



# Integrating Coffee and Biofloc for Regional Economy with Bank of Indonesia

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## Abstract

**Purpose** – This study aims to analyze the role of Bank Indonesia in strengthening the real sector and supporting regional economic growth through the optimization of local potential, particularly through the integration of coffee cluster development and pesantren-based fish farming using the biofloc system.

**Methodology** – This study uses a qualitative descriptive approach based on literature studies and internship results to describe in depth the implementation of the Bank Indonesia Tasikmalaya program.

**Findings** – The results of the study show that Bank Indonesia's facilitation has succeeded in increasing the competitiveness of coffee MSMEs in the East Priangan region such as Kopi Bunar, Kopi Cigalontang, and Tenjo Bumi Kopi as well as encouraging the implementation of an efficient, environmentally friendly biofloc system in Islamic boarding schools, which contributes to local food security.

**Implications** – This initiative has strategic implications for strengthening the real sector and developing a sharia-based economy. In addition, this program can serve as a model for collaboration between financial institutions, MSMEs, and Islamic educational institutions in realizing inclusive sustainable development.

**Originality** – This study offers a new perspective by highlighting the synergy between coffee cluster development and biofloc cultivation in Islamic boarding schools as a model for real sector integration based on sharia economic values and environmental sustainability.

## Introduction

Bank Indonesia (BI) is the central bank of the Republic of Indonesia, which plays a strategic role in maintaining the country's economic stability. Established on July 1, 1953, Bank Indonesia became a symbol of Indonesia's economic independence after taking over De Javasche Bank, which previously functioned as the central bank during the Dutch colonial period. With the establishment of Bank Indonesia, the Indonesian people gained independent monetary authority to manage the national economy (Indonesia, 2024).

Over time, Bank Indonesia has undergone several fundamental changes that have affected its duties, functions, and structure. In 1968, based on Law No. 13 of 1968, Bank Indonesia's role was expanded to include functions as a monetary authority, banking regulator,

and payment system administrator. Bank Indonesia's duties and authorities in terms of regulating and supervising Islamic banking were officially transferred to the Financial Services Authority (OJK) after the issuance of Law No. 21 of 2011 concerning the OJK. Thus, Bank Indonesia now focuses on maintaining monetary stability and controlling inflation (Rachman, 2022). This includes economic empowerment programs for the community. One tangible example of this commitment is Bank Indonesia's support for the economic development of Islamic boarding schools and the empowerment of regional commodity clusters, such as coffee.

To support this, a business unit development program is needed to improve the capacity and quality of Islamic boarding schools. In addition, this step is also part of a strategy to achieve inclusive economic growth, namely growth characterized by a reduction in poverty, a decrease in income distribution inequality, and an increase in employment (Hapsari, 2013). This effort is in line with the economic empowerment theory proposed by Amarta Sen (1999) in his work *Development as Freedom* (Sen, 1999).

Bank Indonesia launched a pesantren business holding program as one of its strategies to empower the pesantren economy. This program aims to strengthen the economic independence of pesantren while accelerating sharia-based economic growth through the development of productive business units within the pesantren environment (Abdurrohman & Ari, 2017). Bank Indonesia Tasikmalaya is taking an active role through its Coffee Cluster MSME Empowerment Program and Biofloc Program as a form of support for Islamic boarding schools and communities in the region to develop efficient, environmentally friendly, and productive fish farming businesses. Biofloc technology, which processes aquaculture waste into natural feed, is expected to support sustainable fisheries.

The agricultural sector covers a wide range of activities, one of which is the coffee plantation sub-sector. Natural resources in this sector tend to contribute steadily to the economy, both in terms of plantation area and production levels (Apriliani, 2021). According to Indonesia-Investments, around 90% of coffee plantations in Indonesia are managed by small farmers. This condition makes the development of coffee production play an important role in improving the welfare of low- to middle-income communities and promoting inclusive economic growth. However, Indonesia's coffee productivity is still relatively low compared to the other three major exporting countries (Zikra et al., 2022).

Coffee, as a leading commodity in the plantation sub-sector, faces major challenges in improving competitiveness and business sustainability. To achieve sustainability, farmers need to optimize the potential and improve the competitive advantage of coffee commodities (Soejono & Zahrosa, 2020). Coffee is an important commodity in the plantation sector and the national economy, contributing significantly to industrial development and job creation in rural areas. Cultivation and harvesting activities involve a large workforce, both directly and indirectly. For farmers, coffee is a major source of income that supports their livelihoods and improves their families' welfare (Ramadhana et al., 2024).

