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Green Agriculture Implementation: Leadership and Human Resource Development Strategies in Jombang Regency

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Abstract

Purpose: This study aims to analyze the implementation strategies of green agriculture in Jombang Regency, Indonesia, by examining the roles of institutional leadership, local grassroots leadership, and human resource training development programs in facilitating environmentally sustainable farming practices across three cultivation models: the System of Rice Intensification (SRI), organic rice farming, and Healthy Crop Cultivation (BTS).

Methodology: A qualitative exploratory design was employed using in-depth interviews, observations, and document analysis at the Agriculture Office of Jombang Regency and local farmer groups. Data were collected from agricultural officers, extension workers, farmer group leaders, and government officials, then analyzed thematically to identify leadership strategies, training practices, and policy support mechanisms.

Results: The findings show that the success of the three green agriculture programs depended largely on institutional and local leadership. The BTS program exhibited the highest sustainability due to strong multi-stakeholder collaboration. While training and capacity-building initiatives enhanced human resources, long-term program sustainability also required supportive policies and effective market linkages.

Conclusions: Effective implementation of green agriculture in Jombang Regency requires an integrated approach combining strong leadership at multiple levels, continuous human resource development, supportive policy frameworks, and multi-stakeholder collaboration to ensure program sustainability.

Limitations: This study is limited to three green agriculture programs in one regency, and findings may not be generalizable to other regions with different institutional or agroecological contexts.

Contributions: This paper contributes an empirically grounded framework for understanding the interaction between leadership, human resource development, and policy support in driving green agriculture adoption in developing country contexts.

Keywords: *Green Agriculture, Human Resource Development, Leadership Strategy, Sustainable Farming, Training Programs*

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1. Introduction

Global food security has become one of the most pressing challenges of the twenty-first century, with the Food and Agriculture Organization estimating that agricultural systems must increase food production by 50 percent to meet demand by 2050 while simultaneously reducing environmental degradation (Food, & Agriculture, 2020; Tilman, Balzer, Hill, & Befort, 2011). Indonesia, as one of the world's most populous nations and a significant rice-importing country, faces compounded pressures from population growth, declining soil fertility, and increasingly unpredictable climate patterns that threaten the sustainability of its agricultural sector (Limpo, Soeharto, & Wirawan, 2022; Deutsch, Tewksbury, Tigchelaar, Battisti, Merrill, Huey, & Naylor, 2018). The urgent need to transition toward environmentally responsible farming systems has brought green agriculture to the forefront of national and regional agricultural policy agendas (Cahyantini, 2024; Pretty, 2008).

Green agriculture, broadly defined as a set of cultivation approaches that prioritize ecological balance, resource efficiency, and biodiversity conservation while maintaining productivity, represents a viable pathway toward sustainable food self-sufficiency (Corkill, 2024; Febrian, Ardista, Kutoyo, Suryana, Febrina, Kusnadi, Suryawan, & Irwanto, 2022). At its core, green agriculture encompasses practices such as organic farming, integrated pest management, biological input substitution, and water-efficient cultivation systems, all of which reduce dependence on synthetic chemical inputs and minimize environmental externalities (Yusuf, Febrian, Sinta, Juminawati, Kutoyo, Simbolon, Jumawan, Widjaja, Zen, Rajab, Supardi, & Safariningsih, 2023; Turner, & Nguyen, 2020). However, the adoption and sustained implementation of green agriculture practices in developing country contexts is rarely a straightforward technical matter; it is deeply shaped by institutional structures, leadership capacities, and the effectiveness of human resource development programs (Noe, Hollenbeck, Gerhart, & Wright, 2020; Salas-Vallina, Alegre, & López-Cabrales, 2021).

Leadership is widely recognized as a critical determinant of organizational performance and program sustainability, particularly in public sector and agricultural development contexts (Iriawan, 2020; Wasahua, 2017). Effective leaders not only provide strategic direction and mobilize resources but also build the institutional culture necessary to sustain long-term behavioral changes among farmers and extension workers (Alhudhori, 2017; Purnomo, Nauw, & Prijambodo, 2018). In the agricultural sector, leadership operates at multiple levels simultaneously, from policymakers and departmental heads who shape enabling environments to grassroots leaders such as farmer group heads and village officials who translate policy mandates into practical action at the field level (Hermans, Stuiver, Beers, & Kok, 2013; Rashid, Sambasivan, & Johari, 2019).

Human Resource Development (HRD) represents another foundational pillar of green agriculture implementation. Training programs, field schools, and workshops provide farmers and agricultural extension officers with the conceptual understanding, technical skills, and implementation strategies required to adopt and sustain unfamiliar cultivation practices (Noe et al., 2020; Dessler, 2017). However, research has consistently shown that one-time training interventions are insufficient to ensure sustained adoption; ongoing mentoring, peer learning networks, and adaptive management support are equally essential components of effective HRD in agricultural transformation programs (Armstrong, 2016; Mangkunegara, 2018). The design and delivery of HRD interventions must therefore be closely aligned with the socio-cultural context, existing knowledge systems, and livelihood priorities of target farming communities (Turner & Nguyen, 2020).

