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Presenting Farmers' Welfare through the Agricultural Innovation System (AIS): A Case Study of the Harvest Moon CSR Program by PT PLN Indonesia Power UBP Banten 3 Lontar

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Abstract. This study aims to explore the implementation of the Agricultural Innovation System (AIS) within the HARVEST MOON CSR program of PT PLN Indonesia Power UBP Banten 3 Lontar, as well as its effectiveness in enhancing the welfare of honey pumpkin farmers in Tangerang Regency, particularly in Lontar Village. The research employed a qualitative method with a case study approach. Data collection techniques included interviews, internal CSR documents, and relevant literature sources. Data analysis was conducted using thematic analysis techniques to map the dimensions of AIS implementation. The findings indicate that the implementation of the Agricultural Innovation System (AIS) in the HARVEST MOON CSR program has successfully improved the welfare of honey pumpkin farmers, as evidenced by an increase in harvest productivity of 960 kg/year (2023–2024) and the lifting of four members of Tim Kreatif Desa Lontar out of poverty. The success of the HARVEST MOON program is supported by the integration of three main AIS dimensions: (1) the integration of agricultural technology innovation, including the use of planting media based on FABA waste and seashells, seed fusion methods as a response to the climate crisis, and crop maintenance technologies; (2) institutional strengthening through the issuance of decrees and capacity-building training for the Tim Kreatif Desa Lontar; and (3) synergy among actors (farmers, academics, village government, and the private sector), successfully realized through mechanisms of translation, alignment, and enrollment.

Keywords: *Farmers' Welfare, Agricultural Innovation System (AIS), Corporate Social Responsibility (CSR), PT PLN Indonesia Power, Harvest Moon Program.*

A. INTRODUCTION

The ongoing global climate change has shown increasingly serious impacts on agricultural conditions in Indonesia. Tarigan et al. (2024) state that climate change has had direct implications for agricultural productivity, particularly staple crops. This is consistent with the findings of Sihombing (2023), who explains that climate change (towards a climate crisis), characterized by prolonged La Niña or El Niño events, has demonstrably reduced crop productivity and harvest quality. According to Sulaminingsih et al. (2024), three symptoms of climate change affect the decline in agricultural productivity, including: (1) abnormal temperature changes, (2) shifting rainfall patterns, and (3) extreme weather. Quoting the Intergovernmental Panel on Climate Change (IPCC) in Kristvik et al. (2019), it is predicted that by 2060 global temperatures will rise by 0.6–2.5°C. Such abnormal increases in air temperature will certainly affect plant physiology (from photosynthesis to respiration) and accelerate the rate of evapotranspiration, causing plants to lose water more rapidly and face risks of water stress (Simamora et al., 2024). Changes in rainfall patterns also have a significant impact on reduced productivity, particularly in staple crops. As is well known, staple crops are highly dependent on sufficient water availability (neither excessive nor deficient). Prolonged droughts can lead to water deficits, hindering nutrient absorption by plant roots (Sitompul et al., 2024). Conversely, excessive rainfall and extreme weather events may result in

waterlogging (even flooding), which can increase the spread of pests and diseases while reducing yields.

