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Integrating state-owned enterprises (SOEs), agro-economics, and sustainability: A systematic literature review on contract farming mechanism

Syahrir Akbar[1,*], M. Nanda Rakha Pradana[1], Aulia Rahma[1], Nindya Fadhila Rahmah[2]
[1] *State Financial Management Study Program, State Finance Polytechnic of STAN, South Tangerang, Banten 15222, Indonesia;*
[2] *Public Asset Management Study Program, State Finance Polytechnic of STAN, South Tangerang, Banten 15222, Indonesia.*
*Correspondence: syahrir_4121230186@pknstan.ac.id

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ABSTRACT

Background: Contract farming has emerged as a strategic mechanism to bridge market access, reduce production risks, and empower smallholder farmers in agricultural economies. However, its effectiveness varies across institutional contexts, particularly in developing countries facing market failures and power imbalances. This study aims to systematically examine the integration of state-owned enterprises (SOEs) within contract farming mechanisms to enhance agro-economic performance and sustainability. Previous studies have primarily focused on private-led contract farming models, with limited exploration of public or hybrid institutional roles, especially those owned by local governments. **Methods:** Using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) method, this study analyzes 19 peer-reviewed articles published between 2020 and 2025. Thematic synthesis is applied to identify key patterns related to institutional involvement, economic impact, and sustainability dimensions. **Findings:** The findings reveal that the integration of (SOEs) into contract farming can improve farmers' access to production inputs, ensure price stability, and support inclusive participation in the value chain, particularly when supported by clear regulatory frameworks and participatory governance. Moreover, models involving public institutions tend to align more closely with long-term sustainability goals such as environmental preservation and rural social equity. **Conclusion:** This study concludes that BUMD holds untapped potential in reshaping the governance of contract farming systems toward more equitable and sustainable outcomes. **Novelty/Originality of this article:** The novelty of this article lies in highlighting the strategic role of local public enterprises such as BUMD in agricultural contracting, an area that remains underexplored in existing literature.

KEYWORDS: SOEs; agro-economics; sustainability; contract farming.

1. Introduction

The global agricultural sector is confronted with a series of deep-seated structural challenges that undermine both environmental sustainability and farmers' livelihoods, particularly in low- and middle-income countries. Overreliance on unfettered market mechanisms frequently exposes producers to volatile price fluctuations and limits their ability to negotiate fair terms within complex supply chains (Abbasi et al., 2021; Hsieh & Luh, 2022). Climate-induced hazards such as droughts, floods, and irregular weather patterns also increase the risk of crop failures, forcing many farming households to adopt short-term coping strategies rather than investing in long-term resilience. Moreover,

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limited access to formal financing and insurance mechanisms often compels farmers to depend on informal credit systems, which are frequently characterized by high interest rates and exploitative practices. The absence of transparent and accessible market infrastructure further restricts smallholders from entering higher-value formal markets, perpetuating cycles of poverty and underinvestment in sustainable agriculture.

In Indonesia, the challenges facing smallholder farmers are even more complex and widespread. According to data from the Central Bureau of Statistics (BPS), approximately 91 percent of farmers in Indonesia are categorized as smallholders, owning less than 0.5 hectares of land (BPS, 2023). These farmers typically operate on a very limited scale and depend heavily on local middlemen, or *tengkulak*, to access markets and agricultural inputs (Satish, 2020). Without strong institutional support, such as access to cooperatives, credit facilities, or extension services, many smallholders are unable to improve their productivity or negotiate better market conditions. A closer look at the structural distribution of farmland in Indonesia further underscores this issue.

As shown in Table 1, the proportion of marginal farmers, those owning less than 0.5 hectares of land, increased from 55.95% in 2013 to 61.67% in 2023, while their share of total land ownership remained low at just 13.11%. The average landholding size for this group even declined slightly from 0.18 to 0.15 hectares over the same period. This trend reflects a worsening fragmentation of land tenure, limiting economies of scale and further entrenching structural poverty in the agricultural sector. For example, a study conducted in the Tempe Lake region of Indonesia shows that recurring floods significantly disrupt farmers' income and agricultural sustainability, despite adaptive strategies such as livelihood diversification and informal cooperatives (Amandaria et al., 2025). A comprehensive policy approach is therefore needed to enhance institutional capacity, promote inclusive value chains, and provide smallholders with greater access to financial and technological resources.

Table 1. Household farmer classification in Indonesia

Household farmer classification	2013			2023		
	Percentage of land-using farmers (%)	Percentage of land ownership (%)	Average land ownership (hectares)	Percentage of land-using farmers (%)	Percentage of land ownership (%)	Average land ownership (hectares)
Marginal farmers (<0.5 ha)	55.95	11.94	0.18	61.67	13.11	0.15
Small farmers (0.5–1.9 ha)	31.68	33.77	0.91	28.06	36.14	0.93
Medium farmers (2.0–2.9 ha)	6.21	15.80	2.18	5.54	16.78	2.18
Large farmers (>3.0 ha)	6.16	38.49	5.37	4.73	33.97	5.17

(BPS, 2023)

Although there are partnership patterns between agribusiness companies and farmers, such as the nucleus-plasma and trade-based models, their effectiveness is still largely influenced by institutional factors, price guarantees, and production efficiency (Nurjati & Wiryawan, 2023). This imbalance is further intensified by the weak local institutional structures that are supposed to support farmers' sovereignty. To address these issues, the contract farming mechanism has been introduced as a proposed solution, with the aim of improving market access, enhancing production efficiency, and increasing farmers' income (Malindretos et al., 2023; Tang et al., 2022). A study by Li & Wang (2024) in China shows that the effectiveness of contract farming is strongly determined by the organizational

model used. Integrated models involving public institutions show a more significant impact on improving green technological efficiency compared to quasi-integrated models. However, in many countries, including Indonesia, the implementation of such schemes continues to be largely driven by the private sector.

In Indonesia, there is currently no systematic approach that incorporates Regional-Owned Enterprises (BUMD) as primary actors in the implementation of contract farming, despite their strategic potential to connect smallholder farmers with fair and sustainable markets (Asian Development Bank, 2022). Existing government interventions tend to adopt a sectoral focus, prioritizing direct support through subsidies such as the distribution of agricultural machinery, as well as institutional reinforcement of village-owned enterprises (BUMDes) and farmer cooperatives. Although these initiatives are relevant, their impact on building long-term farmer autonomy and improving the governance of regional agribusiness systems remains limited (Zhang & Busck, 2025). The absence of BUMD from this framework reflects a broader underutilization of public enterprises in agricultural transformation, especially in linking upstream and downstream actors under equitable contract schemes.

