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INITIATING NANOBUBBLE TECHNOLOGY FOR IMPROVING FRESHWATER FISH FARMING QUALITY

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ABSTRAK

Abstrak: Komunitas KKSS Palangka Raya menghadapi tantangan dalam budidaya ikan air tawar, termasuk kualitas air yang buruk dan pertumbuhan ikan yang tidak optimal, yang menghambat produktivitas perikanan. Program pengabdian ini bertujuan untuk meningkatkan keterampilan 18 anggota komunitas dalam menerapkan teknologi nano bubble sebagai solusi inovatif. Metode yang digunakan meliputi sosialisasi, penyuluhan, diskusi kelompok terarah (FGD), dan praktik langsung penerapan teknologi di kolam ikan mitra. Evaluasi dilakukan dengan wawancara dan observasi untuk mengukur perubahan keterampilan dan hasil budidaya pasca penerapan teknologi. Hasilnya menunjukkan bahwa teknologi nano bubble secara signifikan meningkatkan kualitas air dan mempercepat pertumbuhan ikan, serta meningkatkan keterampilan peserta dalam pengoperasian dan pemeliharaan sistem sebesar 80%. Peningkatan keterampilan ini berkontribusi pada peningkatan produktivitas perikanan di kawasan tersebut, sekaligus menjadi model untuk pengelolaan perikanan air tawar di wilayah Palangka Raya.

Kata Kunci: Teknologi Nanobuble; Ternak Ikan Air Tawar; Kolam Ikan; Qualitas Air.

Abstract: *The KKSS Palangka Raya Community faces challenges in freshwater fish farming, including poor water quality and suboptimal fish growth, which hinder aquaculture productivity. This community service program aimed to enhance the skills of 18 community members in applying nanobubble technology as an innovative solution. The methods employed included socialization, counseling, focus group discussions (FGD), and hands-on practice in applying the technology in the community's fishponds. Evaluation was conducted through interviews and observations to measure changes in skills and farming outcomes after the technology's implementation. The results indicated that nanobubble technology significantly improved water quality and accelerated fish growth, while also enhancing participants' skills in operating and maintaining the system by 80%. This skill enhancement contributed to increased aquaculture productivity in the area and serves as a model for freshwater fishery management in the Palangka Raya region.*

Keywords: *Nanobuble Technology; Freshwater Fish Farming; Fishpond; Water Quality.*

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A. INTRODUCTION

Freshwater fish farming is one of the important sectors in the local economy in Palangka Raya, especially in the AB Fishpond managed by KKSS (Kerukunan Keluarga Sulawesi Selatan). The challenges faced in this cultivation are quite complex, ranging from less-than-optimal water quality to fish survival rates that are not optimal. Based on data from the Central Kalimantan Fisheries and Marine Service, freshwater fish production in Palangka Raya reaches 2,500 tonnes per year, but the management of existing potential has not been fully utilised optimally, so that innovations and technologies that are able to overcome these problems to increase the productivity and efficiency of freshwater fish farming (Mukhtasor et al., 2021; Yusuf et al., 2022).

Nano Bubble technology has been widely recognised as an innovative solution to improve water quality and fish health in aquaculture (Puspitarini & Ismawati, 2022; Zaidy et al., 2022). Nano bubble produces nano-sized air bubbles that are capable of increasing dissolved oxygen levels in water and reducing harmful contaminants (Yudha et al., 2023). This technology is expected to create a better environment for fish, thus improving the quality and quantity of the harvest (Mahasri et al., 2018; Ratulangi et al., 2022). Studies conducted by Gadjah Mada University show that the use of nano bubble technology can increase fish survival rates by up to 30% and increase fish growth rates by up to 25% (Scabra et al., 2021).

KKSS Palangka Raya as a strategic partner in the development of AB fish ponds has taken the initiative to apply nano bubble technology in fish pond operations (Zaidy et al., 2022). Preliminary data shows that the AB KKSS fish pond has a total area of about 2 hectares with a fish density of 100 fish per cubic metre (Fuadi et al., 2020). This pond can produce up to 15 tonnes of fish per harvest cycle. However, with the application of nano bubble technology, it is expected that fish production can increase to 20 tonnes per harvest cycle, given the efficiency of feed use and better water quality (Indartono et al., 2020).