Climate change conditions that negatively impact crop productivity will ultimately have significant implications for farmers' welfare, in the form of declining economic quality and social challenges. In Demak Regency, for instance, a survey by Zuhri et al. (2024) of 248 rice farmers reported that farmers became vulnerable to poverty due to decreasing income (approximately 23.91%) during climate change impacts, prolonged droughts and extreme rainfall. Not only in Demak, Sartika et al. (2024) in Bulukumba also reported that rice farmers' household income decreased significantly when rainfall and planting seasons were unstable. The increasingly uneconomic state of agriculture reduces rural employment opportunities and drives forced urbanization, potentially exacerbating open unemployment rates in urban areas (Masud et al., 2024). Young farmers choose to abandon farming and seek jobs in the non-agricultural sector, which they consider more profitable. On the other hand, the social lives of farmers have also changed after being affected by climate change. For example, farmers now exhibit a high degree of local social dependency, relying heavily on their non-farming family networks simply to survive in managing their land or rice fields (Yuliana & Aryawan, 2024). Capital that is often disproportionate to crop maintenance costs and harvest outcomes makes family social networks the primary option for borrowing money and sustaining livelihoods while hoping for more optimal yields in the next harvest. Furthermore, smallholder farmers with relatively limited resources (gurem) are also facing mental stress and a decline in social security (Sulaiman & Nurhaliza, 2023). Quoting Handayani (2022), farmer households affected by climate change are at risk of altered consumption patterns due to crop failures, which may lead to malnutrition or undernutrition among their children. These figures and data clearly indicate that the welfare of Indonesian farmers is increasingly concerning unless innovations are introduced into the agricultural system.

Considering the complexity of problems caused by climate change, the implementation of the Agricultural Innovation System (AIS) is key. Yongabo et al. (2021) reveal that AIS is a system and an innovative approach regarding how various stakeholders, including farmers, build an ecosystem capable of generating, disseminating, and utilizing knowledge to respond to complex issues in the agricultural sector, including climate variability, policies, and governance. Innovations introduced through technology and knowledge transfer from AIS implementation can serve as an alternative solution to farmers' socioeconomic challenges, as the resulting crop varieties are capable of adapting and withstanding droughts or floods, maintaining soil quality, and creating efficiency in irrigation systems (Abdoulaye et al., 2024). González-Ramírez et al. (2023) add that AIS implementation can address climate change conditions because, in practice, it supports emission reduction through technological and environmentally friendly policy innovations such as fertilizer efficiency, agroforestry, and regenerative agriculture. Furthermore, Aerni et al. (2015) explain that AIS is highly suitable for implementation in tropical countries that have many crop varieties, including horticulture. He also argues that, fundamentally, AIS is not only about technology but also about institutions, market access, regulations, and interactions among actors (researchers, farmers, the private sector, and government), so that the innovation system transferred through extension, education, or policy can function effectively. When the innovation system operates effectively, farmers' welfare and social stability will be able to endure amidst the threats of climate change.

Building upon this, PT PLN Indonesia Power UBP Banten 3 Lontar seeks to promote farmers' welfare (particularly honey pumpkin farmers) in Tangerang Regency through the application of AIS concepts and principles in the form of a CSR program called HARVEST MOON (Harnessing Agriculture Resources via Versatile and Efficient Sustainable Technologies). HARVEST MOON is a community empowerment program managed by a

group of middle-aged youth (Tim Kreatif Desa Lontar) solution to the threats of climate change that cause declining farm productivity and crop failure. The program began with knowledge sharing between the community (farmers) and the company to align the interests of both parties. It was then followed by the provision of seeds and farming tools to farmers, as well as the utilization of company assets in the form of vacant land for honey pumpkin farming activities. According to the SROI Report of PT PLN Indonesia Power UBP Banten 3 Lontar (2024), in 2024, an increase in the welfare of honey pumpkin farmers was recorded due to higher yields in each harvest cycle, as a result of successful technological innovations such as seed fusion and the use of FABA planting media and seashells. The program is scheduled to conclude in 2026, focusing on the primary goal of developing a supply chain system for the distribution of agricultural products.

Therefore, this study aims to examine in greater depth how the Agricultural Innovation System (AIS) is implemented in the HARVEST MOON CSR program and its effectiveness in enhancing the welfare of honey pumpkin farmers in Tangerang Regency, particularly in Lontar Village. Using the case study method, this research is expected to contribute to the enrichment of academic literature related to the urgency of AIS implementation in supporting farmers' welfare amid declining agricultural productivity caused by climate change. Moreover, the findings of this study are also expected to have practical implications for the development of innovative agricultural system implementation, thereby serving as a feasible alternative to be adopted and replicated by other regions in Indonesia in responding to farmers' socioeconomic issues due to the climate crisis.

