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ARTICLE

Pesantren-Based Food Estate: Integrating Agrarian Reform, Islamic Principles, and Food Security in Indonesia

Ujang Maman [1] ***, Achmad Tjachja Nugraha*** [1*] ***, Zulmaneri Manir*** [1] ***, Iwan Aminuddin*** [1]***, Lilis Imamah Icdayati*** [1]***, Holil Nawawi*** [2]***, Gunawan Prayitno*** [3]

[1] *Faculty of Science and Technology, Universitas Islam Negeri Syarif Hidayatullah Jakarta, Kota Tangerang Selatan 15412, Indonesia*

[2] *Faculty of Islamic Religion, Ibnu Khaldun University, Bogor 16162, Indonesia*

[3] *Regional and Urban Planning Department, Brawijaya University, Malang 65145, Indonesia*

ABSTRACT

Indonesia's food estate policy was launched to mitigate the decline of agricultural land, address population growth, and enhance food self-sufficiency amid limited farmland capacity. However, the conventional model—dominated by corporate control—has often marginalized smallholders and reduced rural employment opportunities. This study proposes an alternative food estate model that broadens farmers' access to land and promotes inclusive rural development through the involvement of *pesantren* (Islamic boarding schools) as institutional managers. Employing a mixed-methods approach that integrates literature review, in-depth interviews, and farmer surveys, the research investigates the feasibility of *pesantren*-based governance on redistributed state land. The model envisions state land allocation to *pesantren*, which then implement *al-musaqoh* (yield-sharing) partnerships with local farmers. Farmer perceptions were assessed using a Likert scale and analyzed through Importance–Performance Analysis (IPA). The findings reveal that *pesantren* possess strong potential to act as mediating institutions that combine moral legitimacy, social capital, and managerial capacity in food estate governance. Nonetheless, improvements remain necessary in pre-cultivation, cultivation, and support systems to ensure operational efficiency. By

*CORRESPONDING AUTHOR:
Achmad Tjachja Nugraha, Faculty of Science and Technology, Universitas Islam Negeri Syarif Hidayatullah Jakarta, Kota Tangerang Selatan 15412, Indonesia; Email: achmadtj.uinjkt@gmail.com or achmad.tjachja@uinjkt.ac.id

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embedding Islamic principles of justice, cooperation, and stewardship within agrarian reform, this model bridges state agricultural policy with community-based religious institutions. The study contributes to the discourse on sustainable food governance by offering a faith-based institutional innovation that harmonizes productivity, equity, and cultural legitimacy.

Keywords: Food Estate; Food Security; *Pesantren*; Agrarian Reform; Islamic Economics; Sustainable Rural Development

1. Introduction

The continuous decline of agricultural land in Indonesia represents a structural challenge with profound implications for the sustainability of national food systems and rural livelihoods. Over the last four decades, this trend has become increasingly alarming, signalling systemic weaknesses in land governance and agrarian institutions. According to successive Agricultural Censuses, the area of paddy fields declined from 16.7 million hectares in 1983 to only 8.7 million hectares in 2013 [1], showing an accelerating pace of land conversion. The most recent estimate by the Ministry of Land Affairs (2021) reported only 7.46 million hectares remaining, confirming that Indonesia is losing its agricultural base faster than it can regenerate it.

Beyond the numerical decline, this trend reflects deeper institutional fragility in agrarian governance and fragmented ownership structures. The long-standing theoretical debate between collective and private land management provides an important conceptual lens for understanding these problems. On one side, proponents of collective action such as Ostrom [2], Meinzen-Dick and Di Gregorio [3], and Agrawal [4] emphasize that shared ownership can foster cooperation, reduce transaction costs, and strengthen social equity, particularly in rural contexts with strong local institutions. Conversely, critical perspectives by Deininger and Feder [5], Bardhan and Dayton-Johnson [6], and Platteau [7] warn that collective systems may suffer from coordination failures, elite capture, and weak enforcement, especially when institutional norms are fragmented. These theoretical debates offer an important lens to reinterpret Indonesia's persistent land conversion problem-not only as a spatial or demographic trend but as a manifestation of weak collective governance capacity.

As of 2023, preliminary estimates indicate that the national paddy field area has remained below 7.5 million hectares [8], reinforcing concerns about long-term food self-sufficiency. The decline of paddy fields in Indonesia can also be observed at the micro level within local contexts, particularly in regions close to the capital city, Jakarta. Bogor Regency, one of Jakarta's suburban areas, illustrates this trend clearly. In 2015, Bogor's paddy fields covered 40,912 hectares; however, by 2019, the area had contracted to 36,355 hectares [9]. A similar phenomenon has occurred in Bekasi, which has long served as one of the primary rice-producing centers in West Java. Data from BPS Kabupaten Bekasi [10] indicate that the area of technically irrigated paddy fields was at least 45,825 hectares in 2014. When combined with non-technical irrigation systems, the total paddy land in Bekasi reached 51,961 hectares. Unfortunately, more recent figures from the National Land Agency of Bekasi Regency and the local agricultural services reported that by 2024, the area of wet paddy land had declined to merely 35,244 hectares. If this technically irrigated land is combined with dryland areas designated for horticultural crops and plantations, the figure amounts to only 57 hectares [11].

In peri-urban regions such as Bogor [9] and Bekasi [10], land conversion is driven by rapid urbanization, infrastructure expansion, and industrial growth, leaving little protection for agricultural zones. This phenomenon underscores how food security risks extend beyond rural boundaries into metropolitan regions. However, such trends are not confined to peri-urban areas. They also extend to inland regions farther from Jakarta. Research by Kusdiane et al., in Cimanuk Subdistrict, Pandeglang Regency, Banten Province, confirmed that paddy field conversion has also occurred routinely in more remote locations [12]. Based on in-depth inter-

views with 21 informants, the study found that over the decade preceding the research, approximately 10 hectares of land were converted each year, primarily due to population growth and the corresponding need for housing and settlement infrastructure. Alarmingly, this conversion occurred on productive land, resulting in a shortage of agricultural reserves and exacerbating concerns about long-term food security.

The reduction in rice fields is particularly troubling because it coincides with rapid population growth. According to the 2010 Population Census, Indonesia's population reached 238,518.8 million people [13]. BPS also projected that the population would increase to 255,461.7 million in 2015 and 271,066.4 million in 2020. Further projections estimated continued growth to 284,829.0 million in 2025, 296,405.1 million in 2030, and 305,652.4 million in 2035. Based on demographic indicators such as life expectancy, mortality, and fertility rates, BAPPENAS, BPS, and UNFPA [14] provided similar estimates, predicting 284,829 million people by 2025 and 305,652.4 million by 2035. These projections proved highly accurate. BPS reported that the population recorded during the 2020 Census was 270.20 million, only one million fewer than the earlier estimate for that year [15]. Such demographic dynamics highlight the growing pressure on limited agricultural resources.

The simultaneous processes of land degradation and population expansion have critically weakened Indonesia's agricultural carrying capacity, undermining both food security and rural welfare. The Economist issued warnings about Indonesia's potential vulnerability to food supply crises [16, 17]. In its global ranking based on the indicator of agricultural land availability relative to population growth, Indonesia was placed 109th in 2017 and dropped further to 111th in 2018 out of 113 countries. This categorization underscores Indonesia's inability to preserve sufficient land for agricultural development, especially for food production, placing it even below several African countries in terms of resilience against land conversion.

