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Development of Integrated Farming: Livestock-Agriculture-Aquaculture in Kalisidi Village Based on Participatory Community Development

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Abstract— This community service program aims to develop an integrated agricultural model encompassing the livestock, agriculture, and aquaculture sectors in Kalisidi Village. The approach utilized is Participatory Community Development (PCD), which emphasizes active community participation at every stage of planning, implementation, and evaluation. The methods employed include technical training, farmer group mentoring, and the strengthening of local institutions. The program's results show an increase in the community's capacity to manage natural resources sustainably, diversify income sources, and improve local food security. Active community participation has been key to the program's success, as the community members are not only beneficiaries but also the primary drivers of this integrated agricultural system's development. This program is expected to serve as a replicable model for other villages with similar conditions.

Keywords— Food Security, Participatory, Community Empowerment.

I. INTRODUCTION

Kalisidi Village is one of the villages located in Semarang, Central Java, Indonesia, with abundant natural resource potential, including fertile agricultural land, adequate water sources for aquaculture activities, and an environment conducive to livestock farming. Kalisidi Village has a demographic profile with a majority in the productive age range, accounting for 67.25% of the population. Most of the residents work in the agricultural sector, with more than 500 farmers engaged in various activities spanning agriculture, livestock, and aquaculture [1]. However, this potential has not been fully optimized by the local community.

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Conventional agricultural practices, reliance on a monoculture system, and a lack of knowledge and skills in managing integrated farming, livestock, and aquaculture businesses have resulted in suboptimal productivity.

Moreover, the village faces challenges related to the economic well-being of its residents, as the majority of the population relies on the agricultural sector, which is vulnerable to price fluctuations and weather changes. This situation creates economic insecurity and low household-level food resilience. To address these challenges, a comprehensive and participatory approach is needed to develop an integrated farming model that incorporates the livestock, agriculture, and aquaculture sectors.

The Participatory Community Development (PCD) approach has been chosen because it accommodates active community involvement in the planning and implementation of programs, enabling them to develop a strong sense of ownership over the outcomes achieved [2]. This approach aims to empower communities, promote self-determination, and ensure that development efforts align with local needs and priorities [3]. Moreover, participatory leadership and resource mobilization practices can contribute to building social cohesion and enhancing community participation in development initiatives, by incorporating local values and identity into the planning and implementation of development projects, communities are more likely to engage actively and take ownership of the process [4].

This case is discussed in this article for the broader use of empowerment theory in the community development process in Kalisidi village in the context of integrated agricultural development between livestock-agriculture-aquaculture.

II. METHODOLOGY

The implementation of this community service program utilized the Participatory Community Development (PCD) approach, which emphasizes the active participation of the Kalisidi Village community at every stage of the activities. The program's methodology consisted of several stages: Initial Situation Identification and Analysis, Program Planning, Training and Mentoring, Integrated System Implementation and Management, and Monitoring, Evaluation, and Reporting.

A. Initial Situation Identification and Analysis

Surveys and Observations: An initial survey was conducted to identify the social, economic, and natural resource conditions in Kalisidi Village. The community service team, together with residents, observed agricultural land, aquaculture areas, and livestock farms to understand the potential and challenges faced. Focus Group Discussions (FGD): Stakeholders such as the village head, farmer groups, and community leaders were involved in FGDs to discuss the needs, expectations, and challenges of developing an integrated agricultural system.

B. Program Planning

Action Plan Development: Together with the community, the team developed a detailed action plan, including selecting suitable crops, livestock, and fish species, as well as integrated management strategies to be implemented. This plan was created based on input gathered during the FGDs. Working Group Formation: A working group was established, comprising farmers, livestock owners, and fish farmers committed to developing the integrated agricultural model.