B. METHODS

This research employed a qualitative method with a case study approach. Yin (2018) stated that a case study is an appropriate approach to examine contemporary phenomena within real-life contexts, particularly when the boundary between the phenomenon and the context is not entirely clear. This approach is relevant for understanding the dynamics of the implementation of the Agricultural Innovation System (AIS) in the HARVEST MOON CSR program, which focuses on enhancing the welfare of honey pumpkin farmers amidst the challenges of climate change. Furthermore, according to Baxter & Jack (2016), the case study approach in qualitative research is chosen because it allows researchers to conduct in-depth exploration through various data sources, thereby capturing multi-perspective insights holistically. This is crucial in the context of AIS, as the agricultural innovation system involves a diverse network of actors, including farmers, companies, research institutions, and the government, who collectively form innovation mechanisms to improve agricultural resilience and productivity.

Primary data were obtained through in-depth interviews and participatory observation, while secondary data were collected from CSR program documents of PT PLN Indonesia Power UBP Banten 3 Lontar as well as academic literature on AIS, farmers' welfare, and climate change adaptation. Data analysis was conducted using thematic analysis (Clarke & Braun, 2017), which facilitated the categorization of data into key themes, thereby producing a systematic and in-depth understanding. Data validity was maintained through source and technique triangulation, ensuring that the research findings are academically accountable (Flick, 2018). By employing the case study approach, this study is expected to provide both empirical and conceptual contributions regarding the role of AIS in improving farmers' welfare while also serving as an adaptive strategy to the impacts of climate change.

C. RESULTS AND DISCUSSION

HARVEST MOON (Harnessing Agriculture Resources via Versatile and Efficient Sustainable Technologies) is a community empowerment initiative in the agricultural sector that integrates the use of technology and the management of non-hazardous waste. The program was initiated by PT PLN Indonesia Power UBP Banten 3 Lontar as a form of social and environmental concern amidst the conditions of climate change that have led to declining agricultural productivity in Tangerang Regency. According to the SROI report (2023) of UBP Lontar, the origins of this program date back to 2021 through a collaborative process between the company and Kelompok Wanita Tani (KWT) Agria Lestari in Klebet Village, Kemiri District, Tangerang Regency. Seeing positive results, in the following year (2022), the activities were expanded and replicated to target productive-age youth who were either unemployed or had no permanent jobs. They then gathered under Tim Kreatif Desa Lontar, located in Lontar Village, Kemiri District, Tangerang Regency, Banten. Through the establishment of Tim Kreatif Desa Lontar in 2025, PT PLN Indonesia Power UBP Banten 3 Lontar has focused on its vision of improving the welfare of honey pumpkin farmers by transforming Tangerang Regency into a center for honey pumpkin cultivation and a hub for community learning through agricultural edutourism activities. To reinforce this vision, PT PLN Indonesia Power UBP Banten 3 Lontar and the Tim Kreatif Desa Lontar implemented the Agricultural Innovation System (AIS) as a key solution.

The concept of the Agricultural Innovation System (AIS) is fundamentally rooted in the theory of the National Innovation System (NIS) developed by Christopher Freeman in the late 1980s. Freeman (1987), in his work Technology Policy and Economic Performance: Lessons from Japan, emphasized that innovation is not a linear process but the result of interactions among various public and private institutions in generating, disseminating, and utilizing technology. This idea was further enriched by Lundvall (1992) and Nelson (1993), who underscored the importance of actor networks, policies, and institutional contexts in driving innovation. In the agricultural context, this idea was adapted into Agricultural Knowledge and Information Systems (AKIS) in the early 1990s by Röling and Engel. They emphasized that agriculture does not rely solely on formal research but also on knowledge networks involving farmers, extension workers, research institutions, and other actors in the processes of decision-making and problem-solving (Röling & Engel, 1991). AKIS thus became the initial foundation for the AIS concept, highlighting the importance of integrating local and scientific knowledge to support agricultural innovation.