These findings align with academic studies on the carrying capacity of agricultural land. Mubarokah et al. conducted research in the Cibaliung River Basin, which spans 15 subdistricts in the regions of Lebak and Pandeglang, Banten Province [18]. Their study categorized agricultural land carrying capacity into three types. First, high capacity, where regions can achieve food self-sufficiency while also providing a decent standard of living for residents. Second, optimal capacity, where regions can meet food self-sufficiency but not yet guarantee a decent life. Third, low capacity, where regions are unable to achieve food self-sufficiency and cannot provide an adequate livelihood for residents. Based on this framework, Mubarokah et al. concluded that the Cibaliung area fell into the "low capacity" category, indicating that the region was unable to sustain food self-sufficiency or ensure decent living conditions for its inhabitants [18].

Comparable conclusions have been drawn in other parts of Indonesia. Research in Kota Batu, East Java, applied similar methodologies and identified five villages as unable to achieve food self-sufficiency [19]. Likewise, Pridasari & Muta'ali found that the inland agricultural areas of Bantul Regency, Yogyakarta, generally lack the ability to provide food self-sufficiency [20]. Their study further revealed that in Dlingo Subdistrict, the availability of agricultural land is insufficient to provide staple food for the local population. These studies consistently highlight a structural deficit in the agricultural land base, underscoring the seriousness of the food self-sufficiency challenge and emphasizing the urgency of expanding farmland to meet growing demand.

Government interventions have repeatedly sought to mitigate paddy field conversion and enhance food productivity through regulatory and institutional reforms. One major step was the enactment of Law No. 41/2009, which mandates that regional planning must include sustainable food agricultural areas (SFAA). Under this law, agricultural land designated as SFAA cannot legally be converted to non-agricultural use. Farmers who attempt to convert such land may face criminal sanctions, including imprisonment. The rationale was that achieving food self-sufficiency requires optimization of individually owned farmland, thereby making the burden of food security rest primarily on farming households. However, these measures have remained largely ineffective due to weak enforcement and limited participation by local stakeholders. Research in the northern coastal

region of West Java indicated that SFAA had not been established. Rather than proposing their land for SFAA designation, many farmers resisted it. Educated farmers, in particular, perceived greater economic opportunities in using their land for non-agricultural purposes, leading to widespread rejection of the SFAA initiative [21].

In addition to SFAA, the government attempted to optimize the use of state-owned land to accelerate food self-sufficiency by establishing food estates as centers for food production. On the surface, the policy appeared appropriate, as it sought to leverage underutilized state resources for agriculture. In practice, food estate programs were implemented through a capital-intensive and investor-driven model, which resulted in the de facto privatization of land management and restricted access for smallholder farmers. According to Telapak's report [22], this model effectively hindered farmers' access to land, exacerbated rural inequality, and contributed to the impoverishment of smallholders. This policy trajectory illustrates a broader dilemma in development governance: while privatized approaches often improve short-term efficiency, they risk marginalizing smallholders and eroding social capital. Thus, purely collective systems may fail without institutional legitimacy, while privatized schemes marginalize smallholders. This study, therefore, argues for a hybrid governance model, balancing collective inclusion with managerial efficiency [2, 7], as the foundation for sustainable land governance.

Building upon these shortcomings, this study introduces a faith-based institutional alternative—the pesantren-based food estate—designed to enhance staple food production while ensuring equitable land access for family farmers. This model integrates local wisdom and promotes the prosperity of small-scale farmers, who continue to produce the majority of staple foods in Indonesia and Southeast Asia. Specifically, this model situates *pondok pesantren* (Islamic boarding schools) as faith-based intermediaries that combine moral legitimacy, trust networks, and local participation in agricultural governance. *Pesantren* in Indonesia not only serve as centers of Islamic education but also frequently engage in agricultural development for both students (*santri*) and the surrounding communities. They often establish partnerships with local farmers, positioning them uniquely to serve as hubs of agricultural cooperation.

To explore this potential, the present research examined *pesantren* involvement in agriculture through preliminary studies in Sukabumi Regency, West Java. The findings revealed at least two *pesantren—Assalam* and *Yaspida*—that had already established partnerships with local farmers to cultivate land. These cases demonstrate the feasibility of *pesantren*-based agricultural initiatives, serving as a foundation for the development of a broader food estate model. Accordingly, the pesantren-based food estate is conceptualized as a hybrid institutional model that integrates the ethical foundation and trust networks of pesantren with the management discipline of private enterprises, thereby operationalizing Ostrom's collective action principles within an Islamic moral framework. This approach positions the study within global debates on collective action and rural development, contributing to the theoretical understanding of how faith-based institutions can mediate between collective equity and individual productivity in agrarian transformation. Building on these local experiences and theoretical insights from the literature, this study outlines an alternative framework for food estate development rooted in *pesantren* institutions.

By positioning this model within global debates on farmland decline—including comparable challenges in India and Pakistan [23], the study contributes to the broader discourse on sustainable agrarian transformation, emphasizing the role of faith-based collective institutions in reconciling productivity and equity. In sum, this study revisits the collective action debate by integrating both supportive and critical perspectives, positioning the pesantren-based food estate as a novel institutional innovation bridging collective action theory and Islamic agrarian ethics.

2. Literature Review

2.1. Agrarian Reform, Land Governance and Food Security

Since the mid-20th century, agrarian reform has been central to Indonesia's efforts to reorganize land

rights, enhance agricultural productivity and reduce rural poverty. Early efforts under the Basic Agrarian Law (*UUPA*) emphasized redistributive land reform, yet persistent institutional and implementation challenges have limited their impact. For example, research shows that the dynamics of reform in Indonesia exhibit misalignment between legal frameworks ("das sollen") and social reality ("das sein")—indicative of weak institutional enforcement and unclear ownership structures [24–26].

The decline of agricultural land, especially paddy fields, is widely documented and poses a serious threat to food self-sufficiency. For instance, a lengthy review of agrarian reform policies noted that despite progressive legislation, land conversion and fragmentation continue unabated (Budiman, 2017). These developments highlight that land governance is not merely a matter of policy text, but of effective enforcement, local actor networks, and institutional legitimacy. In this respect, collective action theory becomes relevant: scholars such as Ostrom argue that community-based governance of commons can reduce transaction costs and increase cooperation [2], while critics such as Platteau caution that collective regimes may struggle with coordination failures or elite capture [7]. Hence, the issue of agricultural decline must be seen not only through spatial transformations but as a deeper manifestation of governance deficits.

2.2. Collective Action, Social Capital and Institutional Innovation

The collective action framework offers a powerful lens to explore how rural communities manage shared resources and land. Research in Indonesia has demonstrated that strong local institutions and norms of mutual assistance (gotong-royong) significantly contribute to resource sustainability [27]. Social capital research further supports this by showing how community networks enhance food security by facilitating knowledge sharing and resource pooling [28]. These literatures provide empirical justification to examine faith-based institutions (such as pesantren) as novel sites of collective action and institutional innovation.

