by Engel's law. According to Engel's law, when there is an increase in income, consumers will spend their income on food with a smaller proportion. Then, Damayanti et al (2024) emphasised that income, consumption expenditure, presence of BUMDes and the influence of Covid-19, affect household poverty significantly in Donggala Regency.

Research on food security in the watershed area has been widely conducted, among others: research (Rhoyni et al., 2016) shows that the food security status of farmer households in the Keduang Sub Watershed area is mostly food insecure, and the amount of food expenditure in the Keduang Sub Watershed is influenced by farmer income, the number of family dependents, and the area of land owned. Research on farmers' food security in the Keduang Sub-watershed area was also conducted by Setyarini et al, (2023) showing that the level of food security of 39.83% farmer households was classified as food resilient, 29.65% as food vulnerable, 14.83% as food insecure, and 15.70% as food insecure.

The majority of farmers in Wonogiri cultivate rice and secondary crops. Rice fields in this region can only be planted with rice a maximum of 2 times, this is influenced by geographical conditions and limited water. The cropping pattern on rice fields is rice-paddy-crops, or rice-paddy-bero, while fields or marginal land are usually planted with cassava with a harvest period of 9 months. Based on research (Rahayu et al., 2020) shows that cassava farming is feasible. Research on the feasibility of rice farming in watershed areas was also

carried out by (Setyarini et al., 2021) and factors affecting food security (Marhamah et al., 2022) followed by research on the food security status of farmer households (Setyarini et al., 2023). Therefore, it is necessary to conduct research to determine strategies to improve the food security of farmer households.

From several previous studies, it is explained that the majority of farmer households in the Keduang Sub-watershed area are not food secure, and farmer households do not have a plan on how to improve their household food security. Therefore, it is necessary to improve or develop strategies so that farmer households are able to realize their food security in the midst of various conditions. This research aims to: a) determine the internal and external factors that affect the food security of farmer households, b) formulate strategies to improve or develop food security of farmer households in the Keduang Sub-watershed area of Wonogiri. The novelty of this research is to obtain alternative strategies to improve the food security of farmer households in the Keduang Sub-watershed area.

## Method

The basic research method is exploratory research, which is a research intended to obtain a description or identification of the food security of farmer households in the Keduang Sub Watershed. The method of determining the location of the research was done purposively, and the determination of the sample of the research area was done purposively with consideration of the sub-district that has the largest percentage drained by the Keduang Sub-watershed, so that 3 sub-districts were selected. In this study, it was determined that the area representing the upstream was Jatipurno Subdistrict, the middle area was represented by Jatisrono Subdistrict, and the downstream area was represented by Sidoharjo Subdistrict.

Data collection method were observation, interview, and FGD (Focus Group Discussion). The research instrument was a questionnaire. Key informants in this study included: (a) 1 representative of the Wonogiri District Food Security Office; (b) 1 representative of the Wonogiri District Agriculture Office; (c) 3 representatives of Field Extension Officers (PPLs) in Jatipurno, Jatisrono, and Sidoharjo Sub-districts; (d) 6 representatives of farmer group administrators from the 3 sub-districts.

The data analysis method used was SWOT Analysis. SWOT analysis is a qualitative analysis tool to produce alternative strategies by considering external and internal factors of the organisation. The stages in SWOT analysis are as follows. The matrix is an important matching tool to help parties in the

organization produce four types of strategies, SO strategy, WO strategy, ST strategy and WO strategy. Before conducting a SWOT analysis, it is necessary to create an IFE and EFE matrix to classify internal and external factors that will be the strengths, weaknesses, opportunities and threats of a company. a) Input stage through the Internal Factor Evaluation (IFE) Matrix and External Factor Evaluation (EFE) Matrix, and b) matching stage using the SWOT matrix. In the SWOT matrix, four types of strategies will appear: WO strategy (weakness-opportunity), SO strategy (strength-opportunity), ST strategy (strength-threat), WT strategy (weakness-threat) (David et al., 2017; (Mahfud & Mulyani, 2017)

## Result and Discussion

### *Indonesia's Fish Meal Production and Export Potential*

Indonesia has a well-established fish meal production industry, exporting large quantities to various countries and Indonesia is one of the leading fish meal producers globally, with a large portion of its production dedicated to export markets (Macusi *et al.*, 2023). Indonesia's fish meal products are known for their high quality, which positions the country well to compete in international markets. The fish meal industry plays a vital role in supporting aquaculture feeds around the world, particularly in Southeast Asia. However, exporting to Saudi Arabia would require adjustments to comply with local standards, including halal certification and specific quality controls that meet Saudi regulations for animal feeds. Indonesia will access the Saudi Arabian market, a detailed analysis of its export strengths, weaknesses, opportunities, and threats (SWOT analysis) is essential.