As the concept evolved, international institutions such as the World Bank (2012) legitimized AIS through the publication Agricultural Innovation Systems: An Investment Sourcebook. This document emphasized that AIS encompasses networks of organizations, companies, individuals, as well as institutions and policies that collectively contribute to producing new products, new processes, and new organizational forms applied in social and economic practices. Consequently, AIS is regarded as an evolution of the NIS and AKIS concepts, offering a more comprehensive framework that emphasizes the roles of diverse actors, institutions, policies, and learning processes in addressing agricultural challenges, including climate change. In recent studies on AIS implementation, Mustapit et al. (2025) demonstrated that farmers' behavior and innovation capacity in Yogyakarta are strongly influenced by both internal farmer factors and external support, such as farmer groups, extension services, and the government, all of which are analyzed within the AIS framework. Similarly, Hidayati et al. (2025) found that the adoption of agricultural technologies in Indonesia is often hindered by limited access to information, weak institutional structures, and poor coordination among stakeholders. They therefore stress the need for a systemic AIS-based approach to ensure that innovation produces tangible impacts. Meanwhile, Witjaksono et al. (2020) studied regional agricultural development in Southeast Sulawesi and concluded that

local innovation systems can only succeed if they are well-integrated among research, policy, and development actors. Overall, this body of evidence affirms that the success of agricultural AIS implementation lies in the integration of technological, institutional, and actor-network dimensions. These three aspects also serve as the foundation for PT PLN Indonesia Power UBP Banten 3 Lontar in creating the HARVEST MOON program and applying AIS to improve the welfare of honey pumpkin farmers in Tangerang Regency.

Integrated Agricultural Technology Innovation System

To respond to climate change conditions that have the potential to reduce productivity and farmers' welfare, the first step taken by PT PLN Indonesia Power UBP Banten 3 Lontar and Tim Kreatif Desa Lontar through the HARVEST MOON program was to integrate technological innovation into three phases of agriculture, namely soil preparation, seedling, and crop maintenance. In the first phase, soil preparation, Tim Kreatif Desa Lontar utilized fly ash bottom ash (FABA) waste as a substitute planting medium in farming activities, in which each component used in the planting medium has its role as follows:

Table 1. Composition and Functions of Planting Medium Materials in the HARVEST MOON Program

Material	Function/Role
Burnt husk	serves as an additional organic matter for the soil and helps neutralize heavy metals from FABA & seashells
Cocopeat	rich in fiber, facilitates plant rooting, and lowers the pH of FABA & seashells
Fly ash	sandy in texture, helps roots absorb nutrients, and increases soil pH
Bottom ash	rocky sand texture, rich in Calcium (Ca) and Magnesium (Mg) as macronutrients for plants and helps increase soil pH
Seashells	high in calcium carbonate and helps increase soil pH

Source: SROI Report of PT PLN Indonesia Power UBP Banten 3 Lontar (2023)

Next, in terms of seedlings, Tim Kreatif Desa Lontar introduced a breakthrough through "Metode Fusi Bibit Menjadi Satu Entitas Genetik" (Seed Fusion into a Single Genetic Entity Method), which is a technique of combining two types of plants, honey pumpkin and melon. This innovation was designed to produce a new variety of higher quality compared to the previous plants. Through genetic fusion, it is expected that stronger root and stem structures will be formed, thereby increasing the ability to absorb soil nutrients and enabling optimal plant growth. Beyond merely increasing productivity, this seed fusion method also addresses major challenges faced by the agricultural sector due to climate change threats. With improved resistance to pests and diseases, the fusion varieties can adapt to uncertain environmental conditions, such as droughts or extreme rainfall. This demonstrates that the innovation of Lontar Village does not only focus on harvest quality but also on agricultural sustainability as

a tangible solution to the global climate crisis. Six stages implemented by the Tim Kreatif Desa Lontar in the seed fusion method are: (1) Variety selection honey pumpkin and melon are chosen for their unique adaptive capacity, soil-borne disease resistance, and water-use efficiency; (2) Seed preparation; (3) Execution of seed fusion using the spliced approach grafting technique; (4) Post-grafting recovery; (5) Acclimatization the process of adjusting the fused plants to new environmental conditions (greenhouse) to ensure survival and growth; and (6) Planting in cultivated areas using FABA waste and seashell powder as planting media.