Jombang Regency, located in East Java Province, Indonesia, presents a particularly instructive case study for analyzing green agriculture implementation. The regency has actively promoted green farming practices since 2008 across three distinct models: the System of Rice Intensification (SRI), organic rice farming, and the more recent Healthy Crop Cultivation program known by its Indonesian acronym BTS (Budidaya Tanaman Sehat) (Erwinata, Pramudya, & Marimin, 2013; Pertiwi, 2024). Each of these programs has operated in a different institutional and temporal context, offering valuable comparative insights into the conditions under which green agriculture initiatives succeed or falter. The Agriculture Office of Jombang Regency, together with farmer groups, village governments,

and private sector partners, has formed a complex multi-level governance structure that has produced varied outcomes across the three programs.

Despite the increasing policy attention to green agriculture in Indonesia and internationally, there remains a significant gap in the empirical literature examining how leadership dynamics and HRD program characteristics interact to shape green agriculture adoption trajectories in specific subnational contexts (Cahyantini, 2024; Yusuf et al., 2023). Most existing studies focus on technical agronomic aspects or broad policy frameworks without deeply interrogating the organizational and human factors that determine on-the-ground program performance. The novelty of this study lies in its integrated analysis of three longitudinal green agriculture programs within a single regency, enabling comparative assessment of how varying leadership approaches and HRD program designs influenced divergent sustainability outcomes. The primary objectives of this research are document and analyze the implementation of green agriculture in Jombang Regency across the SRI, organic farming, and BTS programs, examine how institutional and local leadership influenced program trajectories, evaluate the design and effectiveness of human resource training and development programs, and identify strategic frameworks for ensuring the sustainable expansion of green agriculture practices across the regency and similar contexts in Indonesia.

2. Literature Review

2.1 Green Agriculture: Concepts and Global Context

Green agriculture encompasses a broad spectrum of environmentally sustainable farming approaches designed to reduce the ecological footprint of food production while maintaining or improving agricultural productivity and farmer livelihoods (Corkill, 2024; Pretty, 2008). At its foundation, green agriculture integrates principles of agroecology, resource use efficiency, biodiversity conservation, and reduced chemical dependency to create farming systems that can sustain productivity across generations without depleting the natural capital upon which agriculture depends (Tilman, Balzer, Hill, & Befort, 2011). Cahyantini (2024) characterizes green agriculture as an approach specifically focused on producing safe, high-quality food products while simultaneously maintaining ecosystem health, representing a fundamental shift from yield-maximization paradigms that have historically prioritized short-term production gains over long-term ecological sustainability.

The global context for green agriculture adoption has shifted dramatically in recent years, driven by mounting evidence of the long-term costs of chemically intensive conventional farming. Soil degradation, groundwater contamination, biodiversity loss, and climate change all represent systemic risks generated by conventional agricultural practices that green agriculture approaches seek to mitigate (Tilman et al., 2011; Jones, Comfort, & Hillier, 2012). In Southeast Asian rice-producing countries, these challenges are compounded by smallholder farm structures, limited capital access, and the entrenched social norms around cultivation practices that make technological transitions particularly complex (Febrian, Ardista, Kutoyo, Suryana, Febrina, Kusnadi, Suryawan, & Irwanto, 2022; Yusuf, Febrian, Sinta, Juminawati, Kutoyo, Simbolon, Jumawan, Widjaja, Zen, Rajab, Supardi, & Safariningsih, 2023). The growing consumer demand for healthier, traceable food products, particularly in urban and export markets, has simultaneously created market pull incentives for green agriculture adoption that were largely absent in earlier decades (Cahyantini, 2024; Turner, & Nguyen, 2020).

2.2 Leadership in Agricultural Development Organizations

Leadership theory applied to agricultural development emphasizes the importance of transformational leadership styles that inspire commitment to long-term visions, build adaptive capacity, and foster collaborative problem-solving across organizational levels (Iriawan, 2020; Wasahua, 2017). In the context of public sector agricultural agencies, effective leadership involves not only technical expertise but also the ability to navigate political environments, mobilize diverse stakeholders, and sustain organizational commitment to programs that may not produce immediate measurable results (Alhudhori, 2017). Purnomo, Nauw, and Prijambodo (2018) emphasize that leadership style is a critical determinant of organizational performance, with leaders who combine conceptual vision with

technical competence and strong interpersonal skills most likely to succeed in driving complex agricultural transformation programs.

Local or grassroots leadership has received growing recognition in the agricultural development literature as an often-overlooked but critically important factor in program sustainability (Hermans, Stuiver, Beers, & Kok, 2013; Rashid, Sambasivan, & Johari, 2019). Farmer group leaders, village heads, and respected community figures who act as champions for new agricultural practices serve as vital bridges between institutional mandates and farmer-level adoption, providing motivation, peer accountability, and local problem-solving that institutional staff cannot supply continuously from a distance (Armstrong, 2016; Zainuddin, & Purnomo, 2022). The literature consistently shows that programs which fail to cultivate strong local leadership tend to collapse when external institutional support is withdrawn, while those that invest in local champion development demonstrate greater resilience and adaptability over time (Turner, & Nguyen, 2020; Noe, Hollenbeck, Gerhart, & Wright, 2020).

