

DETERMINATION OF FARMERS' HOUSEHOLD FOOD SECURITY THROUGH INSTITUTIONAL ACCESS TO FINANCING: IAD FRAMEWORK AND OLS APPLICATIONS IN CENTRAL JAVA

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Abstract

Food security is a strategic issue in regional development because it is related to the ability of the region to ensure the availability, access, and utilization of food for the community. This study aims to analyze the influence of financial institutions, rainfall, and agricultural land area on the Food Security Index (IKP) in 35 districts/cities in Central Java Province in 2023. The research uses a quantitative approach with the Institutional Analysis and Development (IAD) Framework combined with the Ordinary Least Squares (OLS) method. In the framework of IAD, financial institutions are categorized as rules-in-use, while rainfall and agricultural land area represent biophysical conditions that influence farmers' decision making in the action arena and produce outcomes in the form of food security. The results of the OLS analysis showed that all independent variables had a positive relationship with the Food Security Index. However, partially the variables of financial institutions (p-value = 0.9238), rainfall (p-value = 0.2405), and agricultural land area (p-value = 0.8907) did not have a significant effect on the significance level of 5 percent. These findings indicate that food security in Central Java is not only influenced by institutional and biophysical factors, but also by other socioeconomic factors that have not been included in the model. Therefore, policies that support strengthening financial access, managing agricultural resources, and increasing the capacity of farmers to strengthen regional food security in a sustainable manner are needed.

Keywords: Food Security, Farmer Households, Financing Institutions, Agricultural Productivity, IAD Framework, OLS

INTRODUCTION

Indonesia is one of the countries with a tropical climate and is located on the equator, so it has a large amount of fertile green land and makes it an agricultural country. This is what makes agricultural land an important thing as a staple resource in agricultural activities. So that the majority of the Indonesian population also takes advantage of these advantages to grow crops, and make businesses or professions in the agricultural sector as the main source of income. Therefore, the agricultural sector can be an important sector in Indonesia because basic needs can be met by utilizing raw products from the agricultural sector, which can then be processed into food such as rice for consumption.

Apart from the agricultural sector as a source of food, agriculture can also be a source of national income, a source of investment, and become one of the country's sources of foreign exchange when agricultural products can be exported to other countries. So that agriculture such as rice is currently a popular and in-demand food commodity in Indonesia and beats other food commodities such as corn, eggs, sweet potatoes and vegetables (Pujiati et al., 2020). Then because the agricultural sector is an important sector, this makes the agricultural sector one of the sensitive

sectors in the community's economy because turmoil and prices in this sector will have implications for other sectors.

However, on the other hand, it turns out that businesses in the agricultural sector also face a risk, namely high uncertainty. Indonesia, which is included in the category of very high natural disasters and is often referred to as a "disaster-prone" area, makes business activities in the agricultural sector always faced with high risk of uncertainty. Starting from the risk of agricultural product production affected by natural disasters, to the risk of uncertainty in market prices. So that the state has an important role as a balancing act for the needs of the people at large (Septian & Anugrah, 2014).

Food security is one of the main pillars of sustainable development that is of global and national concern. In the Sustainable Development Goals (SDGs), the second goal, namely Zero Hunger, emphasizes the importance of ensuring people's access to sufficient, safe, nutritious, and sustainable food. Food security is not only related to food availability, but also includes accessibility, utilization, and stability of food that can ensure the quality of life of the community. Therefore, the success of the development of a region is not only measured by economic growth, but also by its ability to realize equitable food security for the entire population.

Central Java Province has a strategic position in the national food system because it is one of the main food barns in Indonesia. The contribution of the agricultural sector to national food supply makes Central Java an important region in maintaining the stability of the national food supply. However, high food production does not necessarily reflect good food security conditions in all regions. Food security is a multidimensional concept that is influenced by various social, economic, demographic, and institutional factors. Food security is not only related to the availability of food, but also the ability of households to access and utilize food sustainably. In the Indonesian context, regional food security shows a fairly high disparity between regions. Research by Wicaksono et al. (2023) found that variations in food security between regions are influenced by differences in access to infrastructure, poverty levels, agricultural capacity, and institutional quality. Therefore, an analysis of the factors affecting food security needs to be carried out specifically at the regional level to produce more effective policy recommendations.