Narayanan (2025) highlights that the success of contract farming is not solely dependent on the contractual arrangements themselves but significantly influenced by the presence of enabling institutions and protective mechanisms for farmers. Effective implementation requires institutions that can mediate power asymmetries, address regulatory gaps, and correct market information imbalances. In this context, BUMD hold potential to function as neutral intermediaries capable of ensuring contract fairness while fostering regional economic resilience. The current policy vacuum regarding their role suggests an urgent need for institutional innovation based on localized capabilities and governance structures tailored to regional agrarian realities.

Previous literature has generally examined the impact of contract farming on farmers' income and technical efficiency. For instance, a study in Vietnam found that although contract farmers demonstrated higher technical efficiency (96.11%) compared to non-contract farmers (88.64%), their incomes were higher even when their meta-technical efficiency was relatively lower (Huong et al., 2025). Similarly, research in Taiwan revealed that dual partnerships involving contract farming and modern distributors significantly increased smallholder farmers' income (Hsieh & Luh, 2022). However, existing studies have yet to explore in depth the integration of regional state-owned enterprises (BUMD) as institutional actors in contract farming schemes that prioritize equity and sustainability. This gap highlights the need to reframe contract farming beyond market-based mechanisms by embedding it within stronger local institutional frameworks.

This study proposes the active involvement of BUMD as third-party institutions in contract farming schemes. With adequate regulatory support and financial capacity, BUMD can serve as guarantor institutions that mediate between farmers and the market while promoting principles of transparency, sustainability, and empowerment. Such a model is expected to address market failures and the institutional deficiencies that hinder the development of a fair and resilient food system. The central assumption of this research is that the structured involvement of BUMD in contract farming schemes will: (1) strengthen the economic position of farmers; (2) enhance efficiency and value addition in regional agribusiness supply chains; and (3) contribute to the long-term transformation of the agricultural system toward sustainability.

Based on this background, the main objective of this study is to systematically review the literature on contract farming mechanisms from agro-economic and sustainability perspectives while exploring the strategic potential of BUMD in developing a fair and resilient contract farming system. To support its empirical claims, this study integrates quantitative data such as technical efficiency metrics, income ratios between contract and non-contract farmers, and comparative performance data on agribusiness partnerships involving formal institutional actors across various countries.

2. Methods

This study employs a Systematic Literature Review (SLR) to examine the role of state-owned enterprises and sustainability within the contract farming mechanism. SLR utilizes a structured and rigorous approach to synthesizing existing research, aiming to uncover and critically assess all relevant studies on specific topics. By minimizing bias, SLR provides a reliable and comprehensive overview, making it particularly valuable for identifying research gaps and establishing a solid foundation for subsequent studies, especially in this field. However, it is crucial to apply SLR with a critical perspective, acknowledging its limitations to ensure balanced and effective outcomes.

To guide the SLR process, we adopted the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology. PRISMA strengthens transparency and clarity by systematically documenting each step of the review process, from the identification of studies to final selection, thereby helping to reduce bias and enhance the completeness of the review results. PRISMA is widely recognized for improving the reliability and relevance of systematic reviews and is regularly updated to align with the latest evidence and research practices. This approach aligns with the objective of exploring the roles of state-owned enterprises and sustainability in contract farming mechanisms, as it enables a comprehensive and unbiased review of literature in this rapidly evolving domain. By systematically collecting and evaluating relevant studies, PRISMA ensures a deep and structured understanding of how the integration of state-owned enterprises and sustainability can enhance agro-economic outcomes within the contract farming framework.

Table 2. Inclusion and exclusions criteria

Inclusion	Exclusion
Include keywords “Contract Farming” AND “State-Owned Enterprises” AND “Sustainability”	Not include keywords “Contract Farming” AND “State-Owned Enterprises” AND “Sustainability”
Quantitative & qualitative	-
Publication between 2020-2025	Publication under 2020
Languange English	-

In selecting the studies, it was essential to meet the needs according to the inclusion criteria. The literature search was conducted using Publish or Perish (covering the OpenAlex, Google Scholar, Crossref, and Scopus databases). Inclusion criteria included studies published in English between 2020 and 2025 to ensure the underlying research was up-to-date, all types of studies (quantitative and qualitative), and studies that were fully available and easily accessible. Additionally, inclusion was based on a combination of the keywords “state-owned enterprises”, “sustainability”, and “contract farming”. On the other hand, studies that did not align with the P (Population), C (Concept), and C (Context) criteria were excluded from the research dataset (Table 2). In detail, the results of the selection of literature articles as research data are presented as follows:

Table 3. Literature selection process

Database	Database searching	Year deleted	Duplicate removed	Screening	Eligible	Included
Crossref	1000	1000	964	345	59	9
Google Scholar	794	220	215	45	12	2
OpenAlex	177	52	52	4	4	2
Scopus	103	59	59	20	13	4
Semantic	369	126	125	68	32	3
Total	1457	1427	1415	482	120	20

The process of literature searching is outlined using the PRISMA Flowchart, which serves as a systematic approach for identifying and screening studies across various

databases. The study selection process, which had undergone duplicate removal and exclusion based on publication year, was then followed by identification based on the inclusion criteria. Subsequently, the articles that passed the identification stage were further screened by title, abstract, and keywords to assess their eligibility. At the "eligible to be included" stage, the articles were thoroughly examined to determine their relevance to the research objectives. The suitable articles were then organized into a table containing information such as the author's name, year of publication, title, research design, results, and conclusions. The results of the final analysis and selection showed that the selected articles originated from Crossref (9 articles), Google Scholar (2 articles), OpenAlex (2 articles), Semantic (3 articles), and Scopus (4 articles).