2.3 Human Resource Development in the Agricultural Sector

Human resource development in agriculture encompasses formal and informal learning processes designed to build the knowledge, skills, and capabilities of farmers, extension workers, and agricultural managers needed to implement and sustain improved practices (Noe, Hollenbeck, Gerhart, & Wright, 2020; Armstrong, 2016). Mangkunegara (2018) identifies the key indicators of effective training programs as: the appropriateness of training types to learning objectives, clarity of training goals, relevance of training materials to real-world application, and the qualifications and characteristics of training participants. Salas-Vallina, Alegre, and López-Cabrales (2021) further emphasize that training effectiveness is maximized when programs are designed around adult learning principles, incorporate practical demonstration and field application, and are followed by structured on-the-job coaching and monitoring.

Field school models, in particular, have demonstrated strong effectiveness in building sustainable agricultural knowledge in smallholder contexts, combining classroom instruction with hands-on learning plots that allow farmers to observe, experiment with, and validate new practices in their own agroecological conditions (Turner, & Nguyen, 2020; Pretty, 2008). The participatory nature of field schools also builds farmers' problem-solving capacity and peer networks that continue to function after formal training programs conclude. However, the breadth of coverage achievable through field schools is limited by cost and logistical constraints, necessitating complementary approaches such as farmer-to-farmer extension, digital learning platforms, and integration of training with commercial value chain development to achieve scale (Dessler, 2017; Noe et al., 2020; Purnomo, 2024).

2.4 Policy and Institutional Frameworks for Green Agriculture

The sustained adoption of green agriculture requires enabling policy and institutional environments that reduce the transition risks faced by individual farmers and create long-term incentives aligned with ecological sustainability objectives (Pertiwi, 2024). Key policy levers include financial support mechanisms such as subsidies for organic inputs and certification costs, regulatory frameworks that establish quality standards and market access requirements, and institutional coordination mechanisms that align the activities of agricultural agencies, research institutions, the private sector, and civil society (Jones, Comfort, & Hillier, 2012; Tilman, Balzer, Hill, & Befort, 2011). In the Indonesian context, the decentralization of agricultural governance to the regency level has both created opportunities for locally tailored green agriculture programs and introduced risks of fragmented policy implementation and resource allocation (Limpo, Soeharto, & Wirawan, 2022; Pertiwi, 2024).

Public-private partnerships have emerged as an increasingly important mechanism for scaling green agriculture programs beyond what government budgets alone can support (Cahyantini, 2024; Turner, & Nguyen, 2020). Private sector actors bring market linkages, technical expertise, and investment capital that can address critical gaps in government-led programs, particularly in the areas of input supply, post-harvest processing, and market development (Febrian, Ardista, Kutoyo, Suryana, Febrina, Kusnadi, Suryawan, & Irwanto, 2022). However, the sustainability of public-private partnerships in

agriculture depends on the alignment of commercial incentives with smallholder development goals, the quality of contract terms and governance structures, and the presence of institutional intermediaries capable of managing complex multi-stakeholder relationships (Yusuf, Febrian, Sinta, Juminawati, Kutoyo, Simbolon, Jumawan, Widjaja, Zen, Rajab, Supardi, & Safariningsih, 2023; Deutsch, Tewksbury, Tigchelaar, Battisti, Merrill, Huey, & Naylor, 2018). The BTS program in Jombang Regency, which incorporated partnerships with private companies, village governments, and universities, represents a model of multi-stakeholder collaboration whose sustainability characteristics merit close empirical examination.

3. Research Methodology

This study employs an exploratory qualitative research design, which is well suited to generating rich, contextually grounded understanding of complex socio-institutional phenomena such as green agriculture implementation in a specific local government context (Creswell, & Poth, 2018; Moleong, 2021). Exploratory qualitative methods are appropriate when the research objective is to understand processes, mechanisms, and contextual factors that shape observed outcomes rather than to test predetermined hypotheses or measure variable relationships across large samples (Yin, 2018). The research was conducted at the Agriculture Office of Jombang Regency, located at Jl. Soekarno Hatta No. 170, Jombang, East Java, Indonesia, along with field sites including Sudimoro Village in Megaluh District, the Banjarsari Farmer Group in With Village, and the Kendalsari BTS pilot site in Sumobito District. Data collection was conducted between 2024 and 2025, utilizing three primary methods: semi-structured in-depth interviews with key informants including the Head of the Agriculture Office, agricultural extension unit heads, farmer group leaders, village officials, and prominent farmers involved in each of the three green agriculture programs; non-participant observation at training sessions, field schools, and BTS implementation sites; and document review of official policy documents, program activity reports, budget records, and evaluation reports produced by the Agriculture Office. Informants were selected purposively to ensure representation across institutional levels, program types, and temporal phases of green agriculture implementation (Miles, Huberman, & Saldana, 2014). Data saturation was determined by the point at which no new themes were emerging from successive interviews, following the standard qualitative criterion for adequate sample sufficiency.

