



# **An Overview of Infrastructure, Corporate Involvement, Financing, and Conservation in the National Strategic Food Estate Project in Siria-Ria Village, Pollung District, Indonesia**

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## **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## **ABSTRACT**

This study investigates the role of infrastructure, corporate involvement, financing, and conservation in the success of the National Strategic Food Estate Project in Siria-Ria Village, Indonesia. Using data from 50 respondents (out of a total of 93 eligible participants), Structural Equation Modeling

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(SEM) and Partial Least Squares (PLS) methods were applied to evaluate the project's performance. The findings reveal that infrastructure (path coefficient = 0.369,  $p < 0.01$ ) and financing (path coefficient = 0.437,  $p < 0.001$ ) have significant positive effects on the project's success. Corporate involvement (path coefficient = 0.258,  $p = 0.054$ ) shows a positive but marginal effect, while conservation (path coefficient = 0.110,  $p = 0.326$ ) demonstrates no significant short-term impact. The study underscores the importance of improving infrastructure, financing schemes, and corporate partnerships to ensure project success. Acronyms RPJMN (National Medium-Term Development Plan) and PSN (National Strategic Project) are critical in understanding the context of Indonesia's food security agenda.

*Keywords: Food estate; infrastructure; corporate involvement; financing; conservation; food security.*

## 1. INTRODUCTION

The National Strategic Food Estate Project is a key initiative being expanded nationwide, aiming to address food security challenges through targeted policies and strategic implementation. Established in Siria-Ria Village since 2020, the project seeks to mitigate imbalances in food supply, threats of food crises, and limited production land (FAO, 2020). These challenges are exacerbated by global disruptions, such as those witnessed during the COVID-19 pandemic, which highlighted vulnerabilities in food supply chains, impacting price stability and access. In response, the Central Government developed the Food Estate as a national priority outlined in the 2019–2024 RPJMN (National Medium-Term Development Plan), targeting stable national food security.

The success of this project requires an integrated approach that accounts for infrastructure, corporate involvement, financing, and conservation—factors recognized as critical determinants for long-term sustainability. Insights from related studies underscore the importance of addressing infrastructure and institutional challenges. For instance, infrastructure development and farmer institutions have been shown to significantly enhance coffee farmers' income in Pematang Sidamanik District, highlighting the transformative potential of targeted investments in agricultural practices and governance frameworks (Tiorma et al., 2024). Similarly, sustainable food systems in Medan City emphasize the role of efficient distribution networks and local production in promoting food security and aligning with the Sustainable Development Goals (Muliadi et al., 2024). These examples demonstrate the need for robust infrastructure and institutional frameworks to bolster food production and distribution.

Moreover, sustainable land management practices are essential to mitigate socio-

economic disruptions caused by land-use changes. Housing development growth in Asahan Regency, while beneficial in certain aspects, has raised concerns about the socio-economic consequences of converting agricultural land to non-agricultural use. These challenges underline the need for balanced land-use planning to ensure sustainable development and regional growth (Eko Suharizki et al., 2024).

The integration of corporate involvement and financing further supports strategic national projects like the Food Estate. Studies in other regions highlight the importance of collaborative approaches among stakeholders. For example, the BRS program in Subulussalam City demonstrates how effective communication and stakeholder coordination can overcome resource limitations and improve target accuracy (Masrizal et al., 2024). Furthermore, financing mechanisms play a vital role in addressing both short-term project needs and long-term sustainability. In Bireuen Regency, optimizing social and educational spending has significantly improved human development indices, underscoring the potential of well-planned financial strategies (Rizki et al., 2024).

Finally, conservation remains a vital yet often overlooked component of sustainable development projects. The case of Sei Nagalawan Village shows how community empowerment and ecotourism initiatives can promote economic welfare, provided they are supported by adequate technological and governmental resources (Anisah, 2024). Similarly, sustainable oil palm cultivation demonstrates the necessity of aligning technical and institutional improvements with legal frameworks to address environmental and labor challenges (Arga et al., 2024). These findings suggest that conservation efforts, while not always immediately impactful, are indispensable for ensuring the long-term viability of strategic projects like the Food Estate.

This study provides a crucial contribution to the scientific community by addressing one of the most enduring global challenges—food security. By focusing on a localized setting, this research highlights grassroots-level conditions and their effects on national food production. The analysis offers data-driven insights that policymakers and practitioners can use to design more effective and inclusive food security initiatives. Additionally, the emphasis on infrastructure, financing, and corporate involvement provides a model for other countries to enhance the efficiency and sustainability of their agricultural strategies.