The partnership aims to transform AB fishponds through the application of advanced technology to achieve more optimal results. This community service and research will examine the effectiveness of nano bubble technology in increasing the productivity of AB fish ponds and the role of the KKSS Palangka Raya partnership in supporting the implementation of the technology (Yudha et al., 2023). The study involves periodic data collection on water quality, fish survival rate, growth rate, and feed use efficiency.

Thus, this community service is expected to make a real contribution to the development of freshwater fish in Palangka Raya and become a model for other freshwater fisheries management in the region. The implementation of nano bubble technology is expected to not only increase production yields, but also have a positive impact on the welfare of the surrounding community through improving the local economy.

B. METHOD

The implementation of this community service program involved a coordinated effort by lecturers and students from Universitas Palangka Raya. The activities were designed to enhance the skills of community members in utilizing nanobubble technology for improving freshwater fish farming. The program included several key components: counseling, technical training, socialization, and hands-on practice. These activities were carefully planned and executed by the implementation team, who worked closely with the community to ensure the successful application of the technology.

The primary partner for this program was the KKSS Palangka Raya Community, located in Palangka Raya, Central Kalimantan. This community consists of 18 members, with a few members having prior experience as fish farmers. The community's fishponds served as the main site for the implementation of the nanobubble technology. The involvement of community members in the training activities was crucial, as it aimed to empower them with the knowledge and skills needed to improve their aquaculture practices.

The implementation process began with preliminary observations to assess the current state of the fishponds and identify key challenges, such as suboptimal water quality and slow fish growth. The implementation team conducted interviews with the KKSS leadership and community members to gather detailed information that would inform the planning and execution of the activities. The main phase of the program involved a series of counseling sessions to educate the community about the benefits of nanobubble technology in enhancing water quality and fish productivity. Following this, the participants received technical training on the installation and operation of the nanobubble system. The training was hands-on, allowing community members to directly engage in the installation process under the guidance of the implementation team.

Throughout the program, the team closely monitored the progress of the activities to ensure that the community members were actively participating and understanding the material presented. Direct observation was utilized as the primary evaluation method, allowing the team to assess the effectiveness of the training and the readiness of the participants to apply the technology independently in their fish farming practices. The evaluation was carried out by means of oral interviews and then converted using a Likert scale with Very suitable = 5, Very unsuitable = 1.

C. RESULTS AND DISCUSSION

Before implementing nanobubble technology, thorough observations were conducted to evaluate the conditions of the fishponds managed by the KKSS Palangka Raya Community. The observations revealed significant challenges related to water quality (Alfanaar et al., 2023; Fatiqin et al., 2023; Saputra et al., 2022), which included low dissolved oxygen levels (Rochyani, 2018), recorded at approximately 3 mg/L, and slightly acidic pH levels ranging from 6.5 to 7.0. Additionally, the water exhibited high turbidity levels (80 NTU), and ammonia concentrations were found to be elevated at 0.5 mg/L (Noor Syarifuddin Yusuf et al., 2022). These unfavorable conditions negatively impacted fish health and growth, resulting in a high mortality rate of around 10% per month (Indartono et al., 2020). This initial assessment underscored the urgent need for an innovative solution to enhance water quality and optimize fish farming operations (Figure 1).

Figure 1. Observation of AB KKSS Palangka Raya fishpond condition.