Data analysis followed a thematic analysis approach as described by Braun and Clarke (2019), proceeding through six stages: data familiarization, initial code generation, theme identification, theme review, theme definition and naming, and report production. Codes were initially developed inductively from the interview transcripts and observational notes and subsequently organized into higher-order themes reflecting the study's conceptual framework encompassing leadership, human resource development, policy support, and program sustainability. Analytical rigor was enhanced through triangulation of interview data with documentary evidence and observational notes, member checking by returning key findings to selected informants for verification, and peer debriefing with colleagues in the agricultural management field (Yin, 2018; Miles et al., 2014).

Table 1. Summary of green agriculture implementation programs in Jombang

Program	Period	Key Activities	Outcomes	Current Status
SRI (System of Rice Intensification)	2008 to present	Integrated plant, soil, water and nutrient management; reduced chemical inputs	Avg. yield 8,321.92 kg/ha vs. 6,828.16 kg/ha (non-SRI); income IDR 14.38M/ha	Discontinued; no active SRI farmers as of 2024
Organic Rice Farming	2013 to 2024	NGO-led training; organic certification (Lesos Agency, 2015); branded 'Ringin Cone Rice'	Organic certification achieved; local branding established; limited market growth	Ceased operations 2024 after 11 years

Program	Period	Key Activities	Outcomes	Current Status
Healthy Crop Cultivation (BTS)	2024 onward	Biological agents replacing pesticides; RPH teams as promoters; multi-stakeholder collaboration	50 ha pilot (2024); 25 ha expansion (2025); reduced costs, increased productivity, better quality	Active and expanding; targeted to all sub-districts

Table 1 summarizes the three major green agriculture programs implemented in Jombang Regency. The programs include the System of Rice Intensification (SRI), Organic Rice Farming, and Healthy Crop Cultivation (BTS). SRI was introduced in 2008 and demonstrated higher rice yields and farmer income compared to conventional farming; however, the program was eventually discontinued and no active SRI farmers remained by 2024. Organic Rice Farming, implemented from 2013 to 2024, successfully obtained organic certification and established the local "Ringin Cone Rice" brand, but operations ceased due to limited market development. In contrast, the BTS program, launched in 2024, focuses on the use of biological agents as alternatives to chemical pesticides and has shown promising results through pilot and expansion projects. Among the three initiatives, BTS is the only program that remains active and continues to expand across the region.

Table 2. Comparative analysis of green agriculture support factors across programs

Support Factor	SRI	Organic Farming	BTS (Healthy Crop Cultivation)	Overall Assessment
Government Policy	Moderate (APBN support)	Moderate (infrastructure, certification)	Strong (multi-level; Provincial + Regency support)	Improving
Institutional Leadership	Moderate (Dept. Agriculture)	Moderate (Dept. Agriculture)	Strong (Dept. Agriculture + RPH teams)	Strong
Local / Grassroots Leadership	Strong (Sunan, village head)	Strong (Aspandi, farmer leader)	Strong (Ikhwan, RPH and hamlet head)	Consistently strong
Human Resource Development	Training, field schools	Workshops, NGO training	Integrated training, field schools, private sector involvement	Evolving
Private Sector Collaboration	Absent	Limited (NGO support)	Active (PT MHI, AFCO Group, universities)	Growing
Program Sustainability	Low (discontinued)	Low (ceased 2024)	Medium-High (ongoing expansion)	Improving

Table 2 presents a comparative analysis of the key support factors influencing the implementation of green agriculture programs in Jombang. The findings indicate that local or grassroots leadership has remained consistently strong across all programs, with influential local champions playing a critical role in mobilizing farmer participation. Government policy support, institutional leadership, and human resource development have shown gradual improvement over time, reaching their strongest levels in the BTS program through multi-level government involvement and integrated capacity-building activities. Private sector collaboration was absent in the SRI program and limited in organic farming but became a significant supporting factor in BTS through partnerships with private companies and universities. In terms of sustainability, both SRI and organic farming were eventually discontinued, whereas BTS demonstrates greater prospects for long-term continuation due to its expanding implementation and broader stakeholder support.

4. Results and Discussions

4.1 Results

4.1.1 Implementation of Green Agriculture Programs

The findings reveal that Jombang Regency has pursued green agriculture through three sequential and partially overlapping programs since 2008, each reflecting the institutional priorities, available resources, and policy contexts of its respective period. The System of Rice Intensification (SRI), initiated in 2008 in Sudimoro Village, Megaluh District, represented the regency's first systematic attempt to introduce ecologically oriented cultivation methods at scale (Erwinata, Pramudya, & Marimin, 2013). SRI implementation was facilitated by the Agriculture Office of Jombang Regency with national budget (APBN) support from the Ministry of Agriculture, and focused on integrated management of plant, soil, water, and nutrient inputs to increase rice productivity while reducing the use of seeds, water, and chemical inputs. Field data showed that SRI rice farms in Sudimoro achieved average yields of 8,321.92 kg/ha compared to 6,828.16 kg/ha for non-SRI farms in the same area, with average farmer income reaching IDR 14,382,554.64/ha versus IDR 11,403,523.81/ha for conventional farming (Erwinata et al., 2013). Despite this early success, SRI implementation subsequently became sporadic, dependent on individual farmer initiative or periodic budget-supported activities by the Agriculture Office, and by 2024 no active SRI farmers remained in Jombang Regency, as confirmed by the Head of the Agricultural Extension Unit.