According to data from the Central Statistics Agency (BPS), total coffee production in 2023 was 774.96 thousand tons. This is a decrease compared to 2022, when total production was 786.19 thousand tons. Most of the coffee in Indonesia is produced by smallholder plantations, so to improve quality, it is necessary to disseminate information on appropriate cultivation and processing technologies so that farmers can understand and apply them. Of the various types of coffee, Arabica and Robusta are the most widely cultivated, but Arabica coffee has a wider range of enthusiasts because its flavors are more varied than Robusta (Mufidah & Ariyani, 2024).

Indonesia is one of the world's largest coffee producers and plays a strategic role in the global coffee market. Coffee is one of the country's main export commodities, contributing significantly to the Indonesian economy in terms of both state revenue and the welfare of farmers in coffee-producing regions (Zacharie, 2024).

In addition to coffee, the fisheries sector is also a promising area for supporting community economic empowerment. Bank Indonesia Branch Tasikmalaya is collaborating with Islamic boarding schools to cultivate fish using biofloc technology. Biofloc technology is a new innovation in aquaculture that was developed to address water quality issues. This technology is

adapted from conventional domestic waste treatment systems, but is applied in the context of fish farming. The main principle of biofloc is to process organic waste produced from fish feed and excrement into microbe clumps (flocs) that can be reused as natural feed for fish (Rizal et al., 2018).

Fish farming plays a strategic role in strengthening food security and the economy of communities, especially in rural areas. However, most fish farming activities are still carried out using conventional methods that face various obstacles, such as low production efficiency, deterioration of environmental quality, and high risk of disease outbreaks (Nursuwars et al., 2025). In addition, conventional aquaculture requires significant costs and a considerable amount of time, which is not proportional to the results. Conventional aquaculture cannot meet the market demand, which is increasing by 80 percent annually (Wulandri et al., 2020).

Thus, biofloc technology not only serves to minimize waste, but also acts as a form of nutrient recycling within the pond. The application of this technology can create an environmentally friendly, sustainable fish farming system that is efficient in its use of water and feed. Through this approach, farmers can increase productivity without damaging the aquatic ecosystem, in line with the principles of the circular economy and sustainable development (Rizal et al., 2018).

The biofloc method is a fish farming technology that utilizes the activity of microorganisms to improve water quality and optimize the absorption of nutrients such as carbon and nitrogen. This system works by forming clumps of organisms (flocs) that function to break down organic waste, making it more environmentally friendly and efficient in the farming process (Dewi et al., 2022). Biofloc technology is a solution to limited land, water, and high feed costs, as it can be applied in small areas with efficient water use without routine replacement (Amin et al., 2020).

The biofloc system is an environmentally engineered fish farming technique that utilizes oxygen supply and microorganism activity to improve feed efficiency. It works by converting organic and inorganic compounds such as carbon, oxygen, hydrogen, and nitrogen into flocs that are beneficial to the pond ecosystem (Budiantoro et al., 2024). The biofloc system can be combined with hydroponics because the wastewater from the biofloc pond contains high nutrients from fish feed residues that can be used as natural fertilizer for hydroponic plants (Wisesa et al., 2022).

Previous research on Bank Indonesia has focused on financial aspects and Islamic economic literacy, without highlighting the cross-sector synergy between regional commodity specialties (coffee) and pesantren-based aquaculture, which are characteristic features of Bank Indonesia's Branch Tasikmalaya program. This research is urgent because it examines a model of regional economic empowerment that not only strengthens the real sector but also integrates Islamic economic values, biofloc technology innovation, and environmental sustainability into a single program framework.

Therefore, the purpose of this study is to analyze and describe the role of Bank Indonesia Branch Tasikmalaya in promoting inclusive economic growth through the empowerment of coffee cluster MSMEs and pesantren-based biofloc fish farming economy, as well as to identify its contribution to the achievement of Sustainable Development Goals (SDGs).

## Literature Review

### Biofloc Technology

Biofloc technology was developed as a sustainable aquaculture system that aims to minimize water replacement while converting nitrogen and organic matter into microbial biomass that can be reused by fish as a natural food source. Floc formation occurs when a carbon source is added to the system, which then stimulates the growth of heterotrophic microorganisms to assimilate dissolved nitrogen into floc mass. The carbon to nitrogen (C:N) ratio is an important factor in this process because it determines the success of floc formation, the efficiency of

ammonia absorption, and the balance between the growth of heterotrophic microbes and nitrifiers (Ashari & Yudhana, 2023).

