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Fish Feeding and Solar Panel Technology Implementation for the Jatiluhur Reservoir Community of Floating Net Cages Farmers

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ABSTRACT

The implementation of Fish Feed Technology and Solar Panels is geared towards enhancing fish farming productivity in the Jatiluhur Dam community, the village of Kertamanah, Purwakarta, where substantial potential awaits but technological support is lacking. Fish farmers grapple with formidable challenges in the feeding process, including uncontrollable, uneven, and immeasurable feed distribution, resulting in a high mortality rate among the fish. To address these challenges, Community Service (PKM) activities were undertaken, involving the design of an innovative fish feed dispenser with a capacity of 20-30 kg using automatic fish feeder technology. Local partners also underwent intensive training on tool usage, maintenance, and repair. The outcomes reveal that partners can autonomously control feed dispensing through timers on control panels, utilizing remote controls, and determining feeding durations. A significant emphasis of this research lies in the incorporation of solar panels, strategically implemented to power the automatic fish feeder system. This addition enables flexible settings for feeding duration and frequency, facilitated by the integration of a timer and a remote controller for distance control. This solar panel implementation is particularly crucial due to the constraints posed by the Floating Net Cage positioned in the center of the dam. Anticipated benefits encompass heightened efficiency in fish feeding management, a reduction in fish mortality rates, and the fortification of sustainable fish farming productivity. Additionally, the integration of solar panels addresses the energy needs of the system, offering an environmentally friendly alternative in the face of restrictions posed by the cage's location. This research significantly contributes to advancing sustainable fisheries business models, effectively harnessing modern technology within the fisheries sector, and laying the groundwork for innovative policies and practices in the future.

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INTRODUCTION

Fish farming in floating net cages has become a significant economic activity, particularly in the Kertamanah Village, Purwakarta Regency. However, challenges in fish feed management and fisheries sustainability remain a primary concern (Harjuni et al., 2022). A study by (Erlania et al., 2010) illustrates the impact of fish feed management on the cultivation of tilapia in floating net cages on the water quality of Lake Maninjau. On the other hand, (Lusi et al., 2020) present an innovative solution by enhancing the capacity and efficiency of fish feeding through fish feeder technology in Parijatah Kulon Village.

(Zaenuri et al., 2014) focus on the quality of pellet-shaped fish feed from agricultural waste, demonstrating the relevance of sustainable fish-feeding practices with agricultural methods. Research by (Putri, 2019) evaluates the sustainability status of cage net fish farming in Jatiluhur Reservoir, providing a holistic overview of the crucial role of fish farming in the context of sustainability.

Within the framework of community empowerment strategies, (Ridwan et al., 2022) explore the analysis of empowerment strategies for fish processing groups in the city of Banjarmasin. Additionally, (Setiawan, 2017), in his thesis, outlines the design and scheduling of an automatic fish feeder monitoring system, making a significant contribution to operational efficiency. An example of the feed provided to the fish can be seen in Figure 1.

FIGURE 1. Fish Feeding Pallet

The village secretary manually provides fish feed due to the cultivation practices conducted. As a consequence, it requires a greater amount of labor and entails time-consuming processes in the feed distribution. The feed distribution is generally carried out conventionally by partners by scattering feed from one side to the other across the fish ponds. The condition of the fish ponds is illustrated in Figure 2.

FIGURE 2. The Floating Net Cage at Jatiluhur Reservoir

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The emphasis on the conservation of natural resources and the adoption of alternative energy sources is noteworthy. Research conducted by (Warsa et al., 2023) illustrates the enhanced productivity and growth rates of fish cultivated in smart floating net cages, utilizing solar panels in Jatiluhur Reservoir. Similarly, the works of (Suryadi, 2021) and (Uddin et al., 2016) depict advancements in the design of automated fish feeder machines, operable through the use of timers and remote controls.

METHODS

In this Community Service activity, the implementation method revolves around addressing the issues identified in the floating net cages (Warsa et al., 2023; Devi et al., 2021). The method is executed through several stages, including:

Location Survey for Community Service Program

Location survey activities are conducted in the floating net cages in Kertamanah village, Sukasari district, together with members of the freshwater fish farming group. This involves observing the field conditions, the surrounding community, and various fisheries potentials.