In the third phase, technological innovation in crop maintenance, PT PLN Indonesia Power UBP Banten 3 Lontar introduced several innovations, including: (1) Construction of greenhouses, (2) Installation of HydroFresh water filter devices, (3) Installation of UV lamps, and (4) Optimization of solar panels. First, regarding the construction of greenhouses, they function as a medium to help farmers reduce the spread of pests and diseases, as conditions inside the greenhouse are isolated from external natural conditions. In addition, greenhouses are also useful in minimizing excessive sunlight exposure received by plants. Currently, PT PLN Indonesia Power UBP Banten 3, together with the Tim Kreatif Desa Lontar, owns three greenhouses, which are sufficient to control the environmental conditions where honey pumpkin plants grow, such as temperature, humidity, and light intensity. The installation of HydroFresh (Hilangkan Payau Air Pesisir dengan Filter Bottom Ash) water filter devices became the second crop maintenance innovation, positively impacting the cultivation of honey pumpkins in Lontar Village. Since HydroFresh was introduced, honey pumpkin farming productivity in Lontar Village has increased as freshwater is now used. Previously, farmers relied on brackish water, which is essentially unsuitable for plants due to its dynamic salinity. HydroFresh of UBP Lontar works effectively because its main filtration tank contains bottom ash, silica sand, and anthracite as filter media.

Next, the installation of UV lamps. This became the third crop maintenance innovation, carried out because of the limited natural light entering the area due to surrounding trees shading the greenhouses. The installation of UV lamps has three main objectives. First, as a means of pest and disease control, UV rays can damage the DNA of microorganisms such as bacteria, fungi, and viruses, thereby suppressing their growth while replacing chemical pesticides and reducing the risk of pest resistance. Second, to stimulate plant growth by inducing the production of secondary compounds such as flavonoids and anthocyanins, which enhance plant resilience to environmental stress, including pathogen attacks and drought conditions. Third, UV lamps help maintain the quality of the growing environment in greenhouses by regulating the lighting cycle and providing the necessary light spectrum for optimal plant development. The fourth crop maintenance innovation, namely solar panel optimization, has proven to deliver significant impact. The use of solar panels with a capacity of 3000 watts has helped farmers reduce group operational costs while simultaneously lowering carbon emissions by replacing fossil energy sources with renewable energy. In addition, the application of clean energy also promotes increased agricultural productivity, ultimately playing an important role in strengthening food security.

The integration of technological innovation into the three phases of agriculture has proven to be a solution amidst the ongoing threats of climate change. According to the SROI Report of PT PLN Indonesia Power UBP Banten 3 (2024), from honey pumpkin cultivation activities carried out three times per year (with each period lasting approximately three months), there has been a significant increase in productivity during the period 2022–2024. In 2022, the honey pumpkin harvest was recorded at 271 kg. This figure rose in 2023 to 1,088 kg. Finally, in 2024, honey pumpkin harvests in Lontar Village reached 2,048 kg. Along with this increase in productivity, data from the 2023/2024 Poor Household Registry of Kemiri District, Tangerang Regency, Banten, as cited in the Social Innovation Report of UBP Lontar (2024),

indicate that four members of Tim Kreatif Desa Lontar succeeded in improving their welfare and escaping the poverty line. This data clearly demonstrates that agriculture today requires not only technological innovation, but rather integrated and systemic innovation, such as the fundamental framework of the Agricultural Innovation System (AIS).