According to FAO (2023), the challenges of global food security are increasingly complex due to climate change, population growth, natural resource degradation, and inequality of economic access. This condition causes food security to become a strategic issue in the sustainable development agenda, especially in the Sustainable Development Goals (SDGs) goal number 2, namely Zero Hunger. Regional food security is greatly influenced by the interaction between institutional factors, economic capacity, and environmental conditions that make up local food systems (Bene et al., 2024). Then food security in Central Java is influenced by the area of harvest area, land productivity, rice prices, and population, which indicates that food security is not only determined by production aspects.

Although Central Java is known as one of the national food buffer areas, various challenges are still faced in maintaining the sustainability of food security. The conversion of agricultural land, an increase in the number of population, climate change, and the still high level of rural poverty are factors that have the potential to reduce the achievement of regional food security. Recent research in 35 districts/cities in Central Java shows that agricultural land area has a positive influence on the Food Security Index, while poverty has a negative and significant effect on the achievement of IKP. The findings show that the problem of food security is not only related to the agricultural sector, but also closely related to the socio-economic conditions of the community.

On the other hand, institutional factors are still relatively rarely discussed as the main determinant of regional food security. In fact, various institutions such as banks, credit institutions, agricultural insurance, farmer groups, and government financing programs have an important role in increasing the economic capacity of farmer households. Access to financing institutions allows farmers to obtain business capital, reduce production risks, improve adaptability to climate change,

and strengthen households' ability to meet food needs. In the perspective of the Institutional Analysis and Development (IAD) Framework, institutions are seen as a set of rules and mechanisms that influence the interaction between actors in managing resources and achieving development goals.

Based on these conditions, this study aims to analyze the role of agricultural financing and resource institutions on the Food Security Index in Central Java Province using the Institutional Analysis and Development (IAD) Framework approach. This research is expected to make an empirical contribution to the development of rural development, agricultural economics, and food security policies, as well as the basis for the formulation of institutional strengthening strategies to improve regional food security in a sustainable manner.

LITERATURE REVIEW AND HYPOTHESIS FORMULATION

Food security is a condition for fulfilling sufficient, safe, nutritious, and sustainable food needs for all people. According to FAO, food security is shaped by four main dimensions, namely food availability, accessibility, utilization, and stability. According to FAO (2023), food security is achieved when all individuals have physical, social, and economic access to sufficient, safe, and nutritious food to meet the needs of an active and healthy life. In addition to the aspect of food availability, the dimensions of access and stability are important factors in explaining the variation in food security between regions.

The study of Manikas et al. (2023) confirms that food security is a multidimensional phenomenon that is simultaneously influenced by economic, environmental, and institutional factors. In the Indonesian context, these conditions are measured through the Food Security Index (IKP) which reflects the ability of a region to ensure people's access to food. Research by Pujiati et al. (2020) shows that regional food security is influenced by various interrelated economic, social, and resource factors.

In the perspective of the Institutional Analysis and Development (IAD) Framework, development outcomes are influenced by the interaction between actors, rules, and available resources (Ostrom, 2005). One of the factors that plays an important role is financing institutions, such as banks, cooperatives, and government financing programs. Access to financing institutions can increase the economic capacity of the community through the provision of business capital and the reduction of economic risks. Meliala and Djamaluddin (2024) found that financing support for the agricultural sector contributes to increasing regional food security in Indonesia.

Access to formal financial services is also one of the important instruments in improving household and regional food security. Research by Kumar et al. (2021) found that financial inclusion is able to increase productive investment in the agricultural sector as well as strengthen the ability of households to deal with economic and climate shocks. Similarly, research by Asante-Addo et al. (2023) shows that access to credit contributes to increasing food security through increasing production capacity and farmers' incomes.