Biofloc technology is currently gaining popularity in shrimp and fish farming because it is considered capable of improving the efficiency and sustainability of aquaculture systems. The basic principle of this method is to process aquaculture waste directly in the rearing tank, while maintaining a balance of dissolved oxygen levels, microorganism populations, and the carbon to nitrogen (C/N) ratio at certain levels.

Various studies have proven the success of biofloc technology in several countries, such as Israel (for tilapia), Indonesia and Belize (for vannamei shrimp), and Australia and Central America (for tiger shrimp). This system is designed to increase feed utilization efficiency through the formation of macroaggregate microbial biomass from organic matter and dissolved compounds.

It is known that most feed in aquaculture activities is not fully absorbed into fish or shrimp biomass. Therefore, microbial flocs function to utilize feed residues and organic waste as additional food sources for cultivated organisms. Biofloc-based waste treatment technology is adopted in aquaculture to reduce the accumulation of organic matter and toxic compounds in the water. Basically, this system mimics and enhances the natural self-purification mechanisms that commonly occur in rivers or estuaries, but is carried out in a controlled manner within intensive farming systems (Wanja et al., 2020).

The basic principle of biofloc technology is based on the assimilation of inorganic nitrogen—mainly ammonia, nitrite, and nitrate by heterotrophic microbial communities living in the cultivation medium. Through this mechanism, nitrogen compounds that were originally waste can be converted into microbial biomass, which is then utilized by cultivated organisms as an additional source of nutrients. This concept forms the basis for the development of biofloc technology in modern land-based aquaculture systems.

Currently, biofloc-based fish farming systems are increasingly being implemented because they offer various advantages over conventional methods. This technology can increase fish survival rates to over 90%, even without the need for regular water changes. In addition, the water produced by aquaculture does not cause unpleasant odors, making it more environmentally friendly. This system also allows for synergy with crop cultivation, such as vegetables and fruits, through the use of nutrient-rich wastewater as liquid organic fertilizer in the integrated aquaculture-agriculture system concept (Oktarina et al., 2025).

### **Coffee Commodities**

Indonesia is known as an agricultural country with abundant wealth in the agricultural sector. In the plantation sub-sector, there are various commodities that still have great potential for development, both in terms of cultivation, processing, and marketing. One of the leading commodities in this sector is coffee. Coffee plays an important role as a significant contributor to the country's foreign exchange earnings compared to other plantation commodities (Zikra et al., 2022).

Indonesia, with its abundant natural resources and strategic location on global trade routes, has been an attraction for foreign traders for centuries. The relationship between foreign traders and local communities created a process of cultural assimilation that was quite harmonious. Initially, this interaction enriched Indonesia's cultural diversity, but over time, foreign cultural influences began to replace some local values, including in the tradition of coffee in Indonesia. Although coffee has now become an important part of Indonesian culture, this plant did not actually originate in the Indonesian archipelago. Around the end of the 16th century, when Indonesia was still under Dutch colonial rule, the Dutch East India Company (VOC) introduced Arabica coffee plants to the region. This step was taken to break Arab dominance in the global coffee trade. The first coffee seeds were planted by the colonial government around Batavia (now Jakarta), and then spread to the Sukabumi and Bogor areas (Ramadhana et al., 2024)

## Research Methods

This study uses a qualitative approach with descriptive analysis, which systematically and factually describes the implementation of the MSME empowerment program for the coffee cluster and pesantren-based economy using biofloc fish farming by Bank Indonesia Branch Tasikmalaya. To ensure the validity and reliability of the data, this study was supported by the application of data triangulation techniques, namely by comparing the results of interviews, observations, and documentation from various sources. Through this approach, the data obtained is expected to be more accurate, objective, and able to provide a comprehensive picture of the phenomenon being studied. This study uses a qualitative approach, with descriptive analysis, namely by systematically and factually describing the implementation of the MSME empowerment program for the coffee cluster and pesantren economy based on biofloc fish farming by Bank Indonesia Branch Tasikmalaya. To ensure the validity and reliability of the data, this study is supported by the application of data triangulation techniques, namely by comparing the results of interviews, observations, and documentation from various sources. Through this approach, the data obtained is expected to be more accurate, objective, and able to provide a comprehensive picture of the phenomenon being studied.