In faith-based agricultural settings, recent work in Indonesia found that Islamic boarding schools (pesantren) can serve as hybrid governance platforms that integrate moral trust networks with agribusiness activities [29–31]. This suggests that beyond the purely institutional or market-based models, faith-based cooperatives may bridge the gap between equity and productivity in agrarian contexts. Thus, the present study's focus on a pesantren-based food estate aligns with emerging institutional literature and offers a fresh contribution to collective action scholarship.

2.3. Role of Faith-Based Institutions in Rural Development

Faith-based institutions have increasingly been recognized for their role in social and economic development. In Indonesia, pesantren have traditionally been centres of Islamic learning but increasingly engage in agricultural development, cooperative enterprises and poverty alleviation [29–31]. Studies show that when pesantren integrate traditional values with entrepreneurial activities, they mobilize community resources, inculcate trust, and enable long-term partnerships with farmers [32].

The theoretical basis for this integration is found in transformative fiqh (Islamic jurisprudence) frameworks which articulate the maqāsid al-sharīʿah (objectives of Sharia) to include justice (ʿadl), welfare (maṣlaḥah), and stewardship of creation. Fatah and Giyoto demonstrate that such frameworks can be operationalised into eco-farming practices that empower farmers and preserve ecological integrity [32]. Therefore, a model of agricultural governance that utilises pesantren as hubs for faith-informed collective action offers a promising alternative pathway for sustainable rural development.

2.4. Hybrid Governance Models for Food Estate Development

Traditional food-estate models in Indonesia emphasise large-scale, capital-intensive, privatized schemes often dominated by corporate actors. Research critiques suggest that such models exacerbate inequality, marginalise smallholders and erode social capital [22]. By contrast, hybrid governance models seek to balance collective inclusion and managerial efficiency [2, 7].

In the context of sustainable rural development, a hybrid institutional approach appears especially relevant. It integrates the managerial discipline of private enterprise with the ethical legitimacy and trust networks of community or faith-based institutions. This dual-approach thus addresses both productivity imperatives and social equity goals. The current study applies this hybrid logic by positioning pesantren as intermediaries between farmers and market/investor structures, thereby reconciling production and access.

2.5. Research Gap and Conceptual Framework

To develop an alternative food estate model, this research explored a range of concepts and theories that provide both theoretical and practical underpinnings. These include the concept of needs, particularly basic needs and their fulfillment; the concepts of land ownership and land distribution; and the partnership between landowners—whether individuals or the state—and tenant farmers, whether individual farmers or collective farmer groups. Since the proposed model is based on *pondok pesantren*, the study also examined the potential of *pesantren* in agricultural development, emphasizing their capacity for institutional partnerships with surrounding communities.

The concept of need is defined as a fundamental requirement necessary for survival, well-being, and participation in society. Needs encompass both physiological requirements, such as food, water, and shelter, as well as psychological components, including love, belonging, and esteem [33, 34]. The fulfillment of these needs is critical to ensuring quality of life and the holistic development of individuals. Needs represent a dynamic interplay between universal human necessities and individual or cultural variations in their expression. Maslow's hierarchy remains a widely recognized framework, although recent contributions, such as those by Kenrick et al. [35], have revised it by incorporating evolutionary perspectives on human behavior. Addressing needs systematically has become central to interventions in psychology, social policy, and public health, promoting human flourishing [36, 37].

Basic human needs are the essential elements required for survival, well-being, and active participation in society. At the most fundamental level, these physiological needs include air, water, food, shelter, clothing, warmth, and sleep. Once these basic requirements are met, higher-level needs, such as safety, become more prominent. Safety involves security, stability, and freedom from fear, including aspects of health, financial security, and personal safety [37]. The recognition of these needs informs both state obligations and community-based models of agricultural development.

From an Islamic perspective, needs are categorized based on the principle of Maqasid al-Shariah (objectives of Islamic law). According to Zainur [38], needs are divided into three levels: dharuriyyat (essentials), which are indispensable for faith, life, intellect, lineage, and property; hajiyyat (complementary), which ease difficulties without being vital for survival; and tahsiniyyat (enhancements), which refine and perfect social conduct. These categories encompass both physical and non-physical aspects, with dharuriyyah explicitly including food as an essential component for sustaining human life [1].

Figure 1 presents the theoretical framework of needs in relation to food estate formation. Needs can be classified into primary, secondary, and tertiary levels based on their intensity, and into individual and group needs based on their subject [38]. Individual needs include both primary (basic) and secondary/tertiary (supporting) needs. The fulfillment of primary needs is the direct responsibility of the state, while secondary and tertiary needs, though not obligatory for the state to fulfill, require enabling conditions so that individuals have the opportunity to meet them. Group needs, such as education, health, and safety, are also classified as essential needs that must be met by state intervention. This framework emphasizes the balance between state obligations and individual opportunities in sustaining livelihoods.

Despite extensive research on agrarian reform, collective action and faith-based community development, gaps remain. First, there is limited empirical work combining these strands in the specific context of Indonesia's food estate policy. Second, while pesantren are recognised for educational and religious roles, their potential as actors in large-scale agricultural governance re-

mains under-explored. Third, few studies systematically integrate collective action theory, aqāṣid al-sharīʿah and food security frameworks into a unified conceptual model of land governance. To address these gaps, this study proposes a conceptual framework that places pesantren at the intersection of collective governance and faith-informed institutional legitimacy, enabling equitable access to land and food production capacity.

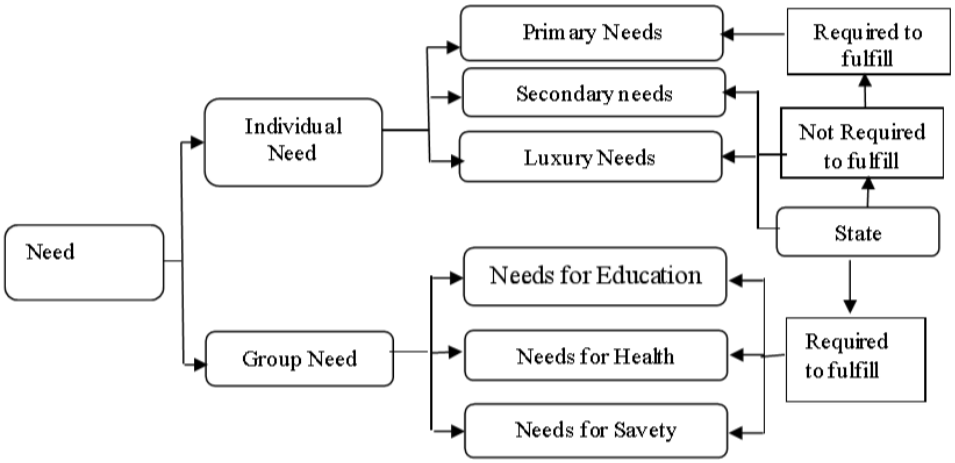

Figure 1. Framework Theory to Food Estate Formation.