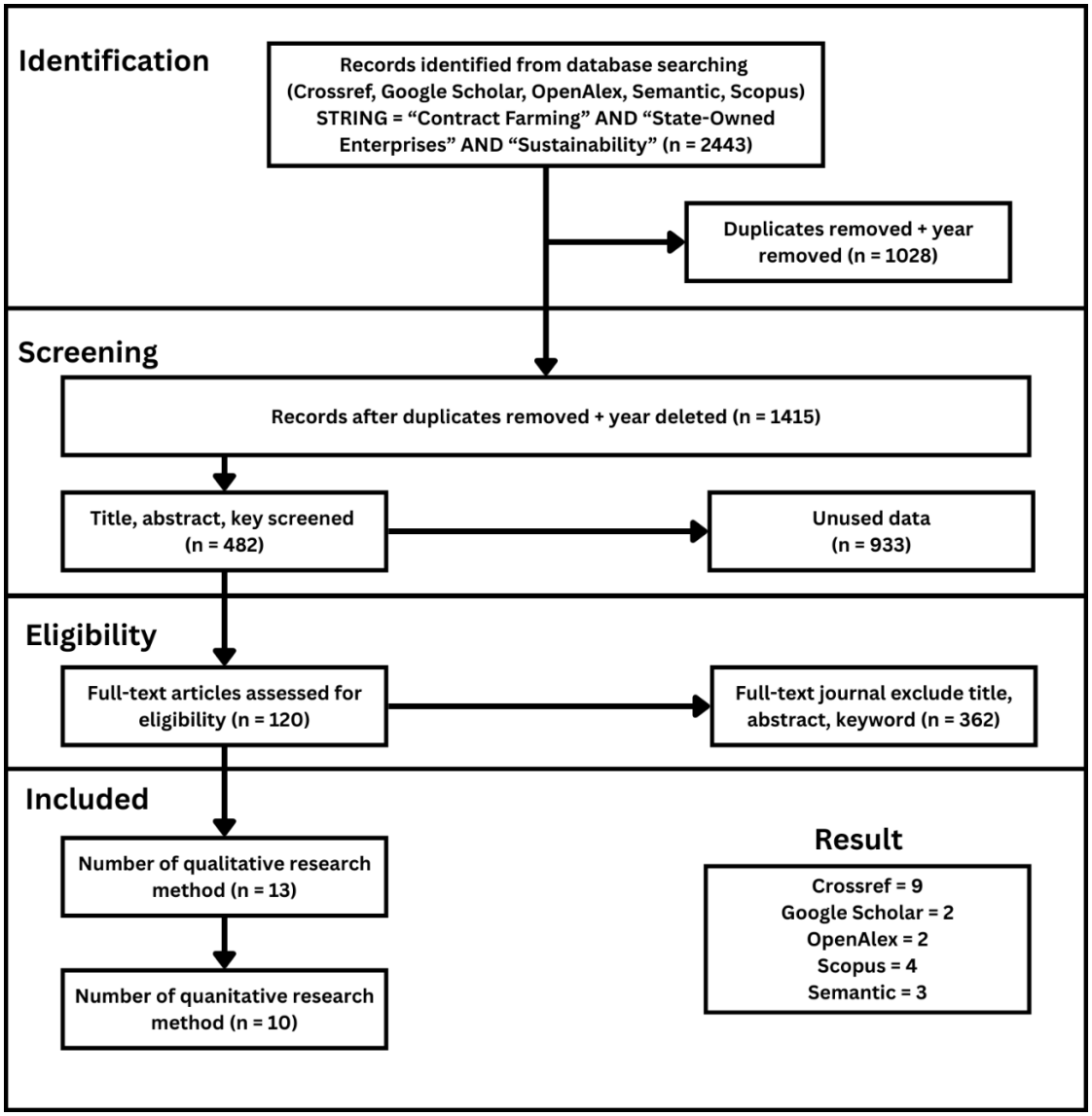

Fig. 1. PRISMA flowchart

3. Results and Discussion

3.1 Overview of selected studius

The bibliographic analysis conducted on studies concerning the integration of State-Owned Enterprises (SOEs), agroeconomics, and sustainability within the context of contract farming reveals a variety of themes and key research focuses. The largest and most central node is *contract farming*, indicating that this theme lies at the core of the research topic. Additionally, there is a strong linkage between contract farming mechanisms and

institutional aspects, as well as the transformation of the public sector through the role of SOEs.

The first major research branch concerns institutional roles and contract governance by SOEs, including government assignment schemes, hybrid organizational structures, and the strategic role of SOEs in infrastructure development and value distribution. The second branch relates to sustainability, encompassing issues such as green innovation, ecological efficiency, and the welfare of smallholder farmers. Studies also highlight the relationship between social preferences, contract incentives, and the success of partnership mechanisms in contract-based agriculture. Smaller nodes in the visualization also display subthemes such as technology adoption, access inequality, and social trust mechanisms.

A total of 20 articles were used in this analysis, selected based on thematic relevance, with a focus on the interaction between SOEs, contract farming, and sustainability in the agroeconomic sector. The selected scientific articles were those included in the OpenAlex, Google Scholar, Crossref, and Scopus databases. This study utilized only these four databases because they were available through Publish or Perish. Indonesian-specific databases (such as Garuda) were not covered, which is a limitation of this study and a potential opportunity for further research.

Table 4. Selected research articles

No.	Author (year)	Main research object	Research result
1.	(Abdulraheem & Tobe, 2022)	Examines the impact of contract farming on value chain sustainability and local farmers.	Contract farming increases income and input access, but challenges such as gender disparities and monopsony persist.
2.	(Akanbi et al., 2019)	Determines the impact of rice production on farmers and the driving/inhibiting factors of technical efficiency in contract farming.	Rice production enhances farmers' income and productivity; technical efficiency is influenced by seeds, labor, and experience, while inefficiency is affected by household size and farming experience.
3.	(Chen & Zhou, 2023)	Analyzes the impact of contract farming on the adoption of green and smart agricultural technologies in Jiangsu.	Contract farming significantly promotes the adoption of green and smart technologies, mediated by high ecological value standards and moderated by farmer income.
4.	(Dubbert et al., 2023)	Analyzes the effect of contract farming on the adoption of sustainable farming practices.	Contract farming reduces sustainability by encouraging pesticide use and discouraging conservation practices in pursuit of profit and productivity.
5.	(Gao et al., 2024)	Examines the influence of relationship strength on contract sustainability among farmers.	Trust, interaction, and reciprocity increase farmers' intention to renew contracts, with reciprocity having the strongest effect.
6.	(Hoang, 2021)	Investigates the impact of contract farming on farmers' income in Vietnam.	Short-term impact is not significant, but it alleviates farming hardships and has potential long-term positive effects.
7.	(Ikeda & Natawidjaja, 2022)	Assesses the sustainability of contract farming between smallholders and suppliers for modern retail chains.	Contracts often fail due to side-selling and weak enforcement; sustainability depends on reputation and training investment.