## 2. RESEARCH METHODS

### 2.1 Research Duration and Location

This study was conducted in the food estate area located in Siria-Ria Village, Pollung District, Humbang Hasundutan Regency. The research spanned from March 2023 to June 2024. Pollung District is geographically situated between 98°12'06" - 98°41'40" E and 3°03'25" - 3°18'22" N. Siria-Ria Village consists of eight hamlets: Aek Pollung, Buhit, Lumban Nauli, Naga Raja, Ria-Ria, Rumaganjang, Sampetua, and Silali.

### 2.2 Research Type, Object, Subject, and Approach

This study employed a quantitative research design utilizing both primary and secondary data. Primary data were gathered directly from respondents through questionnaires, focusing on infrastructure, financing, corporate involvement, and conservation as the main indicators. These indicators encompassed geospatial, on-farm, and off-farm aspects of the project implementation. Secondary data were obtained from related agencies, including field coordinators, operational teams, the Siria-Ria Village Government, the Agricultural Service Office, the Public Works and Spatial Planning Service Office, and the Regional Development Planning Agency (Bapelitbangda). These data offered a comprehensive overview of the project's success in terms of its key variables.

The research object was the implementation of the National Strategic Food Estate Project, particularly its achievement across geospatial, on-farm, and off-farm domains. Respondents were selected through purposive sampling, ensuring relevance to the research objectives. Participants included farmers managing land

within the food estate area and other stakeholders, such as government officials, operational teams, and private sector representatives. Selection was based on their roles and involvement in the program, ensuring access to essential primary data.

### 2.3 Data Collection Techniques

Data collection was carried out using questionnaires distributed to respondents. This method involved presenting a series of written questions or statements for participants to answer. Qualitative responses (perceptions) were transformed into quantitative data using a Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

### 2.4 Data Analysis Techniques

- **Descriptive Analysis:** Descriptive analysis was employed to describe the data obtained from the questionnaires. This analysis outlined respondent characteristics and their tendencies regarding the research variables: infrastructure, corporate involvement, financing, conservation, and the success of the food estate project.
- **Structural Equation Modeling (SEM):** The Structural Equation Modeling (SEM) method, based on Partial Least Squares (PLS), was utilized to model the success of the food estate project. This component-based method is suitable for data with weak normality assumptions or small sample sizes. SEM consists of two primary components: the structural model, which represents relationships among latent constructs, and the measurement model, which links latent constructs to observable indicators.

The SEM-PLS process included designing the structural model (inner model) to establish relationships among latent variables, based on theoretical and conceptual frameworks involving infrastructure, corporate involvement, financing, and conservation. The measurement model (outer model) was designed to link latent variables to their indicators. A path diagram was constructed to visually represent the relationships among latent variables.

Parameter estimation focused on path coefficients among latent variables, latent

variable weights for scoring, and means for latent variables and their indicators. Model evaluation followed a two-stage process:

- **Outer Model Evaluation:** Convergent validity was assessed through loading factors, requiring values above 0.7. Discriminant validity was examined using cross-loading factors. Composite reliability, average variance extracted (AVE), and Cronbach's Alpha were analyzed to ensure reliability and validity thresholds were met.

### 2.5 Inner Model Evaluation

The structural model was evaluated using R-Square values to determine the explanatory power of the model, categorized as substantial, moderate, or weak. Effect size (F-Square) and prediction relevance (Q-Square) were calculated to assess the model's overall strength. Hypotheses were tested through t-statistics using bootstrapping, with a t-statistic greater than 1.96 at a 5% significance level considered significant.

This methodological approach ensures rigorous evaluation of the variables influencing the success of the National Strategic Food Estate Project, providing actionable insights for stakeholders.

## 3. RESULTS AND DISCUSSION

### 3.1 Results

**Overview of the Research Location:** The study was conducted in Siria-Ria Village, Pollung District, Humbang Hasundutan Regency. This area is part of the National Strategic Food Estate Project, aimed at enhancing food security through land utilization for potato, shallot, and garlic cultivation. With its highland geography, the village holds significant potential for horticultural agriculture to support both local and national food security initiatives.