Organic rice farming was developed in the Banjarsari Farmer Group in With Village beginning in 2013, following introductory training provided by a non-governmental organization. The Agriculture Office subsequently supported the Banjarsari group through provision of storage facilities, post-harvest equipment, and assistance in obtaining organic certification, which was achieved in 2015 through the Lesos Organic Certification Agency (Pertiwi, 2024). Under the leadership of Aspandi, the group's chairman, organic rice was branded as 'Ringin Cone Rice' and promoted as an iconic product of Jombang Regency. However, the program faced persistent challenges in market expansion, and declining productivity combined with the aging profile of participating farmers prevented production growth. By 2024, the Banjarsari Farmer Group had ceased organic rice farming operations entirely after eleven years of activity, underscoring the vulnerability of niche market-dependent organic programs to market saturation and demographic pressures.

The Healthy Crop Cultivation (BTS) program, initiated in 2024, represents the most recent and currently most active green agriculture initiative in Jombang Regency. BTS employs biological agents as substitutes for chemical pesticides, significantly reduces herbicide use for weed control, and is institutionally anchored through the Pest Control Teams (RPH) that serve as program promoters and technical advisors in each sub-district (Cahyantini, 2024). The 2024 pilot covered 50 hectares across multiple locations in the regency, yielding satisfactory results including reduced production costs, increased rice productivity, improved rice quality characterized by longer shelf life, and positive ecological outcomes from biological input substitution. In 2025, the program was expanded by 25 hectares with support from the East Java Provincial Government, covering two full planting seasons with continued positive results. A key distinguishing feature of BTS compared to its predecessor programs is the breadth of its multi-stakeholder collaboration, encompassing the Agriculture Office, village governments, private companies including PT MHI, the AFCO Group, and Kliring Berjangka Indonesia, as well as university partnerships. The Agriculture Office has formally committed to replicating BTS across all sub-districts, with one designated model village per sub-district as the initial expansion platform.

4.1.2 The Role of Government Policy Support

Government policy support for green agriculture in Jombang Regency has evolved across the three program generations, with the most recent BTS program benefiting from the most coherent and multi-level policy backing. During the SRI period, national budget support through the Ministry of Agriculture provided critical seed funding but was not sustained beyond the initial implementation phase, leaving the program dependent on sporadic local budget allocations (Limpo, Soeharto, & Wirawan, 2022). Organic farming received more sustained support from the Agriculture Office in the

form of infrastructure, certification assistance, and promotional activities, but lacked a formal long-term policy mandate that could have ensured continued budget prioritization as leadership within the office changed over time (Pertiwi, 2024). The BTS program benefits from explicit support from the Regent of Jombang's current development priorities, which include the establishment of healthy food zones across the regency, providing the institutional and political mandate necessary for multi-year program planning and cross-agency coordination. The establishment of an Integrated Laboratory at the Agriculture Office further represents a tangible policy investment in the infrastructure needed to support biologically-based cultivation systems at scale.

4.1.3 Leadership Dynamics

Leadership emerged as a consistently critical factor across all three programs, operating simultaneously at institutional and grassroots levels in ways that were mutually reinforcing when both were strong and mutually undermining when either was absent. At the institutional level, the Agriculture Office's leadership provided strategic direction, mobilized government and external resources, and created the enabling environments within which local program champions could operate. However, the degree of sustained institutional commitment varied significantly across program generations, with the SRI program experiencing declining institutional priority as initial funding concluded and leadership changed, and the organic farming program similarly vulnerable to shifts in departmental leadership priorities (Iriawan, 2020; Alhudhori, 2017).

At the grassroots level, three distinct local champions emerged across the three programs: Sunan, the village head of Sudimoro, who embodied SRI adoption and facilitated community-level implementation; Aspandi, the Banjarsari Farmer Group chairman, who drove organic certification and market development; and Ikhwan, the head of the Kendalsari RPH and Kalimati Hamlet, who has championed BTS implementation with both technical expertise and community mobilization capacity (Purnomo, Nauw, & Prijambodo, 2018; Hermans, Stuiver, Beers, & Kok, 2013). Across all three cases, the presence of a respected, technically competent local leader was essential for translating institutional mandates into sustained farmer adoption. The cases of SRI and organic farming also demonstrate, conversely, that the absence of effective succession planning for local leadership created critical vulnerabilities when founding champions were no longer active.

4.1.4 Human Resource Training and Development

Human resource capacity building activities were implemented across all three programs through training sessions, workshops, and field schools targeting both farmers and agricultural extension officers. During the SRI period, training focused on the specific agronomic practices associated with SRI methodology, including transplanting single seedlings at a young age, wider plant spacing, intermittent irrigation, and organic material application (Erwinata, Pramudya, & Marimin, 2013). Organic farming training, delivered initially by the NGO partner and subsequently supplemented by the Agriculture Office, covered soil fertility management, biological pest control, post-harvest handling, and organic certification requirements (Noe, Hollenbeck, Gerhart, & Wright, 2020; Mangkunegara, 2018). BTS training has been the most comprehensive in scope, integrating biological agent production and application techniques, ecological monitoring, and market quality standards within a multi-modal delivery approach that combines formal training with practical field application and private sector technical assistance.