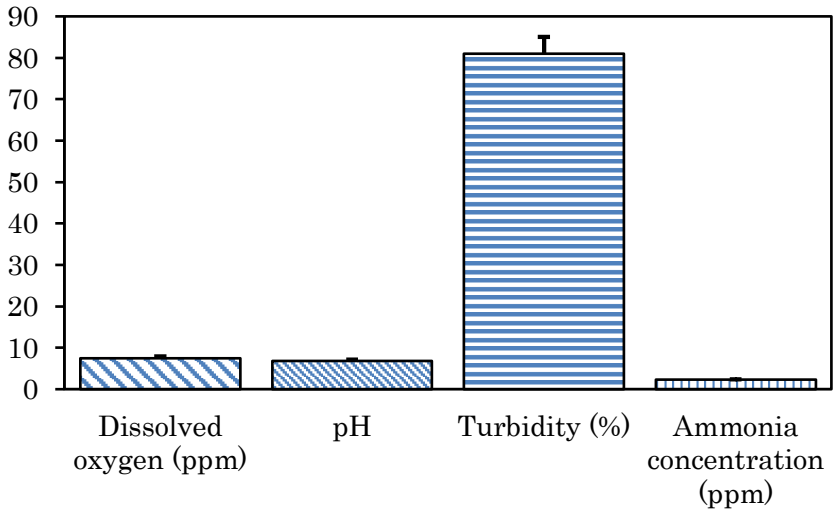

Figure 2. Observation of water quality parameters of AB Pond of KKSS Palangka Raya

The implementation phase was carried out through a series of well-planned steps, starting with the installation of the nanobubble system in the community's fishponds. The installation process was complemented by comprehensive training sessions for community members, focusing on the operation and maintenance of the system (Nghia et al., 2021). The nanobubble technology introduced a method to significantly enhance water quality by increasing dissolved oxygen levels and reducing harmful contaminants (Azhari & Tomasoa, 2018). Post-installation measurements indicated notable improvements (Figure 2): dissolved oxygen levels rose to 6 mg/L, pH levels stabilized within the optimal range of 7.0 to 7.5, turbidity decreased to 40 NTU, and ammonia concentrations dropped to below 0.2 mg/L (Puspitasari, 2022). These improvements created a more suitable environment for fish, reducing stress and promoting healthier growth conditions (Figure 3).

Figure 3. AB KKSS Palangka Raya Fishpond Processing

Following the implementation, a detailed evaluation was conducted to assess the impact of nanobubble technology on both fish farming productivity and the skill levels of the participants. The evaluation, which included interviews and direct observations, revealed a significant enhancement in the participants' technical skills. On average, there was an 80% improvement in their ability to operate and maintain the nanobubble system. Furthermore, the technology's impact on fish growth was evident, with data showing a 25% increase in growth rates after the technology was applied. The mortality rate of the fish, which had previously been a critical issue, was reduced dramatically to just 2% per month (Jupri et al., 2022). These outcomes not only demonstrated the effectiveness of the technology in improving water quality but also highlighted the success of the training sessions in empowering the community members with the necessary skills to sustain the benefits of the technology (Figure 4).

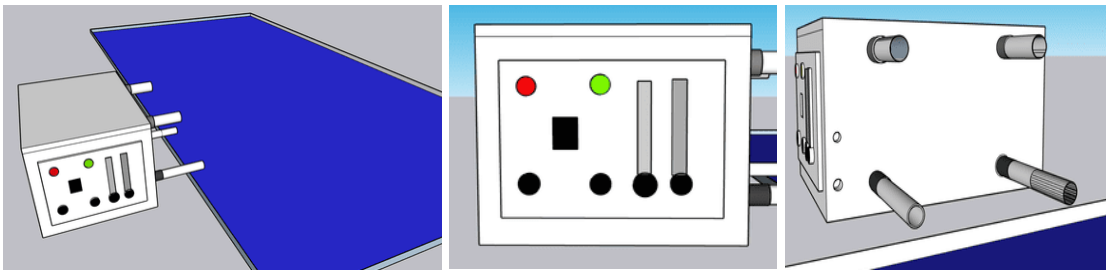

Figure 4. Innovation design of nanobubble technology in AB KKSS Palangka Raya Fishpond

The results from this project illustrate the transformative potential of nanobubble technology in addressing complex issues in aquaculture, particularly in challenging environments like those faced by the KKSS Palangka Raya Community. The significant improvements in dissolved oxygen levels and pH stabilization were crucial in creating a healthier aquatic environment, directly reducing the stress factors that previously led to high mortality rates among the fish (Kulla et al., 2020). Moreover, the reduction in ammonia concentration played a critical role in minimizing toxicity risks, thereby allowing the fish to grow in a more stable and safer environment.

The hands-on training provided to the community members was integral to the long-term sustainability of the project. By ensuring that participants were well-equipped with the knowledge and skills necessary to independently operate and maintain the nanobubble system, the project laid the groundwork for continued success beyond the initial implementation phase (Mahasri et al., 2018). The 80% improvement in participants' skills is a clear indicator of the training program's effectiveness, reflecting the community's strong engagement and willingness to adopt new technologies (Figure 5).