C. Training and Mentoring

Technical Training: Technical training sessions were conducted on integrated agriculture, livestock, and aquaculture. Training topics included crop cultivation techniques, livestock management, aquaculture methods, and organic waste management for use as fertilizer or feed. Sustainable Mentoring: The community service team provided regular mentoring to the working groups. This included monitoring program implementation, solving challenges encountered, and adjusting techniques based on field conditions.

D. Integrated System Implementation and Management

Field Implementation: The community, in collaboration with the service team, implemented the integration of the livestock, agriculture, and aquaculture sectors according to the action plan. Strengthening Local Institutions: Efforts were made to strengthen farmer, livestock, and aquaculture groups through group management training, access to financing, and marketing strategies for their products.

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E. Monitoring, Evaluation, and Reporting

Regular Monitoring: Periodic monitoring was conducted to evaluate program success, identify obstacles, and provide necessary solutions. Final Evaluation: At the end of the program, a comprehensive evaluation was conducted to assess the program's achievements, including improvements in community capacity, agricultural, livestock, and aquaculture production, and the resulting economic impact. Reporting and Dissemination of Results: Program results were documented in a final report presented to relevant stakeholders and disseminated through village forums to strengthen collaboration and ensure program sustainability.

III. RESULT AND DISCUSSIONS

A. Initial Situation Identification and Program Planning

Community service activities in Kalisidi Village have been initiated through various programs, such as the PPK Ormawa program carried out by the Student Executive Board (BEM) of the Faculty of Animal and Agricultural Sciences (FPP) at Diponegoro University in 2023. This program aimed to raise community awareness of the potential for managing inorganic waste. Based on evaluations of the previous program, there was notable enthusiasm from residents for further guidance in handling and managing organic waste. Additionally, several other aspects are illustrated in Figure 1, which highlights the key potentials and challenges identified through surveys, observations, and interviews with relevant stakeholders.

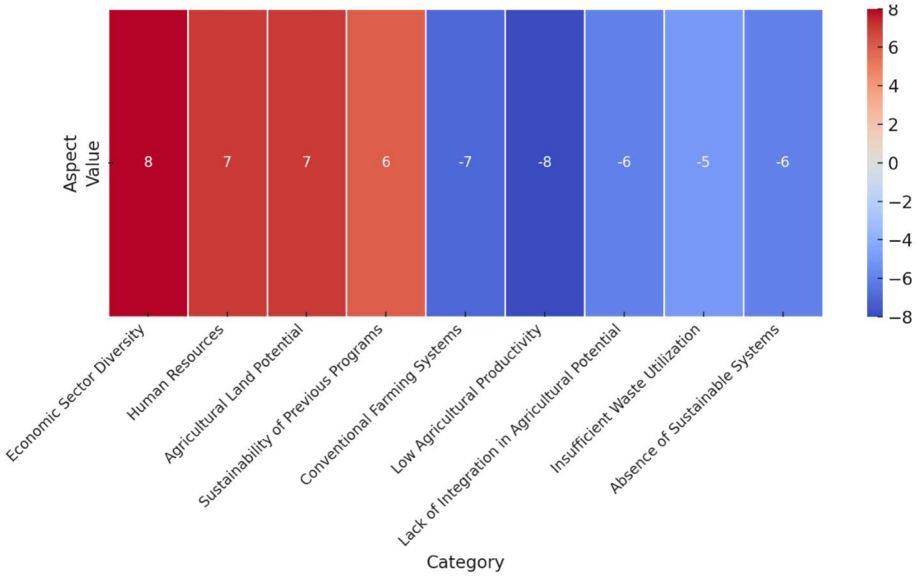

Figure 1. Potential and Issues in Kalisidi Village

Figure 2 reveals that the primary challenges in Kalisidi Village include conventional farming systems, suboptimal waste management, and low agricultural productivity, with the core issue being the absence of a sustainable system. Farmers predominantly rely on inefficient traditional methods, and waste from the agriculture and livestock sectors remains underutilized, particularly for producing organic fertilizers. This lack of integration results in suboptimal agricultural yields, which, in turn, affects the village's food security.