8.	(Indrawati, 2020)	Analyzes elements, benefits, and risks of hybridity in SOEs and its effect on corporate objectives.	SOEs are categorized as hybrid organizations: “Perum” and “Persero”, each requiring alignment with their respective characteristics and objectives.
9.	(Jarnholt, 2020)	Analyzing the implications of rice and sugar contract farming in Tanzania for exchange relations, power distribution, and differentiation.	Power asymmetries and exclusion are prevalent, with non-contract farmers often marginalized.
10.	(Li & Wang, 2024)	Compares the effects of two contract farming models on green technology efficiency.	Only the integrated model significantly improves green efficiency, while the semi-integrated model is ineffective.
11.	(Nivievskyi et al., 2023)	Analyzes the role of smallholder farmers in Ukraine’s agriculture and rural economy.	Smallholders contribute over 50% of Ukraine’s agricultural output but are constrained by policy and market barriers, requiring policy reform and infrastructure support.
12.	(Nurjati & Wiryawan, 2023)	Assesses the sustainability of contract farming patterns in the case of PT SSS in Indonesia.	Core-plasma and trade-based models improve sustainability, but require contract revision, farmer training, and adoption of environmentally friendly technologies.
13.	(Okello & Malenya, 2020)	Investigates the impact of contract management teams on supplier performance in Kenyan SOEs.	Competent and autonomous contract management teams significantly enhance supplier performance.
14.	(Onwunali et al., 2025)	Examines the impact of contract farming on livelihoods and food security among smallholders in Kubau Local Government Area.	Contract farming increases yields, reduces problem indices, and improves access to reSource compared to non-contract farmers, thus enhancing sustainable livelihoods.
15.	(Shonhe & Scoones, 2022)	Compares private and state-led contract farming schemes in Zimbabwe.	Both schemes reinforce social differentiation, with access determined by economic status and political connections.
16.	(Sinaga et al., 2022)	Analyzes the patterns and success factors of contract farming between farmers and PT Bloom Agro.	Facilities, technology, and information transparency significantly influence success.
17.	(Wang & Liang, 2022)	Designs an incentive mechanism for contract farming considering reciprocal attitude.	Reciprocal preferences of both farmers and firms enhance contract compliance and performance efficiency.
18.	(Wibowo & Putri, 2024)	Evaluates government contract assignments to SOEs for infrastructure development in Indonesia.	Assignments accelerate infrastructure development but reduce fair competition with the private sector, necessitating regulatory improvement and transparency.
19.	(Wu et al., 2023)	Develops a contract coordination mechanism to improve green innovation and agricultural supply chain stability.	The "cost-sharing + alliance fee" mechanism enhances green innovation, participant income, partnership stability, and supports green agricultural development.

20.	(Zhu & Miao, 2024)	Evaluates the sustainable management of state-owned forest land in subtropical regions.	Management is generally effective, but indicator-based mechanisms are needed to address challenges such as lack of mechanization and staff incentives.

Based on a synthesis of selected articles, the overall literature indicates that the contract farming mechanism plays a significant role in promoting production efficiency, increasing farmers' income, and integrating smallholder farmers into the agro-industrial value chain. However, several studies also highlight challenges in implementing this scheme, such as unequal contractual relationships, monopsony risks, and limitations in long-term sustainability. Globally, contract farming has been implemented in various forms, both through private schemes and state interventions, including by SOEs, which play a strategic role in infrastructure development, input distribution, and strengthening contractual compliance in the agricultural sector.

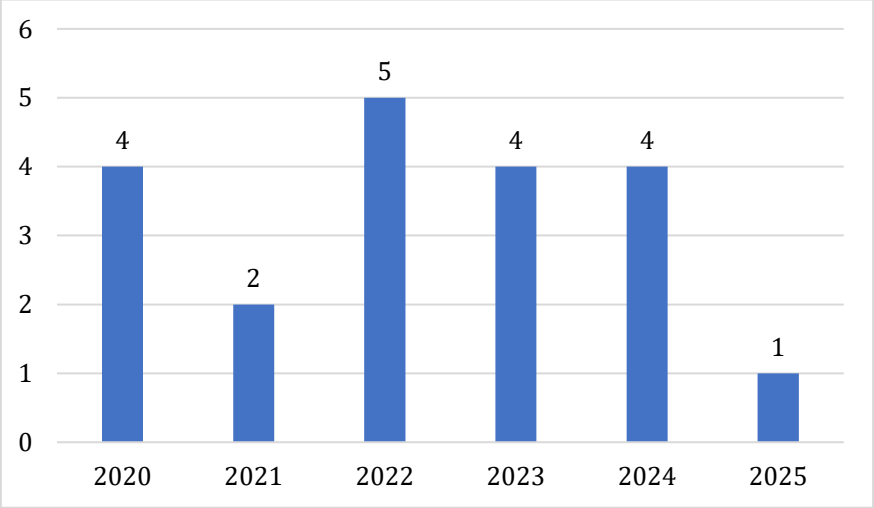

Fig. 2. Number research by year

The distribution of publication years shows a concentration of studies in 2022, followed by relatively consistent outputs from 2020 to 2024. This suggests increasing scholarly attention to the topic in recent years.

Table 5. Number of receptors in each container

Research design	Number of research
Qualitative	10
Quantitative	7
Mixed	3
Total	20

Qualitative methods dominate the reviewed literature, particularly in research related to contract farming, SOEs, agroeconomics, and sustainability. These often take the form of case studies, regulatory analysis, or fieldwork involving interviews. Quantitative studies, though fewer, frequently apply regression models and structural equation modeling (SEM). Mixed-methods research combines surveys and interviews within integrated designs.

3.2 The role of state-owned enterprises in contract farming

The implementation of contract farming is certainly inseparable from the challenges and problems faced, because basically contract farming is a relationship between two or more parties to achieve a goal (Sinaga et al., 2022). Contract farming experiences various

obstacles, not only from internal factors but also external factors. Constraints in the context of internal factors are closely related to the capabilities or abilities of farmers. The average farmer who has a low level of education is a serious challenge in achieving sustainable contract farming. Especially in understanding and practicing organic crop cultivation technology. In addition, the success of contract farming implementation is also strongly influenced by external factors. One of the most important is extreme climate change that can occur at any time (Sinaga et al., 2022).

From the various challenges and problems faced in the implementation of contract farming, efforts and innovations are needed to keep the effectiveness of contract farming in line with what is expected. That is where the crucial role of the government is needed. Through SOEs, the government can make the implementation of contract farming run well amidst various obstacles and uncertainties. There are at least several advantages of SOEs compared to private companies. First, SOEs in the infrastructure sector are better qualified than private companies so that education of farmers can be maximized. Secondly, because SOEs are involved, contracts can be executed with certainty so that farmers are protected from external uncertainties that threaten contract farming itself. Third, contract farming through StateSOEs can cut down on the bureaucratic and convoluted tender process, resulting in much lower costs (Wibowo & Putri, 2024).

There are at least three potential positive outcomes that can be generated through a contract farming scheme based on SOEs. First, SOEs generally have better technical and financial capabilities than private companies. This makes it much easier for SOEs to contribute to building the necessary infrastructure. Secondly, government-based contracting through SOEs makes the time required and procedures to be carried out faster and more effective. This effectiveness is due to the fact that the government does not need a complicated tender or bidding process. Third, the government will gain a positive impression from the public, especially by farmers, in its strategic efforts to develop the agricultural sector through SOEs. This is important in terms of increasing public trust and participation (Wibowo & Putri, 2024).