### *Identification of Internal Factors*

Identification of internal factors in SWOT analysis has the aim of knowing the factors that exist within the organisation or business, namely in the form of strengths and weaknesses (Hunger & Wheelen, 2003)

### *Strengths*

The results of the study illustrate that the strength factors consist of: *First*, Farmers are interested in horticultural cultivation. Farmers in the Jatipurno, Jatisrono, and Sidoharjo sub-districts are interested in cultivating horticultural crops in the form of vegetables including spinach, long beans, and chilies. Many vegetable plants are cultivated in the yard, this is the development of the Sustainable Food Home Area (KRPL) program. This is in line with research (Ningsih & Sustiyana, 2022) which explains that vegetable cultivation in the yard has a strategic role to increase the diversity of food consumption patterns and improve

household nutrition. Farmers are very interested in cultivating chili even though the risk is high, because based on the experience of farmers chili farming is profitable. This is in accordance with research (Prasetyo et al., 2020) farmers dare to take more risks because farmers want changes for the better. Farmers dare to spend more capital in managing their farms because farmers expect optimal chili farm production and high selling prices so as to get maximum profit;

*Second*, Farmers have practiced crop rotation and multiple cropping. The cropping pattern on irrigated land is rice-soybean-corn/soybean, while on less irrigated land or rainfed land, the cropping pattern is rice-soybean-bero, or rice- cassava. The condition of paddy fields in the Jatisrono area is a paddy field with fertile soil and water conditions because it is located on the slopes of Mount Lawu, so it is able to carry out multiple cropping, where in addition to paddy fields, horticultural crops (chili) are also planted, as well as vegetables (mustard greens, spinach, long beans). Crop rotation and multiple cropping are strategies for optimizing agricultural cultivation land (Sartono & Sari, 2023).

*Third*, Clean water availability with PAMSIMAS. To achieve food security, access to clean water is essential. PAMSIMAS aims to improve rural communities' access to clean water services. *Fourth*, Availability of latrines in every household. The provision of latrines is an effort to improve public health by providing basic sanitation that can improve environmental health. Farmer households in the study area already have family latrines, so it can be concluded that farmer households are aware of the importance of health. *Fifth*, Availability of roads, bridges and market infrastructure. The development of irrigation facilities, roads, bridges and other agricultural infrastructure will increase agricultural productivity, thereby increasing farmers' income, which will affect the food security of farmer households. This is in line with research (Nurwanto et al., 2023) which explains that the village fund program used for agricultural infrastructure development will increase agricultural productivity and local food availability in Bojonegoro.

*Sixth*, Farmer households are accustomed to consuming food with a simple menu. Farmer households consume rice as a source of energy, vegetables, and side dishes such as tofu, tempeh, eggs, and chicken meat as a source of protein. *Seventh*, Farmer households save their harvest (rice) for their own consumption and sell the rest. Farmer households do not buy more rice for consumption. They assume that if they buy rice from outside, it will cost more for their daily needs. The majority of farmers save their harvest to be consumed until the next harvest season. Farmers also save crops for social reasons, for example to give to

neighbors or relatives who have an occasion. According to Elviansyah et al, (2022), education and length of time in farming influence farmers' decision to save rice harvest.

*Eighth*, the availability of carbohydrate sources other than rice, namely cassava and corn. In accordance with research Setyarini et al, (2023) states that local food in the form of cassava and corn serves as a source of energy other than rice. *Ninth*, Protein Adequacy Rate (AKP) has been met. Farmer households have fulfilled their protein needs even though it is not ideal, because protein adequacy is mostly met from vegetable protein. This is because animal protein is more expensive than vegetable protein. The protein adequacy rate of farmer households is fulfilled, corroborated by research Setyarini et al, (2023) which explains that the protein adequacy rate at the consumption level is around 58.90 gr/person/day, higher than the average protein adequacy rate of the Indonesian people, which is 57 gr/person/day. *Tenth*, Food prices are relatively stable. In the study area, the price of staple food is relatively stable, which is one of the strengths for farming households to be able to access food at all times.

