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Determinants of Food Expenditure and Household Income in Gunungkidul's Karst Region

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ABSTRACT

Poverty is closely linked to both household income and food security. This condition is related to the insufficient purchasing power that people have to have access to food. The purpose of this study is to determine the determining factors of food expenditure and incomes of agricultural households in the karst region of Gunungkidul, Indonesia. The broader implications occur when the low welfare of farmers (with indicators of household income and food security) results in a declining human development index that hampers regional development. Due to the high level of poverty, the study is located in the karst mountainous region of Gunungkidul Regency. Soil infertility affects agricultural production, making it sub-optimal. Multiple linear regressions are used to estimate this study's findings by employing ordinary least squares (OLS). The research data uses primary data with questionnaires to respondents. The study concludes that the estimated parameters of farm household income, off-farm income, remittances, total household income and non-food expenditure are significantly correlated with total food expenditure. The estimated parameters of education, age, assets, remittances and off-farm employment of the head of the household are significantly correlated with total household income. Therefore, off-farm income and remittances contribute to the increase in total household income, alleviation of food insecurity and reduction of poverty in Karst Gunungkidul. The contribution of this research is that the results obtained can be taken into consideration for policy makers or local stakeholders to pay attention to significant determinants of total food expenditure and total household income.

1. INTRODUCTION

Food is one of the basic needs of every human being. Ensuring food security is paramount to developing a country. In Indonesia, there are several obstacles to the achievement of food security, including challenges related to production and consumption. Indonesia has a population of 258.705 million in 2016 [1]. Indonesia is ranked as the world's third highest consumer of rice [2]. The demand for rice in Indonesia cannot be met by the country's rice production and therefore rice must be an import. According to study [2], Indonesia's rice trade balance was in deficit during the period 1983-2016. This situation leads to food security problems.

The issue of food security is intrinsically tied to poverty. Poverty hinders the attainment of food security. This situation stems from the low purchasing power of people in obtaining food. As per study [3], 25.14 million Indonesians were considered poor, including 9.9 million urban and 15.15 million rural inhabitants. This data reveals that the impoverished population is mostly located in rural regions. Given that most rural inhabitants are farmers.

The most crucial challenges due to poverty in Indonesia are the inadequate expenditure on basic needs including food and non-food. Especially basic food needs such as rice, resulting in a nutrition crisis and stunting [4]. If poverty increases, food security in households will decline far from life expectancy. One of the efforts to alleviate poverty is to improve welfare [5].

One of the rural areas with a high poverty rate is Gunungkidul Regency [6]. The majority of Gunungkidul Regency comprises a karst landscape. Karst is a type of landform that is identified by a closed cavity, drainage and cave systems at the earth's surface [7]. As a regency that relies on agriculture for its livelihood, Gunungkidul has challenges to agriculture, such as drought [8]. Thus, drylands contribute little to the income of farming households.

The unique physical features of the karst in the southern part of Gunungkidul Regency are correlated to the region's water scarcity and poverty, making it a defining characteristic of the area [9]. The groundwater system in this region is dominated by dissolution cracks which cause drier surface conditions [10]. The land in this karst region is characterised as arid. As a result, the land in this region is infertile, which negatively affects agricultural cultivation and limits its potential [11]. The area has seen unexpected changes in rainfall and has recently been subject to severe climatic disruptions with incidents such as devastating tropical cyclones [12].

Karst is an ecosystem that is easily damaged so that its management must be carried out carefully so as not to cause damage to the karst ecosystem. An ecosystem has natural resources that can be utilized by people living in karst areas. This makes its own potential and challenges for agriculture. Moreover, there are underground rivers that overflow with water under the karst surface [13].

Farming incomes in the Gunungkidul karst area are extremely low, as the land is infertile and relies solely on rainwater for agriculture. As such, the area experiences low crop productivity which in turn results in high rates of poverty [6, 8]. Household income is the primary factor for meeting basic needs. Researches [14, 15] have revealed that household income positively impacts food security.

In view of the above, the focus of this study is on farm households in the karst mountain region of Gunungkidul Regency. In addition, the present study aims to establish food security in the karst region of Gunungkidul by using the food expenditure approach. This study also makes an important contribution by describing how farm households in unproductive dry land areas for agricultural cultivation can meet their needs without harming the resilience of the ecological-social system.