## Results and Discussion

### Optimizing the Potential of Regional Coffee Clusters

The local economic empowerment program carried out by Bank Indonesia's Tasikmalaya Representative Office is a concrete example of MSME development based on regional potential. One of the products developed is Cigalontang coffee, a specialty coffee from Tasikmalaya that has high economic value due to its superior quality. Support from Bank Indonesia's Tasikmalaya Representative Office has helped coffee farmer groups increase their previously limited production capacity, and they are now able to produce around 10 tons per month from 125 hectares of potential land. Arabica coffee is the main variety cultivated because it is suitable for the Cigalontang soil, which is rich in volcanic ash, resulting in a distinctive flavor and high competitiveness. In terms of price, this coffee is marketed from IDR 9,000 per kilogram for cherries to IDR 350,000 per kilogram for brown beans. Furthermore, Cigalontang coffee has begun to attract the attention of the international market, although exports are currently still carried out through a consignment system, with the hope that in the future, exports can be carried out directly by the farmer group (Dejabar, 2019).

Coffee is one of Indonesia's leading export commodities, highly competitive in the global market. Recognizing this potential, Bank Indonesia's Tasikmalaya Representative Office (Branch) is collaborating with the local government to provide assistance to coffee businesses in the East Priangan region. This assistance focuses not only on one aspect, but covers the entire value chain from upstream to downstream. These efforts include cultivation training, capacity building in the post-harvest stage, product downstreaming, provision of access to financing, and opening up domestic and export market opportunities. With this strategy, it is hoped that the quality of coffee products will be more standardized and have higher competitiveness (Tasikmalaya, 2025). One concrete example is Cigalontang Coffee, Bunar Coffee, and Tenjo Bumi Coffee, which are MSMEs under the guidance of Bank Indonesia Tasikmalaya. Through a mentoring program, these MSMEs have succeeded in improving the quality of their products so that they can compete with coffee from other regions. This success shows that strategic intervention by financial institutions can encourage quality improvement while expanding the marketing reach of local coffee.

From the perspective of community empowerment theory, the assistance activities carried out by Bank Indonesia Branch Tasikmalaya reflect the process of increasing the capacity and independence of the community in managing local economic resources. The training and facilitation provided are a form of knowledge transfer and capability building, as stated by Amartya Sen (1999), that true development occurs when communities have the freedom and ability to determine the direction of their lives. Thus, this assistance strategy not only improves

the quality of coffee products, but also expands business actors' access to markets and sources of financing, which ultimately realizes sustainable economic empowerment.

Bank Indonesia Branch Tasikmalaya has initiated the development of the Gunung Raja Coffee cluster in Cigalontang by providing facilities and infrastructure such as drying houses, warehouses, and processing machines, as part of its support for local coffee MSMEs. The provision of these facilities aims to strengthen the entire coffee value chain, from production to marketing, especially products that are export-oriented. The development program is implemented comprehensively, covering institutional, human resources, financial, production, and marketing aspects, with the hope that this intervention will enhance the capacity and competitiveness of coffee SMEs in Tasikmalaya (Bukhari, 2021).

Bank Indonesia Branch Tasikmalaya's support for Bunar coffee focuses on comprehensive assistance, ranging from improving production quality and providing access to financing to expanding market share. This assistance is also manifested through participation in international events such as World of Coffee, which is an important gateway for promoting local coffee on the global stage. The results of this assistance program are clearly visible. Bunar coffee is now able to produce coffee beans that meet export quality standards, which are in demand by buyers from Japan and European countries. This achievement demonstrates that local coffee from East Priangan has great potential to compete in the international market, while also reinforcing that the intervention of financial institutions in supporting coffee MSMEs can have a direct impact on increasing global competitiveness. (Tasikmalaya, 2025)

These findings are consistent with the results of research conducted by Afriani Sinaga, Charles M. Sianturi, and Vera A.R. Pasaribu (2021) in a journal entitled *Analysis of Coffee Farmer Empowerment Activities in Increasing Coffee Production in Sidikalang District, Dairi Regency*. The study shows that empowerment activities carried out by local organizers through cultivation training and post-harvest assistance were able to increase the productivity and quality of Sidikalang farmers' coffee yields. The similarity of these results shows that continuous assistance based on farmers' needs is a key factor in increasing the competitiveness of coffee in various regions.

