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APPLICATION OF PROBIOTIC TECHNOLOGY IN FEED TO INCREASE NILE TILAPIA AQUACULTURE PRODUCTIVITY

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Artikel info

Abstrak. *Tingginya biaya produksi, terutama pada komponen pakan yang dapat mencapai 60–70% dari total biaya operasional, menjadi kendala utama bagi para pembudidaya ikan nila di Desa Purnakarya. Sebagai solusi atas permasalahan tersebut, program pengabdian kepada masyarakat ini bertujuan untuk mengenalkan dan menerapkan teknologi probiotik pada pakan sebagai strategi peningkatan efisiensi nutrisi, pertumbuhan, serta kesehatan ikan nila. Metode pelaksanaan kegiatan ini menggunakan pendekatan partisipatif dan edukatif, yang terdiri dari tahapan sosialisasi, penyuluhan, pelatihan dan demonstrasi penambahan probiotik pada pakan, hingga pendampingan dan monitoring berkala di lapangan. Hasil evaluasi program menunjukkan adanya peningkatan pengetahuan serta keterampilan mitra terkait formulasi pakan berprobiotik secara signifikan. Dari aspek teknis budidaya, aplikasi pakan berprobiotik selama pemeliharaan terbukti mampu meningkatkan pertumbuhan bobot ikan sebesar ±25%, mencapai tingkat kelangsungan hidup (SR) hingga 90%, dan memperbaiki nilai konversi pakan (FCR) menjadi 1,4. Secara keseluruhan, dapat disimpulkan bahwa penerapan teknologi probiotik merupakan inovasi tepat guna yang mudah diaplikasikan, ekonomis, serta secara efektif mampu meningkatkan produktivitas budidaya ikan nila dan kemandirian pembudidaya.*

Abstract. *The high production cost, especially the feed component which accounts for 60–70% of total operational costs , is a major challenge for Nile tilapia farmers in Purnakarya Village. To address this issue, this community service program aims to introduce and apply probiotic technology in feed as a strategy to improve nutritional efficiency, growth, and health of Nile tilapia. The implementation method used a participatory and educative approach , consisting of socialization, counseling, training and demonstration of probiotic application in feed, followed by periodic mentoring and monitoring in the field. The evaluation results showed a significant increase in the partners' knowledge and skills regarding the formulation of probiotic-*

enriched feed. Technically, the application of probiotic feed during the rearing period successfully increased fish weight growth by ±25%, achieved a survival rate (SR) of up to 90%, and improved the feed conversion ratio (FCR) to 1.4. In conclusion, the application of probiotic technology is an appropriate innovation that is easy to implement, economical, and effectively increases both the productivity of Nile tilapia aquaculture and the independence of the farmers.

Keywords:
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INTRODUCTION

Aquaculture is one of the strategic sectors in community economic development, particularly in rural areas. Nile tilapia (Oreochromis niloticus) farming is a significant and promising commodity because the species is relatively easy to culture, has broad environmental tolerance, and continues to experience increasing market demand. Purnakarya Village, located in Tanralili District, Maros Regency, is one of the areas with considerable potential for developing Nile tilapia aquaculture. This potential is supported by the availability of adequate natural resources, including water sources and local raw materials for feed, which can be optimized to support sustainable aquaculture practices. However, the main challenge faced by farmers in this area is the high cost of production. Feed constitutes the dominant expenditure, reaching approximately 60-70% of total operational costs. Most farmers in Purnakarya Village still depend on commercial feed, which substantially increases production costs and reduces their profit margins.

To reduce production costs, farmers have initiated the production of self-formulated feed using locally available raw materials. Training on independent feed production had also been conducted in the previous year. Nevertheless, these efforts have not yet fully addressed the nutritional quality of the feed. The urgent priority is therefore the relatively low quality of locally produced feed and the limited knowledge of farmers regarding probiotic technology in feed formulation. This condition results in suboptimal fish growth and low feed conversion efficiency (FCR), which ultimately affects productivity and farmer income. Accordingly, technological innovation to improve the effectiveness of self-formulated feed is urgently needed.