Previous studies were limited to focusing only on income distribution to increase economic growth [16]; the determination of real variables between poor and non-poor groups that have not been associated with food security, especially in food expenditure consumption [17]. Therefore, to answer the research gap, a research update is carried out on the determinants of food expenditure and household income in Gunungkidul's karst.

2. METHODOLOGY

The study was conducted in the karst mountainous Gunungsewu region of Gunungkidul Regency. The investigation centred on the Girusubo District, which is situated in the southern part of the Gunungsewu karst region and encompasses a vast area [8, 18]. Revenue of farmers in the Gunungkidul karst region is meagre primarily because of infertile soil that is solely dependent on rainwater. As a result, this situation leads to high poverty.

The survey was carried out in 2022. The research was gathered from households of farmers who were chosen as samples using a structured interview method with the help of a structured questionnaire. We applied purposive sampling, we choose karst's farmers. The respondents were appointed by the head of farmer group. There were not all farmer willing to interviewed. Farmer who live in karst area are innocent farmer and feel reluctant to be respondents. They are afraid that the answer is wrong and does not match with was asked. So that the head of the farmer group appointed farmers who were willing and have the ability to answer questions from researchers.

To gather the required information, a standardized questionnaire was used that included details about the socioeconomic characteristics, farming systems, input and output of crops, food and non-food expenses, farm and off-farm income, assets, poverty alleviation programs, and contextual variables. The purpose of this study was to investigate the subsistence food security and income determination of agricultural households, particularly in the karst region of Gunungkidul, Indonesia.

2.1 Income determination

The study uses a household model based on the empirical model from the study [16]. This model is considerable improvement on the standard ordinary least square (OLS). This study will employ the following econometric model to estimate the income determination function.

$$I = \alpha_0 + \alpha_1 \text{Educ} + \alpha_2 \text{Age} + \alpha_3 \text{Asset} + \alpha_4 \text{Damage} + \alpha_5 \text{Remit} + \alpha_6 \text{Off-farm} + \mu \quad (1)$$

where,

I = Total Income of Household (IDR/year)
α = Constanta
α_{1-6} = Coefficients
Educ = Education of Household Head (year)
Age = Age of Household Head (year)
Asset = Assets (IDR)
Damage = Percentage of damage in paddy cultivation (%)
Remit= Remittance (IDR/year)
Off-farm = Dummy occupation of household. If the family member has non farming job, then = 1, otherwise = 0

2.2 Food expenditure

According to study [19], food expenditures rise in proportion to income and family size, but food budget shares decrease as income increases. Food expenditure is widely used as a gauge for evaluating food security [20]. Farm household food security function is developed based on the theory of household consumption, which is derived from the utility function with household budget, time and production constraints. The food security level of a farm household is determined by the household's ability to provide food availability, maintain stability in food availability throughout the seasons, ensure access and affordability of food, and meet food quality standards. Household food security is closely tied to household consumption, and thus the household consumption theory is employed to develop the household food security function [21, 22].

$$I = \alpha_0 + \alpha_1 \text{Riceprod} + \alpha_2 \text{IncomeFarm} + \alpha_3 \text{Income Off-farm} + \alpha_4 \text{Remit} + \alpha_5 \text{Farmmember} + \alpha_6 \text{Income} + \alpha_7 \text{Land} + \alpha_8 \text{Nonfood} + \mu \quad (2)$$

where,

Y = Food Expenditure (IDR)
α_0 = Constanta
α_{1-8} = Coefficients
Riceprod = Rice Production (Kg)
Income farm =Farm Household Income (IDR/year)
Income off-farm = Off-farm Income (IDR/year)
Remit = Remittance (IDR/year)
Fam member = Number of Household (Person)
Income =Total Household Income (IDR/year)
Land = Land Area (Hectare)
Noon food = Non-food Expenditure (IDR/year)

3. RESULTS AND DISCUSSION

3.1 Geographical conditions

On the southern side of the Indian Ocean lies Gunungkidul Regency. The Gunungkidul Regency is bordered to the east by

the Central Java Province's Wonogiri Regency. Gunungkidul Regency is north of Klaten Regency and Sukoharjo Regency in Central Java Province, and west of Bantul Regency and Sleman Regency in DI Yogyakarta Province. The Gunungkidul Regency spans a total area of 148,536 hectares, with the Girisubo sub-district accounting for 9,457 hectares of the total area. Located in the southeastern part of the Gunungkidul Regency, the Girusubo district covers the area [1, 23].

