

Strengthening Local Food Security Through Analysis of The Impact of The Pumped Irrigation Program In Lebak Regency

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ABSTRACT

This study aims to evaluate the implementation of the Pumped Irrigation Program in Lebak Regency, Banten, and its impact on food security. The agricultural sector in Lebak faces significant challenges, including suboptimal productivity and a high dependence on rainfed land, which threaten regional food security. This study employs an evaluative qualitative approach using a six-criteria framework from William N. Dunn (effectiveness, efficiency, adequacy, equity, responsiveness, and accuracy) to conduct a comprehensive analysis. Data were collected through in-depth interviews with key stakeholders, participatory observations, and the analysis of program documents and statistical data. The results revealed a significant “implementation deficit,” in which the program's potential was hampered by systemic weaknesses. Although there was local effectiveness in improving crop indices, the overall impact was constrained by operational inefficiencies, inadequate resource allocation, uneven aid distribution, and a lack of responsiveness to local needs. Furthermore, critical socio-technical discrepancies were identified, where the provision of technology was not supported by sufficient human capacity building or institutional support. The study concludes that the program's contribution to food security remains suboptimal due to implementation shortcomings. Policy recommendations focus on strengthening monitoring and evaluation systems, adopting data-based and participatory targeting, integrating technical training with technology distribution, and developing sustainable operational models.

Keywords: Development Administration; Food Security; Lebak Regency; Policy Evaluation; Pump Irrigation.



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INTRODUCTION

The agricultural sector plays a vital role as the foundation of the economy and the front line in realizing national food security in Indonesia (Setiartiti, 2021). Its significant contribution to the gross domestic product and labor absorption confirms its position as a strategic pillar of development (Jaya & Kholilah, 2020). However, the reality on the ground shows that the sector still faces a series of complex structural challenges that significantly hinder productivity growth and

affect farmers' welfare (Losch, 2022).

Among these various obstacles, the issue of sustainable water availability serves as the main limiting factor, with insufficient irrigation infrastructure identified as the root of the problem (Borsato, Rosa, Marinello, Tarolli, & D'Odorico, 2020). This is increasingly critical in rainfed land ecosystems, which are highly vulnerable to fluctuations in water supply. This condition is further exacerbated by intensifying global climate anomalies, such as the El Niño phenomenon that causes prolonged dry seasons (Rifai, Li, & Malhi, 2019). The direct impact of this phenomenon is a drastic decrease in water availability for agriculture, which leads to lower planting frequency (crop index) and a significant contraction in harvest yields (Liliane & Charles, 2020).

In the context of Banten Province, these general problems manifest as significant socio-economic disparities (Amalia & Fitriyanto, 2022). The province, which relies on Lebak and Pandeglang Regencies as major rice production centers, paradoxically displays a persistent rural poverty rate that remains higher than that of urban areas (Connor et al., 2023). This phenomenon indicates a structural issue in which abundant agrarian resources are not directly proportional to the welfare of agricultural actors, a paradox often found in the agricultural production pockets of Indonesia (McCarthy, Nooteboom, & McWilliam, 2023).

One of the key underlying issues is the high dependence on rainfed agricultural systems, which account for around 60% of the total rice fields in Lebak Regency (Al Viandari, Wihardjaka, Pulunggono, & Suwardi, 2022). Such systems inherently possess high production uncertainty and are extremely susceptible to hydrometeorological shocks, thus creating chronic economic vulnerability among farming households (Mavhura, 2019). This systemic vulnerability is reflected in data showing a declining trend in rice production in Banten Province during the 2022–2024 period (Irwandhi et al., 2024), which has direct implications for weakening the pillars of availability and stability within the regional food security framework (Guiné et al., 2021).