However, what distinguishes the findings of this study from Sinaga et al.'s research is that the empowerment program in Tasikmalaya was carried out by a monetary authority (Bank Indonesia), which not only focused on improving the technical capacity of farmers but also opened up access to financing and international market networks. Thus, BI Tasikmalaya's approach demonstrates a more comprehensive empowerment model because it combines the aspects of production, financing, and global marketing into a single strategic framework for strengthening local coffee MSMEs.

### **The Role of Bank Indonesia in the Development of Coffee MSMEs**

Bank Indonesia plays an active role in promoting the development of coffee as a commodity as part of its efforts to support regional economic growth, improve farmers' welfare, and strengthen exports. This role is not limited to the macro level, but is also realized through direct assistance to business actors, particularly coffee MSMEs, which are the backbone of the local production and marketing chain.

According to Mr. R, a representative of Bank Indonesia Branch Tasikmalaya, Bank Indonesia's development strategy is carried out comprehensively with an end-to-end approach, covering the entire coffee value chain from upstream to downstream. At the upstream level, BI plays a role in strengthening the coffee commodity cluster ecosystem by collaborating with farmers, cooperatives, business actors, financing institutions, and local governments to create a competitive coffee ecosystem. At the downstream stage, support is provided in the form of access to financing, strengthening business institutions, and marketing facilitation.

During the production stage, BI also focuses on increasing capacity and quality through technical training in cultivation, post-harvest processing, and product innovation, so that local coffee can meet domestic and global market standards. BI also facilitates access to financing and strengthens financial literacy for coffee businesses. This program aims to enable MSMEs to

manage capital effectively and sustainably, so that their businesses can continue to grow. In line with national policies towards a green economy and digital transformation, BI also encourages the use of digital technology in the coffee supply chain to improve efficiency, expand market information, and ensure sustainable and environmentally friendly cultivation practices.

In terms of promotion and market access, Bank Indonesia provides tangible support by facilitating the participation of coffee businesses in various national and international exhibitions and business matching events. One concrete form of this support is the involvement of three coffee MSMEs under its guidance, namely Kopi Bunar-Muezza Roastery, Kopi Cigalontang, and Tenjo Bumi Kopi, in the prestigious World of Coffee (WOC) 2025 event held at the JiExpo Convention Center (JICC) in Jakarta. Through this event, local coffee products from East Priangan have the opportunity to expand their market reach, increase product value, and strengthen Indonesia's position in the global coffee industry.

Participation in the WOC was a strategic opportunity for East Priangan coffee MSMEs to showcase the quality of their products on the international stage. As a result, the three MSMEs attracted the attention of buyers from various countries, including Dubai, Malaysia, the Philippines, and a number of major cities in Indonesia such as Jakarta, Surabaya, Bali, and Lampung, and secured eight letters of intent (LoI) with a transaction value of Rp1.5 billion (Tasikmalaya, 2025)

The program reflects the application of community empowerment theory as proposed by Amartya Sen (1999), which states that true development is not only material economic improvement, but also the expansion of people's capabilities and freedom to manage their own economic resources. Through training, access to financing, and international promotion, Bank Indonesia not only helps farmers increase their yields, but also gives them control and confidence to actively participate in the global economic chain.

### **Strengthening the Economy of Islamic Boarding Schools through the Biofloc Fish Farming Program**

The biofloc method is a modern technology in aquaculture that utilizes microorganism management to increase production efficiency. This technology is widely chosen by fish farmers because it can produce harvests while minimizing adverse effects on the environment. Biofloc itself is a collection of microorganisms such as bacteria, protozoa, and algae that form clumps (flocs) in aquaculture ponds. These microorganisms function to reduce organic waste, both from feed residues and fish feces, into nutrients that can be reused by fish. This method is generally applied in ponds with intensive aeration systems, creating conditions that support optimal biofloc growth (Soleh, 2024).

Since 2022, Bi Tasikmalaya has distributed aid in the form of biofloc ponds, aerators, feed, and fish seeds to several Islamic boarding schools. An example of implementation is the provision of 8 biofloc ponds at one of the boarding schools, with an average production of 200 kg in a 3-month cycle (Radar Tasikmalaya, 2024). In addition to providing facilities, Bi also provides technical training to managers, including water quality management, aeration, and feeding. Several activities are also collaborated with horticultural greenhouse programs to create synergy between agriculture and fisheries.