The Girisubo sub-district is located inside the Gunungsewu Karst. The Gunungsewu Karst is characterized by a terrain with carbonate materials that features hills with flat tops, formed through rapid erosion and denudation of the terrain in a humid tropical environment. Furthermore, according to reference [24], the hills have a sinoid to cone-shaped pattern. The geology of Gunungsewu Karst tells the story of tectonic events, erosion, denudation, and deposition processes that date back to the Miocene epoch [24].

The crops grown in Girisubo are paddy, corn, nuts, and cassava. Corn and nuts are cultivated either in the rainy season or the dry season. Rice cultivation relies on rainfall, also known as rainfed rice. Based on soil conditions, rice cultivation may not be optimal in dry areas. Rice can only be sown once a year when the rainy period begins. It is not possible to plant rice during other seasons as it needs a considerable amount of water.

3.2 Poverty alleviation programs

Gunungkidul Regency has the highest poverty rate in Yogyakarta Province [6]. Poverty is a serious problem for the government of Gunungkidul Regency. The higher poverty rate in Gunungkidul Regency may cause a higher level of suicides. According to study [25], the loss of jobs, insufficient family needs, and other factors cause suicide in Gunungkidul Regency, which has the highest suicide rate in Yogyakarta Province. Suicides occur consistently throughout the year in this region. The government made several attempts to alleviate poverty. Poverty alleviation programmes cover various areas such as education, health, and social welfare. The following initiatives have been embraced by the rural community in the Girisubo sub-district.

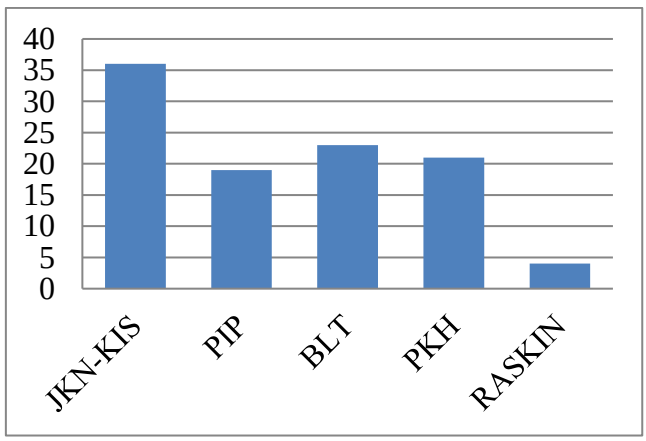

Figure 1. Poverty alleviation programs in Girisubo sub-district

The National Health Insurance (JKN-KIS) is a health programme provided by the government to impoverished sectors of society. The objective is to support and assist all underprivileged families. This support comes in the form of complimentary healthcare services at health centres, clinics, and hospitals throughout Indonesia in line with the type of illness. As shown in Figure 1, 36 out of 60 respondents in Girisubo District received the JKN KIS program. In addition, PIP/The Smart Indonesia Program offers monetary aid in the form of educational cash grants to school-age children (aged 6-21) from poor households, disbursed through the Smart Indonesia Card. The program caters students from primary, middle school and high school. This initiative aims to break the cycle of poverty by offering education programs. To enable the poor to attend school without incurring expenses. As shown in Figure 1, 19 out of 60 respondents in Girisubo sub-district receive the PIP program.

Moreover, BLT, a direct cash transfer, is a government program aimed at assisting the poor due to the effects of increasing fuel prices. Indicators used to classify poor communities include floor area, floor and wall type, toilet, lighting and drinking water sources, fuel, meat consumption, clothing affordability, dietary habits, land area ownership, and level of education of the household head. Figure 1 indicates that 23 out of 60 respondents in the Girisubo sub-district are beneficiaries of the BLT program. PKH, or the Family Hope Program, is the successor of the direct cash transfer program. The Family Hope Programme is a social assistance programme dedicated to needy families identified as PKH beneficiaries. The objective of this programme is to assist extremely poor households in avoiding destitution and ensuring sound health and primary education for the ensuing generation. This programme's primary target audience comprises children between the ages of 0 and 6, adolescents below the age of 18 without basic education, and women who are pregnant or who have recently given birth. It is evidenced by Figure 1 that 21 out of the 60 respondents from the Girisubo subdivision are beneficiaries of the PKH programme.