In addition to financing institutions, agricultural resources are also an important factor in supporting food security. The availability of agricultural land, agricultural labor, and food production capacity determine a region's ability to maintain food availability. Research by Fuadi and Istiqomah (2025) shows that increasing the capacity of agricultural resources has a positive effect on regional food security. Therefore, financing institutions and agricultural resources are expected to be important determinants in improving the Food Security Index in Central Java.

The area of agricultural land is an important indicator in determining the food production capacity of an area. Research by Zhang et al. (2022) shows that uncontrolled conversion of agricultural land can reduce food production capacity and threaten long-term food security. Therefore, protecting agricultural land is one of the important strategies in maintaining the sustainability of the food system.

In addition, rainfall is also one of the main biophysical factors that affect agricultural productivity and food supply stability. Changes in rainfall patterns due to climate change can increase the risk of crop failure and reduce regional food security. According to the IPCC (2023), the agricultural sector is one of the most vulnerable sectors to climate change, especially in areas that still depend on rainfed agriculture.

Hypothesis

Food security is the result of the interaction between institutional factors, natural resources, technology, and human resources. From the perspective of the Institutional Analysis and Development (IAD) Framework, the existence of financial institutions can increase access to financing and economic capacity of the community so as to support food security. In addition, biophysical factors such as rainfall and irrigation technology play a role in maintaining the availability of water for agricultural activities. Meanwhile, the number of farmers and the area of agricultural land reflect the capacity of food production that can support the increase in the Food Security Index (IKP). Based on this theoretical framework, the research hypothesis is formulated as follows:

H1: Financial institutions have a positive effect on the Food Security Index.

H2: Rainfall affects the Food Security Index.

H3: The area of agricultural land has a positive effect on the Food Security Index.

RESEARCH METHODS

This study uses a quantitative approach with cross section data in 2023 covering 35 districts/cities in Central Java Province. Central Java was chosen as the research location because it is one of the national food production centers that has diverse food security characteristics between regions. The data used is secondary data obtained from the Central Statistics Agency (BPS), the National Food Agency (Bapanas), and other related agencies.

The dependent variable in this study is the Food Security Index (IKP). Independent variables consist of financial institutions proxied by the number of bank offices, annual rainfall (mm), and agricultural land area (ha). The selection of variables is based on the Institutional Analysis and Development (IAD) Framework developed by Ostrom (2005). In this framework, financial institutions represent the rules-in-use aspect, while rainfall and agricultural land area are included in the biophysical conditions that influence the decision-making of actors in agricultural systems and food security.

The research analysis was carried out in two stages. First, the IAD Framework is used to identify the relationship between institutional factors and biophysical conditions in influencing regional food security. Second, the influence of financial institutions, rainfall, and agricultural land area on the Food Security Index was analyzed using the Ordinary Least Squares (OLS) method. To ensure the validity of the model, classical assumption testing was carried out which included normality, multicollinearity, and heteroscedasticity tests. In addition, a partial test (t test), a simultaneous test (F test), and a determination coefficient (R^2) were carried out.

The empirical model used in this study is formulated as follows:

$$(Y_i) = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + U_i$$

Where:

β = Variable regression coefficient

Y_i = Food Security Index

X_{1i} = Number of financial institutions

X_{2i} = Rainfall

X_{3i} = Farm area

U_i = Error Term

I = Cross Section

RESULTS AND DISCUSSION

Analysis Institutional Analysis and Development (IAD) Framework

This study uses the Institutional Analysis and Development (IAD) Framework developed by Ostrom (2005) to explain how institutional factors and biophysical conditions affect regional food security. The IAD Framework is an analytical framework that is widely used in the study of rural development, natural resource management, and food security because it is able to explain the relationship between institutions, actors, and resources in producing a development outcome. According to Ostrom (2005), the success of a system is not only determined by the availability of resources, but also by the rules and institutional mechanisms that govern the behavior of actors in utilizing these resources. Understanding Institutional Diversity

In the IAD Framework, there are three main exogenous components that affect the action arena, namely rules-in-use, biophysical conditions, and attributes of community (Ostrom, 2005). This research focuses on the analysis on rules-in-use and biophysical conditions. Rules-in-use are represented by financial institutions that play a role in providing access to financing, credit, and financial services for farmers. Meanwhile, biophysical conditions are represented by rainfall and agricultural land area that determine the food production capacity of an area.