**Respondent Characteristics:** Respondents, selected through purposive sampling, were landowners participating in the food estate project. The study involved 50 respondents out of 93 eligible farmers, with demographic characteristics identified as follows:

- **Gender:** 80% male and 20% female.
- **Age:** 70% were over 40 years old, 26% aged 31-40, and 4% aged 21-30.
- **Education Level:** 70% completed high school or equivalent, 20% had a diploma, and 10% held a bachelor's degree.
- **Farming Experience:** 36% had over 15 years of experience, 30% between 11-15 years, 24% between 6-10 years, and 10% between 1-5 years.
- **Primary Livelihoods:** 70% were engaged in agriculture, forestry, and animal husbandry, 20% in services, and 10% in government administration.

**Data Analysis Results:** Using Smart PLS, the analysis explored the impact of infrastructure, corporate involvement, financing, and conservation on the project's success. The findings for each variable are summarized below:

**Impact of Infrastructure:** Infrastructure demonstrated a significant effect on the success of the project, with a path coefficient of 0.369 and a P-value of 0.006. Adequate infrastructure, including roads, irrigation systems, and storage facilities, played a vital role in streamlining production and distribution processes. These facilities enabled farmers to manage their land effectively and transport their harvest to distribution centers more efficiently, boosting productivity and local economic stability. Additionally, well-established infrastructure facilitated the adoption of modern agricultural technologies, further improving crop yields and labor efficiency.

**Table 1. Path Coefficients Antar Variabel**

|                       | Original sample (O) | Sample mean (M) | Standard deviation (STDEV) | T statistics ( O/STDEV ) | P values | Conclusion      |
|-----------------------|---------------------|-----------------|----------------------------|--------------------------|----------|-----------------|
| Infrastructure        | 0.369               | 0.367           | 0.136                      | 2.723                    | 0.006    | Significant     |
| Conservation          | 0.110               | 0.107           | 0.112                      | 0.982                    | 0.326    | Not Significant |
| Corporate Involvement | 0.258               | 0.257           | 0.134                      | 1.929                    | 0.054    | Significant     |
| Financing             | 0.437               | 0.430           | 0.133                      | 3.294                    | 0.001    | Significant     |

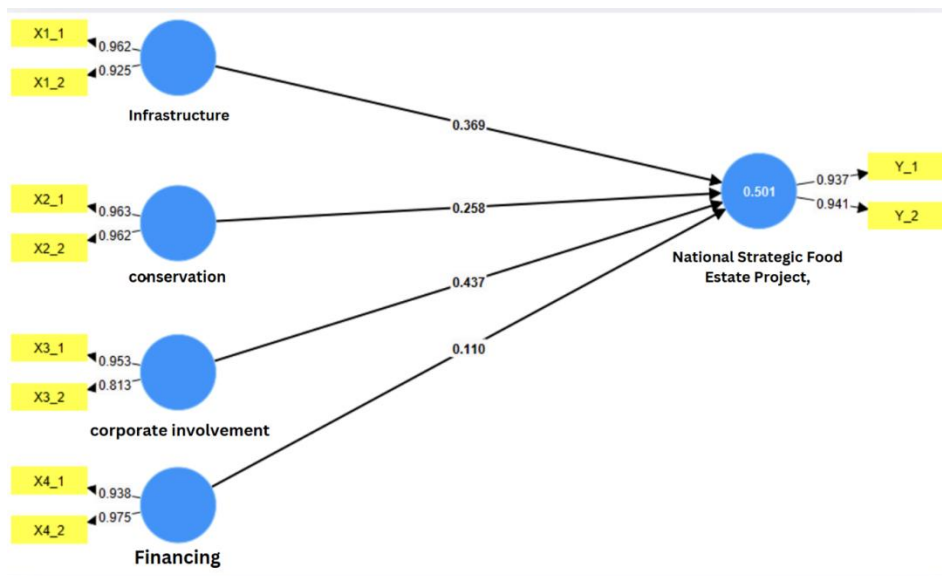


Fig. 1. Outer loading smart PLS

**Impact of Corporate Involvement:** Corporate involvement showed a positive influence on project success, with a path coefficient of 0.258 and a P-value of 0.054, approaching significance. Corporate contributions were instrumental in providing agricultural inputs, such as seeds and fertilizers, which were highly beneficial for local farmers participating in the food estate program. Moreover, corporations helped smallholder farmers connect with broader markets, both domestic and international, thereby increasing their income.

