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RAIN-FED RICE FIELD MANAGEMENT TO IMPROVE FOOD PRODUCTIVITY: A CASE STUDY OF REMBANG REGENCY

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Abstract

As the owner of the highest percentage of rain-fed rice fields in Central Java, Rembang Regency faces serious challenges in increasing food productivity due to dependence on rainfall, land degradation, and the impact of climate change. This study aims to analyze the governance of rain-fed rice fields to increase food productivity in Rembang Regency, as well as the factors that inhibit it. The research method uses a qualitative-descriptive approach through in-depth interviews with farmers and related stakeholders. Secondary data comes from regulations, data from the Central Statistics Agency (BPS), journals, books, and websites. The results show that rice productivity in Rembang averages 5.5-5.6 tons/ha, lower than the provincial average (5.69 tons/ha), with the main factor being limited water infrastructure (only 17.24% of land has access to reservoirs/irrigation). Farmers receive insufficient support and outreach to understand rainfed rice management. A lack of innovation and limited information on superior rice varieties prevent farmers from comprehensively understanding which rice seeds are more suitable for their needs based on climate conditions. Regulations are not supported by technical measures at the regional level and tend to operate without integrative coordination between stakeholders. Good rainfed rice management to achieve sustainable food security as targeted by the SDGs requires not only technical development but also improvements in agricultural governance, including coordination, participation, capacity, and policies. Infrastructure development must emphasize community participation and be village-based. With farmer collaboration and policy integration between relevant agencies, food security in Rembang is not impossible to achieve. This research is not only relevant to Rembang Regency, but also other regions with similar rainfed land characteristics in Indonesia and globally.

Keywords: Rainfed rice fields, food productivity, food security

INTRODUCTION

Rembang is a regency in Central Java, covering an area of 1,036.70 km². Located at the northern tip of Central Java, Rembang borders Tuban Regency, East Java. Rembang Regency borders the sea to the north, Pati Regency to the west, and Blora Regency to the south. Rembang is home to 660,016 residents, spread across 14 sub-districts and 294 villages.[1] Geographically, Rembang is a lowland, with 4 sub-districts located at an altitude of more than 700 meters above sea level, namely Sedan, Pancur, Gunem, and Kragan.

Figure 1: Location Map of Rembang Regency, Central Java

In terms of land use, Rembang is divided into several areas: rice paddies, non-rice paddy fields, and non-agricultural land. Rice paddies are agricultural land divided into sections, delimited by embankments to retain water distribution.[2] Non-rice fields are areas used for other agricultural purposes, such as gardens/fields, smallholder plantations, forest areas, and fish ponds. Non-agricultural land, on the other hand, is land used for residential, industrial, office, and public facilities.

The majority of the population in Rembang Regency, Central Java, are farmers. They rely heavily on rice for their rice paddies. Rice is considered the most profitable crop for farmers. Reasons for this are its favourable selling price, harvest time, ease of distribution by middlemen, and collaboration with the National Logistics Agency (BULOG). Rembang farmers' understanding of superior rice varieties is very limited. The lack of guidance and references on superior rice varieties for farmers presents a challenge. Farmers in Rembang rely solely on traditional planting patterns and have little knowledge of rice seeds that are tolerant to dry soil in rain-fed rice fields.

Based on the percentage of land area, rain-fed rice fields in Rembang Regency are the highest in Central Java, accounting for 82.76% of the total 26,634 hectares of rice fields. This reality disrupts food productivity in Rembang, as it is dependent on rainfall in the region. Irrigated rice fields in Rembang only cover 4,591 hectares, or 17.24%. Irrigated rice fields are typically planted with rice and can be harvested at least 2-3 times a year. Meanwhile, rain-fed rice fields can only harvest rice once or twice a year. Rembang, despite its vast land potential, has not been managed properly. Rice production in Rembang has not yet reached the average rice production in Central Java province. This reality illustrates the importance of improving the management of rain-fed rice fields in Rembang Regency.

Unpredictable climate change, coupled with farmers' lack of knowledge of the climatology in their surrounding areas, makes it impossible to plan planting seasons. This limited information often results in crop failures. Frequently changing weather conditions leave farmers with limited options for ideal crops during unpredictable seasons.