According to Michael D. McGinnis and Ostrom (2014), institutions function as a set of rules that influence the choice of actions of actors in a socio-ecological system. Effective institutions can reduce uncertainty, improve coordination between actors, and improve resource allocation resulting in better development outcomes. The study shows that the IAD Framework is relevant for analyzing food security issues because it is able to connect institutional factors with the behavior of actors and the resulting development outcomes.

Table 1. IAD Components

IAD Components	Research Targets	Role
<i>Rules in Use</i>	Financial Institutions	Determining access to financing and economic resources
<i>Biophysical Conditions</i>	Rainfall, Agricultural Area	Determining production capacity and food availability
<i>Action Area</i>	Farmer	Economic and production decision-making
<i>Outcome</i>	Food Security Index	The end result of institutional interactions and biophysical conditions

In the context of this study, farmers and agricultural households act as the main actors in the action arena. Farmers' decisions regarding land use, water resource utilization, and access to finance are influenced by available biophysical and institutional conditions. The availability of financial institutions allows farmers to obtain business capital, increase productive investment, and strengthen their capacity to adapt to production risks and climate change. Research by Kumar et al. (2021) shows that financial inclusion contributes to increased agricultural investment and household ability to cope with economic and climate shocks.

On the other hand, biophysical conditions in the form of rainfall and agricultural land area determine the food production capacity of an area. Adequate rainfall supports the availability of water for agricultural activities, while the area of agricultural land reflects the region's ability to produce food. According to the IPCC report (2023), changes in rainfall patterns due to climate change can increase the risk of food production instability, especially in areas that still depend on rainfed agriculture. In addition, research by Zhang et al. (2022) shows that reduced agricultural land area due to land conversion can threaten food production capacity and long-term food security.

The interaction between institutional factors and biophysical conditions in the action arena resulted in outcomes in the form of food security levels measured through the Food Security Index (IKP). In the perspective of the IAD Framework, outcomes are not seen as the result of a single factor, but rather as a consequence of the interaction of various components in a socio-ecological system. The findings of Béné et al. (2024) show that food security is the result of a complex relationship between resource access, institutional capacity, environmental conditions, and community adaptability. Therefore, the IAD approach is relevant to explain how financial institutions, rainfall, and agricultural land area contribute to food security in Central Java.

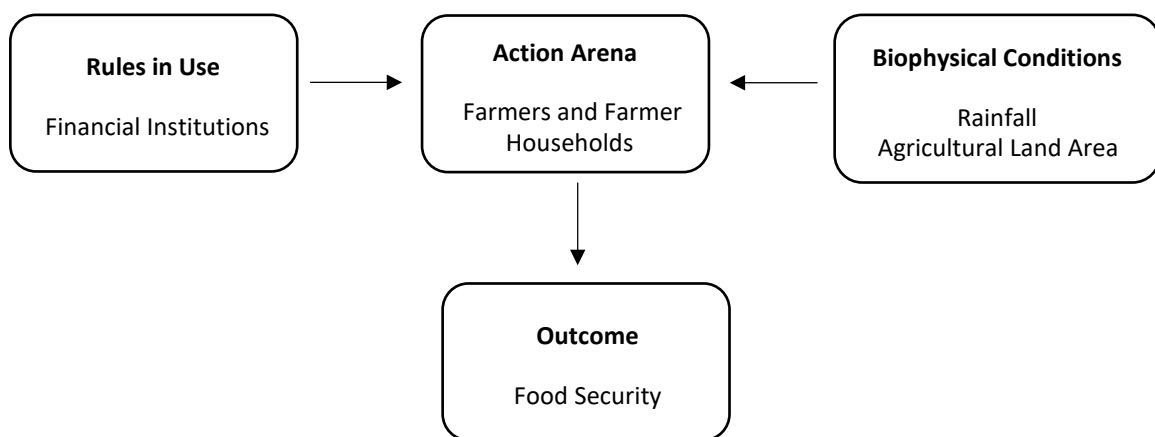


Figure 1. IAD Frameworks

OLS Regression Analysis Results

The influence of financial institutions, rainfall, and agricultural land area on the Food Security Index was analyzed using the Ordinary Least Squares (OLS) method. The results of the model estimation show that the regression model as a whole has a positive effect on food security, so that independent variables are simultaneously able to explain the variation in the Food Security Index in Central Java.