The Raskin programme is one of many food-based poverty reduction and social protection programmes conducted by the central government as subsidized rice assistance for low-income families (those who are poor and socially exposed). The Raskin programme aims to decrease a part of the target family's financial burden in fulfilling their fundamental food needs via rice. Figure 1 illustrates that four out of sixty respondents in Girisubo sub-district are beneficiaries of the Raskin programme.

3.3 Result

This study employs multiple linear regression and estimates it using ordinary least squares (OLS). Regression models estimate the impact of various explanatory variables on food expenditure and income determination measures. The variable selection adheres to the existing literature. Table 1 displays the relevant explanatory variables utilized to estimate the impact on household food expenditures and income determinations.

Total food expenditure denotes the annual household expenditure on food. It includes rice, other carbohydrate-based food, broiler chicken, beef, fish, eggs, onion, garlic, red chili pepper, green chilies, cayenne pepper, other vegetables, nuts, fruit, oil and fat, beverages, seasoning, and others. Rice production can be quantified in terms of kilograms per annum. The total sum of income from rice farming, corn farming, nuts farming, and cassava farming in a year constitutes the farm household income. Off-farm income is the annual earnings gained from non-farm employment. Remittance is the sum of

money sent by family members within a year. The number of households was measured based on the total number of individuals present in each. The land area is a continuous variable measured in hectares.

Table 1. Input potential determinants of food expenditure and income

Variables	Mean	Standard Deviation	Min.	Max.	Amount
Food Expenditure (IDR/Year)	9,482,170	2,928,126	4,224,000	19,963,800	
Rice Production (Kg)	394.791	187.610	100	1000	
Farm Household Income (IDR/Year)	3,014,239	2,932,437	-1,380,833	11,659,000	
Off-farm Income (IDR/Year)	7,000,000	9,607,362	0	48,000,000	
Remittance (IDR/Year)	3,310,000	6,425,735	0	36,000,000	
Number of Household (Person)	3.183	1.171	1	7	
Land Area (Hectare)	0.450	0.219	.25	1	
Non-food Expenditure (IDR/Year)	4,968,722	2,539,655	2,063,000	16,800,800	
Total Household Income (IDR/Year)	15,216,323	10,552,855	482,285.700	51,178,667	
Education of Household Head (Year)	7.066	2.748	0	16	
Age of Household Head (Year)	53.500	13.773	23	85	
Asset (IDR)	111,797,417	40,452,508	66,200,000	261,100,000	
Damage in paddy cultivation (%)	16.583	13.428	0	45	
Off-farm job (dummy variable) If the family member has non farming job, then = 1, otherwise = 0	0.483	0.503	0	1	48% 52%

1 USD = 13,295 IDR

Total household income refers to the annual monies obtained from farm income, off-farm income, and remittances. The level of education of the household head was determined by the number of years of formal education received. The age of the household head was determined as a continuous variable in years. Assets were measured based on livestock, such as cows, goats, and chickens, owned land, agricultural machinery, house, jewellery, transportation, non-agricultural machinery, electronics, furniture, and other properties. Damage on paddy cultivation indicates the percentage of loss incurred in paddy cultivation. Of course, the damage that occurs results in crop failure, which will affect the amount of income that should be obtained. Crop failure will reduce household income. Off-farm job is measured via a dummy variable, which is set to 1 if the family member has a non-farming job, and 0 otherwise.

Table 2 illustrates the result of food expenditure analysis. Variable of farm household income, off-farm income, remittance, total household income, non-food expenditure significantly. In contrast, rice production, number of household, and land area does not affect the food expenditure.

Table 2. Estimation result for determinants of food expenditure

Variable	Coefficient	Std. Error
Rice Production	2168.405^{ns}	3026.366
Farm Household Income	1.028397*	.5935893
Off-farm Income	1.108859*	.5905844
Remittance	1.17785**	.5822786
Number of Household	286392.9^{ns}	288683.9
Total Household Income	-1.114265*	.5938159
Land Area	-1821677^{ns}	1926340
Non-food Expenditure	.5310025***	.1427689
Constant	8090252***	1990250
Numb Observation	60	
R-Squared	0.4346	

*Significant at 10% level; **significant at 5% level; ***significant at 1% level, ^{ns} not significant

Table 3 illustrates the result of household income analysis. Variable of education, age, asset, remittance and off farm job influence the household income significantly. In contrast, damage on paddy cultivation does not affect the household income.