However, government-based contract farming schemes through SOEs are certainly not without loopholes, especially in the internal aspects of the SOEs themselves. Because of its enormous power, the implementation of such government-based contracts often provides room for anyone to achieve personal interests. In economics, this phenomenon is often referred to as an agency-problem that occurs due to asymmetric information between the parties involved. For example, regulations that allow SOEs to appoint subsidiaries or other companies affiliated with them to run contract farming projects without going through a competitive selection process. This will certainly be a serious challenge, because in addition to potentially causing bankruptcy to private contractors, this kind of practice will also reduce the integrity of the SOEs themselves and pave the way for greater acts of corruption (Wibowo & Putri, 2024). Such practices have occurred, among others, in the country of Zimbabwe. The country has implemented a government-based contract farming scheme. However, the contract farming implemented is closely related to political relations and patronage. As a result, input distribution is only concentrated on farmers with strong political and military connections (Shonhe & Scoones, 2022).

3.3 Agro-economic impact of contract farming

Research conducted by Onwunali et al. (2025) in Kubau LGA, Kaduna State, Nigeria, highlights yield disparities between contract and non-contract farmers. As shown in Fig. 3, contract farmers tend to dominate at higher yield levels (kg/ha), while non-contract farmers are more prevalent at medium and lower yield levels. This suggests that contract farming may be associated with higher productivity under similar land conditions.

The results also show that farmers who use contract farming experience improvements in yield and experience relatively few production problems at higher yield levels. Ultimately, the practice of contract farming improved farmers' livelihoods (Onwunali et al., 2025). Providing access to various production inputs such as seeds, fertilizers and pesticide

supplies is considered as the reason why contract farming is very profitable for farmers. In addition, observations on contract farming in Kubau LGA, Kaduna State, Nigeria also show very impressive results. Where companies or SOEs can assist with proper planting through land preparation and post-harvest handling, planting can be done efficiently. Furthermore, the application of contract farming also facilitates farmers to adapt new farming techniques with education and training in the agricultural sector (Onwunali et al., 2025).

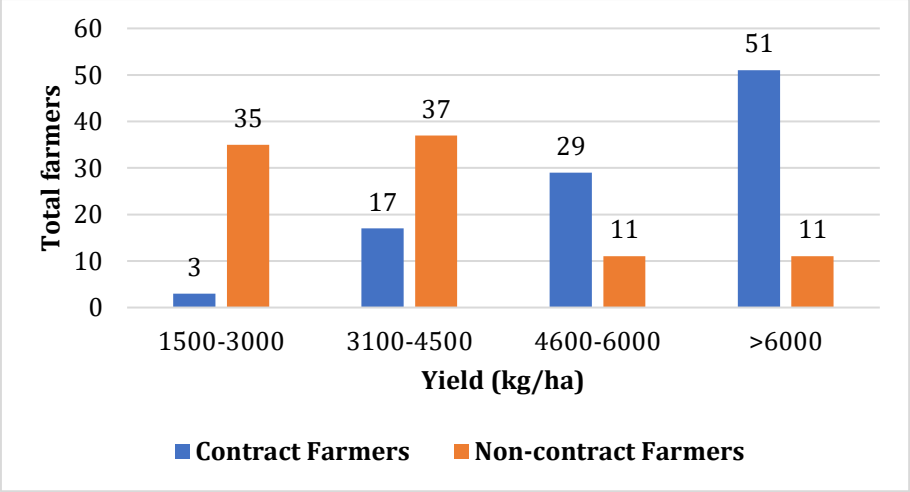

Fig 3. Relative output of contract farmers in Nigeria (Onwunali et al., 2025)

Economically, contract farming makes farmers feel that their income has increased, their selling price has also become higher with lower production costs and there is certainty regarding the sale of their products in the market. In terms of technical aspects, the implementation of contract farming has also improved farmers' knowledge and technical skills. Lastly, farmers also benefit socially because contract farming strengthens the relationship between farmers and increases their motivation to continue producing in agriculture (Sinaga et al., 2022). However, there is a slightly different impact of the implementation of contract farming in Vietnam. The impact of contract farming on income, sustainability and welfare for farmers there is divided into three stages: short-term, medium-term and long-term (Hoang, 2021).

3.3.1 Short term

At this stage, contract farming may require substantial initial investments from farmers, which include costs for adjusting farming practices, purchasing standardized inputs, and adapting to new technologies required under the contract agreement. These increased production costs, coupled with a temporary decline in productivity due to the learning curve associated with new methods, can lead to lower net incomes for farmers. Moreover, the contracted selling price of agricultural products may not significantly differ from prevailing market prices, thereby limiting immediate finansial gains. Consequently, during this early phase, many farmers may experience finansial strain or perceive the scheme as less profitable. This highlights the importance of initial support mechanisms—such as subsidies, training, and technical assistance—to help farmers transition and minimize the economic burden during the early implementation period.

3.3.2 Medium term

Although in the short term, contract farming may reduce farmers' income. There are beneficial follow-on effects, such as: wider market access, new knowledge and skills, better product quality and safety, techniques and technology, trust and support from the government (Hoang, 2021). These follow-on impacts will in turn create higher selling

points, greater production capacity and linkages in the value chain. As a result, contract farmers may achieve higher incomes. The bottom line is that the positive impact of contract farming may start to be seen in the medium term due to these knock-on effects.

3.3.3 Long-term

After a period of time, contract farmers will have a strong competitive base due to high capacity and capability (technique, knowledge, experience, technology, market information, etc.), have high quality and certified products, reduce production costs, increase total production and create high selling prices (Hoang, 2021). Simply put, contract farming will have a significant impact on income, sustainability and welfare in the long run.

3.4 Sustainability aspects in contract farming practices

Contract farming is widely recognized as a crucial mechanism for advancing sustainable agricultural development, particularly by integrating smallholder farmers into modern agri-food value chains. A well-structured contract farming model enables farmers to access markets, technology, and economic incentives that support the adoption of environmentally friendly practices, such as the use of organic fertilizers and natural pesticides (Li & Wang, 2024). By delivering productive services, contract farming arrangements also encourage land consolidation and improve production efficiency, thereby enhancing resource efficiency and reducing waste (Gao et al., 2024). In practice, price incentive schemes and technical assistance offered by contracting firms further strengthen the transition toward environmentally and socially sustainable agriculture.

However, the extent to which contract farming contributes to sustainability is highly dependent on its institutional design and practical implementation. Without adequate oversight, contractual arrangements risk reinforcing opportunistic behavior or deepening power asymmetries between farmers and agribusiness actors (Nurjati & Wiryawan, 2023). The success of contract farming in promoting sustainability also varies significantly across contexts, influenced by factors such as commodity type, contract structure, and the strength of institutional support systems (Dubbert et al., 2023). Consequently, the sustainability benefits of contract farming should not be regarded as inherent but are contingent upon effective governance, appropriate incentive mechanisms, and the meaningful involvement of farmers in decision-making processes.