Table 1
Land Use Data In Rembang Regency In 2023

No	Subdistrict	Land Use (ha)			Total (ha)
		Rice Fields	Non-Rice Fields	Non-Agricultural Land	
1	Sumber	3,032	3,856	785	7,673
2	Bulu	1,530	7,571	1,139	10,240
3	Gunem	1,233	6,375	412	8,020
4	Sale	1,752	8,322	641	10,715
5	Sarang	2,384	5,513	1,236	9,133
6	Sedan	2,007	4,784	1,173	7,964
7	Pamotan	1,321	5,135	1,700	8,156
8	Sulang	1,993	4,487	1,974	8,454
9	Kaliori	3,437	1,087	1,626	6,150
10	Rembang	3,084	1,696	1,101	5,881
11	Pancur	899	2,384	1,311	4,594
12	Kragan	2,219	2,794	1,154	6,167
13	Sluke	760	2,370	629	3,759
14	Lasem	983	2,634	888	4,505
	Amount	**26,634**	**59,008**	**15,768**	**101,410**

Source: Food Crops and Horticulture Sector, 2023

Rain-fed rice fields are the highest contributor to rice production after irrigated rice fields.[3] The area of rain-fed rice fields in Indonesia is 29.4% of the total area of standard rice fields (7,463,950 ha).[4] As an agroecosystem that is vulnerable to the impacts of climate change, the use of adaptive rice varieties is recommended for rain-fed rice fields to support food security.[5] Rainfed rice fields are areas that rely entirely on rainfall for their water supply. The higher the rainfall, the greater the potential for land utilization. Besides Rembang, rainfed rice fields in Indonesia generally rely heavily on rice as their primary crop.

Lack of infrastructure also hinders the utilization of rain-fed rice fields in Rembang Regency. Water sources, such as reservoirs, cannot reach and irrigate all the rice fields in the regency. During the dry season, these reservoirs even dry up due to the lack of springs.

Reservoirs only serve to store rainwater for a longer period before diverting it to the surrounding rice fields. Due to this limited infrastructure, farmers struggle to access water to irrigate their rice fields.

Table 2
Data on Rice Field Land Use in Rembang Regency 2023

No	Subdistrict	Land Use (ha)		Total (ha)
		Irrigated Rice Fields	Rain-fed Rice Fields	
1	Sumber	282	2,750	3,032
2	Bulu	75	1,455	1,530
3	Gunem	481	752	1,233
4	Sale	468	1,285	1,752
5	Sarang	-	2,384	2,384
6	Sedan	436	1,571	2,007
7	Pamotan	579	742	1,321
8	Sulang	34	1,959	1,993
9	Kaliori	1,127	2,310	3,437
10	Rembang	-	3,084	3,084
11	Pancur	350	549	899
12	Kragan	-	2,219	2,219
13	Sluke	760	-	760
14	Lasem	-	983	983
	Amount	**4,591**	**22,043**	**26,634**

Source: Food Crops and Horticulture Sector, 2023

With such unpredictable climate change, farmers who rely on rain-fed rice fields can only surrender to the situation by simply waiting for traditional weather forecasts or waiting for the water level to rise sufficiently. This dependence on a single commodity, coupled with the condition of rain-fed rice fields in Rembang Regency, has also hampered the economy of Rembang. In 2024, Rembang was listed as one of the poorest regencies in Central Java Province. Rembang Regency ranks as the 7th poorest in Central Java Province with a population of 91.45 thousand people, or 14.02%. The condition of the population's livelihoods and their dependence on rain-fed rice fields significantly impacts the community's purchasing power and income.

This reality makes it urgent to establish changes and governance of rain-fed rice fields in Rembang Regency. This is in line with the central government's promotion of food self-sufficiency in Sustainable Development Goals (SDGs) 2 (Zero Hanger), which aims to eradicate hunger, achieve food security and good nutrition, and promote sustainable agriculture. This is in accordance with regulations at both the national and international levels. Several key points in formulating food security boundaries are:[6]

a) Fulfilment of food needs for the country down to the individual level.

b) The benchmark for fulfilling food needs includes several aspects, namely: sufficient quantity, good quality, not in conflict with religious norms, beliefs and community culture, and affordable.

c) c) The provision and affordability of food is intended so that people, including individuals, can live healthily, actively and productively in a sustainable manner.