As a policy response to these challenges, the government implemented the Pumped Irrigation Program—a technocratic intervention formulated within the framework of national agricultural modernization policies mandated by Law Number 19 of 2013 concerning the Protection and Empowerment of Farmers. Conceptually, this program seeks to address the water deficit on non-technically irrigated land by providing access to alternative water sources (Rosado, Fárez-Román, Müller, Nambi, & Fohrer, 2024). This intervention is expected to markedly increase the cropping index (IP) and land productivity (Jiang et al., 2017).

Nevertheless, the success of such aid-based programs depends not only on their technical design but also on their implementation at the field level (Clements,

2020). Studies on agricultural intervention programs in Indonesia have consistently revealed substantial implementation gaps (Schoneveld et al., 2019). These often manifest as classic issues such as inappropriate aid distribution, weak post-project monitoring and evaluation mechanisms, and low technological sustainability due to inadequate technical support (Akeju et al., 2022). Initial observations at the research site affirm the existence of similar problems, raising critical questions about the Pumped Irrigation Program's effectiveness and real impact on food security among farmers (Senbeta, 2023).

The concept of the implementation deficit provides a crucial analytical framework in public policy scholarship, referring to the systematic gap between policy intentions formulated at the planning stage and the actual outcomes achieved during execution (Hudson, Hunter, & Peckham, 2019). This phenomenon occurs when well-designed policies fail to yield intended results due to operational-level weaknesses within governance systems (Keong & Islam, 2020). According to Van Meter and Van Horn (1975), implementation deficit arises from six key dimensions: clarity of policy standards and objectives, resource availability, quality of inter-organizational communication, characteristics of implementing agencies, economic and political contexts, and implementers' dispositions.

In the specific context of agricultural technology transfer, implementation deficit typically manifests through: (1) technological distribution without adequate capacity building; (2) inadequate post-distribution technical support and maintenance; (3) misalignment between technology specifications and local agro-ecological conditions; (4) weak monitoring mechanisms that fail to capture operational constraints; (5) limited stakeholder participation in program design and execution; and (6) the absence of sustainable operational models ensuring long-term functionality. This conceptual framework is particularly relevant to the evaluation of technology-based agricultural interventions, where success depends not merely on hardware provision but also on the integration of comprehensive socio-technical systems encompassing human resources, institutional coordination, maintenance infrastructure, and community engagement mechanisms.

These issues collectively signify the existence of an implementation deficit—a condition in which a conceptually sound policy framework fails to achieve its intended results due to weaknesses at the operational level. This failure is not purely technical but rooted in governance deficiencies related to the distribution and utilization of technology, where aspects such as participation, accountability, and sustainability are often overlooked (Kandachar & Halme, 2017).

Therefore, this study aims to conduct a systematic and comprehensive

policy evaluation of the Pumped Irrigation Program in Lebak Regency, utilizing William N. Dunn's six-criteria evaluation framework—effectiveness, efficiency, adequacy, equity, responsiveness, and appropriateness—to deeply analyze the nature and manifestations of the implementation deficit. This evaluative framework was purposefully chosen for its proven capacity to facilitate multidimensional analyses that move beyond mere output measurements, allowing for a holistic examination of both technical performance and socio-institutional dimensions of policy implementation (Dawodu, Cheshmehzangi, & Sharifi, 2021).

The specific objectives of this research are fourfold. First, to assess the effectiveness of the Pumped Irrigation Program in achieving its stated goals of increasing the cropping index and agricultural productivity among beneficiary farmers. Second, to evaluate the efficiency of resource allocation and operational sustainability mechanisms embedded in the program's design and implementation. Third, to analyze the equity dimensions of program distribution, determining whether assistance reaches the most vulnerable and drought-affected farming communities. Fourth, to examine the responsiveness and appropriateness of the program with respect to local agro-ecological conditions, farmers' needs, and prevailing agricultural practices.