Development of Work Plan Program

The subsequent phase involves developing a work plan program that encompasses the design of the fish feeder technology. This includes providing guidance on the machine's operation system, explaining each component and its respective functions, educating on cost calculations for acquiring the tool and the efficiency benefits, conducting demonstrations and practical usage sessions by partners at their respective pond locations, and providing guidance on the processing and marketing of fisheries products (Ridwan et al., 2022).

Design, Production, and Testing of Devices

The device design phase aims to ensure that the fish feeder operates effectively according to the identified needs (Uddin et al., 2016). The process in this stage involves designing the power distribution system for the machine, as illustrated in Figure 3. The automatic fish feeder machine is designed to assist pond fish farmers in the feeding process, a task that is traditionally carried out manually. The machine is engineered with automatic control for motor movement, allowing its operating time to be regulated by its timer. Due to its automatic control, the fish-feeding process becomes well-regulated and timely.

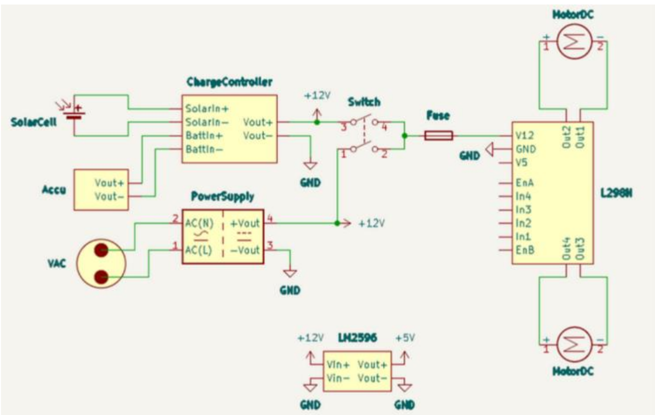

FIGURE 3. The Power Supply Circuit

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Advantages of the Design and Construction of the Automatic Fish Feeder Machine: a. Utilization of Automatic Control: The machine incorporates automatic control, enhancing its operational efficiency; b. Solar-Powered Operation: The utilization of solar energy eliminates the need for conventional electrical power sources, such as PLN; c. Comprehensive Settings: The device offers complete control, including automated scheduling, feeding duration adjustment, and remote control functionality through a remote control device. d. Compact Dimensions: The equipment is designed with compact dimensions, ensuring practicality and ease of use.

The manufacturing phase will span the duration of the Community Service (PKM) program, lasting for two weeks, during which coordination with partners will be maintained to facilitate feedback collection. Testing of the device will be conducted in the floating net cages (KJA) and will include assessments of:

- Automated Schedule Adjustment Functionality: Evaluating the machine's ability to automatically regulate scheduling, operational duration, feeding repetition, and remote-control manipulation via a remote-control device.
- Feeding Distance and Dispensing System Testing: Assessing the throwing distance and overall efficiency of the feeding mechanism.

Community and Fish Farming Group Education

In the village of Kertamanah, Sukasari district, education initiatives are extended to both the community and fish farming groups. This comprehensive educational effort involves detailing and explaining the upcoming processes through First, Education on the Use of Fish Feeder Technology: The educational program focuses on acquainting participants with the intricacies of employing fish feeder technology. By providing in-depth insights into its functionality, participants gain a clear understanding of the application and advantages associated with this innovative technology.

Second, Education on the Machine Operation System: Participants are guided through the operational intricacies of the machinery, with detailed explanations covering each component and its respective functions. This segment ensures that individuals possess a comprehensive comprehension of the entire system, fostering effective and informed utilization.

Third, Education on Cost Calculation and Economic Benefits: This aspect of the education program delves into the financial aspects of tool procurement, elucidating the associated costs and economic gains. Through demonstrations and practical sessions at partner pond locations, participants gain hands-on experience in the application of the fish feeder tool, further enhancing their understanding of its economic implications. Fourth, Education on Fish Feeder Maintenance: Maintenance is a crucial aspect of technology utilization. Participants receive guidance on the proper care and upkeep of the fish feeder tool, ensuring its longevity and optimal performance. This educational segment emphasizes the significance of regular maintenance practices for sustained operational efficiency.

RESULT AND DISCUSSION

Contextual Background and Implementation of Community Service Activities

In response to the challenges faced by fish farmers, particularly one of the farmers in the partner village, the project team conducted a series of community service activities over a period of two weeks. The detailed activities included: The initial step involved conducting surveys with the partner farmers to gather information and identify their specific challenges. This process aimed to establish a comprehensive understanding of the issues faced by the partners in the cultivation of fish farmers. Subsequently, the team proceeded to develop a preliminary design, encompassing drafts, material and tool specifications, and

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conceptual frameworks. This design phase laid the foundation for the creation of the machine, serving as a benchmark for its subsequent construction.