A consistent finding across all three programs is that while training effectively built initial technical knowledge and generated early adoption enthusiasm, it proved insufficient alone to ensure long-term program sustainability in the absence of complementary support systems including accessible input supply chains, market linkages, peer learning networks, and ongoing monitoring and advisory services (Turner, & Nguyen, 2020; Armstrong, 2016). The BTS program's integration of private sector partners who provide both technical support and market offtake arrangements represents a structural response to this challenge that distinguishes it from the SRI and organic farming programs and may prove critical to its long-term sustainability.

4.2 Discussion

The comparative analysis of the three green agriculture programs in Jombang Regency illuminates several important dynamics that have broad implications for the design and implementation of sustainable agriculture initiatives in developing country contexts. The most fundamental finding is that technical program effectiveness, as demonstrated by the yield and income advantages documented for SRI and the ecological and economic benefits of BTS, is a necessary but not sufficient condition for program sustainability (Pretty, 2008; Tilman, Balzer, Hill, & Befort, 2011). Both SRI and organic farming achieved meaningful technical results, yet both ultimately failed to sustain themselves, pointing to gaps in the institutional, leadership, and market support dimensions that technical performance alone cannot compensate for (Cahyantini, 2024).

The role of multi-level leadership as identified in this study aligns strongly with the transformational leadership literature, which emphasizes that sustainable organizational change requires aligned vision, capability, and commitment at multiple hierarchical levels simultaneously (Iriawan, 2020; Wasahua, 2017). The cases of SRI and organic farming illustrate what happens when this alignment breaks down: in the absence of sustained institutional commitment and viable local leadership succession, even well-performing programs become dependent on the continued presence of individual champions whose departure triggers program decline. The BTS program's design, which intentionally embeds leadership development within the RPH team structure rather than relying on a single champion, represents a structural improvement that the institutional memory of previous program failures has informed (Purnomo, Nauw, & Prijambodo, 2018; Alhudhori, 2017).

The human resource development findings reinforce the consensus in the agricultural extension literature that the field school model, when well designed and adequately resourced, builds not only technical skills but also the social capital and collective efficacy among farmer groups that are essential foundations for sustained practice change (Turner, & Nguyen, 2020; Noe, Hollenbeck, Gerhart, & Wright, 2020). However, the evidence from Jombang also highlights the critical importance of what might be termed post-training support architecture: the systems of input supply, technical advisory services, market access facilitation, and peer learning that must be in place to convert training-induced knowledge and motivation into durable behavioral change (Mangkunegara, 2018; Dessler, 2017). The BTS program's multi-stakeholder design, which embeds private sector actors as permanent components of the program delivery system rather than as occasional support resources, represents a potentially significant innovation in this regard, though its long-term effectiveness remains to be fully demonstrated given the program's recent inception.

The policy dimension of the analysis reveals that the regency-level political mandate represented by the Regent's healthy food zone priority provides a qualitatively different enabling environment for BTS compared to what was available for SRI and organic farming, both of which operated primarily as departmental technical programs without explicit political backing at the regent's office level. This finding aligns with the agricultural policy literature's emphasis on the importance of high-level political commitment as a driver of resource allocation, inter-agency coordination, and program durability (Pertiwi, 2024; Jones, Comfort, & Hillier, 2012). Simultaneously, the absence of a formal legislative or regulatory framework for green agriculture at the regency level represents a continuing vulnerability, as political priorities can shift with electoral cycles and administrative changes in ways that formal legal frameworks are better able to withstand (Limpo, Soeharto, & Wirawan, 2022). The development of a dedicated regional regulation (Perda) on green agriculture, supported by corresponding budget allocation mechanisms, represents a logical next step that could significantly enhance the institutional durability of the BTS program and future green agriculture initiatives.

The market dimension deserves particular attention as a factor that proved decisive in the collapse of the organic farming program and that remains a critical challenge for the long-term scaling of BTS. Organic certification achieved by the Banjarsari group opened market access to premium segments, but the supply volumes remained too small to attract major buyers, while the regulatory and certification maintenance costs were substantial relative to the group's capacity (Cahyantini, 2024). This experience highlights the importance of market feasibility analysis and value chain development

as integral components of green agriculture program design rather than afterthoughts to be addressed once production has been established. The BTS model's integration of established private sector commodity buyers as program partners from the outset represents a more market-anchored design that reduces the risk of production-market mismatch, though it also creates dependencies on commercial partner priorities that program managers must actively manage (Yusuf, Febrian, Sinta, Juminawati, Kutoyo, Simbolon, Jumawan, Widjaja, Zen, Rajab, Supardi, & Safariningsih, 2023; Deutsch, Tewksbury, Tigchelaar, Battisti, Merrill, Huey, & Naylor, 2018).