Strengthening the Institution of Tim Kreatif Desa Lontar

As explained by Freeman (1987) and reinforced by Aerni (2015), the second dimension that plays an important role in the successful implementation of the Agricultural Innovation System (AIS) is institutional strength. Scott (2008) highlights that the primary dimension in institutional development and strengthening is the regulative or legitimacy dimension. In terms of legitimacy, PT PLN Indonesia Power UBP Banten 3 facilitated the issuance of an Institutional Decree for Tim Kreatif Desa Lontar (as the main actor in the HARVEST MOON program) in 2023, one year after the group was established. The official issuance of this Decree granted legal legitimacy to the group, enabling Tim Kreatif Desa Lontar to obtain legal access to resources and funding support. Following this, PT PLN Indonesia Power UBP Banten 3 also conducted organizational governance training, which covered: (1) basic principles of organizational governance, (2) organizational structure and the roles of each member (chairperson, secretary, etc.), (3) administration and financial management (basic bookkeeping, monthly reporting), (4) strategic planning through social mapping (identifying potentials, opportunities, and challenges), (5) group problem-solving methods (managing potential internal conflicts), and (6) program monitoring and evaluation.

In addition to issuing the Institutional Decree and conducting governance training, PT PLN Indonesia Power UBP Banten 3 also strengthened the Tim Kreatif Desa Lontar through capacity building in agricultural training and development. In 2023, the training focused on mixing Fly Ash Bottom Ash (FABA) with seashells as a substitute planting medium for honey pumpkin cultivation, in collaboration with IPB University. The mixture of FABA and seashells as an alternative growing medium for honey pumpkin farming has become one of the key innovations in supporting sustainable agriculture. Through this activity, Tim Kreatif Desa Lontar was introduced to techniques for utilizing previously undervalued industrial and marine waste, which was then processed into a mineral-rich planting medium. FABA improves soil structure and enhances aeration, while calcium-rich seashells help strengthen plant tissues. The combination is expected to create a more fertile and environmentally friendly planting medium. Beyond boosting productivity, this training also provided farmers with a new understanding that waste can serve as a solution to reduce dependency on conventional growing media, which are relatively costly. By using planting media based on FABA and seashells, honey pumpkin cultivation can potentially become more efficient, climate-adaptive, and aligned with the principles of a circular economy through waste utilization. This step not only benefits agricultural sustainability but also strengthens food security and enhances farmers' welfare.

In 2024, the focus of training and development conducted by PT PLN Indonesia Power UBP Banten 3 for Tim Kreatif Desa Lontar was training on agricultural sensitivity to climate change mitigation and adaptation. This training served as a strategic step to enhance the capacity of Tim Kreatif Desa Lontar in facing global challenges, particularly climate change. As is well known, the impacts of climate change have led to declining productivity due to droughts, floods, and more intensive pest attacks. Therefore, innovations are needed in the form of crop diversification and fusion, as well as the use of environmentally friendly technologies. The crop fusion training was implemented through the practice of fusing honey pumpkin and melon. Meanwhile, in terms of technology training, there were two activities: training on the working system and maintenance of the FRP or HydroFresh (Hilangkan Payau Air Pesisir dengan Filter Bottom Ash) water filter device, and training on the working system and

maintenance of the drip irrigation system. According to FAO (2013), agriculture that applies sustainable farming and climate-smart agriculture approaches can integrate the objectives of increasing productivity with emission reduction, while also strengthening the resilience of food systems.

Furthermore, as stated by Altieri & Nicholls (2017), agroecology based on local wisdom, technological integration, and crop diversification practices has been proven to increase the resilience of smallholder farmers to climate shocks. Through these various trainings, Tim Kreatif Desa Lontar not only gained technical skills but also developed critical awareness that every agricultural practice has an environmental impact. This aligns with the perspective of Stern (2007) in The Economics of Climate Change, which emphasizes that early investment in adaptation and mitigation is far less costly than bearing the economic losses caused by future climate change impacts. Thus, strengthening the capacity of Tim Kreatif Desa Lontar through climate-sensitive training serves as an essential foundation for ensuring the sustainability of honey pumpkin farming while also supporting national food security.