#### *Weaknesses*

Weakness factors obtained from the research results consist of: a. Undulating and hilly topography. The condition of available water and the amount of rainfall an area receives are significantly affected by the topography of an area. The topography of the study area consists of undulating hills and some chalk; b). Some villages have no water sources, so pompanization cannot be carried out. This is related to the topography of the region, where some areas (Sidoharjo sub-district, and parts of Jatisrono sub-district) are calcareous hills so there are no water sources; c). Income from farming does not meet household needs. The majority of farming households seek additional income outside of farming because if they only rely on farming, it will not be able to meet household needs. This is in line with research Setyarini et al, (2023) which states that off-farm income accounts for 58.46% of total farm household income. Farmer household members seek additional income from trading, factory workers, and workers in transportation, services, and others; d). In the third growing season (June-September) most land cannot be planted or is fallow. This happens because there is no water to irrigate the farmland, so farmers choose not to plant their land; e). Households migrate/boro, after rice planting farming activities. Some heads of household after the rice planting period will migrate outside the city/outside the island to look for other sources of income; f). Lack of utilization of yard land in farmer households. This is also due to limited water or lack of awareness of housewives in utilizing yard land; g). Diet

is not varied or does not think about nutrition. Most housewives in the study area serve a less varied and monotonous food menu. The available food menu includes tofu and tempeh; h). Farmer households are not accustomed to food diversification. Local food potentials available in the study area include corn, cassava, sweet potato. However, farming households only consume rice as their energy source. Existing local foods are used as snacks; i). Energy adequacy rate (AKE) has not been met; j). Protein adequacy is not ideal as most of it is sourced from plant-based proteins; dan k). Lack of awareness of food safety among farming households.

#### *Identification of External Factors*

Identification of external factors in SWOT analysis has the aim of knowing the factors that exist outside the organisation or business, namely in the form of opportunities and threats. (Hunger & Wheelen, 2003)

#### *Opportunities*

The results of the study illustrate that the opportunities factors consist of: a). The existence of a government program to expand the planting area with pompanization; b). Assistance in making boreholes; c). Government assistance for poor families, namely the PKH program, Direct Cash Assistance (BLT), rice assistance, and so on; d). The existence of government programs to strengthen food security through food diversification, nutritious, diverse, balanced and safe (B2SA) food houses, livestock assistance, plant seed assistance, and food processing production equipment assistance.

#### *Threats*

Threats factors obtained from the research results consist of: a). Regeneration of farmers is not running (the average farmer is old). In the research area, the average age of farmers is above 50 years old. The younger generation is not interested in working in agriculture because they consider it unpromising. Stereotypes of agriculture that are synonymous with poverty, low levels of education, and high school dropout rates in farming families (Oktafiani et al., 2021); b). Climate change that disrupts the growing season. The impact of climate change that is currently being felt is the change in rainfall patterns, which disrupts the planting and harvesting time of agricultural cultivation. In the agricultural sector, climate change causes changes in rainfall patterns and an increase in the frequency of extreme climates. Long dry seasons can also have an impact on the availability of planting water or poor water drainage, so that plants cannot grow and experience crop failure. Long dry seasons can also cause the planting season to be delayed (Rozci, 2024); c). In some locations there are attacks by pests and plant

diseases (rats and sundep). Pest and disease attacks in the study area are not endemic; d). The increasing number of conversion of agricultural land and land fragmentation. Land conversion occurs mainly on paddy fields or yards located near the highway. In the research area, non-agricultural land conversion occurs for the construction of houses, shops, and so on. Much of the land fragmentation that occurs is due to inheritance division. According to (Ntihinyurwa & de Vries, 2021) agricultural land fragmentation is strongly related to food diversification, acceptability, and sovereignty at the local (household and individual) level. Efforts to overcome land fragmentation can be done by consolidating farmland, and reorganizing farmland; e). The availability of ready-to-eat foods that

are easily available/obtained. This can pose a threat to food security, especially access to food utilization. For housewives, providing ready-to-eat food may be practical, but attention must also be paid to its nutritional content and food safety.

The IFE matrix is used to identify internal factors of household food security that are relevant to strengths and weaknesses, and then weighted. Based on Table 1, it explains that the greatest strength is the availability of carbohydrate sources other than rice (0.203). The major weaknesses are that some villages do not have water sources, diets are not varied or do not think about nutrition, and the lack of awareness of farming households on food health (0.051).