In sum, the literature suggests that sustainable agricultural land governance must move beyond binary modes of collective vs. private control and towards hybrid institutional mechanisms that embrace local wisdom, religious ethics and market responsiveness. The conceptual framework outlined above guided the methodological steps presented in this section.

2.6. Theoretical Position and Contribution of the Study

While previous studies have extensively debated collective action and land governance within secular or state-centered frameworks[2, 5, 7], limited attention has been given to how faith-based institutions may serve as mediators of collective ownership and agrarian cooperation. This study fills that theoretical gap by conceptualizing a *pesantren-based food-estate model* rooted in Islamic institutional governance. Building upon principles of *Maqasid al-Shariah*—which emphasize justice (*adl*), stewardship (*khalifah*), and mutual cooperation (*ta'awun*)—the model integrates moral authority with collective land management. Such an approach bridges two theoretical domains often seen as incompatible: the efficiency and accountability associated with private property systems, and the social equity and solidarity underpinning collective ownership. Therefore, the study contributes to the broader literature on collective action by offering a hybrid, faith-driven institutional mechanism for equitable and sustainable land use.

3. Methodology

3.1. Research Design

This study employed a mixed-methods sequential exploratory design that integrates qualitative exploration with quantitative validation to formulate the pesantren-based food estate model. The qualitative phase identified pesantren potentials, partnership structures, and institutional roles, while the quantitative phase measured the perceived importance and performance of key attributes related to land governance, agricultural management, and institutional cooperation.

3.2. Study Setting and Case Selection

The study was conducted in two pesantren located in Sukabumi Regency, West Java: Assalaam and Yaspida. These pesantren were purposively selected because they demonstrate active agricultural programs and clear managerial commitment to land-based production. Both in-

stitutions represent different scales of pesantren governance, allowing examination of how institutional structures mediate farmer partnerships. Fieldwork was conducted between October and November 2024, using an integrated qualitative–quantitative schedule to ensure consistency in observation and data collection.

3.3. Sampling and Participants

After identifying attributes through the qualitative phase, the research advanced to the quantitative survey. Given the small population of tenant farmers in Assalaam and Yaspida, total population sampling was applied, encompassing all 30 active tenant farmers.

All respondents met the inclusion criteria (active tenancy during the study period, direct involvement in pesantren-managed farming). This approach eliminated sampling bias and ensured representativeness of the pesantren partnership structure.

3.4. Research Instruments and Measures

Attributes were constructed following the Importance–Performance Analysis (IPA) framework, based on prior qualitative findings. Three main domains were used: (1) pre-cultivation and input readiness, (2) cultivation and post-harvest management, and (3) supporting and institutional activities. Each item was assessed using a 4-point Likert scale (1 = very low to 4 = very high) for both importance and performance. Instrument validation: The questionnaire was pre-tested and refined through expert review. Cronbach's alpha values indicated high reliability ($\alpha = 0.918$ for importance, $\alpha = 0.898$ for performance), exceeding standard thresholds ($\alpha \geq 0.70$). Ordinal responses were converted to interval scales using the Method of Successive Intervals (MSI) prior to averaging to meet parametric assumptions.

3.5. Data Collection Procedures

Data collection comprised two sequential stages:

(1) Qualitative phase — in-depth interviews with pesantren managers and key informants to elicit details of partnership systems, operational practices, and barriers. Findings informed the final list of measurable attributes.

(2) Quantitative phase — structured questionnaires administered face-to-face to all tenant farmers to measure perceived importance and performance levels.

Quality control included daily data verification, follow-up for incomplete entries, and double data entry to minimize errors. Ethical clearance and informed consent were ensured through pesantren leadership.

3.6. Data Analysis Procedures

Data analysis in this study employed the Importance–Performance Analysis (IPA) framework developed by Martilla and James [39]. All ordinal responses from the four-point Likert scale were first transformed into interval data using the Method of Successive Intervals (MSI) to ensure compatibility with parametric analysis. The mean values for both importance and performance were then calculated for each attribute to facilitate comparative assessment of farmer perceptions across domains.

The resulting mean scores were plotted onto a Cartesian coordinate matrix divided into four interpretive quadrants. Attributes positioned in Quadrant I (high importance but low performance) indicate priority areas that require improvement. Those in Quadrant II (high importance and high performance) represent attributes that should be maintained and strengthened. Attributes falling within Quadrant III (low importance and low performance) are considered lower-priority areas for development, while those in Quadrant IV (low importance but high performance) suggest potential overinvestment and may be re-evaluated for resource optimization.

To determine the overall placement of each attribute, the grand mean of importance and performance scores was calculated as reference axes using the formulas $\bar{X} = \frac{\sum X}{n}$ and $\bar{Y} = \frac{\sum Y}{n}$. Visualization of the IPA diagram was conducted using SPSS version 26, enabling a clear mapping and interpretation of each attribute's relative position.

Finally, a Spearman's rank correlation test was applied to examine the degree of association between im-

portance and performance scores, providing additional insight into the alignment between perceived significance and actual implementation across attributes.

Ethical practices were observed throughout. Participants were informed of study purposes, participation was voluntary, and data confidentiality was maintained following the research ethics code of Universitas Brawijaya.

4. Results

The results of this study are presented systematically in line with the structure of the *pesantren*-based food estate model, which was analyzed through both qualitative insights and quantitative measurement using Importance–Performance Analysis (IPA). Attributes are categorized into three main stages: pre-cultivation (X1), cultivation/maintenance/harvest (X2), and supporting attributes (X3). For each stage, the results are explained in terms of importance and performance ratings, priority mapping in quadrants, and their broader implications. The discussion also integrates relevant contextual insights from interviews with farmers and *pesantren* leaders. Tables and figures included in the original manuscript are referenced in their respective order but not reproduced here.

4.1. Pre-Cultivation Attributes

The pre-cultivation phase lays the foundation for successful agricultural production, ensuring that farmers begin their activities with adequate preparation, resources, and skills. Nine attributes were identified, coded X1.1 through X1.9. These included: availability of irrigation, availability of equipment such as tractors, farmers' knowledge and skills in cultivation, ease of obtaining seeds and fertilizers, access to *pesantren*-owned seedling facilities, farmers' ability to produce seedlings, ease of accessing fertilizer at the field site, availability of medicines, and the availability of labor (**Table 1**).

Table 1. The Average of Importance and Performance of Pre-Cultivation Attribute.

Code	Pre-Cultivation Attribute (X1)	Average of Importance Level	Average of Performance Level
X1.1	Availability of irrigation on cultivated land	3.44	3.38
X1.2	Availability of equipment, such as tractors, to cultivate the land	3.53	3.47
X1.3	Skills in using agricultural machinery, such as tractors, in cultivating land	3.34	3.34
X1.4	Farmers' skills in cultivating agricultural land	3.56	3.22
X1.5	Ease of obtaining seeds, seedlings and medicines for planting rice	3.28	2.91
X1.6	*Pesantren* have their own seeding	3.25	3.09
X1.7	Farmers' skills to produce seedlings and seeds independently	3.41	3.00
X1.8	Ease of obtaining fertilizer at the land location being cultivated	3.25	3.09
X1.9	Availability of labor that can help work the land	3.47	3.50
	Average of the Average	3.39	3.22

Source: The primary data (processed).