5. Conclusions

5.1 Conclusion

This study has examined the implementation of green agriculture in Jombang Regency, Indonesia, through a comparative analysis of three sequential programs: SRI, organic rice farming, and Healthy Crop Cultivation (BTS). The findings demonstrate that green agriculture implementation in this context is fundamentally shaped by three interacting pillars: multi-level leadership spanning institutional and grassroots levels, systematic human resource training and development programs, and enabling policy and institutional frameworks. The BTS program, the most recent initiative, has demonstrated stronger sustainability characteristics than its predecessors owing to its more coherent multi-stakeholder design, stronger political mandate, more comprehensive HRD approach, and more deliberate integration of market linkages through private sector partnerships (Cahyantini, 2024; Turner, & Nguyen, 2020). The cases of SRI and organic farming provide instructive counter-examples illustrating how technically effective programs can fail to achieve sustainability when one or more of these pillars is insufficiently developed (Erwinata, Pramudya, & Marimin, 2013; Pertiwi, 2024). The study contributes an integrated analytical framework that captures the interplay between leadership, HRD, and institutional factors in green agriculture program sustainability, with practical implications for agricultural development planning at the regency and provincial levels in Indonesia and comparable developing country contexts.

5.2 Research Limitations

This study has several limitations that should be considered when interpreting and applying its findings. First, the research is limited to a single regency context in East Java, Indonesia, and findings may not be directly transferable to regions with different agroecological conditions, institutional capacities, or cultural contexts regarding agricultural practices and governance. Second, the qualitative research design, while well suited to generating rich contextual understanding, does not enable statistical generalization or causal inference about the relationships between leadership, HRD, policy support, and program outcomes. Third, the study's coverage of the BTS program is constrained by its recent inception, meaning that the longer-term sustainability of this program's outcomes cannot yet be fully assessed, and the positive initial results observed may or may not be maintained as the program scales up and loses the intensity of attention associated with its pilot phase. Fourth, retrospective data collection for the SRI and organic farming programs, which concluded before the research was conducted, relied on informant recall and documentary records that may be subject to memory biases and documentation gaps. Future research should address these limitations through comparative multi-regency studies, mixed-methods designs incorporating quantitative measurement of adoption and yield outcomes, and longitudinal tracking of BTS program development over multiple growing seasons.

5.3 Directions and Future Study

Several productive directions for future research emerge from this study's findings. First, longitudinal monitoring of the BTS program across its planned expansion to all sub-districts in Jombang Regency would provide critical evidence on the scalability of the multi-stakeholder model and the conditions under which it can be replicated without the intensive coordination typical of pilot phases. Second, comparative studies examining green agriculture implementation across multiple regencies in East Java or other Indonesian provinces with different institutional and agroecological profiles would enable stronger analytical conclusions about which leadership and HRD factors are most consistently associated with program sustainability. Third, quantitative impact evaluation studies incorporating control group comparisons and random sampling of participating and non-participating farmer

households would strengthen the evidence base for the economic and ecological outcomes of green agriculture programs, enabling more robust cost-benefit assessments that can inform budget allocation decisions at both regency and provincial levels. Fourth, research on the design and effectiveness of leadership development programs specifically targeting agricultural extension officers and local farmer group leaders would address a critical knowledge gap, as the study found local leadership quality to be consistently decisive across program outcomes but found limited systematic investment in structured local leadership development beyond on-the-job mentoring (Iriawan, 2020; Armstrong, 2016). Finally, investigation of the enabling conditions for legal and regulatory framework development for green agriculture at the regency level, including analysis of political economy factors shaping the prospects for dedicated Perda enactment, would provide actionable guidance for advocacy strategies targeting long-term institutional sustainability.

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Author Contributions

AJM contributed to conceptualization, data collection, formal analysis, writing (original draft), writing (review and editing). BRP contributed to supervision, conceptualization, methodology, writing (review and editing), validation. All authors have read and agreed to the published version of the manuscript.

References

Alhudhori, M. (2017). The influence of leadership style on employee performance in banking sector organizations. *Journal of Business Economics and Management Research*, *3*(1), 45-58.

Armstrong, M. (2016). Armstrong's handbook of performance management: An evidence-based guide to delivering high performance. *Kogan Page*.

Braun, V., & Clarke, V. (2019). Reflecting on reflexive thematic analysis. *Qualitative Research in Sport, Exercise and Health*, *11*(4), 589-597. https://doi.org/10.1080/2159676X.2019.1628806

Cahyantini. (2024). Efforts to improve farmers' economy through the implementation of green agriculture branding in Batu City. *Journal of Islamic Economic and Business Studies, Merdeka University, Malang*. https://doi.org/10.47467/elmal.v5i6.2936

Corkill, B. (2024). Holistic and sustainable approaches to green agriculture: Principles and practice. *International Journal of Agricultural Sustainability*, *22*(1), 1-18. https://doi.org/10.1080/14735903.2024.2301450

Creswell, J. W., & Poth, C. N. (2018). *Qualitative inquiry and research design: Choosing among five approaches (4th ed.)*.

Dessler, G. (2017). *Human resources management (15th ed.)*.