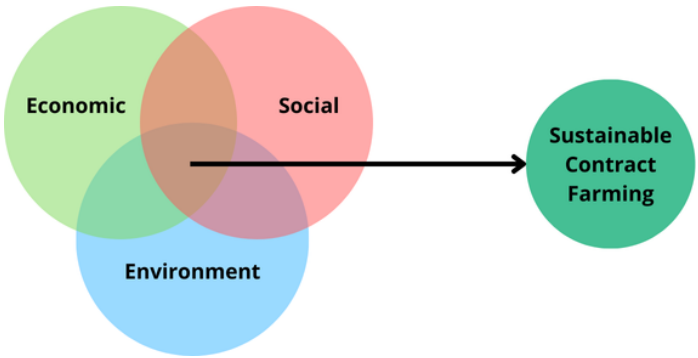

Fig.4. Sustainability diagram

Sustainability within the contract farming system itself encompasses three core dimensions: environmental, social, and economic.

3.4.1 Environmental sustainability

Contract farming presents considerable potential for fostering environmentally sustainable agricultural practices. In Ghana, participation in contractual arrangements has

been associated with a higher likelihood of adopting soil and water conservation techniques, as well as intercropping systems, among cashew farmers (Dubbert et al., 2023). Similar trends are evident in China, where contract farming increases the probability of organic fertilizer adoption by 50.7% among vegetable growers (Gao et al., 2024). In the Indonesian context, agreements between sugar mills and farmers have included provisions to restrict the use of chemical fertilizers and pesticides, thereby supporting environmental preservation goals (Nurjati & Wiryawan, 2023). These cases highlight that the environmental outcomes of contract farming are closely shaped by contract design and the presence of robust collective oversight mechanisms.

3.4.2 Social sustainability

The social dimension of sustainability in contract farming encompasses the empowerment of marginalized groups, the promotion of inclusivity, and the reinforcement of social networks. In the palm oil sector, the absence of transparency and equitable benefit-sharing in contract farming arrangements has been shown to generate social tensions and conflict (Nurjati & Wiryawan, 2023). Conversely, contract farming models that are rooted in social enterprise principles tend to enhance social welfare by fostering reciprocal and mutually beneficial relationships between farmers and agribusiness firms. In the Ghanaian context, the willingness of farmers to renew contracts has been found to depend largely on the strength of social ties and the degree of mutual trust among stakeholders—key components of what is referred to as relational sustainability (Dubbert et al., 2023). These findings suggest that social outcomes in contract farming are shaped not only by formal institutional structures but also by the quality of interpersonal and community-level interactions.

3.4.3 Economic sustainability

From an economic standpoint, numerous studies have demonstrated that contract farming can improve farmers' incomes and production efficiency. In China, both production and marketing contracts have been found to significantly raise farmers' earnings. Similarly, in Ethiopia, contract farming has contributed to asset accumulation among barley producers by facilitating better access to markets and financial services (Li & Wang, 2024).

Table 6. Sustainability Indicator

Aspect	Implications	Indicators
Environmental	Reduces soil degradation and improves soil health.	Organic input adoption: 40–55%
	Promotes eco-friendly pest control practices.	Pesticide use reduction: 10–25%
	Improves irrigation efficiency and conserves natural reSource.	Water-saving technology adoption: up to 20% farms
Economic	Improves household financial stability.	Avg. income increase: +18–35%
	Enhances productivity and market efficienc.	Yield increase per hectare: +15–30%
	Reduces market vulnerability for smallholders.	Price fluctuation reduction: 10–25%
Social	Supports gender inclusion (especially for women.	Women farmer participation: 35–50%
	Promotes generational regeneration in agriculture.	Youth engagement rate: 30–45%
	Enhances trust and cooperative contract compliance.	Farmer satisfaction index: >70%

(Chen & Zhou, 2023; Dubbert et al., 2023; Gao et al., 2024; Li & Wang, 2024; Nurjati & Wiryawan, 2023)

However, the adoption of environmentally sustainable technologies within these contractual frameworks does not always lead to immediate economic gains, particularly when the associated input costs outweigh short-term revenues. As such, contract designs that incorporate risk-sharing mechanisms and offer long-term economic incentives are critical to fostering sustained economic viability for participating farmers.These implications are inherently associated with measurable indicators. Indicators serve as the basis for evaluating the outcomes of each dimension of sustainability. These indicators can be categorized quantitatively, as illustrated in the following table. Ultimately, the sustainability of contract farming practices depends heavily on how well environmental, social, and economic objectives are integrated into the contractual framework. While empirical evidence confirms positive outcomes such as increased farmer income, greater inclusion of marginalized groups, and adoption of eco-friendly inputs, these benefits are not guaranteed in all settings. The effectiveness of sustainability outcomes is shaped by contract design, governance quality, and institutional support—particularly when state-owned enterprises or public actors are involved. Therefore, to maximize the long-term sustainability of contract farming, a multi-dimensional approach is essential—one that aligns financial incentives, participatory governance, and environmental stewardship within a coherent institutional system.

3.5 Proposed integrated model for sustainable contract farming

Contract farming has become an important instrument in bridging the relationship between farmers and markets, while also serving as a means to sustainably increase agricultural productivity. However, various studies show that the success of this scheme largely depends on institutional structures, access to capital and technology, and the clarity of contracts that favor smallholder farmers. In developing countries like Indonesia, market-based contract farming alone has yet to create significant leverage for improving farmers' welfare. Therefore, a model is needed that not only regulates buying and selling mechanisms but also ensures sustainability from social, economic, and environmental perspectives.

The integrated model proposed in this study is an institutional and operational design that combines the role of the state through government-owned enterprises, agricultural business actors, and farming communities. This approach aims to strengthen the position of smallholder farmers in the agricultural value chain through fair and transparent contract systems. Moreover, the model is designed to improve production efficiency, encourage the adoption of green agricultural technologies, and create protection mechanisms against climate risks and price volatility. By combining principles of economic justice and good governance, this model is expected to serve as a framework for structural reform in sustainable agricultural development. This model is based on a partnership between three main actors: smallholder farmers as the primary producers and beneficiaries; SOEs/Regional or Village-Owned Enterprises (BUMD/BUMDes) as contract managers and market intermediaries; and local and central governments as providers of regulations, funding, and oversight. The key to the model's success lies in the simultaneous integration of economic incentive systems, institutional capacity building, and the implementation of sustainability standards.

Fig. 5 Sustainable contract farming model

To explain the mechanism of this policy model, there are several basic concepts that need to be understood to clarify first.

3.5.1 Policy funding scheme

The policy funding scheme refers to the allocation of financial resources to support the implementation of contract farming. These resources may come from the State Budget (APBN), regional budgets (APBD), or be mobilized through public-private partnerships and financing institutions focused on agricultural development. As discussed by Cohen et al. (2017), public financing plays an essential role in expanding the reach of agricultural production contracts. This scheme is designed to cover capital needs and provide financial facilities for farmers, whether in the form of loans, working capital, or subsidies.