This research makes important contributions to both academic scholarship and policy development. Academically, it advances the theoretical understanding of implementation deficit in agricultural technology transfer programs, particularly within decentralized governance contexts typical of contemporary Indonesia. It enriches policy evaluation literature by demonstrating the application of Dunn's comprehensive framework to irrigation infrastructure interventions—an approach still underutilized in Indonesian agricultural policy research. Methodologically, the integration of qualitative data collection techniques with systematic evaluative criteria provides a replicable model for assessing similar agricultural support programs across diverse regional settings.

From a practical perspective, this research produces evidence-based policy recommendations essential for optimizing the Pumped Irrigation Program's role in strengthening farmers' food security and enhancing program sustainability. The findings directly support policy refinement within the Lebak Regency Agriculture Office and offer actionable insights for the Ministry of Agriculture in scaling up agricultural technology interventions nationally. For development practitioners, the study identifies key success factors and common pitfalls in irrigation technology distribution, providing practical guidance for program design, stakeholder engagement, and operational management. Ultimately, by diagnosing the socio-technical mismatches and governance weaknesses undermining program effectiveness, this research contributes to building more resilient and

equitable food security systems in vulnerable agricultural regions.

RESEARCH METHOD

This study employed a qualitative approach with an evaluative research design to gain an in-depth and contextual understanding of the implementation and impact of the *Pumped Irrigation Program*. The qualitative approach was chosen to uncover the complexity of social interactions and institutional dynamics underlying policy implementation (Sujarweni, 2022). The evaluative study design allowed the researcher to assess the program's outcomes while analyzing the processes, challenges, and dynamics that occurred during its implementation (Adhayanto et al., 2021).

The research was conducted in Lebak Regency, Banten Province. The location was selected purposively based on the consideration that Lebak Regency was one of the primary recipients of the *Pumped Irrigation Program* assistance in 2024. This made it a critical case for evaluating program performance and impact in the field (Distan, 2024).

Research informants were identified using a combination of purposive and snowball sampling techniques. Purposive sampling was applied to select individuals with relevant knowledge, experience, and strategic roles in the program (Palinkas et al., 2015). Key informants included policy-level officials such as the Head of the Agriculture Office and activity coordinators (PPK). The snowball sampling technique was then used to reach additional participants through recommendations from previous informants, particularly technical implementers and beneficiaries such as Agricultural Extension Officers, Farmer Group Chairs, pump operators, and individual farmers (Naderifar et al., 2017).

To enhance data validity and reliability, this study applied a method triangulation strategy (Flick, 2018). Triangulation was conducted through three main techniques. First, participatory observation was used by directly engaging in activities at the research sites to understand pump infrastructure conditions, water management practices, and farmer group interactions (Rahardjo, 2017). Second, in-depth interviews were conducted with selected informants to explore their perceptions and evaluations of the program based on Dunn's six evaluation criteria (Brinkmann & Kvale, 2015). Third, a documentation study was performed on official documents, including program guidelines, implementation reports, and agricultural statistical data from BPS and the Agriculture Office, which served as secondary sources to validate and complement field data (Bowen, 2009).

All collected data were analyzed using an interactive model of qualitative data analysis, encompassing four interrelated stages: data collection, reduction, presentation, and conclusion drawing or verification (Miles et al., 2014). The coding and categorization processes were guided by Dunn's six-criteria evaluation

framework, enabling the development of structured conclusions that directly addressed the research objectives.

RESULTS AND DISCUSSION

An in-depth analysis of field data structured based on Dunn's six evaluation criteria reveals a complex and multifaceted picture of the performance of the Pumped Irrigation Program. The findings show that this program has significant potential to increase agricultural productivity, but its potential is hampered by various systemic and structural implementation weaknesses.

From an effectiveness perspective, the Pumped Irrigation Program is theoretically able to be an instrument to increase land productivity. In several study locations, the implementation of this program has been proven to be successful in increasing the Crop Index (IP) from one planting to two to three plantings per year. Increasing planting intensity is one of the main pillars in agricultural intensification strategies to strengthen food security (Simatupang et al., 2021). This sporadic success shows that technically, pumping technology is indeed able to answer water needs in rainfed land and has the potential to strengthen food security at the local level (Distan, 2024).