As a problem-solving framework, the application of probiotic technology in feed is a highly relevant and practical solution. The literature indicates that probiotics, as beneficial live microorganisms, play an essential role in Nile tilapia culture by improving digestibility, balancing intestinal microbiota, enhancing feed efficiency (FCR), and strengthening resistance to disease. In addition to physiological benefits for fish, probiotic supplementation may also positively influence the aquatic environment because microbial bioconversion can reduce ammonia and organic matter in the water, thereby supporting more stable water quality.

Based on these considerations, this Community Service Program (PkM) aimed to introduce and apply probiotic technology in feed as a strategy to improve nutritional efficiency, growth, and health of Nile tilapia. More specifically, this activity was directed at increasing aquaculture productivity through improved growth performance, feed conversion ratio (FCR), and survival rate (SR), while also establishing a sustainable partnership between the university and the community in transferring appropriate technology in the field of aquaculture.

Data and Methodology

The implementation of this Community Service Program (PkM) employed a participatory and educational approach to address partner problems related to high commercial feed costs and low growth efficiency in Nile tilapia aquaculture. The innovative solution offered and implemented was the application of probiotic technology to self-formulated feed. This solution was selected to improve feed nutritional quality, digestibility, and fish health in an economical manner.

The community service activity was conducted in Purnakarya Village, Tanralili District, Maros Regency. The target community consisted of 10 fish farmers who are members of the Gertaqu Fish Farmers Group (Pokdakan). The main activity was implemented on Saturday, 26 October 2025, followed by continuous monitoring for approximately one month after the technology was applied in the partners' ponds.

The work procedure was arranged sequentially by combining awareness-raising and education, workshop-based training, mentoring, and evaluation. The implementation stages are described as follows.

Awareness Raising and Education (Socialization and Counseling): This stage began with coordination and problem identification, followed by face-to-face technical counseling. The activity aimed to provide partners with technical understanding of the role of probiotics in the digestive system and their benefits for feed efficiency and water quality.

Workshop and Training (Direct Practice): The community service team provided hands-on demonstration training at the partner aquaculture pond. Partners were actively involved in practicing the innovation of mixing EM4-type probiotics into feed. The procedure included preparing 10 ml of EM4 probiotic diluted in 300 ml of boiled freshwater, spraying the solution evenly onto 1 kg of feed, leaving the feed for approximately two hours, and then air-drying it before feeding it to Nile tilapia.

Mentoring and Evaluation: After the training, partners independently applied probiotic technology with periodic assistance from the team. Program success was evaluated through direct observation and field measurement during the first month. The parameters measured included fish weight gain, survival rate (SR), and feed conversion ratio (FCR).

Results and Discussion

The implementation of this Community Service Program (PkM) consisted of four main activities arranged sequentially: socialization, counseling, training, and monitoring. The socialization stage provided partners with an initial understanding of the objectives, scope, and benefits of applying probiotic technology in Nile tilapia feed. This activity was attended by members of the Gertaqu Fish Farmers Group (Pokdakan), the hamlet head, and community leaders of Purnakarya Village.

The next stage was technical counseling, which focused on increasing partners' knowledge of the role of probiotics in the digestive system, their benefits for feed efficiency, and the application of EM4-type probiotics in Nile tilapia feed. The counseling activity was conducted interactively, as shown in Figure 1, through material presentation and question-and-answer sessions. Once the partners understood the basic concept, the team conducted direct training and practice at the aquaculture pond. Partners practiced each step of probiotic mixing, starting from preparing 10 ml of EM4 probiotic diluted in 300 ml of boiled freshwater, spraying it evenly onto 1 kg of feed, leaving it for approximately two hours, and air-drying the feed before it was given to the fish.

***Figure 1**. Counseling activity*

After the training stage, partners applied probiotic technology independently within their aquaculture system under continuous mentoring and monitoring for approximately one month. The rearing results indicated a highly positive improvement in several aquaculture performance parameters.

***Figure 2.** Spraying probiotics onto feed and feeding Nile tilapia with probiotic-enriched feed*

***Tabel 1.** Observed parameters before and after probiotic application*

Performance Parameter	Before the Program	After Probiotic Application
Weight gain	Low to moderate	Increased by approximately 25%
Survival Rate (SR)	Variable	Stable at approximately 90%
FCR	Less efficient	Improved to approximately 2.4

The weight gain of Nile tilapia increased by approximately 25% compared with the condition before the technology was applied. This improvement occurred because the colonization of probiotic microorganisms, particularly lactic acid bacteria in the EM4 product, can produce additional digestive enzymes such as protease, amylase, and lipase. These enzymes optimize the breakdown of macronutrients into forms that are more easily absorbed by the fish. The energy obtained by fish can therefore be used more effectively for anabolic processes, including the development of muscle tissue.