Improving agricultural governance, particularly irrigation, the government previously established an Irrigation Commission based on Regent's Regulation (Perbup) No. 3 of 2008. The commission's purpose was to coordinate, maintain, and improve the irrigation network in Rembang Regency. Seventeen years later, the implementation of the Regent's Regulation appears to be stagnant, given the reality of many rice fields in Rembang still lacking irrigation facilities.

According to Edwards III (1980), policy implementation is the policy-making stage between the formation of the policy and the consequences of the policy for the society it influences.[7] There are several factors that influence it, including:

a) Communication

For implementation to be effective, the person responsible for implementing a decision must know what needs to be done. When implementing a policy, orders to implement the policy must be transmitted to the appropriate personnel, and the instructions must be clear, accurate, and consistent.

b) Resources

Every policy must be supported by adequate resources, both human and financial. Human resources refer to the adequacy of the implementers' quality and the ability to reach all target groups. Financial resources refer to the adequacy of investment capital for a program/policy. Both must be considered in policy implementation. Without the presence of implementers, policies become less effective and progress slowly. Financial resources, on the other hand, ensure the sustainability of policies. Without adequate financial support, programs cannot run effectively and quickly in achieving their goals and objectives.

c) Disposition

The character of an implementer with a high level of commitment and honesty will consistently persevere through the obstacles encountered in policy implementation. Honesty guides the implementer to remain within the program outlined in the program/policy guidelines. Their commitment and honesty lead them to be more enthusiastic in consistently implementing the program's stages. A democratic attitude will enhance the positive impression of the implementer and the policy among members of the target group. This attitude will reduce community resistance and foster trust and concern among the target group for the implementer and the program/policy.

d) Bureaucratic Structure

This aspect of bureaucratic structure encompasses two important aspects: the mechanism and the implementing organization's structure. Program implementation mechanisms are usually established through standard operating procedures (SOPs) included in the program/policy.

In line with this phenomenon, this study is intended to analyse the management of rain-fed rice fields in increasing food productivity in Rembang district, as well as the factors that inhibit it..

METHODOLOGY

This study employed a descriptive qualitative method. Data sources included in-depth interviews with farmers, the agricultural service, and relevant stakeholders. Secondary data came from journals, books, laws, government statistics, websites, and regulations related to agricultural governance. The focus of this study was rain-fed lowland agriculture in Rembang Regency, Central Java.

RESULTS AND DISCUSSION

Factors Inhibiting Food Productivity

Agriculture, the primary food source, relies heavily on energy inputs, including machinery, fertilizers, seeds, and irrigation systems. Energy is also required by the processing industry. Traditional agricultural practices consume significant amounts of energy, often derived from non-renewable sources. This energy-food nexus underscores the need for a holistic approach to addressing the interconnected challenges of energy demand and food security.[8] Over the past few decades, human demand for water has increased dramatically, placing enormous pressure on the ability of ecosystems to provide water services.[9] Understanding the water services impacted by agricultural expansion helps in managing the risks associated with floods and droughts and guides future expansion to reduce these risks.[10] The synergy between climate, soil, and plants also determines food production in rain-fed lowland agroecosystems. Efforts to optimize the productivity of rain-fed rice fields to support food self-sufficiency are influenced by environmental factors and non-physical components such as social, cultural, and economic aspects.[11] The productivity of rain-fed lowland rice is determined by environmental improvements (land management, fertilization, and cultivation techniques).[12]

The low average rice productivity is caused by various biophysical constraints such as poor soil fertility, low rainfall, and limited tolerant varieties suitable for rain-fed agriculture.[13] Biophysical constraints on rainfed land cause it to be suboptimal. Suboptimal land is land with low natural productivity in terms of soil biology, chemistry, and physics, climate factors, high temperatures, and low rainfall.[14] Based on land suitability standards for agricultural commodities, land with a pH level <5, a cation exchange capacity <5, a base saturation <35, organic carbon <0.8%, and low to shallow N, P, and K nutrient content can make rice difficult to grow. In fact, estimated production on marginal land is only around 60% of its maximum potential.[15] Based on this reality, natural constraints related to rainfall intensity are a classic problem affecting the productivity of planting in rain-fed rice fields. The supply of poor-quality seeds and fertilization procedures pose challenges to increasing agricultural productivity in rain-fed rice fields.