Negotiations were undertaken with the fish farmers to reach mutual agreements on the proposed interventions. This step ensured alignment with the farmers' needs and preferences, fostering collaborative decision-making. Following the agreement phase, the team commenced the actual construction of the machine, adhering to the specifications outlined in collaboration with the partners. The constructed machine underwent rigorous testing, evaluating its production capacity, operational efficiency, and maintenance requirements.

The project also included a crucial phase of socialization and training, wherein the community was educated on the operation and maintenance of the newly developed machine. This initiative aimed to empower the farmers with the necessary knowledge and skills to effectively utilize and sustain the equipment. Finally, the completed machines, along with comprehensive manual books, were formally handed over to the partner farmers. This transfer marked the culmination of the community service activities, providing the farmers with the tools and information needed for the continued success of their fish farming endeavors.

Development and Implementation of the Automatic Fish Feeder Device

The design of this machine incorporates an automatic control system for motor movement, allowing precise regulation of the machine's activation and deactivation times through a control mechanism. The automated control ensures that the dispensing of fish feed occurs systematically and on schedule, contributing to the provision of feed to the fish in an organized and timely manner.

FIGURE 4. Automatic Fish Feeder (courtesy of eFishery)

Operational Mechanism of the Automatic Fish Feeding Machine

The operational procedure of this apparatus commences with the deposition of fish feed into the conical container, strategically positioned at the top and capable of accommodating 20-30 kg of feed. Following this initial step, the fish feed smoothly descends within the container, facilitated by the gravitational force. This innovative design ensures a seamless and controlled release of the feed, optimizing the feeding process for aquatic organisms. The gravitational descent mechanism, combined with the container's substantial capacity, enhances the efficiency of the machine, providing a reliable and continuous supply of nourishment for aquatic life.

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As the fish feed descends within the apparatus, it enters and occupies the impeller, a critical component seamlessly connected to the driving motor, as illustrated in Figure 4. The dispensing methodology is ingeniously orchestrated, employing an impeller set into motion by a meticulously controlled motor. This automated control mechanism ensures precision and reliability in the dispensing process. Subsequently, the fish feed held within the impeller undergoes a dynamic expulsion through a designated opening. This expulsion is skillfully facilitated by the centrifugal force generated by the calculated motion of the motor. The integrated system of the impeller and the motor, working in tandem, exemplifies a sophisticated yet efficient approach to fish feed dispensation, contributing to the overall efficacy and precision of the feeding process within aquatic environments.

FIGURE 5. Control Panel Installation

The fabrication of the Control Panel takes place directly at the Community Service Program (KKN) site, facilitating the subsequent stages of assembly, integration, and system testing, as visually represented in Figure 5. The decision to undertake the creation of the Control Panel on-site is strategically made to streamline the manufacturing process, ensuring seamless integration with the broader system components. This approach not only enhances logistical efficiency but also enables immediate troubleshooting and adjustments during the assembly phase. The on-site production of the Control Panel underscores a hands-on and adaptive methodology, allowing for real-time modifications and optimizations as needed. This meticulous strategy contributes to the overall effectiveness and reliability of the control system, reinforcing its successful implementation within the designated community service context.

In contrast to other comparable community service products, this product's design features a user-friendly interface on the control panel for managing the autonomous system. Additionally, it incorporates solar panels to maintain a sustainable power source, eliminating the necessity for any additional power supply from the grid. Unlike products developed by (Lusi et al. 2020; Azhar et al. 2021), which solely employ timer controllers for the autonomous system, this product does not rely on power sources from the grid.

System and Devices Testing

Following the completion of the fish feeder machine's construction, a rigorous testing phase is initiated to evaluate its performance and functionality. The testing protocols are executed in a practical setting, specifically within the Floating Net Cage (Kolam Jaring Apung or KJA) at Jatiluhur. This intentional choice of testing environment allows for a comprehensive understanding of the device's real-world application and

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identification of any potential issues that may arise, as illustrated in Figure 6. The testing procedures encompass an array of scenarios to simulate diverse operational conditions, ensuring the robustness and adaptability of the fish feeder. This meticulous testing phase serves as a crucial step in the quality assurance process, providing valuable insights for refinement and optimization before the final implementation of the fish feeder within the designated aquaculture setting.