The survival rate (SR) of Nile tilapia during one month of rearing reached approximately 90%. This relatively high SR indicates that probiotics play a crucial role in maintaining fish health. Probiotics may stimulate the non-specific immune system through phagocytic stimulation, increased mucus production, and enhanced immune cell activity.

In addition, probiotics can inhibit the colonization of pathogenic bacteria through competition for space and nutrients, thereby increasing fish resistance to fluctuations in environmental quality.

Improved feed efficiency was also indicated by a better feed conversion ratio (FCR), reaching approximately 2.4. Although this value has not yet reached the theoretical ideal category of less than 2.0, it represents a significant improvement compared with the partners' initial inefficient condition. This improvement indicates that fish were able to convert feed into biomass more effectively, which directly contributes to reducing feed production costs that previously accounted for 60-70% of total operational expenses.

In addition to its physiological benefits, the application of probiotic technology also had a positive effect on the aquaculture environment. Field observations indicated that pond water became clearer and had less unpleasant odor. Probiotics contribute to the bioconversion of ammonia and organic matter from residual feed into less toxic forms through the activity of decomposer microbes. Reducing the accumulation of organic matter also reduces physiological stress in fish, thereby supporting more stable and sustainable aquaculture conditions.

***Table 2**. Targeted internal and external outputs*

Type of Output	Achievement Indicator	Description
Internal Mandatory Outputs	**Internal Mandatory Outputs**	**Internal Mandatory Outputs**
Short activity video	Uploaded to the LPkM UMI YouTube channel	Available
Poster	Prepared	Available
LPkM UMI website publication	Published	Available
External Mandatory Outputs	**External Mandatory Outputs**	**External Mandatory Outputs**
Scientific publication in a national journal	Submitted	Available
Increase in partner income	Probiotic-enriched feed product	Available
Additional Output	**Additional Output**	**Additional Output**
Socialization in a national seminar	Conducted	Available

Beyond physical outputs and publications, the most important output of this activity was the improvement of human resource capacity. Fish farmers who are members of Pokdakan Gertaqu now have a more comprehensive understanding of the benefits of probiotics, proper application techniques, and the recording of aquaculture outcomes.

This community service program has strong potential for sustainability. From a technical perspective, partners showed full readiness to apply this technology continuously because the method is practical, economical, and does not require complex equipment. The practical skills acquired by the partners enable them to produce probiotic-enriched self-formulated feed, thereby reducing their high dependence on expensive commercial feed. From social and institutional perspectives, the activity also strengthened solidarity and cooperation among members of the aquaculture group in adopting new innovations. This internal partnership network reinforces the institutional capacity of Pokdakan Gertaqu to plan future business expansion.

The sustainable partnership established between the university and the community creates opportunities for further mentoring related to other aquaculture innovations. Overall, the evaluation indicates that this program did not merely provide an incidental solution but also contributed to building rural economic independence through the practical application of science and technology.

Conclusion

The Community Service Program (PkM) on the application of probiotic technology in Nile tilapia feed in Purnakarya Village was successfully implemented and achieved its program objectives. The application of this appropriate technological innovation proved to be easy for the community to adopt and effectively improved the knowledge and skills of partner farmers. Based on field evaluation, probiotic application had a positive impact on aquaculture productivity and efficiency, as indicated by an approximately 25% increase in fish weight gain, an optimal survival rate (SR) of 90%, and an improved feed conversion ratio (FCR) of approximately 2.4 after about 30 days of rearing.

In addition to improving fish growth performance through better nutrient digestibility, probiotic use also contributed directly to improving pond water quality. Overall, the program enabled partners to prepare probiotic-enriched feed independently, thereby reducing their dependence on expensive commercial feed. This not only improved the efficiency of partner operational costs but also established a sustainable partnership between the university and the community for the development of the aquaculture sector.

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