Quantitatively, the results showed that the average importance across all nine pre-cultivation attributes was 3.39, while the average performance was 3.22. This consistent gap between importance and performance suggests that farmers acknowledge the crucial role of pre-cultivation attributes but remain dissatisfied with the actual support and services provided.

Looking at specific attributes, irrigation availability (X1.1) scored 3.44 in importance and 3.38 in performance. This small gap indicates that irrigation is already relatively well-provided, although farmers expect even greater consistency. In interviews, several tenant farmers emphasized that reliable irrigation reduced their dependency on unpredictable rainfall, especially during transitional seasons; however, they also noted occasional maintenance problems with the channels. Equipment availability (X1.2) emerged as one of the top concerns, with an importance score of 3.53 and performance of only 3.47. While tractors and mechanical tools are available, their supply is often limited, forcing farmers to wait for access during peak periods.

The largest gaps emerged in the area of farmers' skills. For example, cultivation skills (X1.4) scored 3.56

for importance but only 3.22 in performance, highlighting an urgent need for training and technical assistance. Farmers admitted that while they had experience in traditional methods, modern cultivation techniques and efficient soil preparation strategies were less familiar to them. Ease of obtaining seeds and seedlings (X1.5) also revealed a notable gap, with importance rated at 3.28 and performance at only 2.91. Many farmers complained about the irregular supply of quality seeds, noting delays in procurement and inconsistent quality.

The quadrant mapping in **Figure 2** placed equipment availability (X1.2) and farmer cultivation skills (X1.4) in Quadrant I, meaning they were high in importance but low in performance. These two attributes represent urgent areas requiring intervention. Irrigation (X1.1) and labor availability (X1.9) were placed in Quadrant II, as both were rated highly in importance and already achieved strong performance, making them attributes to be maintained. In contrast, attributes such as seedling access and fertilizer supply fell into Quadrant III (low importance and low performance), marking them as secondary priorities. Taken together, the pre-cultivation findings suggest that pesantren-based food estates must focus on strengthening access to equipment and farmer training, while preserving irrigation systems and labor arrangements. These measures will ensure that farmers enter the cultivation phase with greater readiness and efficiency.

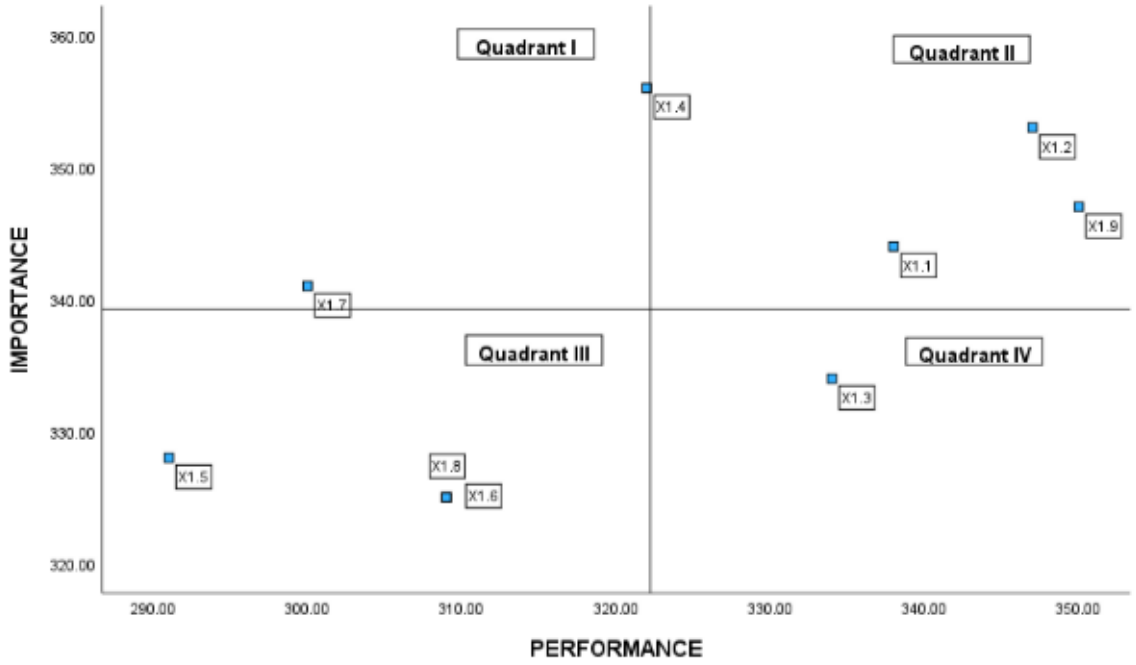

Figure 2. The Cartesian Diagram for Pre-Cultivation Attribute.

4.2. Cultivation, Plant Maintenance, and Harvest Attributes

The second stage of the rice production cycle involves cultivation, plant maintenance, and harvesting. Eight attributes (X2.1–X2.8) were assessed in this stage: knowledge of good seeds, planting skills, fertilization practices, synchronized planting schedules, pest and disease management, knowledge of organic farming, skills in producing organic inputs, and the presence of rice processing facilities (**Table 2**).

On average, importance across these attributes was 3.25, while performance averaged 2.99. The gap here was even wider than in pre-cultivation, highlighting that weaknesses in cultivation and maintenance are among the most significant barriers to productivity in the pesantren-based food estate.

Knowledge of good seeds (X2.1) scored 3.31 in importance and 3.28 in performance, indicating strong alignment between expectations and achievements.

Farmers confirmed in interviews that pesantren often facilitated access to improved seed varieties, which enhanced crop resilience and yield. Planting skills (X2.2), however, showed a greater gap, with an importance rating of 3.44 and a performance rating of 3.22. While farmers are proficient in traditional methods, modern spacing techniques and mechanized planting are less commonly practiced, leading to inefficiencies.

Table 2. Attribute of Cultivation, Plant Maintenance, and Harvest.

Code	Attribute of Cultivation, Plant Maintenance and Harvest (X2)	Average of Importance Level	Average of Performance Level
X2.1	Farmer's knowledge about good types of seeds and seedlings	3.31	3.28
X2.2	Farmer skills on how to plant properly and correctly	3.44	3.22
X2.3	Farmer skills on how to do proper fertilization	3.25	3.19
X2.4	Planting rice at the same time as other or adjacent farmers	3.31	2.78
X2.5	Farmers' knowledge about how to control rice pests and diseases	3.34	2.59
X2.6	Farmers' knowledge of organic rice farming systems	2.75	2.69
X2.7	Farmers' skills in making organic fertilizers and pesticides	2.91	2.47
X2.8	The existence of a rice processing factory at the *Pesantren*	3.72	3.72
	Average of the Average	3.25	2.99

Source: Primary data (Processed).

The largest gaps in this stage were in synchronized planting (X2.4) and pest/disease management (X2.5). Both attributes were rated highly in importance (3.31 and 3.34, respectively), but poorly in performance (2.78 and 2.59, respectively). These findings confirm that lack of coordination among farmers and inadequate knowledge of pest control remain pressing vulnerabilities. Farmers mentioned that without synchronized planting, pest outbreaks spread more easily, undermining yields. Likewise, while they understood the dangers of pests, many lacked training in integrated pest management strategies.