**Impact of Financing:** Financing had the most significant positive impact on project success, with a path coefficient of 0.437 and a P-value of 0.001. Adequate financial support was critical during the initial stages of the project, enabling activities such as land clearing, seed procurement, and the establishment of basic infrastructure. Sufficient capital empowered smallholder farmers to compete more effectively and actively participate in the food estate program. Accessible financing schemes offered by the government played a crucial role in ensuring inclusivity.

**Impact of Conservation:** Conservation exhibited a minimal and non-significant influence on project success, with a path coefficient of 0.110 and a P-value of 0.326. While the immediate impact of conservation efforts was negligible, their importance for long-term sustainability cannot be understated. Practices such as agroforestry and crop rotation remain

underutilized within the project. Over time, these practices can support soil and water sustainability, ensuring the ecological longevity of the food estate initiative.

Before the intervention, the average harvest volume for potatoes was 5 tons per hectare, but after implementing the Food Estate Project, this figure rose to 8.5 tons per hectare, representing a 70% increase. The introduction of irrigation infrastructure played a pivotal role in this improvement. Similarly, farmer incomes increased by 40% due to enhanced access to broader market channels facilitated by corporate partnerships.

### 3.2 Discussion

**Significance of Infrastructure:** Infrastructure emerged as a foundational element in the success of the National Strategic Food Estate Project. Roads facilitated efficient logistics, reducing transportation costs and enabling farmers to access markets. Irrigation systems optimized water usage, crucial for areas with limited water resources. Moreover, infrastructure investments encouraged the adoption of advanced agricultural tools, enhancing productivity and reducing labor inefficiencies. Previous studies, such as Wahyudi et al. (2020), corroborate these findings by emphasizing the transformative role of infrastructure in rural agricultural development. Continued and sustained investment in infrastructure is necessary to overcome logistical challenges and

ensure the long-term success of food estate initiatives.

**Role of Corporate Involvement:** Although marginally significant, corporate involvement positively influenced project outcomes by bridging gaps in resource provision, management expertise, and market access. Corporations provided essential inputs and technologies, alleviating financial and logistical burdens for farmers. Tangkudung (2020) highlighted the potential of public-private partnerships to enhance agricultural productivity and access to larger markets. However, balancing corporate benefits with farmer welfare requires robust regulatory measures to prevent inequitable profit distribution and ensure the program's inclusivity and fairness.

**Importance of Financing:** Financing was identified as a key driver of success in the food estate project. Capital support facilitated the establishment of foundational infrastructure and operational stability in the project's early stages. Azhar and Syahputra (2022) also emphasize the necessity of substantial initial funding for large-scale agricultural projects. Beyond the initial phase, long-term success depends on effective management and technological integration. Inclusive financial frameworks are essential to empower smallholder farmers and enable widespread participation in the program.

**Conservation and Long-Term Sustainability:** While conservation did not exhibit a significant immediate impact, its long-term importance for sustainability is undeniable. Practices like agroforestry and crop rotation are vital for maintaining soil and water quality, but their implementation remains limited. Wahyudi et al. (2020) similarly noted the underemphasis on environmental sustainability in large-scale agricultural projects. Policy interventions promoting sustainable practices and providing incentives for eco-friendly farming techniques can bridge this gap, ensuring the environmental resilience of food estate initiatives (Lubis et al., 2024).

#### 4. CONCLUSIONS AND RECOMMENDATIONS

The study concluded that infrastructure and financing are the most critical factors in the success of the National Strategic Food Estate Project in Siria-Ria Village. Infrastructure facilitates efficient production and distribution,

while financing supports foundational activities and empowers farmer participation. Corporate involvement also positively impacts project outcomes, though its potential requires stronger regulatory frameworks. Conservation, while not significant in the short term, remains essential for ensuring long-term sustainability.

To enhance the success and sustainability of food estate projects, the following recommendations are proposed:

- **Infrastructure Development:** Continued investment in transportation, irrigation, and storage facilities to overcome logistical barriers and support technological advancements.
- **Inclusive Financing Schemes:** Financial models accessible to smallholder farmers to encourage active participation and improve competitiveness.
- **Strengthened Corporate Partnerships:** Equitably regulated corporate involvement to ensure a balance of benefits among all stakeholders.
- **Promotion of Conservation Practices:** Policies incentivizing sustainable agricultural techniques to safeguard environmental resources and ensure long-term project viability.

These strategies will contribute to achieving sustainable food security and promoting equitable economic development in the food estate regions.

#### DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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