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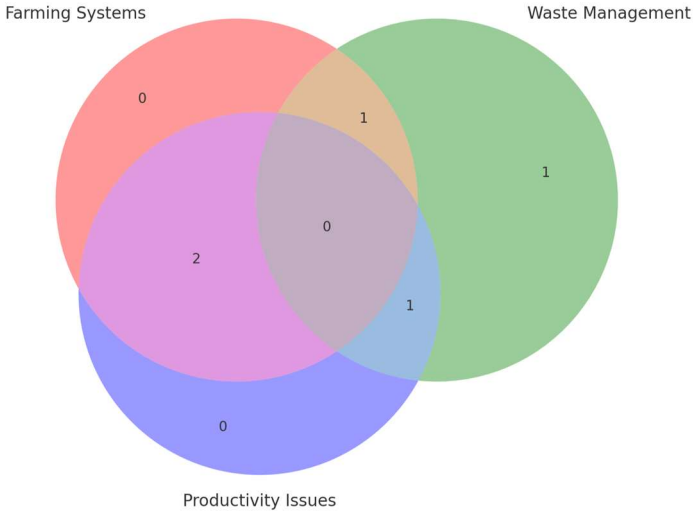

Figure 2. Venn Diagram of Issues in Kalisidi Village

Numerous studies have documented the consequences of non-integrated agricultural practices. For instance, research by Boschiero et al., indicates that farms employing integrated practices can achieve yields that are 20-60% higher than those relying on conventional monoculture methods [5]. In contrast, villages that do not adopt integrated approaches often face challenges such as soil nutrient depletion, which can reduce crop yields significantly, Nagy [2], stated monoculture refers to the agricultural practice of growing a single crop species over a wide area for consecutive seasons. While this method can lead to short-term economic gains and simplified management, it often results in significant soil nutrient depletion. The continuous cultivation of the same crop can exhaust specific nutrients essential for plant growth, particularly nitrogen, phosphorus, and potassium (NPK).

As a solution (Figure 3), community service programs could focus on implementing smart farming practices, such as automated irrigation technology and the use of livestock waste for fertilizer production to improve efficiency and yields. Moreover, the program could be strengthened by fostering collaboration among the community, village authorities, and government partners to establish an integrated system. Education and training for farmers on modern agricultural technology and waste management are also essential to increase awareness and skills within the community. Through this program, it is expected that sustainable innovation-based food security can be achieved, enhancing productivity while preserving the environment.

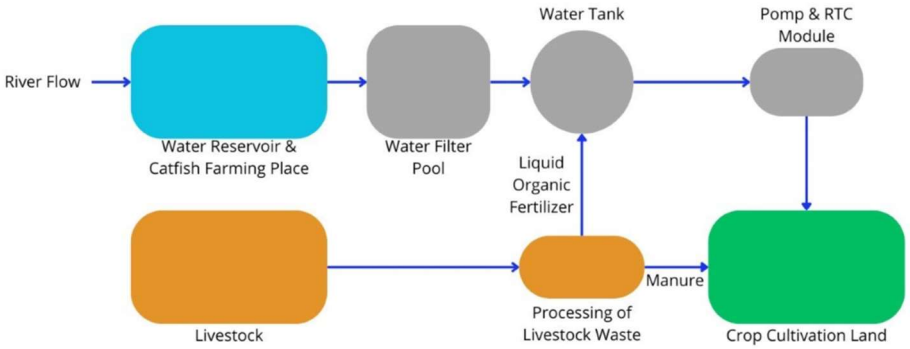

Figure 3. Schemes of Integrated Farming between Livestock-Agriculture-Aquaculture

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B. Enhancing Community Capacity in Integrated Farming Management