However, this effectiveness is partial and has not been able to provide a significant aggregate impact. Success at the micro level (beneficiary farmers) is not converted into success at the macro level (district). This is reflected in the downward trend in total rice production in Lebak Regency from 430,413 tons (2022) to 357. (BPS, 2024)). This phenomenon can be explained by the coverage gap, where program interventions are still very limited and have not been able to reach the majority of farmers in need. With around 60% of rice fields in Lebak still in the status of rain catchment (Lebak Regency Agriculture Office, 2023), the positive impact of the program seems to be drowned out by a much larger scale of problems. Thus, this program is effective for a handful of recipients, but it is not yet effective as a district food security policy.

In terms of efficiency, the program shows glaring structural weaknesses. The monitoring and evaluation system that runs tends to be stuck in the output orientation, which is to measure success based on the number of pump units that have been distributed, rather than on the outcome orientation or the real impact on increasing production and farmers' welfare. This kind of evaluation practice, as criticized in the public administration literature, often ignores the sustainability and long-term effectiveness aspects of an intervention (Mustopadidjaja, 2003). A statement by a Field Extension Officer confirming that "evaluations often focus

only on the amount of aid delivered, not on the impact," is empirical evidence of this systemic weakness.

This condition gives birth to a social incompatibility. This program is treated as a simple technical intervention of the distribution of "hardware" (pumps) without considering the social, institutional, and economic ecosystems that become "software" to sustain its functionality (Kusnadi, 2019). Field observations confirmed this failure: many pump units were in a damaged or unused condition. The root of the problem is the lack of technical training, the absence of a spare parts supply scheme, and high operational costs which are disincentives for farmers (Hasan, 2005). As a result, significant public investment becomes inefficient because distributed assets fail to transform into productive capital.

The adequacy criterion measures whether a policy intervention is able to adequately address the problem. In this case, the Pumped Irrigation Program is considered insufficient (inadequate). The capacity of the program, both in terms of the number of units and the reach, was found to be disproportionate to the scale of the drought problem faced by farmers in Lebak Regency. This phenomenon underscores the importance of policy design that is not only on target but also has a relevant scale to create significant impact (Handayani & Nurrahmat, 2020).

This inadequacy manifests on two levels. First, technical incompatibilities, where the capacity of the pump often does not match the area of land to be irrigated. Second, the absence of program integration with a broader water resource management strategy. The program runs partially without taking into account fluctuations in the availability of water at the pumping source (rivers or wells), whose discharge decreases drastically during the peak of the dry season. This shows that the program has not been comprehensively designed to address the challenge of water scarcity in a sustainable manner.

One of the most critical findings in this study is the issue of equity. The distribution of aid is indicated to be unfair and uneven, reflecting the phenomenon of elite capture, where program benefits tend to accumulate in groups with stronger political or social access (Hadiz, 2010). Although the allocation data shows the concentration of aid in priority districts such as Lebak and Pandeglang, the distribution at the internal district level is uneven.

Interviews revealed that farmer groups in highland areas that are more drought-prone have difficulty accessing aid, while groups in locations that are easier to reach or have better connections are more likely to receive. This phenomenon reflects an implementation paradox: planning at the central level appears rational and based on aggregate data, but execution at the micro level is political and evidence-poor. There is a disconnect between planning and

execution which ultimately creates inequity in access and reduces the effectiveness of the program as a whole (Rahardjo, 2017).

The program is implemented with a rigid top-down approach and shows a low level of responsiveness. In this model, farmers are positioned as passive objects of aid recipients, rather than as active subjects participating in the planning and management processes. In fact, stakeholder participation is the key to the success and sustainability of rural development programs (Chambers, 1994).

The absence of a meaningful consultation mechanism in determining locations, pump specifications, or distribution schedules results in aid often not being in line with the real needs of farmers. Furthermore, the absence of a functional feedback or complaint channel causes operational problems in the field to remain unresolved. This low level of responsiveness, exacerbated by the lack of socialization, creates a gap between the program and its beneficiaries.