In the context of training and certification, funding is primarily provided by the government, through national or regional agricultural extension programs. In many cases, the government collaborates with SOEs or private companies that act as off-takers, forming cost-sharing arrangements for training programs. These programs are vital for preparing farmers to meet production and quality standards set in the contracts.

3.5.2 Mapping the role of SOEs in contract farming

SOEs, including BUMN, BUMD, and BUMDes, serve as strategic intermediaries in contract farming schemes. Their function is not only to act as off-takers but also to connect small farmers to broader markets. These enterprises can operate more flexibly than public institutions and are better equipped to handle business operations under commercial terms. To address agency problems often found in BUMD operations, governance mechanisms such as performance-based contracts, independent supervision, and transparency obligations are applied. Clear separation of commercial and social mandates is necessary to ensure their dual role as development agents and profit-driven entities does not conflict. With appropriate institutional arrangements, BUMD can become credible partners in agricultural transformation by aligning their operational incentives with public service goals (Nasution & Sirait, 2018).

3.5.3 Fair contract mechanism

A fair contract mechanism ensures that agreements between farmers and SOEs are equitable and legally enforceable. The contents of such contracts include a transparent formulation of rights and obligations, fair pricing formulas that may be indexed to market prices, and clear payment terms. Down payment schemes at the beginning of the contract period are included to help farmers access working capital. Risk-sharing clauses are also inserted to provide compensation for losses due to weather, pest outbreaks, or market price drops.

Importantly, legal enforceability is ensured through contract notarization, oversight by local authorities, and access to formal dispute resolution mechanisms, including arbitration or agricultural courts. In cases of contract violations, such as non-payment, breach of delivery quantity, or manipulation of product quality, sanctions include financial penalties, removal from future program participation, and, in severe cases, legal prosecution under civil contract law (Qian & Olsen, 2022).

3.5.4 Provision of infrastructure and supporting facilities

Infrastructure and support facilities are crucial to reduce production costs, improve logistics, and enhance market access for farmers. These include irrigation systems, storage warehouses, transportation links, and digital platforms for monitoring. Infrastructure investments are typically the responsibility of the central and regional governments, but SOEs and private partners may also contribute through capital expenditure or joint ventures. For example, Sinaga et al. (2022) showed that the collaboration between PT Bloom Agro and the Bangkit Berbabu farmer group was significantly enhanced by the provision of integrated technology infrastructure. With better facilities, contract

implementation becomes smoother and more efficient, benefiting both producers and aggregators.

3.5.5 Capacity building and training for farmers

Capacity-building efforts are focused on equipping farmers with knowledge and practical skills in sustainable agricultural practices, financial management, and contract compliance. These programs are delivered through agricultural extension offices and are often supported by educational institutions or development agencies. Three methods have proven particularly effective: experiential learning through field demonstrations, increased organizational capacity within farmer groups, and diversification of farming and financial risks. The government, in coordination with BUMD or BUMDes, often takes the lead in organizing these programs, while co-financing schemes with private agribusiness partners increase program reach and sustainability.

3.5.6 Incentive schemes to support sustainability

Incentive mechanisms are designed to promote environmentally friendly and economically viable farming practices. Farmers who adopt organic fertilizers, crop rotation systems, or soil conservation techniques may receive benefits such as price premiums, certification subsidies, or preferential access to future contracts. The goal is to encourage long-term behavior change that maintains land productivity and ecosystem health. Assessment of farmers' eligibility for incentives is conducted by extension agents or third-party monitors. Compliance is reviewed periodically, and results are linked to incentive disbursement. This linkage ensures that farmers are rewarded for practices that align with broader sustainability goals.

The success of a sustainable contract farming model depends not only on the structure of participating actors but also on the quality and responsiveness of the implementation stages. Past program failures have often stemmed from institutional and technical unpreparedness, and from the absence of localized, phased strategies. This model adopts a four-stage development cycle—starting from financing and preparation, moving through implementation and coordination, followed by monitoring and evaluation, and ending with enforcement and incentivization. Each stage is designed to respond to real-world challenges, ensuring that the contract farming ecosystem remains inclusive, legally robust, and adaptable to local conditions.

Table 7. Stage of sustainable contract farming model

Stage	Description
1	Habituation, classification, and initial contract
2	Provision of infrastructure, technology, and training
3	Certification and long-term contract
4	Evaluation, risk management, and product diversification

3.5.6.1 Stage 1: Habituation, classification, and initial contract

Farmers are provided with comprehensive education on the contract farming system, along with a down payment scheme to secure initial capital. Regional SOEs classify farmers based on commodity type, business scale, and technological readiness, which serves as the foundation for further development. Contracts are drafted with principles of fairness and flexibility, and include harvest-based incentives.

3.5.6.2 Stage 2: Provision of infrastructure, technology, and training

Regional SOEs, in collaboration with the government, provide facilities such as agricultural equipment, digital access, and water-efficient irrigation. These facilities are

distributed through a performance-based lending scheme: farmers who meet sustainability standards within a certain period will receive the facilities as grants. Intensive training covers precision farming, financial management, and environmentally friendly practices.

3.5.6.3 Stage 3: Certification and long-term contract

Farmers who meet quality and sustainability criteria will receive product and process certification, thereby gaining access to premium and export markets. The regional SOEs then establish long-term contracts (3–5 years) with fixed base prices, price index schemes, and income protection for farmers. Certifications cover environmental aspects, food safety, and product quality.

3.5.6.4 Stage 4: Evaluation, risk management, and product diversification

Periodic evaluations are conducted with local governments to assess production effectiveness and contract compliance. Climate and price risks are mitigated through agricultural insurance, crop diversification, and the channeling of unsellable products to village-owned enterprises (BUMDes) for processing into derivative products. Monitoring includes quality audits and digital-based harvest reporting.

In designing a sustainable contract farming model, foundational principles are needed to guide every stage of implementation. These principles are not only normative but also operational, as they influence policy direction, contract design, and interactions among actors within the system. An effective model must be able to address structural challenges in national agriculture while providing tangible incentives for farmers to participate actively. Therefore, the basic principles of this model encompass five main dimensions: institutional, economic, social, environmental, and market.

Table 8. Dimension and strategic description

Dimension	Strategic description
Institutional	SOEs function as intermediaries between farmers and the market through formation of contract farming schemes, facilitation of access to cooperatives and extension services, and coordination with relevant institutions
Economic	Financial incentive schemes, equipment subsidies, and price guarantees to increase income
Social	Inclusion of young and female farmers, strengthening cooperatives, and classification based on potential
Environmental	Organic certification, efficient irrigation, reduction of pesticide use, and green technology.
Market	Opening access to export markets through standardization and digital logistics integration

Each dimension functions as a framework for formulating comprehensive strategies and policy interventions. The institutional dimension governs governance and the roles of actors, while the economic dimension focuses on creating incentives and production efficiency. The social aspect emphasizes the empowerment of vulnerable groups and strengthening farmer community networks, whereas the environmental dimension ensures that the entire production process considers ecosystem carrying capacity. Lastly, the market dimension highlights the need to integrate farmers into modern value chains to create equitable access to distribution, pricing, and demand.