The implementation of the program begins with the formation of a program management organization, which activity involves the Women Farmers Group (KWT), the Livestock Farmers Group (KTT) and Agricultural Extension Workers. The process of forming this organization is carried out to support the sustainability of the program (Figure 4.). According to Thomas et al., explained that the existence of a strong organization and having a vision is the most important factor in the success of the program and the sustainability of the program. A strong organization is characterized by effective leadership, clear roles and responsibilities, robust governance structures, and the capacity to mobilize resources [6]. Such organizations are better equipped to navigate challenges, adapt to changing circumstances, and implement strategies that align with their goals, such as Pennsylvania Association of Sustainable Agriculture (PASA) [7]. This is also in line with the opinion of Schmidt et al that the involvement of community groups with stakeholders to formulate problems and empowerment program plans is a key part of the implementation of Participatory Community Development [8].

(a) (b)

Figure 4. KWT Revitalization Program and Socialization of Program Plans in Kalisidi Village, (a) KWT Margo Utomo, and (b) KWT Sri Rejeki

C. Technical Training and Implementation Process

The implementation of introduction and technical training on the use of RTC-based automatic watering systems, training on making organic fertilizer from household waste and livestock waste, as well as catfish cultivation training has been carried out in Kalisidi Village as shown in Figure 5.

(a) (b) (c)

Figure 5. Training and Implementation Program, (a) RTC System Technical Training, (b) Waste Management Training, (c) Training and Implementation Aquaculture and Water Catchment

Community involvement in determining the technology to be used is the foundation for achieving common goals in community development. The selection of a time-based automatic watering system is part of a community decision by considering the

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capabilities of existing human resources, compared to using an automatic watering system based on temperature and soil moisture sensors. This is based on the sustainability of the program, so that the community can easily carry out maintenance and duplication in other agricultural areas in the future. According to Nagy [2], choosing the right technology with community needs is important for the success of technology downstreaming and technology adoption by community groups, that program implementation must consider existing human resources, both in terms of ability, skills, and resource needs. Zulkifli et al. emphasizes that the process from technological innovation to farmer adoption is influenced by the institutional frameworks in place, which can either facilitate or hinder the dissemination of new technologies. The study illustrates that effective institutional support can lead to higher adoption rates and better integration of technologies into existing farming practices [9].

This integrated farming provides many benefits to the community groups in Kalisidi Village. The application of Integrated Farming realizes diversification of crops, in addition to the main crops from the agricultural and livestock sectors as is usually obtained but also gets the harvest from the catfish cultivation process, as well as by-products in the form of organic fertilizer production. In addition, the implementation of integrated farming can create a sustainable and environmentally friendly agricultural system with water catchment areas and the use of organic fertilizers that go hand in hand with the reduction of organic and livestock waste.

D. Mentoring and Community Learning Process

The mentoring carried out in Kalisidi Village is effective if it is able to combine the delivery of theory with the application of direct practices that are relevant to the community. The learning process takes place through several stages, starting from socialization to increase awareness, followed by intensive training on modern agricultural technology, such as automatic watering systems (smart farming), and waste management into organic fertilizer. Participatory approaches, such as focus group discussions (FGD) and simulations, encourage the community to actively ask questions, discuss, and try new technologies directly (Figure 6.).

(a) (b) (c)

Figure 6. Collaborative Learning Process, (a) Community Participation,
(b) Assistance and Discussion Program, (c) Learning Process

The assistance program conducted in Kalisidi Village demonstrates significant potential in fostering knowledge transfer and sustainable agricultural practices. The learning process is designed to be participatory, emphasizing practical engagement through workshops, demonstrations, and hands-on activities. Farmers are actively involved in the installation and operation of smart farming technologies, such as automated irrigation systems, ensuring they gain firsthand experience. Additionally, knowledge-sharing sessions, coupled with mentoring from experts, help simplify the transition from conventional farming to modern, technology-based approaches.