**Table 1.** IFE Matrix

No	Internal Factors	Weight	Rating	Score
<b>STRENGTHS</b>				
1	Farmers interested in horticulture	0.051	3	0.152
2	Crop rotation and multiple cropping	0.048	3	0.143
3	Clean water available with PAMSIMAS	0.044	4	0.178
4	Sanitation/toilets in every household available	0.044	4	0.178
5	Road, bridge and market infrastructure available	0.044	4	0.178
6	Farmer households are accustomed to consuming food with a simple menu	0.038	4	0.152
7	Farmer households save the harvest (paddy) for their own consumption, the rest/part for sale	0.051	3	0.152
8	Carbohydrate sources other than rice are available: cassava, corn	0.051	4	0.203
9	Protein sufficiency rate (PPA) has been met	0.044	3	0.133
10	Food prices are relatively normal	0.051	3	0.152
<b>WEAKNESSES</b>				
1	Undulating & hilly topography	0.044	2	0.089
2	Some villages have no water springs, so pompanization is hampered	0.051	1	0.051
3	Income from farming does not meet household needs	0.051	2	0.102
4	In the third planting season, most land is not planted/boiled	0.051	2	0.102
5	Households migrate/boro, after rice planting farming activities	0.044	2	0.089
6	Lack of utilization of yard land in farmer households	0.051	2	0.102
7	Diet is not varied or does not think about nutrition	0.051	1	0.051
8	Farmer households are not accustomed to food diversification	0.044	2	0.089
9	Energy Adequacy Rate (AKE) has not been met	0.051	2	0.102
10	Protein adequacy is not ideal, because most of it is sourced from vegetable protein	0.044	2	0.089
11	Lack of awareness of farmer households on food health	0.051	1	0.051
<b>TOTAL</b>		1.000		2.537

**Table 2.** EFE Matrix

No	External Factors	Weight	Rating	Score
<b>OPPORTUNITIES</b>				
1	Planting area expansion program with pompanization	0.106	2	0.212
2	Assistance in making boreholes	0.121	3	0.364
3	The existence of assistance from the government: rice assistance, BLT, PKH	0.106	3	0.318
4	The existence of programs from the government: food diversification, B2SA food houses, livestock assistance, plant seed assistance, equipment assistance	0.106	3	0.318
<b>THREATS</b>				
1	Farmer regeneration is not working (average age of farmers is old)	0.106	3	0.318
2	Climate change that disrupts the growing season	0.121	4	0.485
3	Pest and plant disease attacks: rats, sundep	0.121	3	0.364
4	Fragmentation and land conversion	0.121	4	0.485
5	Availability of ready-to-eat food that is easily obtained	0.091	2	0.182
<b>TOTAL</b>		1.000		3.045

Based on table 2, it is known that the biggest opportunity in the study area is the assistance in making boreholes (0.364), while the biggest threats are climate change and the fragmentation and conversion of land (0.485). To analyze alternative strategies using a SWOT matrix that produces 12 alternative strategies, which include: *First*, Strengths - Opportunities (SO) strategy, consists of: 1). Increase the food availability of farmer households by increasing farm production starting from the planning of planted commodities, in accordance with agro-climate and location-specific (e.g. after rice, secondary crops or horticulture that has high economic value); 2). Assistance by relevant agencies (Department of Agriculture, Department of Food) and all stakeholders through counseling and training on food diversification, health and food safety.

*Second*, Weaknesses - Opportunities (WO) Strategy, consists of: 1). Reduce farming inputs, for example by using organic fertilizers and plant-based pesticides to develop sustainable agriculture; 2). Increase farmer household income with non-farm, livestock, and utilization of yard land planted with fruit and vegetable crops; 3). Counseling and training by health cadres to housewives on nutrition that includes meeting the ideal energy and protein requirements; 4). Creating water reservoirs to increase crop productivity.

*Third*, Strengths - Threats (ST) strategy, consists of: 1). Incentivize millennial farmers who are able to develop food security in their region; 2). The use of rice varieties that are low in emissions and resistant to pests and diseases so that they have ecological and economic impacts; 3). Government regulations governing land conversion so that agricultural land is protected; 4). Adjustment of planting time and pattern to increase crop production.

*Fourth*, Weaknesses - Threats (WT) strategy, consists of: 1). Selection of dry-resistant food crop commodities (e.g. sorghum); 2). Planting plantation crops (types of crops adapted to the agro-climate and contours of the land) so as to reduce erosion and have an economic impact on farmers.

## Conclusion

Internal factors that are the main strengths for farmer households in the Keduang sub-watershed area to improve their food security are the availability of carbohydrate sources other than rice, namely cassava and corn, while the weaknesses include several villages with no spring water sources, a diet that is not varied or does not think about nutrition, and a lack of awareness of farmer households about food health. External factors that become opportunities for farmer households are assistance from the government for the construction of

boreholes, while threats include climate change, fragmentation and land conversion.

Based on the SWOT matrix, 12 alternative strategies were obtained, namely increasing the availability of food for farmer households; assistance by related agencies regarding food diversification, food safety and health; reducing farming inputs; increasing farmer household income; training and counseling on nutrition; making reservoirs; incentives for millennial farmers; using rice varieties that are low in emissions and resistant to pests and diseases; government regulations on land conversion; adjusting planting times and patterns; selecting drought-resistant food crop commodities and planting plantation crops.

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## Author Contributions

All authors had significant contributions in completing this manuscript

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## Conflicts of Interest

The authors declare that they have no conflicts of interest related to this study.

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