Synergy of Actor Networks

After the integration of technology and institutional strengthening had been achieved, the success of AIS implementation in the HARVEST MOON program was also determined by the third dimension, namely, the strengthening of synergy among the networks of actors involved. In addition to PT PLN Indonesia Power UBP Banten 3 and Tim Kreatif Desa Lontar as the main actors of the HARVEST MOON program, other actors included KWT Agria Lestari, the Lontar Village Government, IPB University, and Cap Panah Merah. Kelompok Wanita Tani (KWT) Agria Lestari has played a role as the program initiator since 2021. This group has become the driving force linking farmers' needs with external support. Through KWT, honey pumpkin cultivation training has been conducted regularly, while also creating spaces for knowledge sharing among farmers. Beyond sharing technical skills, KWT Agria Lestari has also functioned as a space for social learning. Members exchange experiences in dealing with daily agricultural problems, thereby strengthening local knowledge with innovations obtained from program partners. This has been the foundation for Tim Kreatif Desa Lontar to quickly actualize the HARVEST MOON program.

Another important actor in the HARVEST MOON program is the involvement of academics from IPB University. Collaboration between PT PLN Indonesia Power UBP Banten 3 and IPB began with the placement of internship students in the field for approximately four months. The presence of these students contributed significantly, especially in the daily monitoring of cultivation activities. With their agricultural background, they were able to provide initial analyses when problems such as pest attacks or droughts occurred. These problems were then discussed with supervising lecturers to find appropriate solutions that could be immediately applied in the field. In addition to monitoring, collaboration with IPB also strengthened the research aspect of the program. Together with the company, IPB conducted laboratory tests on the content of Fly Ash Bottom Ash (FABA) and seashells used as planting media. These tests not only improved agricultural quality but also opened opportunities for the utilization of non-hazardous industrial waste as an environmentally friendly alternative resource. Thus, the involvement of IPB made HARVEST MOON both a science-based and community-applied program.

The Lontar Village Government also played a crucial role in supporting the HARVEST MOON program. They contributed significantly by providing policy support to ensure the program's sustainability. One initiative was the "One House, One Tree" program, which encouraged every household in Lontar Village to plant at least one honey pumpkin tree in their yard. This policy not only expanded production coverage but also fostered a sense of

community ownership of the program. The initiative of the Lontar Village Government represented a strategic step to strengthen community participation. By involving every household, the HARVEST MOON program did not stop at the farmer group level but transformed into a village-wide movement. This, in turn, contributed to food self-sufficiency while also opening opportunities for additional household income from honey pumpkin harvests. Equally important, the role of Cap Panah Merah as a seed supplier and cultivation training provider also had a significant impact. The company delivered specialized material on adaptive farming strategies in dealing with climate change challenges. This knowledge has been highly valuable in helping farmers anticipate extreme weather conditions and maintain crop productivity. Consequently, the HARVEST MOON program not only prepares farmers for present challenges but also equips them to face future climate uncertainties.

The key to the success of strengthening the synergy of roles among actors undertaken by PT PLN Indonesia Power UBP Banten 3 lies in its ability to translate Callon's (1986) concept of Actor-Network Theory (ANT), wherein network strengthening can be carried out in three stages: Translation, Alignment, and Enrollment. In relation to the first stage, namely translation, UBP Lontar, through an initial socialization activity, conveyed the grand vision of HARVEST MOON as an agriculture-based empowerment program that utilizes technology and local resources. This socialization is crucial to ensure that all actors, whether farmer groups, village governments, or educational institutions, share a common perception regarding the direction and benefits of the program, thereby motivating them to provide conscious support.