Finally, from the appropriateness criterion, this program shows weaknesses because it applies a "one-size-fits-all" approach. The type of pump and installation scheme tend to be standardized without considering the diversity of agro-ecological conditions, topography, and availability of water sources in Lebak Regency. This generalist approach often fails because it ignores the unique local context, a crucial factor that determines the success or failure of an agricultural technology intervention (Nugraha & Hidayat, 2021). The right program should be able to adapt to specific conditions in the field, not impose a uniform technical solution.

Field observations found cases where pumps were installed in locations far from reliable water sources or in areas with soil contours that make it difficult to distribute water. This indicates a lack of adequate land and water suitability analysis before the installation stage, a critical prerequisite in the implementation of irrigation technology (Prastowo E. & Las, 2015). Furthermore, this program is often not in line with the planting patterns and local wisdom of farmers. This neglect of local knowledge systems causes the technologies introduced to fail to integrate effectively into existing agricultural practices and risk disrupting the balance of established agro-ecosystems (Adnan et al., 2018). The following table summarizes the results of the overall evaluation, as follows: established agro-

ecosystems (Adnan et al., 2018). The following table summarizes the results of the overall evaluation,

Table 1. Pump Irrigation Evaluation Results

Criteria	Evaluation Results	Information
Effectiveness	Increasing IP in Lebak Regency	Increasing IP and rice production in Lebak Regency
Efficiency	Operating costs are high and many tools are not maintained.	Observation in the field many pumps were broken in the field.
Adequacy	The capacity of the program is not proportional to the area of rainfed land and water needs during peak drought.	Fluctuations in water sources are not anticipated.
Equitable	Aid is concentrated in areas that are easily accessible but in farmer groups in remote areas are neglected.	Uneven aid allocation data
Responsiveness	There is no effective feedback mechanism.	Lack of socialization and involvement in planning.
Accuracy	The placement of the pumps is not based on adequate technical surveys and local agro-ecological conditions.	Incompatibility with local planting patterns.

Source: data Processed by Researchers, 2025

Although the overall evaluation points to various systemic implementation weaknesses, the findings that this program. The success of the program in increasing the Crop Index (IP) in several specific farmer groups, in the midst of failures on a broader scale, can be interpreted through the concept of pocket effectiveness. This theory explains how certain units or programs within a larger bureaucracy or policy system can achieve high performance and deliver positive results, even if the institutional environment is generally weak or unsupportive (Roll, 2014).

In the context of this study, farmer groups that have successfully utilized irrigation pumps to be able to increase their IP to three times a year can be seen as pockets of effectiveness. This partial success is most likely due not only to technical interventions, but to a combination of microfactors unique to the site. These factors can include strong farmer group leadership, high social capital among members, intensive support from proactive field agricultural extension workers, and the suitability of local agro-ecological conditions with the

technology provided (Leonard, 2008). Thus, this local success is not a testament to the effectiveness of the program as a whole, but rather a manifestation of how positive local agencies and conditions can create superior performance on a limited scale, despite the weaknesses of policy design at the macro level.

CONCLUSION

The evaluation of the Pumped Irrigation Program in Lebak Regency revealed a systemic implementation deficit that undermined its contribution to local food security. The shortcomings stemmed not from conceptual design but from weak execution characterized by socio-technical gaps, where technology distribution was not matched with adequate capacity building or institutional support. The program's reliance on aggregate, data-driven macro planning disconnected from field-level realities led to inefficiencies, inequitable resource allocation, and poor responsiveness to local needs, causing it to fall short of key evaluation criteria such as efficiency, equity, and accuracy. Future research should focus on developing integrated socio-technical implementation models that combine infrastructure provision with participatory planning, data-driven local adaptation, and continuous capacity strengthening to enhance program sustainability and impact.

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