Irrigation plays an important role in rural areas, as it achieves higher technical efficiency compared to urban areas.[16] However, the irrigated area has decreased over time due to factors such as sedimentation, limestone mining, and reduced water supply from the Reservoir.[17]. In Rembang Regency, several irrigation systems have been constructed, powered by reservoirs. These reservoirs are mini-reservoirs constructed to store water from springs, rainwater, and other sources. Of the 141 reservoirs built, only 104 are operational.[18] The government's lack of monitoring and funding is the root of the problem. Ownership and management of reservoir assets fall under the authority of the Central Java province. Active participation by district governments and prioritization of provincial government programs for reservoir management are required.

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Figure 2: Condition of Lodan Reservoir, Sarang District – Rembang Regency

Farmers in Rembang lack access to knowledge about quality rice seeds. Their involvement in current variety research is minimal. They rely solely on traditional cropping patterns and lack comprehensive information on rice variety research from relevant stakeholders. Understanding of drought-tolerant rice varieties needs to be deepened through research and relevant agencies, leading to the development of superior varieties. Research in southern India has shown substantial improvements in both grain yield and stress tolerance, particularly under moisture deficit and flooding conditions.[19] They can develop resilient rice varieties, and make significant contributions to advancing sustainable rice farming and strengthening food security initiatives in drought-prone areas across the country.

Land Management Strategy

Culturally and geographically, Rembang's land is fertile and strategic for increasing food productivity, particularly rice. Given its significant potential, despite its limited land availability, which relies heavily on rainfall, policy intervention from the local government is essential. Collaboration between stakeholders is crucial for managing Rembang's rice fields. Rembang's land not only has the potential for local self-sufficiency but also contributes significantly to national development. With its vast land area and easy distribution, collaborative policies between the local, provincial, and central governments must be more aspirational, reaching farmers.

Farmers in Rembang have conducted numerous field drilling trials to increase water sources. Drilling is generally conducted to a depth of approximately 50 meters. While some drilling has been successful, many have also failed. Farmers' knowledge and technology for identifying water sources are very limited. Some of the tens of meters of drilling conducted by farmers have yielded no water source, and some have produced saltwater. Interviews with one source revealed that some areas are unsuitable for drilling because they lack springs. This geological reality has made the community reluctant to apply for groundwater drilling assistance from the government. This concern stems from the success rate of groundwater drilling in several sub-districts in Rembang Regency, such as Kragan and Sedan. Mining and logging activities near springs have made it difficult to obtain water sources for rice paddies in nearby areas. Rembang's proximity to the sea also poses a risk that water obtained through drilling activities will produce saltwater.

In pursuing better rainfed rice farming practices, it is important to recognize that unique agroecosystems in each region require local adaptations, making it crucial for farmers to exchange valuable experiences and insights in the field with fellow farmers, researchers, and policymakers.[20] Technologies to increase rice productivity require farmer involvement to achieve social, cultural, and economic acceptance. The complexity of agricultural issues necessitates adaptive testing with farmers in local agroecosystems. Rice cultivation using the same technology package, during the same season, and on the same land can still result in productivity variations. Economic factors (rising prices and limited availability of inorganic fertilizers) also contribute to differences in production results.[21]

Weeds are also a challenge in maintaining food security. To increase rice productivity in rain-fed rice paddies, we should try innovations like those implemented in Ferralsos, Madagascar. They have tested a no-till and living mulch (NTLM) planting system using the cover crop Stylosantes guianensis in this area and proven effective in limiting weed pressure while increasing yields.[22] This method has been proven to effectively increase soil fertility without increasing plant parasite pressure.[23] This innovation makes supporting research into land management methods urgent. New technologies should serve as a reference for national agricultural development.