Organic farming knowledge (X2.6) and skills in producing organic inputs (X2.7) scored lower, with importance around 2.75–2.91 and performance between 2.47–2.69. These results suggest that organic practices are not yet a priority for farmers, although pesantren leaders viewed them as important for long-term sustainability. Interestingly, the rice processing facility (X2.8) scored very high on both importance (3.72) and performance (3.72), making it a clear achievement to maintain. Farmers expressed satisfaction with the availability of a local milling unit, which reduced dependence on distant commercial facilities and allowed for quicker turnaround.

Quadrant mapping revealed that synchronized planting (X2.4) and pest/disease knowledge (X2.5) fell in Quadrant I, indicating a need for urgent improvement. Knowledge of seeds, planting skills, fertilization practices, and rice processing facilities was in Quadrant II, representing achievements to maintain. Organic knowledge and practices fell into Quadrant III, suggesting they remain secondary. This analysis emphasizes that the pesantren-based food estate will not succeed without coordinated planting and enhanced pest management. While infrastructure, such as rice mills, is already in place, technical training and extension services remain urgently needed **(Figure 3)**.

4.3. Supporting Attributes

The final category, supporting attributes (X3.1–X3.7), represents enabling conditions that allow pre-cultivation and cultivation activities to succeed. These included fostering piety (X3.1), extension on planting (X3.2), extension on fertilization (X3.3), extension on pest control (X3.4), regular pest monitoring (X3.5), manual weeding (X3.6), and pesantren-provided financial aid (X3.7) (**Table 3**).

Supporting attributes scored the highest among the three categories, with an average importance of 3.50 and an average performance of 3.24. This indicates that pesantren are already performing well in these enabling roles, though there remain gaps in technical extension services. Fostering piety (X3.1) scored importance at 3.69 and performance at 3.31, underscoring the pesantren's distinctive contribution beyond material

agriculture. Farmers reported that religious programs reinforced discipline and communal spirit, strengthening their motivation. The extension on planting (X3.2) yielded balanced scores of 3.31 for both importance and performance, indicating overall satisfaction. However, extension on fertilization (X3.3) scored 3.50 for importance but only 3.13 for performance, highlighting a training deficit. Similarly, extension on pest control (X3.4) scored 3.28 versus 2.84, showing that farmers urgently need better instruction.

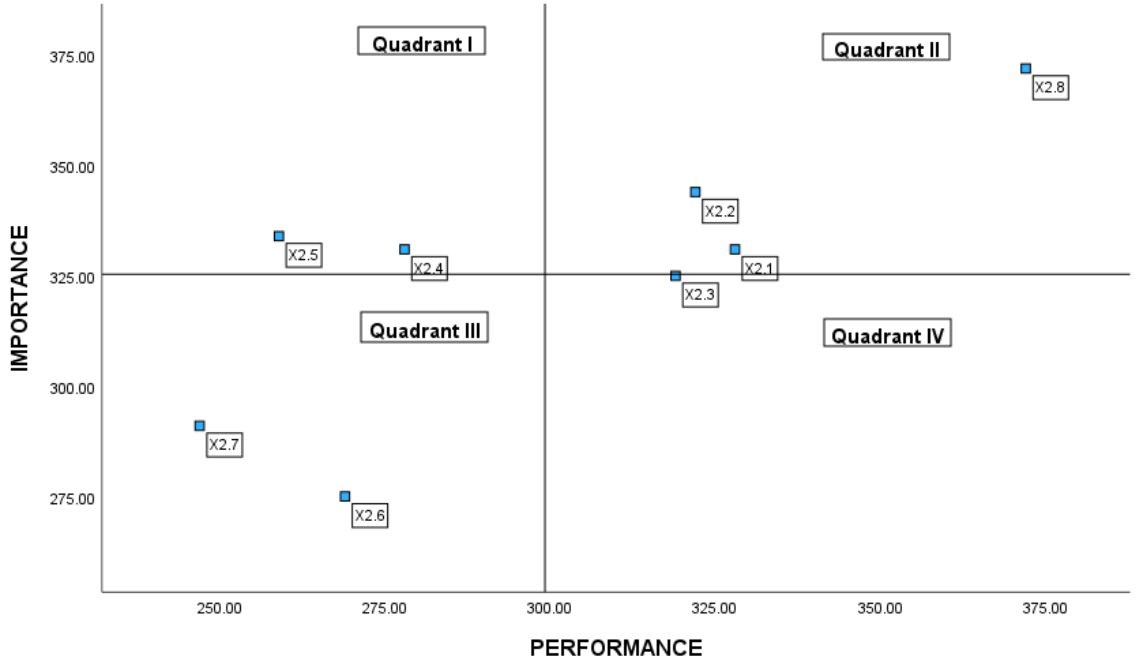

Figure 3. The Cartesian Diagram for Cultivation and Harvest Attribute.

Table 3. Attributes of Supporting Activity to Land Cultivation.

Code	Attributes of Supporting Activity to Land Cultivation (X3)	Average of Importance Level	Average of Performance Level
X3.1	Extending for fostering the piety of employees and land tenant of *pesantren;*	3.69	3.31
X3.2	Extension on how to plant rice properly and correctly	3.31	3.31
X3.3	Extension on how to do proper fertilization	3.50	3.13
X3.4	Extension on how to control rice pests and diseases	3.28	2.84
X3.5	Regular monitoring of rice pests and diseases	3.50	3.09
X3.6	Cleaning weeds manually/using tools	3.53	3.44
X3.7	Financial aid from *pesantren* to facilitate rice production	3.66	3.53
	Average of the Average	3.50	3.24

Source: Primary data (Processed).

Regular pest monitoring (X3.5) scored 3.50 in importance but only 3.09 in performance, another critical gap. Manual weeding (X3.6) scored strongly on both importance (3.53) and performance (3.44), reflecting the value of traditional practices. Finally, financial aid (X3.7) scored 3.66 in importance and 3.53 in performance, demonstrating pesantren's vital role in bridging capital shortages. Quadrant mapping in **Figure 4** showed that fertilization extension (X3.3) and pest monitoring (X3.5) fell into Quadrant I, indicating a need for urgent improvement. Fostering piety, manual weeding, and financial aid were in Quadrant II, representing clear achievements that needed to be maintained. Pest control extension (X3.4) was in Quadrant III, meaning it remains a secondary priority. Planting extension (X3.2) was in Quadrant IV, suggesting overinvestment. These findings highlight that pesantren are uniquely positioned to combine spiritual, financial, and technical

support. However, to fulfill their potential as food estate managers, they must significantly strengthen their extension services, especially in fertilization and pest management.