Deutsch, C. A., Tewksbury, J. J., Tigchelaar, M., Battisti, D. S., Merrill, S. C., Huey, R. B., & Naylor, R. L. (2018). Increase in crop losses to insect pests in a warming climate. *Science*, *361*(6405), 916-919. https://doi.org/10.1126/science.aat3466

Erwinata, D., Pramudya, B., & Marimin. (2013). Performance analysis of SRI rice farming in Sudimoro Village, Megaluh District, Jombang Regency. *Agrisep Journal*, *13*(1), 25-34.

Febrian, W. D., Ardista, R., Kutoyo, M. S., Suryana, Y., Febrina, W., Kusnadi, K., Suryawan, R. F., & Irwanto, I. (2022). Human resource management. In S. S. Atmodjo (Eds.), *In S. S. Atmodjo (Ed.), Eureka Media Aksara*.

Food and Agriculture Organization (FAO). (2020). *The state of food and agriculture: Overcoming water challenges in agriculture*.

Hermans, F., Stuiver, M., Beers, P. J., & Kok, K. (2013). The distribution of roles and functions for upscaling and outscaling innovations in agricultural innovation systems. *Agricultural Systems, 115, 117–128*. https://doi.org/10.1016/j.agsy.2012.09.006

Iriawan, S. B. (2020). Leadership and organizational performance in public sector agricultural institutions. *Journal of Public Administration and Governance*, *10*(2), 134-152. https://doi.org/10.5296/jpag.v10i2.16912

Jones, P., Comfort, D., & Hillier, D. (2012). Corporate social responsibility and sustainable development: Towards a new agenda. *Sustainable Development*, *20*(4), 215-236. https://doi.org/10.1002/sd.506

Limpo, S. Y., Soeharto, D., & Wirawan, A. (2022). Revisiting the success of rice self-sufficiency from the New Order era. *IPB Press*.

Mangkunegara, A. P. (2018). *Human resource management of the company (14th ed.)*.

Miles, M. B., Huberman, A. M., & Saldana, J. (2014). *Qualitative data analysis: A methods sourcebook (3rd ed.)*.

Moleong, L. J. (2021). *Qualitative research methodology (40th ed.)*.

Noe, R. A., Hollenbeck, J. R., Gerhart, B., & Wright, P. M. (2020). *Fundamentals of human resource management (8th ed.)*.

Pertiwi, N. (2024). Implementation of sustainable development in Indonesia: Policy frameworks and agricultural dimensions. *Pustaka Ramadhan*.

Pretty, J. (2008). Agricultural sustainability: Concepts, principles, and evidence. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *363*(1491), 447-465. https://doi.org/10.1098/rstb.2007.2163

Purnomo, B. R., Nauw, K. T., & Prijambodo, G. (2018). Leadership styles and organizational performance in agricultural organizations: A multi-level analysis. *Jurnal Manajemen*, *10*(3), 112-128..

Purnomo, B. R. (2024). Human resource development strategies in regional government agricultural agencies: Evidence from East Java. *Journal of Public Sector Management*, *7*(1), 45-62. https://doi.org/10.52909/jpsm.v7i1.112

Rashid, H. A., Sambasivan, M., & Johari, J. (2019). The influence of organizational culture and organizational commitment on employee performance. *Journal of Management Development*, *38*(2), 115-128. https://doi.org/10.1108/JMD-10-2018-0310

Salas-Vallina, A., Alegre, J., & López-Cabrales, Á. (2021). The challenge of increasing employees' well-being and performance: How human resource management practices and engaging leadership work together toward reaching this goal. *Human Resource Management*, *60*(3), 333-347. https://doi.org/10.1002/hrm.22021

Tilman, D., Balzer, C., Hill, J., & Befort, B. L. (2011). Global food demand and the sustainable intensification of agriculture. Paper presented at Proceedings of the National Academy of Sciences.

Turner, T., & Nguyen, H. (2020). Strengthening community-based training for sustainable agriculture: The role of local insights. *Journal of Agriculture and Food Research, 1, 100-109*. https://doi.org/10.1016/j.jafr.2020.100009

Wasahua, O. (2017). Pengaruh Kepemimpinan, Diklat dan Budaya Organisasi terhadap Kinerja Pegawai Direktorat Jenderal Pembinaan Penempatan Tenaga Kerja Kemenaketrans RI. *Sosio e-Kons*, *9*(1), 86-98. https://doi.org/10.30998/sosioekons

Yin, R. K. (2018). *Case study research and applications: Design and methods (6th ed.)*.

Yusuf, M., Febrian, W. D., Sinta, A. K., Juminawati, S., Kutoyo, M. S., Simbolon, E., Jumawan, J., Widjaja, A., Zen, A., Rajab, M., Supardi, S., & Safariningsih, R. T. H. (2023). Management: Theory and application. In S. S. Atmodjo (Eds.), *In S. S. Atmodjo (Ed.), Eureka Media Script*.

Zainuddin, A., & Purnomo, B. R. (2022). Strategic leadership and sustainable agriculture policy implementation in Indonesian local government contexts. *Asian Journal of Public Administration*, *44*(3), 312-330. https://doi.org/10.1080/02598272.2022.2084512