Furthermore, the development and management of agricultural infrastructure, such as reservoirs or ponds, also need to be improved. Water management through pumps and reservoirs can provide water for plants and enrich soil nutrients. Reservoirs are designed to optimize the efficient use of limited water resources. Soil management combined with organic fertilizers also affects soil physical properties, such as soil moisture. Given the constraints of rain-fed land systems that depend on rainfall in the area, water management can be utilized as efficiently as possible. Dry upland rice, familiar in Indonesia, has proven to thrive in Africa, particularly in Kenya. Amid water limitations, the addition of nitrogen fertilizer containing sufficient nutrients allows rice to continue growing and yielding.

One innovation in China, optimizing water use in rain-fed rice fields, is implementing an intermittent irrigation system, alternating wet and dry conditions. Intermittent irrigation in rain-fed rice fields, with intervals of up to five days, does not significantly reduce crop yields. Irrigation every three days results in higher rice yields than daily irrigation.[24] This irrigation model is worth trying in Rembang, as well as in Indonesia as a whole, where the majority of rice fields still rely on rain-fed irrigation. Optimal water efficiency is essential for maximum yields.

Realitas Kondisi dalam konteks SDGs 2

Based on the results of the study, rice productivity in Rembang averages 5.5-5.6 tons/ha, lower than the provincial average (5.69 tons/ha). According to BPS data, the production of rice, the main consumption of Rembang residents, can only be covered by 75%. Rembang residents must bring in production from surrounding areas such as Delanggu (Klaten), rice distribution from Bulog, and others. For Rembang residents, access to rice is not that difficult to obtain. The easy distribution of goods makes the price relatively affordable. However, the ease of food affordability is not accompanied by the nutritional adequacy of the Rembang population. The stunting rate for infants and children in Rembang is still quite high at 13.8%. This percentage is only slightly below the national average of 14%. This is not in line with Sustainable Development Goals (SDGs) 2 which targets eliminating hunger and ensuring access for all people, especially the poor and those in vulnerable conditions, including infants, to safe, nutritious, and sufficient food throughout the year. Visible indicators include insufficient food consumption, which is still dependent on external sources, as well as malnutrition due to stunting.

The welfare of the population in Rembang, the majority of whom are farmers, is reflected in the relatively low Regency Minimum Wage (UMK). Rembang ranks fourth as the regency with the lowest UMK in Central Java in 2025, at Rp2,336,168.78. This wage has increased by 6.5% from the previous UMK, which was Rp2,099,689. This wage is relatively low when compared to other regencies around the north coast of Java, such as Pati:

Rp2,332,350, or Tuban, East Java: Rp3,050,400. The low UMK also makes it difficult to allocate adequate nutrition for Rembang residents. Generally, farming is a secondary job for Rembang residents. Some of them earn a living as fishermen, traders, retirees, and carpenters/bricklayers. They cannot yet rely on agriculture as their main occupation. Income fluctuations, access to capital, and the risk of crop failure due to climate change are challenges.

Fertilizer is a vital element in addressing the low productivity of rain-fed rice fields. In Nepal, to address limited irrigation water, farmers increase fertilizer doses to increase yields. Farmers in Nepal believe that dependence on rainfall and a lack of fertilizer are the main constraints to rice production.[25] Farmers are initially limited by water scarcity, and later by soil fertility. Adequate water supply combined with high fertilizer inputs can increase rice yields.[26] Fertilizer prices in Rembang Regency and nationally are often unaffordable for farmers. In the context of fertilizer control, the Rembang Regency Government has established several Regent Regulations (Perbup) to control agricultural subsidies, particularly subsidized fertilizer prices. These regulations are outlined in Perbup No. 25 of 2014 and Regent Decree No. 521.3/1252/2024 concerning the allocation and Highest Retail Price (HET) for subsidized fertilizer in Rembang. These regulations only control or monitor prices related to the distribution of subsidized fertilizer, but the allocation of such fertilizer remains limited and does not reach farmers equally.

Agricultural Sector Policy Governance

Regarding collaboration in agricultural sector governance in Rembang, multi-institutional cooperation between the central and regional governments has been progressing quite well. However, effectiveness and appropriateness remain issues. One example of this collaboration is the construction of medium-sized reservoirs with a capacity of 200-500 m3. Most of these reservoirs merely retain water during the rainy season but dry out quickly during the dry season. Only a small number, such as in the Sarang and Sale sub-districts, produce abundant reservoir water due to the presence of springs in the area.