The next stage, alignment, or the harmonization of interests among actors, was carried out by PT PLN Indonesia Power UBP Banten 3 through Focus Group Discussions (FGDs) facilitated by the company's Community Development Officer (CDO). This forum allowed all actors involved to voice their aspirations, needs, and challenges encountered in agricultural activities. The open and participatory discussions created a healthy negotiation space in which diverse interests could be unified into collective goals. Therefore, FGDs not only strengthened cooperation but also fostered a sense of ownership of the program among all partners. The final stage was enrollment, namely the affirmation of each actor's role within the network. Following the socialization and FGDs, PT PLN Indonesia Power UBP Banten 3 ensured that every actor had clear responsibilities in line with their respective capacities. For example, KWT Agria Lestari, together with Tim Kreatif Desa Lontar, focused on sharing knowledge regarding cultivation and plant maintenance, IPB contributed research and technical assistance, the village government supported through local regulations and policies, while the company provided infrastructure assistance and conducted monitoring and evaluation. This clear division of roles enabled the network of actors in the HARVEST MOON Program to work synergistically without overlap.

D. CONCLUSION

The decline in agricultural productivity due to climate change has broad implications for the socio-economic conditions of farmers. The impacts are not limited to reduced yields but also include declining household incomes, increased vulnerability to poverty, and weakened competitiveness of the agricultural sector at both local and national levels. This situation affirms that climate change is not merely an environmental issue but also a socio-economic concern that requires serious responses through adaptation and mitigation policies that prioritize smallholder farmers. The findings of this study demonstrate that PT PLN Indonesia Power UBP Banten 3 has successfully increased productivity and improved the welfare of honey pumpkin farmers in Tangerang Regency through the CSR program HARVEST MOON as a manifestation of the application of the concepts and principles of the Agricultural

Innovation System (AIS). The success of AIS implementation in the HARVEST MOON CSR program was determined by the integration of three dimensions, namely an integrated technological innovation system, the strengthened institution of Tim Kreatif Desa Lontar, and robust synergy among actor networks in the program.

The first dimension, the technological innovation system in the HARVEST MOON program, focused on three phases of agriculture, namely the preparation of growing media, seeding, and plant maintenance. Innovation in growing media was carried out through the utilization of FABA and seashell waste. Innovation in seeding involved the fusion of honey pumpkin and melon seedlings. Meanwhile, innovations in plant maintenance included the construction of greenhouses, the installation of HydroFresh water filter devices, the use of UV lamps, and the optimization of solar panels. The second dimension, institutional strengthening of Tim Kreatif Desa Lontar, was achieved through the issuance of the Institutional Decree and a range of capacity-building training programs, such as: organizational governance training, climate-resilient agricultural practice training (soil/media processing and seed fusion), and agricultural technology training (HydroFresh and drip irrigation system). Finally, for the third dimension, actor synergy, PT PLN Indonesia Power UBP Banten 3, through the HARVEST MOON program, optimally strengthened networks through the three stages of translation, alignment, and enrollment. As a result of the successful AIS implementation in the HARVEST MOON program, honey pumpkin agricultural productivity in Lontar Village increased by 960 kg during 2023–2024, and four members of Tim Kreatif Desa Lontar were lifted out of poverty due to significant income improvement.

Based on the above, it can be concluded that the HARVEST MOON program has become a best practice in the implementation of the Agricultural Innovation System (AIS) at the local level. This program not only demonstrates tangible contributions to strengthening food security and improving farmer welfare but also provides relevant empirical evidence for the development of agricultural innovation policy frameworks oriented toward sustainability. Therefore, the success of this program holds strategic value, both as a conceptual model and as a practical reference for public policy formulation. Furthermore, future research is expected to elaborate on the potential replication of the program across various geographical and social contexts, emphasizing the importance of harmonization among technological innovation, local institutional strengthening, actor network synergy, or even the expansion of literature on socio-ecological justice principles that can be advanced through AIS implementation. The researcher believes that such studies will make a highly positive contribution to enriching the literature on AIS while providing an applied basis for sustainable agricultural development planning in response to the dynamics of future climate change.

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