The Bank Indonesia Tasikmalaya Biofloc Program provides assistance in the form of biofloc ponds, catfish fry, feed and vitamins, as well as technical training in aquaculture. The implementation of this program involves Islamic boarding schools such as the Amanah Muhammadiyah Islamic Boarding School in Tasikmalaya City, which received 15 biofloc ponds for fish farming. Additionally, the Raudathul Irfan Islamic Boarding School in Ciamis Regency also received biofloc assistance from Bank Indonesia Branch Tasikmalaya. Furthermore, the An Nur Jarnauziyyah Islamic Boarding School in Tasikmalaya City was also one of the recipients of biofloc assistance from Bank Indonesia Branch Tasikmalaya, the results of which were used to meet the needs of the students. Then, when the students' needs were met, the products were sold to congregations or communities around the boarding school. The results of this biofloc program were also able to meet the needs of the fish market near the boarding school. The An Nur

Jarnauziyyah Islamic boarding school regularly delivers its catfish harvest to the fish market (departemen ekonomi dan keuangan Syariah, 2020).

This biofloc technology enables efficient use of water and feed by using microorganisms to break down waste into natural fish feed, thereby optimizing fish growth and reducing production costs. Two harvest cycles can be achieved in a year with significantly increased yields. In its implementation, Bank Indonesia is collaborating with a number of Islamic boarding schools in the East Priangan region as partners. Each boarding school plays an active role in managing fishery business units, both to meet internal consumption needs and for commercial activities to support the financial independence of the institution. The boarding schools involved in the biofloc development or tilapia farming program include the following:

1. Pesantren Al Kautsar 561 Cineam, Kabupaten Tasikmalaya
2. Pesantren Urwatul Wustha
3. Pesantren Hamalatul Quran, Manonjaya, Kabupaten Tasikmalaya
4. Pesantren Amanah Muhammadiyah
5. Pesantren Darusshoba Al Muwaddah
6. Pesantren Miftahul Ridwan
7. Pesantren Bahrul Ulum, Kabupaten Ciamis
8. Pesantren Al Hidayah
9. Ponpes Dadali Dinilah
10. Pesantren Fathurrohman Assaefiyah
11. Pesantren An Nur Jarnauziyyah
12. Pesantren Darussalam, Ciamis
13. Pesantren Riyadlusshorfi Wal Mantiq Babakan Jamanis, Kabupaten Pangandaran
14. Pesantren Raudhotul Irfan

The participation of various Islamic boarding schools demonstrates a shared commitment to strengthening the economy of Islamic boarding schools through modern aquaculture technology innovation. The biofloc system that is being implemented has a number of advantages over conventional cultivation methods.

The biofloc method has a number of advantages that make it one of the leading technologies in modern aquaculture. One of the main advantages of this system is its feed efficiency. Microorganisms that develop in biofloc are able to convert feed residues and fish waste into natural proteins that can be consumed again by fish, thereby reducing the need for external feed and lowering production costs. In several studies, this method has even been proven to reduce the feed conversion ratio (FCR) by up to about 30 percent. In addition, the biofloc system also plays an important role in reducing environmental pollution. Microorganisms in the pond process organic waste into beneficial flocs, keeping water quality stable and allowing the water to be used for longer periods of time without needing to be changed frequently. This not only saves water, but also reduces the liquid waste produced from the farming process.

In terms of productivity, biofloc technology has been proven to increase production capacity because it allows farmers to raise fish at higher densities without compromising water quality. In practice, this system can accommodate up to 100–300 fish per cubic meter, which is a much larger number than conventional methods. In addition, biofloc also contributes to improving fish health. The microorganisms in the floc act as natural probiotics that strengthen the fish's resistance to disease and maintain the balance of the pond ecosystem. The stable oxygen levels in this system also help reduce fish stress, resulting in more optimal growth.

From an economic perspective, the application of the biofloc method has proven to be more efficient in the long term. Although it requires a relatively high initial investment, this system can reduce operational costs by 20–40 percent due to savings in feed, water, and medication use. The last but not least important advantage is its environmentally friendly nature. Biofloc supports the principles of sustainable development by minimizing organic waste, conserving water resources, and optimizing the natural nutrient cycle. With this combination of

advantages, the biofloc system is considered capable of creating an efficient, sustainable, and adaptive model for fish farming in the face of modern environmental challenges (Soleh, 2024).