FIGURE 6. Feeding Devices and System Testing

Through the meticulous testing process, several partial issues have been identified, most notably the concern that the fish feed ejected from the feeder device tends to reach distances beyond the desired range. Addressing this challenge necessitates thoughtful modifications, particularly in refining the design of the device's funnel mechanism. Additionally, it is noteworthy that the overall functionality of the device exhibits commendable performance. The automated working mechanism operates seamlessly, and the remote control, allowing for distance control, functions effectively. The predetermined settings configured on the control panel are accurately reflected in the device's operations, showcasing the reliability and precision of the remote-controlled features. While the identified issue prompts targeted refinements, the positive performance aspects underscore the successful integration of automated operations and remote-control functionalities within the fish feeder system. These findings serve as valuable insights for further optimization, ensuring that the device meets the highest standards of efficiency and precision in its ultimate application.

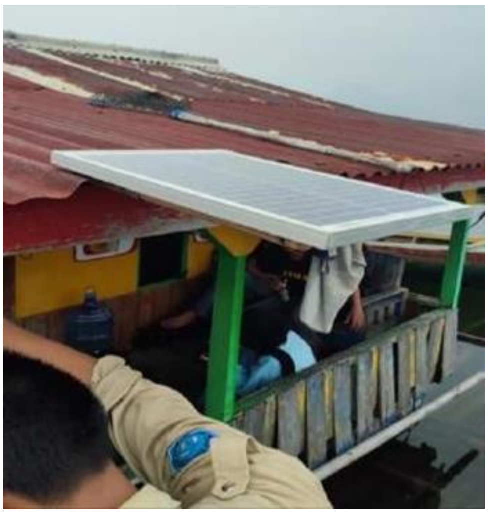

FIGURE 7. Solar Panel Testing

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Extensive testing has been undertaken to assess the performance of the solar panel power supply system, ensuring seamless integration with the fish feeder mechanism. This meticulous examination encompasses various aspects, including the positioning and efficiency of the solar panels. Notably, the solar panels are strategically placed atop the roof to maximize sunlight absorption, as illustrated in Figure 7. The positioning on the roof is a deliberate choice aimed at optimizing exposure to sunlight, thereby enhancing the overall efficiency of the solar power system. The testing procedures meticulously evaluate the solar panels' capacity to harness solar energy effectively, ensuring that they contribute optimally to powering the fish feeder system. This integrated approach aligns with sustainable practices, harnessing renewable energy sources to drive the aquaculture system. The outcomes of these tests provide valuable insights into the effectiveness of the solar power component, guiding any necessary adjustments for the seamless incorporation of this eco-friendly energy source within the fish feeding apparatus.

Feeding Machine Operational Training

The operational training of the machine involves a comprehensive understanding of several key aspects that the partners need to grasp concerning the device's utilization. This training initiative, as depicted in Figure 8, serves as a platform for students to impart knowledge on the operational intricacies of the machine to the local community. It encompasses a range of topics, including but not limited to, the fundamental operations of the machine, troubleshooting protocols, and the optimal utilization of the automated features. This training session acts as a crucial bridge between the technological innovation and its end-users, fostering a collaborative and inclusive approach to knowledge dissemination. The hands-on approach during the training allows community members to actively engage with the machine, gaining practical experience under the guidance of the students. The exchange of insights and expertise during this training period not only enhances the technical proficiency of the end-users but also strengthens the collaborative ties between the academic institution and the local community, fostering a sustainable and mutually beneficial partnership.

FIGURE 8. Operation Training and Demonstration

The comprehensive training program for the utilization of the fish feeder machine encompasses a multifaceted approach to ensure that the end-users, the partners, are well-versed in its operation. Firstly, the training initiates with a detailed exposition of the Standard Operating Procedures (SOP) for the fish feeder machine. This includes a step-by-step guide elucidating the intricacies of the machine's operation, providing a foundational understanding for the participants. Secondly, a pivotal component of the training

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involves a live demonstration of the machine's usage by the dedicated team from the Community Service Program (PKM). This hands-on demonstration not only offers practical insights into the machine's functionalities but also allows the participants to observe its seamless operation in real-time.

The third element of the training encompasses focused sessions conducted directly with the partners (as depicted in Figure 9). This tailored training provides a platform for the partners to actively engage with the machine, guided by the expertise of the PKM team. This interactive approach fosters a collaborative learning environment, empowering the partners with the skills needed for proficient machine operation. Moreover, it provides an opportunity for the PKM team to address specific queries or concerns raised by the partners, ensuring a thorough and personalized understanding of the machine.