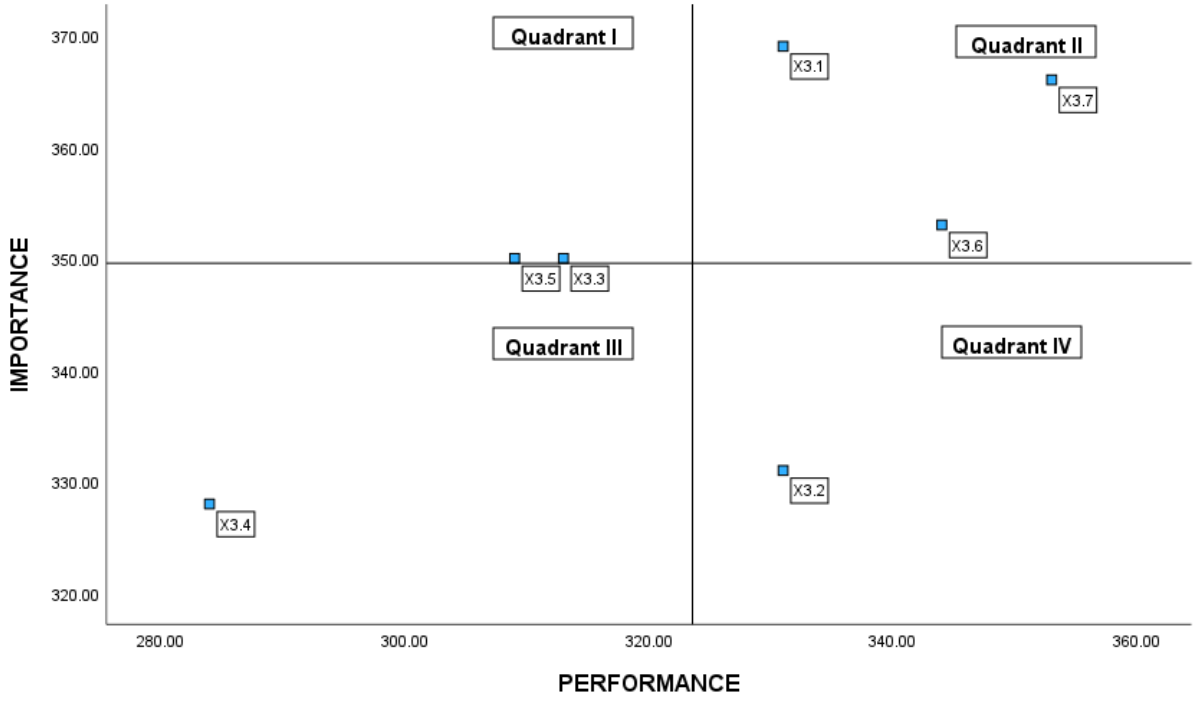

Figure 4. The Cartesian Diagram for Supporting Attribute.

4.4. Integrated Synthesis

Taken together, the results demonstrate consistent gaps between importance and performance across nearly all attributes. Farmers consistently rated attributes as highly important but expressed lower satisfaction with their actual implementation. The largest gaps occurred in equipment availability (X1.2), cultivation skills (X1.4), synchronized planting (X2.4), pest and disease management (X2.5), fertilization extension (X3.3), and pest monitoring (X3.5). These attributes represent the priority areas for improvement in the pesantren-based food estate model.

The results also reveal strengths that pesantren should maintain, including irrigation availability (X1.1), rice processing facilities (X2.8), fostering piety (X3.1), manual weeding (X3.6), and financial aid (X3.7). These attributes highlight pesantren's dual role in providing both material and spiritual support, differentiating them from purely commercial food estate models. **Tables 1–3** and **Figures 2–4** collectively illustrate how importance and performance scores map onto action priorities. The IPA framework provides pesantren leaders and policymakers with a clear roadmap: focus on urgent Quadrant I issues, maintain Quadrant II strengths, consider Quadrant III issues as secondary, and avoid over-investing in Quadrant IV attributes.

4.5. Broader Implications

The implications of these results extend beyond the two pesantren studied. The consistent gaps in technical training, extension, and coordination suggest systemic weaknesses in Indonesian smallholder agriculture. By leveraging their institutional legitimacy and community reach, pesantren can help close these gaps. However, this requires structured investment in capacity-building programs, better integration with government extension services, and improved access to farming inputs. Qualitative data confirmed that farmers appreciate pesantren's role in facilitating access to credit and fostering discipline through religious programs. Yet they

remain concerned about practical matters such as pest control and planting synchronization. Bridging this divide requires pesantren-based food estates to balance their spiritual mission with concrete technical interventions. By maintaining achievements such as irrigation, milling facilities, and financial aid, while focusing on urgent training and access to inputs, pesantren can transform themselves into credible, sustainable managers of state-owned food estates. In doing so, they can contribute to both national food security goals and equitable rural development.

5. Discussion to Adopt the Alternative of the Food Estate Model

The proposed pesantren-based food estate model offers a timely response to Indonesia's ongoing struggle to reconcile food self-sufficiency with equitable land governance. Over the past decade, national food estate programs have primarily emphasized productivity through large-scale, corporate-oriented schemes. While such initiatives accelerated short-term output, they often triggered extensive forest conversion, tenure insecurity, and marginalization of smallholders, who remain the backbone of Indonesia's agricultural system [40–42]. This criticism is further intensified by the observation that these initiatives can obstruct farmers' access to land and employment opportunities, hindering sustainable livelihoods for vulnerable communities [43, 44]. Hence, the pesantren-centered model reorients this paradigm by restoring the role of local institutions as mediators of collective ownership, moral legitimacy, and community participation—dimensions that are crucial for long-term sustainability.

Existing regulations under the Ministry of Environment and Forestry permit forest clearing for food estates, typically initiated through top-down proposals by ministers or governors. This hierarchical approach has drawn concerns regarding transparency, inclusiveness, and accountability. From a governance perspective, the pesantren-based alternative represents a bottom-linked mechanism, connecting state policy with grassroots management through trusted religious institutions. By embedding food production within socially legitimate structures, it addresses the governance gap often found in industrial food estate projects while strengthening tenure security and rural justice [45, 46]. Thus, the traditional food estate model embodies a development dilemma in which efficiency-driven industrial approaches conflict with equity-driven strategies aimed at empowering smallholders [47, 48].

The introduction of Presidential Regulation No. 62/2023 on land redistribution has created institutional space for more inclusive models. Within this framework, the eligibility of legal entities such as pesantren allows them to act as institutional anchors bridging government programs and community-based agriculture [49, 50]. This policy convergence enhances the model's feasibility, as pesantren can translate agrarian reform into locally grounded, faith-based practices that combine state legitimacy with cultural trust [51–54].

The eligibility criteria for receiving redistributed land under this framework are intentionally broad, covering individuals, community groups, and legal entities such as *pesantren* (Islamic boarding schools) [40, 42]. Given their historical and cultural significance, pesantren are uniquely positioned to act as effective institutional anchors for alternative food estate models. Their established organizational structures and moral authority may enable them to serve as intermediaries between government land allocation policies and smallholder farming practices, thus enhancing community engagement and empowerment [51, 55]. This compatibility positions pesantren as strong candidates for agrarian reform programs that prioritize social justice, food sovereignty, and community empowerment [45, 52].

Central to the proposed model is the partnership framework grounded in Islamic economic ethics, particularly the principle of *al-musaqoh*, which promotes equitable sharing of agricultural yields between land custodians and cultivators [56, 57]. This arrangement operationalizes collective action theory within a religious context by ensuring mutual accountability and shared benefit [2], while the moral authority of pesantren prevents elite capture and reinforces cooperative norms. Thus, the pesantren model aligns both with Islamic jurisprudence and with theories of institutional trust and common-

pool resource governance.