Table 2. OLS Regression

Variable	Coefficients	Std Error	t-Statistic	pvalue
CONSTANT	70.6553	10.7927	6.54659	0.0000
Agricultural Land Area	0.0864175	0.624075	0.138473	0.89079
Financial Institutions	0.000529456	0.00549319	0.0963841	0.92385
Rainfall	1.58901	1.32712	1.19734	0.24055

The results of the OLS regression estimate show that all independent variables have a positive coefficient to the Food Security Index (IKP). However, based on the results of the partial test (t-test), the variables of agricultural land area, financial institutions, and rainfall have not shown a statistically significant effect at a significance level of 5 percent. Although the influence of the three

variables is not statistically significant, the direction of the relationship is positive and shows that institutional and biophysical factors still have a contribution to regional food security. These findings are in line with the research of Béné et al. (2024) who stated that food security is the result of the interaction of various factors that work simultaneously so that the influence of a single variable is often not strong enough to explain the variation in food security between regions.

The variable of agricultural land area has a coefficient of 0.0864 with a probability value of 0.8907. These results show that an increase in agricultural land area tends to increase the value of IKP, but this effect is not significant. These findings indicate that the area of agricultural land has not yet become the main factor that determines food security between districts/cities in Central Java. This condition can occur because food security is not only determined by land availability, but also influenced by land productivity, food distribution, and people's ability to access food.

The variable of financial institutions has a positive coefficient of 0.0005 with a probability value of 0.9238. These results show that the existence of financial institutions tends to increase food security, but the effect is not statistically significant. In the context of Central Java, the existence of bank offices does not necessarily reflect the level of accessibility of farmers to financial services. Low financial literacy, limited access to agricultural credit, and low utilization of formal financial services can be the cause of the suboptimal contribution of financial institutions to food security.

Meanwhile, rainfall has a positive coefficient of 1.5890 with a probability value of 0.2405. These findings suggest that regions with higher rainfall tend to have better levels of food security, although the effect is not significant. These results indicate that water availability is not the only factor that determines food security, as the existence of irrigation infrastructure, agricultural technology, and farmers' adaptability also play a role in maintaining the stability of food production.

CONCLUSION

This study aims to analyze the influence of financial institutions, rainfall, and agricultural land area on the Food Security Index in 35 districts/cities in Central Java Province in 2023 using the Institutional Analysis and Development (IAD) Framework approach and Ordinary Least Squares (OLS) regression. Based on the results of the analysis, all independent variables showed a positive relationship with the Food Security Index. However, partially the variables of financial institutions, rainfall, and agricultural land area have not had a significant effect on the Food Security Index.

From the perspective of the IAD Framework, financial institutions as rules-in-use as well as rainfall and agricultural land area as biophysical conditions continue to have a role in shaping food security through the decision-making process carried out by farmers in the action arena. However, empirical results show that food security in Central Java is not only influenced by institutional factors and biophysical conditions, but also by other socio-economic factors that have not been included in the research model.

The policy implications of this study are the need to strengthen farmers' access to more inclusive financial services, increase the efficiency of agricultural land utilization, and strengthen water resource management systems to support regional food security. In addition, local governments need to pay attention to socio-economic factors such as poverty, education, and infrastructure that have the potential to affect food security more significantly.

This study has limitations in the use of cross section data in 2023 and a relatively limited number of variables. Therefore, further research is recommended using panel data and adding other variables such as poverty level, agricultural productivity, irrigation, government spending in the agricultural sector, and education to obtain a more comprehensive picture of the determinants of food security in Central Java.

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