Table 3. Estimation result for determinants of household income

Variable	Coefficient	S.E
Education of Household Head	-1113636***	371585.4
Age of Household Head	-254115.8***	79400.05
Assets	0.056025*	0.021290
Damage on paddy cultivation	50816.42^{ns}	67092.6
Remittance	1.244596***	0.145420
Off-farm job (dummy variable)	1.41e+07***	1868089
Constant	1.86e+07***	6260155
Number of obs	60	
R-squared	0.6774	

*Significant at 10% level; **significant at 5% level; ***significant at 1% level, ^{ns} not significant

Education and age of household head has negative impact to the household income. While, asset, remittance and off-farm job have positive effect to the household income.

3.4 Discussion

The parameters of rice production do not significantly influence food expenditure. Rice production is intended for both self-consumption and for sale within the market. This causes the land to become infertile for rice cultivation. Additionally, farmers consume cassava as their staple food. The estimate for the parameter for the size of households is negative, but it is not statistically significant to food expenditure. This occurs because there is a member of the household who is an immigrant worker. They moved to another region or district to fulfil their needs.

Food expenditure has a significant and positively correlated effect with farm household income. Increasing farm income enhances household purchasing power, enabling them to meet their food requirements. This indicates that farm household income plays a crucial role in enhancing food expenditure, which serves as an indicator of food security. The natural resources available in the karst mountainous region of

Gunungkidul have led residents to work primarily as farmers. The agricultural commodities grown comprise rice, corn, peanuts, and cassava. In addition to off-farm activities, farm activities can contribute to enhancing food security and nutrition, as stated by study [26].

Total household income has a significant negative impact on food expenditure. As total household income increases, food expenditure decreases. This indicates that, with the increase in income, households do not entirely allocate their income to food expenditure. However, high-income households have the privilege of allocating some of their income to non-food needs, such as secondary and tertiary expenses. This is related to the previous discussion where the total income variable is found to have a negative influence on food expenditure due to it being used for non-food expenditure.

Income from non-agricultural sources positively and significantly impacts food expenditure. If off-farm income increases, households will be able to improve their purchasing power and meet their food needs. According to study [20], off-farm activities can help improve food security and nutrition. Farmers who earn off-farm income mostly work in construction. Other individuals work as traders, drivers, or laborers in the market. This job, not related to agriculture, has a significant role to play. This is because farmers who solely depend on nature can't fulfill their food requirements.

The estimated remittance parameter has a statistically significant positive effect on food expenditure at a 5% level. Remittance income increases households' access to food. This indicates that remittance plays an important role in enhancing food security through increased food expenditure. In families who live in areas with high poverty rates such as the karst mountainous Gunungkidul, remittance is crucial. This is consistent with study [22] which shows that remittance income in Bangladesh is pivotal in improving the food security of rural people experiencing poor food consumption or severe hunger. Food security in Africa is greatly enhanced by remittances. Remittances, as additional income, promote food access and stability. This is measured by the incidence of undernourishment and the volatility of food production per capita [27]. Remittances in Nigeria are used for household food consumption [28]. Remittances significantly contribute to food expenditure in the southern region than in the northern region, as well as in urban locations compared to rural ones [29].

The estimated parameter for non-food expenditure exerts a beneficial and noteworthy influence on food expenditure. This indicates that food expenditure will increase when non-food expenditure increases. These needs could include secondary or non-food items like tarsiers. Needs such as housing, goods and services, clothing, and social needs, all of which are non-food related, are also taken into consideration.