Unlike the corporate paradigm, the pesantren-based system preserves direct farmer access to land and promotes family-based farming resilience. It integrates moral education, local wisdom, and agricultural training within a unified institutional framework [41, 58]. This integration not only safeguards livelihoods but also enhances social cohesion and adaptive capacity—two key determinants of sustainability identified in collective-action literature [4, 7, 59]. Consequently, the model transforms the notion of food estates from a purely economic enterprise into a socio-ethical approach to rural regeneration.

The convergence between state-led agrarian reform and Islamic legal-economic principles provides dual legitimacy for the pesantren model. The *al-musaqoh* framework, underpinned by fairness (*adl*) and stewardship (*khalifah*), complements the state's redistributive agenda by promoting just access to land and productivity. Such alignment offers a blueprint for multi-level policy synergy—where national regulations provide structure, and pesantren institutions deliver grounded implementation.

Cross-national experiences in collective farming—such as Israel's *kibbutzim*, Tanzania's *ujamaa*, and China's rural communes—underscore the need for voluntarism, social trust, and local legitimacy [60, 61]. Similarly, Tanzania's ujamaa program aimed to advance social equality through communal farming but often failed due to coercive implementation and limited local ownership [62, 63]. China's people's communes initially improved resource mobilization but later faced inefficiency and disincentivized individual effort [64]. In contrast, the pesantren-based food estate model differs fundamentally by embedding collective action within religious ethics and social trust networks. The moral legitimacy of pesantren leadership, combined with voluntary participation grounded in shared Islamic values, offers an institutional resilience that previous state-enforced collective systems lacked. Thus, the model represents not a replication of global collectivism, but a contextual hybrid that integrates spiritual motivation, community participation, and equitable land stewardship.

Despite its potential, the pesantren-based approach faces institutional asymmetries. While some pesantren possess strong managerial capacity, others may lack resources for scaling [53, 58]. Transparent profit-sharing, participatory decision-making, and robust accounting mechanisms are prerequisites for ensuring equity. Government agencies thus play a critical role in capacity-building, monitoring, and establishing clear operational guidelines to sustain accountability within pesantren–farmer partnerships [42, 48].

Environmental considerations remain central to the model's credibility. Although pesantren-led management minimizes deforestation risks typical of corporate estates, ecological resilience must still be ensured through soil conservation, biodiversity protection, and climate-adaptive practices [43, 45]. By integrating Islamic stewardship values with modern agroecological methods—such as organic farming, water conservation, and integrated pest management—pesantren can foster faith-driven environmental ethics that reinforce sustainable production [45, 50].

Beyond production, pesantren can evolve into rural innovation centers, combining agricultural education with moral and vocational training. Through integrating farming modules into curricula, pesantren can cultivate a generation of *santri* who are both spiritually grounded and technically competent in sustainable agriculture [44, 46]. This approach embeds innovation within local traditions, ensuring that food estate development grows organically from within rural communities, not as an external imposition [48, 49].

In summary, the pesantren-based food estate model articulates a faith-informed, community-centered alternative to Indonesia's corporate agrarian paradigm. It aligns with the redistributive vision of Presidential Regulation No. 62/2023 and embodies *maqasid al-shariah* principles that link productivity with justice. While challenges persist regarding institutional consistency and environmental safeguards, the model's moral legitimacy, participatory governance, and ecological consciousness make it a promising pathway for sustainable rural transformation. Its success will ultimately depend on policy continuity, transparent governance, and active collaboration between the state, pesantren, and farming communities [54, 56].

6. Conclusions and Recommendation

This study proposes a *pesantren*-based food estate model as an innovative framework for equitable and sustainable agrarian development in Indonesia. The model positions pesantren as institutional managers of redistributed state-owned land, combining legal legitimacy from the national agrarian reform framework with moral legitimacy derived from Islamic jurisprudence. By empowering *pesantren* to manage agricultural land—whether converted from forest or non-forest areas—the state can utilize their organizational capacity, social credibility, and ethical influence to establish inclusive partnerships with local farmers. Through the mechanism of al-musaqoh, or profit-sharing contracts recognized in Islamic law, farmers maintain direct access to land while sharing yields fairly with pesantren as institutional custodians.

The model's strength lies in its dual alignment with both state policy and Islamic ethical principles. Its foundation within Indonesia's Presidential Regulation No. 62/2023 on Land Redistribution ensures institutional feasibility, while its grounding in maqasid al-shariah—particularly the principles of justice (*adl*), stewardship (*khalifah*), and cooperation (ta'awun)—enhances its normative authority. By doing so, the model offers a credible alternative to the corporate-driven food estate paradigm, which has often led to social exclusion, environmental degradation, and the marginalization of smallholders. The pesantren-based approach instead promotes inclusive growth, agrarian equity, and ecological balance, aligning food production with the broader goals of social welfare and sustainability.

For effective implementation, several policy implications emerge. First, the government should revise and harmonize regulatory frameworks to explicitly recognize pesantren as eligible legal entities for land redistribution and management under national agrarian reform. Second, institutional capacity-building must be prioritized through training in farm management, cooperative finance, and participatory governance to ensure that pesantren can operate both efficiently and transparently. Third, technical and financial support mechanisms, including agricultural extension, access to credit, and sustainable farming incentives, should be embedded within the model to strengthen its long-term viability. Finally, monitoring and evaluation systems are essential to maintain transparency, prevent elite capture, and ensure equitable benefit distribution among farmers and pesantren communities.

In conclusion, the pesantren-based food estate represents a strategic innovation that integrates production efficiency with agrarian justice. By merging state policy, local institutional strength, and Islamic ethical governance, it offers a replicable framework for achieving food security, social equity, and rural prosperity. Beyond its practical contribution, this model also provides a conceptual bridge between collective action theory and faith-based development, illustrating how moral institutions can mediate the balance between efficiency and fairness in land governance. The success of this approach ultimately depends on sustained government commitment, institutional collaboration, and community participation, ensuring that Indonesia's pursuit of food sovereignty remains both just and sustainable.

Author Contributions

Conceptualization, U.M. and A.T.N.; methodology, U.M.; software, Z.M.; validation, U.M., A.T.N. and G.P.; formal analysis, U.M. and A.T.N.; investigation, U.M.; resources, I.A.; data curation, L.I.I.; writing—original draft preparation, U.M. and H.N.; writing—review and editing, A.T.N. and G.P.; visualization, Z.M.; supervision, A.T.N.; project administration, A.T.N.; funding acquisition, G.P. and A.T.N. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement

Ethical review and approval were waived for this study because it involved non-interventional interviews

with minimal risk and no collection of personal, medical, or sensitive data. At the time of the study, no institutional review board process was required by the authors' institution for socio-economic interviews of this nature.

Informed Consent Statement

Informed consent was obtained from all participants involved in the study. Participation was voluntary, and respondents were informed about the purpose of the research, anonymity, and their right to withdraw at any time.

Data Availability Statement

The data used in this study are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

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