The fish farming program using the biofloc system initiated by Bank Indonesia's Tasikmalaya Representative Office is one of the economic empowerment innovations for Islamic boarding schools that utilizes modern technology to improve production efficiency and support environmental sustainability principles. Based on documentation and field data, since 2022 BI Tasikmalaya has distributed assistance in the form of biofloc ponds, aerators, fish seeds, and feed to several Islamic boarding schools, such as the Amanah Muhammadiyah Islamic Boarding School in Tasikmalaya City, the Raudathul Irfan Islamic Boarding School in Ciamis Regency, and the An Nur Jarnauziyyah Islamic Boarding School. This program is also complemented by technical training on water quality management, aeration, and feeding, and is even collaborated with horticultural farming activities through a greenhouse program, thereby creating synergy between the agriculture and fisheries sectors.

The findings of this study are in line with the results of a study by Eka Maulana et al. (2023) in the journal *Training in Fish Farming with the Biofloc System for Students at the Ash-Shuufiyah Islamic Boarding School in Kencong, Jember*. In that study, the biofloc training activities carried out by the Brawijaya University community service team were proven to improve the skills of students in managing biofloc ponds, from the creation of aeration systems to water quality and feed management. Both programs share the same goal, which is to build the economic independence of Islamic boarding schools through the application of environmentally friendly and efficient biofloc technology.

However, the fundamental difference between the two programs lies in the role of the organizing institution and the scope of benefits. While the training at the Ash-Shuufiyah Kencong Islamic Boarding School is educational and limited to improving the technical knowledge of students, the program run by Bank Indonesia Branch Tasikmalaya has a broader scope as it includes support for production facilities, business management assistance, and integration with the local economic system. In addition to providing educational benefits, the Bank Indonesia program is also oriented towards long-term economic empowerment, where the results of production are used to meet the needs of the pesantren and the surrounding community, and have the potential to become a source of sustainable income.

From the perspective of Amartya Sen's economic empowerment theory (1999), this program reflects efforts to expand the capabilities of the pesantren community to be independent in managing economic resources. Through training and the provision of production facilities, students and pesantren administrators acquire knowledge, skills, and substantive freedom to develop modern technology-based business units. Thus, pesantren not only serve as educational institutions, but also become agents of economic empowerment for the community, contributing to the improvement of the welfare of the surrounding community.

### **Economic and Social Impacts of Biofloc**

Based on findings in the field, the biofloc program in Islamic boarding schools is designed not only to increase fisheries productivity, but also to foster economic independence in these schools. Findings in the field show an increase in boarding school income and production cost efficiency. One biofloc pond with a capacity of 1,000 catfish can produce an average of 200 kg of fish every 3 months with feed costs that are around 30-40% lower than conventional systems. This is because the microorganisms that grow in the pond become additional natural feed, lowering the feed conversion ratio (FCR) and increasing profit margins.

From a social perspective, the involvement of Islamic boarding school students in biofloc management also has a positive impact on human resource development. This program equips them with technical skills in fish farming, business management, as well as values of discipline and responsibility.

Overall, these findings show that the biofloc program run by Bank Indonesia Tasikmalaya is able to integrate economic, social, and environmental dimensions into a single pesantren-based empowerment model. This program not only strengthens food security and resource efficiency,

but also fosters entrepreneurship and economic independence among santri. Thus, biofloc activities in BI-assisted pesantren are a concrete implementation of the synergy between economic empowerment theory, human capital development, and sustainable development that can strengthen the overall welfare of the community.

Based on Amartya Sen's economic empowerment theory (1999), the essence of development lies not only in increasing income, but also in expanding individuals' capabilities to choose and manage the lives they value. In this context, the application of biofloc technology in Islamic boarding schools supported by Bank Indonesia Tasikmalaya can be seen as a concrete manifestation of this expansion of capabilities. Through technical training, production facility support, and business assistance, students and boarding school administrators gain substantive freedom to manage economic activities independently. They are no longer merely recipients of aid, but have become active actors in productive economic activities, from cultivation to marketing of crops.