The concluding phase involves a comprehensive discussion where both the partners and the PKM team engage in an evaluative dialogue about the machine's performance. This discussion forum allows for the exchange of feedback, experiences, and insights, facilitating a collaborative refinement process. The insights garnered from these discussions contribute to a continuous improvement cycle, ensuring that the fish feeder machine aligns with the specific needs and expectations of the end-users. In essence, this training program aims not only to impart operational knowledge but also to establish a dynamic feedback loop, fostering a symbiotic relationship between the technology developers and the community end-users.

FIGURE 9. Operational Training for Farmers

The outcomes derived from this initiative encompass both technological and informational transfers, manifesting as the implementation of appropriate technology in the fish feeding process. The significance of experimentation and operational training for this tool becomes apparent, considering that the partners were initially engaged in the manual feeding process. Therefore, a more detailed comprehension of the machine's functionalities and operational principles is crucial, as depicted in Figure 9.

Throughout this endeavor, a comprehensive elucidation of the timer's principles for regulating the feeding schedule was provided. Given that the partners were initially accustomed to manual feeding practices, there was palpable enthusiasm among them to grasp the intricacies of the machine. This enthusiasm was particularly evident during the trial sessions, where the partners displayed a keen interest in experimenting and independently configuring the feeding methods. Notably, they expressed a desire to explore both manual feeding techniques and those governed by programmable schedules and durations.

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The tangible results of these activities extend beyond the mere introduction of technology. They signify a shift in the partners' understanding and operational capabilities, fostering a sense of empowerment and autonomy. The emphasis on hands-on experimentation and personalized control over the feeding process has not only accelerated the acceptance of the technology but has also nurtured a proactive engagement from the partners. This transformative process underscores the effectiveness of the training approach, which prioritizes practical experiences and collaborative learning, ensuring that the partners are not just users but informed operators capable of optimizing the technology to suit their unique contexts and preferences. In essence, this initiative marks a successful stride towards technology adoption and integration, fueled by knowledge transfer and hands-on engagement.

Automatic Fish Feeding Handover

The handover of the Automatic Fish Feeder tool, as illustrated in Figure 10, transpired symbolically through the utilization of a remote control and a manual book. The symbolic transfer was orchestrated by the team leader of the Community Service Program, and witnessed by team members and local officials. Following the official handover, a comprehensive discussion ensued to gather feedback regarding the activities undertaken. This feedback session served as a valuable forum for the partners to share their insights, express their observations, and voice any concerns or suggestions they might have regarding the tool and the entire project. The interactive nature of this discourse not only facilitated the formal transfer of the equipment but also fostered a collaborative environment, encouraging open communication and mutual understanding between the project team and the partners. Furthermore, this post-handover discussion served as a reflective platform, paving the way for iterative improvements, adjustments, and enhancements in subsequent implementations. In essence, the symbolic handover ceremony transcended mere formality, evolving into a dynamic exchange that encapsulated the spirit of cooperation and continuous improvement within the collaborative ecosystem.

FIGURE 10. The Symbolic Handover

The Deputy Village Head expressed his enthusiasm for the regular use of the fish feeder tool, emphasizing its potential to serve as a catalyst for technological advancement in the field of aquaculture within the Floating Net Cage (KJA) at Jatiluhur Reservoir, Kertamanah Village, Sukasari Subdistrict, Purwakarta Regency.

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CONCLUSION

The community service activities conducted for fish farmers in the Floating Net Cages (KJA) in Kertamanah Village, Sukasari Subdistrict, Purwakarta Regency, have produced notable outcomes. The overall initiative has successfully elevated the knowledge and skills of partners concerning fish feeder technology, laying the groundwork for the initial modernization of fisheries technology within the Floating Net Cages at Jatiluhur Reservoir. Emphasizing the advantages of combining solar panel technology with the automatic fish feeder, the community's enthusiastic response to the program was marked by active participation and wholehearted engagement in the various sessions. Notably, the implementation of the fish feeder tool, coupled with the integration of solar panels, presents a remarkable stride toward achieving enhanced efficiency in aquaculture practices within the Floating Net Cages. This harmonious combination not only represents a significant step in technological advancement but also underscores the potential for sustainable and eco-friendly aquaculture practices in the region.

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