Several reservoirs that were built have also suffered damage, such as silting and inadequate infrastructure to accommodate the water flow. In some villages, efforts are being made to drill wells for irrigation. However, this mechanism is hampered by the lack of water sources when drilling to a depth of approximately 50 meters. This was found in several villages in Kragan and Sedan sub-districts. One person interviewed by the researchers said he did not dare budget for a groundwater drilling application to the government due to the risk of failure in finding new water sources. This is due to limited equipment for validly detecting water sources and the limited water content in the surrounding area.

Table 3
Number Of Reservoirs in Rembang Regency 2023

No	Subdistrict	Land Use (ha)				Total (ha)
		Good Condition	Slightly Damaged	Moderate Damaged	Heavily Damage	
1	Sumber	13	1	-	-	14
2	Bulu	7	5	2	-	14
3	Gunem	9	-	-	-	9
4	Sale	3	5	3	7	18
5	Sarang	8	-	-	-	8
6	Sedan	3	-	-	-	3
7	Pamotan	8	-	1	1	10
8	Sulang	10	1	1	-	12
9	Kaliori	3	5	-	-	8
10	Rembang	27	-	1	-	28
11	Pancur	7	-	-	-	7
12	Kragan	2	-	-	-	2
13	Sluke	-	-	-	-	-
14	Lasem	4	3	-	1	8
	Amount	**104**	**20**	**8**	**9**	**141**

Source: Agricultural Infrastructure and Facilities Sector

Regarding the implementation of policies in the management of rain-fed rice fields, there are several related factors, namely:

a). Communication

In reality, agricultural policies related to rain-fed rice field management have not been properly disseminated. This dissemination is based solely on a top-down model, without active participation from communities or farmer groups.

The Rembang Regency Agriculture and Food Service's policy in its 2021-2026 Strategic Plan (Renstra) noted that the primary pressing issue to be addressed is the provision of agricultural infrastructure. However, the reality on the ground is that many plots of land in several sub-districts still struggle to access water. This is evident in the 141 reservoirs that existed in 2023, but 37 still need improvement. Reservoir construction is also uneven across sub-districts. Infrastructure development policies are based solely on proximity, not on the quantity of rain-fed rice fields. Communication often occurs through transactional means within development programs, involving political networks and personal relationships. Many farmers and farmer groups who should receive priority and benefit from development are unable to access them.

Anticipation of climate change has also not been well-socialized. Rembang farmers, as adherents of traditional agriculture, lack a clear understanding of the impact of unpredictable climate change, making them unable to predict the use of superior seeds appropriate for specific climates. Water shortages for agricultural facilities are a routine problem for rain-fed rice farming. However, farmers have not been provided with information from relevant agencies on how to deal with rice fields affected by months of flooding. Rice varieties that are resistant to prolonged waterlogging are needed to maintain food security. Given the erratic rainfall patterns caused by climate change, it is crucial to prioritize the development of rice genotypes with strong waterlogging tolerance (around 50 cm of water surface) during the vegetative stage (from the seedling stage to the final tillering stage) and resistance to waterlogging (50-70 cm of water surface) during the reproductive stage (from the fertilization stage to the milk production stage).[27] Short-duration semi-dwarf varieties offer significant potential to increase cropping intensity and optimize input efficiency in flood-prone areas.[28]

b). Resources

One of the obstacles to agricultural governance is human resource capacity. This limitation stems from the lack of knowledge and traditional practices of many farmers. Most farmers in Rembang Regency are elderly. Young people of productive age avoid farming, using it only as a last resort because the income generated from farming is minimal.