These principles are interconnected and mutually reinforcing, so implementation in one dimension positively influences the others. By adopting this multidimensional approach, the proposed integrated model is expected not only to address issues of efficiency and productivity but also to contribute to the transformation of national agriculture toward a resilient, equitable, and sustainable food system. These principles will be further elaborated as implementable strategies adaptable to local conditions and regional policies.

The Integrated Sustainable Contract Farming Model is expected to significantly increase farmers' productivity by around 20–30% through intensive technology transfer and training. This estimate is a rough projection based on trends observed in previous studies and pilot programs that implemented similar integrated models in smallholder farming contexts. With the introduction of precision farming technology, modern equipment, and access to digital information, farmers can optimize the use of resources such as water and fertilizers more efficiently. Continuous training also enhances farmers' business management skills, enabling them to manage production and finances more professionally. A productivity increase within this range is considered significant because it can substantially improve farm profitability, strengthen household resilience through more stable income, and promote environmentally efficient practices by reducing input waste. This impact will improve crop yields while reducing technical errors that have been common challenges in small-scale farming.

Furthermore, the model guarantees farmers' income certainty through long-term contracts that provide fixed base prices and price protection schemes adaptable to market fluctuations. Initial financing schemes and performance-based access to agricultural tools reduce capital burdens, allowing farmers to start their businesses with lower financial risks. Agricultural insurance is also a key instrument to mitigate risks of crop failure due to climate or pest attacks, offering financial protection that maintains business stability. With product certification and access to export markets, local farmers' products gain stronger competitiveness, opening up opportunities for increased income and sustainable business development.

Overall, this model offers a holistic approach that integrates institutional, economic, social, and environmental aspects into an inclusive and sustainable agricultural system. The role of SOEs/BUMDs as market intermediaries and contract managers strengthens institutional frameworks that support smallholder farmers. With appropriate policy support, public funding, and active community participation, the model not only contributes to national food security but also drives the transformation of Indonesian agriculture into a more modern and globally competitive sector. Successful implementation of this model is expected to serve as a replicable example across various regions with diverse local conditions.

4. Conclusions

This study concludes that contract farming is an effective mechanism for enhancing agricultural production efficiency, increasing smallholder farmers' income, and integrating them into agribusiness value chains. The scheme enables farmers to access broader markets, agricultural inputs, and modern farming technologies. However, the effectiveness of contract farming largely depends on its institutional design and the distribution of roles among participating actors. In many developing countries, including Indonesia, contract farming remains heavily dominated by the private sector, while the involvement of public institutions is still limited and fragmented. One of the key contributions of this study is the identification of Regional-Owned Enterprises (Badan Usaha Milik Daerah or BUMD) as strategic yet underexplored actors in the development of a more equitable and sustainable contract farming framework. Unlike State-Owned Enterprises (BUMN) at the national level, whose roles in agricultural value chains have been relatively well-documented, the involvement of BUMD has received limited academic and policy attention. This gap is particularly striking given the institutional proximity of BUMD to local farming communities and their potential to serve as accessible, responsive intermediaries. The role of BUMD in contract farming can include functioning as contract managers, infrastructure developers, aggregators, and market linkers. Their technical, financial, and managerial capacities often surpass those of smallholders or informal cooperatives, making them well-positioned to reduce transaction costs, enforce fair contracts, and stabilize farm gate prices. This study finds that a BUMD-based model could address several persistent structural issues in the agricultural sector, such as unequal access to production inputs, price volatility,

and low adaptive capacity to climate-related risks. Moreover, through such a model, farmers may gain access to training, climate-resilient technologies, minimum price guarantees, and insurance protection.

To realize this potential, strong institutional and regulatory support is required. Policymakers are advised to consider revising the legal framework governing BUMD, particularly Law Number 23 of 2014 concerning Regional Government, to clarify and strengthen BUMD's mandate in public service-oriented agricultural ventures. In addition, the government should provide fiscal incentives for BUMD that implement inclusive and sustainable contract farming schemes, such as tax relief, matching grants, or preferential access to agricultural infrastructure funds. These policy instruments would encourage local governments and BUMD to actively participate in addressing food security and rural development goals. Nevertheless, the involvement of BUMD is not without challenges. Issues such as governance quality, potential conflicts of interest, and the politicization of BUMD operations must be addressed through robust oversight, transparent partner selection mechanisms, and performance-based evaluation systems. Without these safeguards, the risk of inefficiency, rent-seeking behavior, or elite capture may undermine the intended developmental impact.

In conclusion, this study proposes an integrated contract farming model in which farmers, BUMD or BUMDes, and the government serve as the principal actors in transforming the agricultural sector toward greater competitiveness and sustainability. The model emphasizes fairness in contractual relations, production efficiency, environmental sustainability, and social inclusion, especially for marginalized groups such as women and young farmers. By integrating five core dimensions—institutional, economic, social, environmental, and market-related—the model aims to respond to the structural constraints of agricultural development in Indonesia. With appropriate regulatory reforms, fiscal incentives, and locally tailored implementation strategies, this model holds significant promise for replication and scaling across diverse regional contexts in Indonesia.

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Biographies of Authors

Syahrir Akbar, State Financial Management Study Program, State Finance Polytechnic of STAN, South Tangerang, Banten 15222, Indonesia.

- Email: syahrir_4121230186@pknstan.ac.id
- ORCID: N/A
- Web of Science ResearcherID: N/A
- Scopus Author ID: N/A
- Homepage: https://scholar.google.com/citations?user=4Nk3iQQAAAAJ&hl=id

M. Nanda Rakha Pradana, State Financial Management Study Program, State Finance Polytechnic of STAN, South Tangerang, Banten 15222, Indonesia.

- Email: nanda_4121230286@pknstan.ac.id
- ORCID: N/A
- Web of Science ResearcherID: N/A
- Scopus Author ID: N/A
- Homepage: N/A

Aulia Rahma, State Financial Management Study Program, State Finance Polytechnic of STAN, South Tangerang, Banten 15222, Indonesia.

- Email: aul_4121230348@pknstan.ac.id
- ORCID: N/A
- Web of Science ResearcherID: N/A
- Scopus Author ID: N/A
- Homepage: N/A

Nindya Fadhila Rahmah, Public Asset Management Study Program, State Finance Polytechnic of STAN, South Tangerang, Banten 15222, Indonesia.

- Email: nindya_4111230104@pknstan.ac.id
- ORCID: N/A
- Web of Science ResearcherID: N/A
- Scopus Author ID: N/A
- Homepage: https://id.linkedin.com/in/nindyarahmah