4. CONCLUSIONS

The government has attempted to reduce poverty through various means. Poverty alleviation programs encompass various aspects, including education, health, and economic and social measures. The goals of the programs are to decrease household expenditure and to maintain household income stability. Independent variables play a crucial role in policy-making. The results indicate a significant correlation between the estimated parameters of farm household income, off-farm income, remittance, total household income, non-food expenditure and total food expenditure. The estimated parameters indicating the education level, age, assets, remittance, and off-farm employment status of the household head are significantly correlated with the overall income earned by the household. Econometric approaches have shown that sources of income, such as farm and off-farm activities, as well as remittance inflows, contribute to an increase in household purchasing power and, consequently, to improvements in food expenditure. All of the variables associated with the income sources increase the purchasing power of the household, enabling them to meet their food and nutrition requirements. In areas with karst geology, unfertile land poses a significant challenge to crop cultivation, adversely affecting agricultural production. The damage to land has resulted in the farmers incurring losses. In order to ensure optimal farm income. Off-farm income has an important role in increasing total household income, in relation to this situation. It is important to promote the rural off-farm sector. Diversification of off-farm income is already widespread among rural households. Off-farm income and remittances contribute to increasing total household income. This can help to alleviate food insecurity and poverty in the karst region, Gunungkidul.

The level of education of the household head is significantly negatively correlated with household income. There is a suggestion that higher education may reduce household income. Field conditions demonstrate that the education level of farmers is still low. Household heads who graduated from elementary school are the majority in the study area. This finding contradicts with study [30] because farmers in karst regions require extensive experience to cultivate paddy in a more effective manner. Older farmers with extensive experience in farming often choose not to pursue higher education. After completing primary school, they work in the agricultural sector to support their families.

The estimated age parameter is negatively and significantly associated with household income at a 1% level of significance. This suggests that younger farmers tend to have higher household incomes compared to older farmers who have relatively lower household incomes. The majority of respondents in the karst mountainous region of Gunungkidul are elderly, resulting in significant agricultural degeneration. There is a critical need for farmer regeneration in this area.

The estimated assets parameter is only significantly positive for the total household income. Assets will increase the total household income. A farmer who has assets could reduce their expenses. For example, a farmer who owns land would have no rental expenses. Land is used for growing annual crops such as rice, corn, peanuts, and cassava, as well as perennial crops like mangoes and petai. Similarly, farmers who own livestock generate supplementary income through animal husbandry. Farmers who own livestock rear cows, goats, and chickens for income. Cows and goats are raised for future investment. Ethiopia has the largest livestock population in Africa [31].

The coefficient of damage on paddy cultivation is negative, but it is not significant to household income. In other words, the damage on paddy cultivation does not have any effect on household income. This is because farmers have been able to manage farming well by adapting to it. Local knowledge has been used to devise traditional seasonal calendars. This can be referred to as 'pranoto mongso'. Pranoto mongso is a type of indigenous knowledge related to agricultural activity. This local knowledge has been used to develop traditional seasonal calendars. As per traditional knowledge, pranoto mongso

advises farmers to observe signs of nature when devising cropping strategies. Natural phenomena are used in Pranoto Mongso as a direction for farming time. Pranoto Mongso utilises various natural phenomena, such as animal behaviours, plant conditions, and temperature changes [32].

At the 1% level, the estimated remittance parameter exhibits a markedly beneficial effect on household income. Thus, it can be inferred that remittances contribute significantly to the total household income. Usually, remittances are sent by their migrating children and husbands from more developed areas. They work in other districts before reaching the country's capital city. The frequency of different shipments varies, ranging from monthly to every 3 months, to every 18 months, with some shipments being once a year. As per study [33], the nutritional impact of remittances is expected to be positive, given that they contribution to higher household earnings and, as a result, better nutrition.

The estimated parameter of 'dummy off-farm' shows a significantly positive effect on total household income. Being classified as 'off-farm' will result in an increase in total household income compared to being classified as non-off-farm. To clarify, seeking employment outside of farming can enhance the overall income within Gunungkidul's karst mountains. This circumstance can be attributed to the nature of karst terrain. As cited in study [34], certain crops' experimental cultivation fails due to water scarcity, and it may result in the death of livestock. One of the consequential outcomes is the decreased income from on-farm activities [35].

The government must pay attention to determinant factors that affect food expenditure, such as Farm Household Income, Off-farm Income, Remittances, Total Household Income, and Non-food Expenditure. Efforts that need to be made by the Government are to open up employment opportunities in the modern and sustainable agricultural sector, as well as the non-agricultural sector, so that income will increase, poverty can decrease, and have an impact on food expenditure.

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