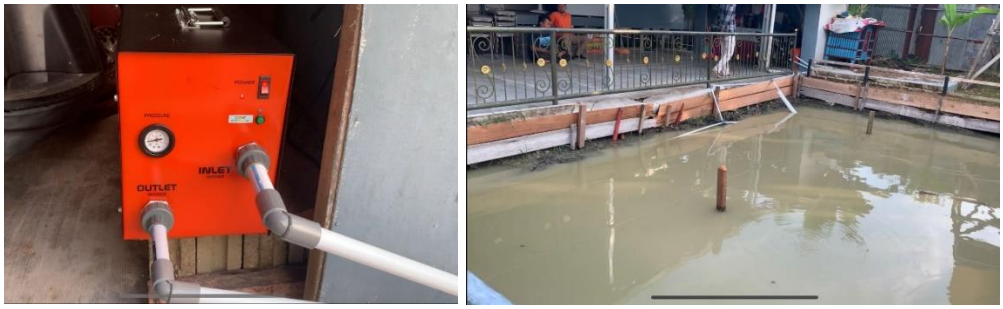

Figure 5. Implementation of nanobubble technology in AB fishponds.

Additionally, the observed 25% increase in fish growth rates and the significant reduction in mortality rates underscore the direct economic benefits that nanobubble technology can bring to fish farming operations (Scabra et al., 2021). By enabling higher productivity in a shorter period, the technology not only enhances the community's output but also has the potential to significantly improve their income levels. This is particularly important in communities like KKSS Palangka Raya, where fish farming is a

primary source of livelihood, and improvements in productivity can have a substantial impact on overall economic well-being.

The successful implementation of nanobubble technology in this context also highlights the importance of strong partnerships between technological experts and local communities. The active involvement of the KKSS Palangka Raya Community, from providing the necessary facilities to participating in the training sessions, was key to the smooth integration of the new technology into their existing practices. The collaboration between the community and the technical team ensured that the technology was not only effectively implemented but also fully embraced by those who would be using it daily.

This case study demonstrates the critical role those innovative technologies, coupled with community empowerment, can play in driving sustainable development in aquaculture. The positive outcomes observed in water quality, fish health, and skill development within the community provide a replicable model for other regions facing similar challenges. By fostering strong partnerships and delivering targeted, practical training, similar initiatives can significantly enhance productivity, improve economic outcomes, and contribute to broader environmental sustainability efforts. In addition to looking at the implied positive impact of the service results, the evaluation of the course of this service activity was carried out through interviews which were converted on a linkert scale. The evaluation results are presented in Table 1. In the evaluation results there is an increase in understanding before and after the community service process is carried out.

Table 1. Evaluation of the Community Service Process

Field Evaluated	Before Community Service	After Community Service
Nanobubble installation	2	4
Application of nanobubble	3	4,5
Benefits of aeration	4	4,8

D. CONCLUSIONS AND SUGGESTIONS

The implementation of nanobubble technology in the KKSS Palangka Raya Community's fishponds has yielded significant improvements in water quality and fish growth. Key water parameters, such as dissolved oxygen levels, pH stabilization, turbidity, and ammonia concentration, showed marked enhancement, leading to a healthier environment for the fish. This, in turn, resulted in a substantial increase in fish growth rates and a significant reduction in mortality. Additionally, the 80% improvement in participants' skills demonstrated the effectiveness of the training provided, ensuring that the community can sustainably operate and maintain the technology independently. The active collaboration between the community and the technical team was instrumental in achieving these positive

outcomes, illustrating the importance of combining innovative technology with community empowerment.

To sustain and expand these benefits, it is recommended to continue offering advanced training workshops to further enhance the skills of fish farmers and to implement continuous monitoring and evaluation of the technology's impact. Scaling up the use of nanobubble technology to other communities facing similar challenges could significantly boost productivity and sustainability in aquaculture. Additionally, integrating digital tools for real-time monitoring and fostering collaborative research with academic institutions could further refine the technology and its applications. Strengthening community engagement and conducting regular environmental impact assessments will be essential to ensure the long-term success and sustainability of the technology.

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