Agricultural extension services are rare, resulting in limited farmer knowledge regarding the management of critical land, such as rain-fed rice fields. Effective agricultural extension services, through awareness-raising and capacity-building programs for rural farmers, are needed to increase the adoption of climate-resilient agricultural technologies by their households. The government should focus more on technology adoption to help mitigate the impacts of climate change by increasing resilience to uncertain climate conditions. Local governments can incentivize the adoption of climate-friendly agricultural practices through targeted subsidies and low-interest loans for sustainable agricultural technologies. Mechanisms such as capacity-building programs, community-based resource management, and public-private partnerships can increase technology adoption among farmers.[29]

Farmers in Rembang also face difficulties accessing capital. Banks are hesitant to provide capital to farmers, given the uncertainty of income from their crops. The condition of rain-fed rice fields, which depend on seasonal planting, presents a crucial challenge. Farmers often borrow from itinerant borrowers at high interest rates. This means that agricultural profits are sometimes insufficient to cover their living expenses. Active government support is needed through banks or cooperatives offering low-interest rates to access financing for agricultural land. The reality in Rembang is that agriculture and farming are often considered secondary occupations, with the harvest earmarked for savings.

c). Disposition

The leadership and stakeholders are still based on a rigid and transactional bureaucratic system. This creates the potential for bureaucratic behavior that lacks transparency and accountability. Many agricultural programs in the regions are funded through aspiration funds from the House of Representatives (DPR) and Regional People's Representative Councils (DPRD). These funds are distributed unevenly and are limited. Public awareness of local government programs has not yet reached farmers at the grassroots level. Only a few farmers actively lobby and proactively respond to government programs for farmers in Rembang.

In 2008, Regent Regulation No. 3/2008 was issued, establishing an irrigation commission in Rembang Regency. This commission aims to democratically manage irrigation channels. However, access to irrigation network procurement remains very limited. The irrigation commission has proven ineffective, especially in infrastructure development procurement, which has been unevenly distributed. Implementation of the Regent Regulation, which mandates collaboration between stakeholders in relevant agencies, such as the regional secretariat, the public works department, and the energy and mineral resources department, has not been optimal. In practice, they operate independently within their respective departments. The collaboration expected to improve infrastructure development and management has not been successful.

d). Bureaucratic Structure

Bureaucratic structures remain a major obstacle for farmers in accessing government assistance programs in the agricultural sector. The bureaucracy relies solely on policies from the central and provincial governments and lacks innovation. Villages, as the smallest unit of local government, have yet to optimize their contribution. Village involvement in agricultural management is largely limited to personal coordination, not institutional support. Village

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participation has not been fully utilized as a facilitator between local governments and agricultural agencies and farmers. Farmers are left to their own devices to access local government programs due to limited knowledge and networks. Meanwhile, village funds, a potential budget that could be maximized for food self-sufficiency, are minimally allocated to irrigation and other agricultural infrastructure. Consequently, much agricultural land in Rembang Regency remains neglected due to underutilization as a national food barn.

CONCLUSION AND RECOMMENDATIONS

The productivity challenges of Rembang's rainfed rice fields are not only technical but also heavily influenced by weaknesses in governance, particularly regarding coordination, participation, capacity, and policy. A multi-stakeholder, collaborative governance model with clear structures and mechanisms is needed to integrate technical, institutional, and policy efforts. Implementation of regulations to integrate policies across agencies in Rembang in 2008 was not optimal and requires policy continuity. Government commitment to managing rainfed rice fields is needed at both the district and provincial levels of Central Java.

As the spearhead of village governance, village/sub-district institutions are rarely involved in infrastructure development to optimize food production productivity, particularly rice production in Rembang Regency. Farmers, with limited funds, knowledge, and networks, have limited access to these resources.

Based on this phenomenon, this research recommends:

a) Development of rural-based water infrastructure and community participation (reservoirs and drilled wells), preceded by comprehensive research on water sources.
b) Farmer training in crop diversification (corn, sorghum) and climate change literacy.
c) Integration of cross-sector public policies (agriculture, Public Works and Spatial Planning (PUPR), environment) in water management planning.
d) Support for agricultural funding from state-owned banks, and optimization of contributions from village funds and the Red and White cooperative in agricultural infrastructure development.
e) Strengthening cooperation between the government and the private sector to fund research and innovation.
f) Academic collaboration in seed research and human resource capacity development.

Implementing this strategy is expected to increase food productivity by 25% within five years, while simultaneously strengthening sustainable food security in line with the SDGs

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targets. These findings are relevant not only to Rembang but also to other regions in Indonesia and globally with similar rainfed rice field characteristics.

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