These findings show that the biofloc program not only increases economic productivity, but also expands the economic freedom of the pesantren community in line with Amartya Sen's concept of development as freedom. When santri have skills and pesantren are able to manage business units sustainably, development no longer depends on external assistance, but grows from the internal capabilities of the community itself. Thus, Bank Indonesia Tasikmalaya's biofloc program reflects the practical application of Amartya Sen's theory, in which empowerment based on science, technology, and religious values is key to creating sustainable economic independence for the community.

### **The Relationship between the Biofloc Program in Islamic Boarding Schools and the SDGs and Sharia Economics**

The Sustainable Development Goals (SDGs) agreed upon by UN member states constitute a global framework comprising 17 main goals and 169 specific targets. Several of these are highly relevant to biofloc-based Islamic boarding school activities, particularly:

1. SDG 1 (No Poverty)  
Through the economic empowerment of Islamic boarding schools and surrounding communities, biofloc fish farming activities can increase income and reduce dependence on unstable sources of income.
2. SDG 2 (Zero Hunger)  
Biofloc enables relatively fast, efficient, and accessible production of animal protein (fish) for Islamic boarding schools and local communities. This helps provide sufficient nutritious food.
3. SDG 8 (Decent Work and Economic Growth)  
By opening up business and employment opportunities in Islamic boarding schools and surrounding communities (e.g., pond management, feed processing, maintenance, marketing), programs such as biofloc promote inclusive local economic growth.
4. SDG 12 (Responsible Consumption and Production)  
The Biofloc system utilizes nitrogen waste and microorganisms to produce natural feed in ponds, reducing water waste and clean water usage, and promoting resource efficiency.
5. SDG 17 (Partnerships for the Goals)  
Biofloc programs in Islamic boarding schools often involve partnerships between the boarding schools, government, research institutions, and local communities. This strengthens the network to support sustainable development.

The Bioflok Program in Islamic boarding schools can support SDGs and the Islamic economy through technical training in bioflok, which can enrich production skills, business management, and economic literacy, thereby supporting SDG 4 and the principles of education in the Islamic economy. Bioflok enables environmentally friendly and efficient fish farming, supporting responsible production (SDG 12) and economic growth (SDG 8).

With productive Islamic boarding school business units and local employment opportunities, Islamic boarding schools become agents of inclusive economics, helping to

alleviate poverty (SDG 1), in line with the values of Islamic economic justice. The success of this program depends on collaboration between Islamic boarding schools, financial institutions, the government, and technical or marketing institutions, which strengthens SDG 17. The Islamic economy encourages halal production and fair consumption, while the use of biofloc minimizes waste and considers environmental welfare, so that biological and ecological consumption and production become part of business activities.

## Conclusion

The program to empower coffee cluster MSMEs and the pesantren economy through biofloc fish farming, initiated by Bank Indonesia's Tasikmalaya Representative Office, demonstrates the strategic role of state financial institutions in strengthening the regional economy based on local potential. The assistance provided to coffee businesses, from upstream to downstream, has succeeded in increasing production capacity and product quality, as well as expanding access to both domestic and international markets. These results reflect the success of an economic empowerment model that fosters the capability of MSME actors to become independent and globally competitive.

Meanwhile, the biofloc program in Islamic boarding schools not only serves as a means of increasing productivity and food security, but also as a forum for entrepreneurial learning and empowerment of students. Through technical training, provision of production facilities, and managerial assistance, Bank Indonesia provides space for Islamic boarding schools to manage economic resources independently and sustainably. This program expands the substantive freedom of the pesantren community to determine their own economic direction, as explained by Amartya Sen (1999) in *Development as Freedom*, that true development occurs when people have the capability to make valuable choices in their lives.

The positive impact of this program is not only seen in increased income and production cost efficiency, but also in the growth of social values such as independence, collaboration, and responsibility among students. This makes Islamic boarding schools not only religious educational institutions, but also agents of social and economic transformation in the region. With an approach based on Islamic economic values and sustainable development principles (SDGs), this program demonstrates how strengthening local economic capacity can go hand in hand with environmental preservation and social justice.

Thus, the synergy between the development of coffee cluster MSMEs and the economic empowerment of Islamic boarding schools through biofloc is a concrete implementation of Amartya Sen's theory of economic empowerment, in which development is seen as a process of expanding the freedom and ability of communities to achieve sustainable prosperity. This initiative by Bank Indonesia Tasikmalaya proves that community-based inclusive development strategies can be an effective model for realizing a fair, independent, and socially just economy in accordance with Islamic principles and SDG goals.

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