The learning process unfolds in a collaborative environment, where farmers, local leaders, and facilitators work together to identify problems and develop solutions. Continuous feedback loops—via regular meetings and monitoring—ensure that the program adapts to local needs and challenges. This approach not only increases the relevance of the program but also builds trust and confidence among community members.

Based on Restrefo et al. suggest that a ‘collaborative learning’ process includes four steps: (A) establishing cooperation, (B) dialogue, (C) discovery, and (D) application of new knowledge. Collaborative learning that engages various actors holds significant potential for addressing challenges and driving change within complex social-ecological systems. While the involvement of

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interconnected actors—often referred to as stakeholders—is widely acknowledged as a critical factor in collectively resolving shared problems, this approach shows promise in fostering meaningful solutions [10].

The application of new knowledge in daily practices is evident through the adoption of smart farming techniques and the utilization of agricultural waste as organic fertilizer. Farmers who previously relied solely on conventional methods now integrate automated irrigation, which improves efficiency and productivity. Furthermore, waste management enables households to actively participate in sustainable waste practices, benefiting both the community and the environment. The program's effectiveness lies in its ability to transform knowledge into tangible outcomes, fostering a culture of innovation and sustainability.

E. Program Achievements

Based on the community service activities carried out in Kalisidi Village, achievements were obtained including the implementation of an intercropping farming system between chili and edamame by implementing an automatic watering system with water sources from water catchment ponds, as well as the use of processed manure as an intake of nutrients needed by plants as presented in Figure 7.

Figure 7. Program achievements, (a) Water Reservoir and Catfish Farming Place, (b) Irrigation Automated System and Crop Cultivation Land, (c) (d) The Yield Production from Aquaculture and Agriculture Works

F. Long-Term Impacts and Sustainability

The long-term impacts of this program on the Kalisidi Village community are expected to be transformative, fostering economic growth, environmental sustainability, and improved quality of life. By integrating modern agricultural technologies, such as automated irrigation systems and waste-to-fertilizer innovations, the program enables farmers to achieve higher productivity and resource efficiency. This shift not only enhances food security but also strengthens the economic resilience of the village, reducing dependency on external resources. Furthermore, the focus on participatory learning and capacity building ensures that community members gain the knowledge and skills necessary to maintain and evolve these systems independently over time.

In terms of sustainability, the program's collaborative framework, which involves local stakeholders, government agencies, and academic institutions, provides a strong foundation for its continuity. Regular monitoring, feedback mechanisms, and the establishment of local leadership cadres are key to ensuring that the program remains adaptive and relevant. Additionally, the emphasis on waste management and circular economy principles contributes to environmental preservation, aligning the program with global sustainable development goals.

G. Recommendations for Further Development

To enhance the program in Kalisidi Village and similar areas, future efforts should focus on expanding community training to include advanced agricultural technologies, such as precision farming and climate-resilient crops. Strengthening partnerships with government agencies and private stakeholders is vital to secure funding and expertise for long-term sustainability. Additionally, integrating digital tools for real-time monitoring and data-driven decision-making can improve efficiency. Establishing a model farm as a learning hub for surrounding communities will foster knowledge exchange and encourage replication. Lastly, increasing youth involvement through educational initiatives will ensure intergenerational knowledge transfer and long-term program continuity.

IV. CONCLUSIONS

The community service program in Kalisidi Village successfully developed an integrated farming model encompassing the livestock, agriculture, and aquaculture sectors based on the Participatory Community Development (PCD) approach. The program results demonstrated significant improvements in the community's capacity to sustainably manage natural resources, contributing to income diversification and enhanced local food security. Active community participation in every stage of planning and implementation was key to the program's success, transforming them from mere beneficiaries into primary drivers of the system's development. Strengthening local institutions also played a crucial role in ensuring the program's future sustainability. This success highlights that the PCD-based integrated farming model can serve as an effective, replicable solution for other villages with similar conditions, aiming to improve community welfare and food security.

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