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PROFIL OF THE DOUBLE LAYER FLOATING NET CAGE FISH CULTIVATION BUSINESS IN THE SAGULING RESERVOIR (CASE STUDY OF BONGAS VILLAGE, CILILIN DISTRICT, WEST BANDUNG REGENCY)

Profil Usaha Budidaya Ikan Karamba Jaring Apung Jaring Lapis Ganda Di Waduk Saguling (Studi Kasus Desa Bongas Kecamatan Cililin Kabupaten Bandung Barat)

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ABSTRACT

Fish raising using nets is part of intensive reservoir fish farming. This method is known as floating net cages or KJA in reservoirs. The purpose of this research is to examine the overall description of double-layer net KJA fisheries in Bongas Village, as well as the technical performance of these enterprises. The research was carried out in double-layer floating net cages at Saguling Reservoir. A case study research methodology was applied. Purposive sampling was utilized to obtain data from respondents who met the following criteria: fish farmers, active KJA cultivation, 5 years of business experience, and KJA owners/workers. The analysis employed was descriptive. According to the study's findings, there were 44,065 KJA plots and a total output volume of 27,824 tons. The population is in productive age, with 5337 people; the main occupation of respondents is KJA fish farmers, with 17 people (54.84%), business experience of more than 5 years; and in terms of technical performance, one KJA plot measures 7 m x 7 m, with a top net measuring 7 m x 7 m x 4 m. The second layer is 14 m x 14 m x 9 m, with the KJA located at a depth of 8 meters. The brightness of the KJA site is 0.45m, the pH concentration is 6-8, the current strength is 20-40 cm/s, and the fish species include tilapia, carp, and patin. Stocking density: 50-100 fish per m3. Feed 788 and S99. Treatment involves painting or purchasing new ones. Vitamins or antibiotics are given to fish to maintain their health. The water quality around the KJA is pretty excellent. The investment expenses vary from 25 million to 50 million. For operations, KJA owners engage one person to monitor up to ten KJA devices.

Keywords: Fish Cultivation, General Description, Double Layer Net, Technical Demonstration, Saguling

ABSTRAK

Budidaya ikan intensif di waduk merupakan budidaya ikan dengan menggunakan jaring apung. Metode ini disebut dengan Keramba Jaring Apung (KJA) di waduk. Penelitian ini bertujuan

untuk mengkaji karakteristik usaha budidaya ikan KJA jaring apung di Desa Bongas secara keseluruhan dan mengevaluasi kinerja teknis usaha budidaya ikan KJA jaring apung di lokasi yang sama. Penelitian dilakukan di Keramba Jaring Apung (KJA) jaring apung di Waduk Saguling. Metodologi penelitian yang digunakan adalah pendekatan studi kasus. Metode pengumpulan data yang digunakan adalah purposive sampling dengan kriteria responden meliputi pembudidaya ikan, pembudidaya KJA aktif, individu dengan pengalaman usaha lima tahun, dan pemilik atau staf KJA. Analisis yang digunakan adalah analisis deskriptif. Hasil penelitian menunjukkan bahwa jumlah petak KJA sebanyak 44.065 petak dengan hasil produksi 27.824 ton. Penduduk usia produktif sebanyak 5.337 orang dengan pekerjaan responden yang paling banyak sebagai pembudidaya ikan KJA yaitu sebanyak 17 orang atau sebesar 54,84%. Petani ini memiliki pengalaman usaha selama lima tahun. Dari segi spesifikasi teknis, satu petak KJA berukuran 7 m x 7 m, sedangkan dimensi jaring bagian atas 7 m x 7 m x 4 m. Lapisan kedua berukuran 14 m x 14 m x 9 m, dengan KJA terletak pada kedalaman 8 meter. Luminositas di lokasi KJA berukuran 0,45 m, tingkat pH 6 sampai 8, kecepatan arus antara 20 sampai 40 cm/detik, dan jenis ikan yang ada meliputi nila, ikan mas, dan ikan patin. Kepadatan penebaran 50-100 ekor per meter kubik. Menyediakan makanan untuk 788 dan S-99. Restorasi dengan pengecatan atau pembelian barang baru. Kesehatan ikan dilengkapi dengan vitamin atau antibiotik. Kualitas air di sekitar KJA patut dipuji. Biaya investasi bervariasi antara 25 juta sampai 50 juta. Pemilik KJA menugaskan satu orang untuk mengawasi hingga 10 unit KJA.

Kata Kunci: Budidaya Ikan, Gambaran Umum, Jaring Lapis Ganda, Keragaan Teknis, Saguling

INTRODUCTION

Intensive aquaculture in reservoirs often involves cultivating fish in nets supported by floating devices such as drums or styrofoam. This method is often known as floating net cages or KJA in reservoirs. Since 1988, aquaculture in KJA has grown rapidly in many lakes and reservoirs, including the Saguling Reservoir (Warsa & Astuti, 2022).

The use of double-layer nets in the KJA system is based on many important benefits. Double-layer nets can reduce the risk of pest and disease attacks on fish, improve water quality around the KJA, and reduce fish mortality due to net breaks. This technique increases feed efficiency and optimizes fish growth conditions, thereby increasing production results and profitability for aquaculture businesses. This technique was chosen to achieve a balance between high production and environmental sustainability (Warsa *et al*., 2023).

Saguling Reservoir has the potential for aquaculture with floating net cages (KJA). The Saguling Reservoir has a height of 97.50 meters, a length of 301.40 meters, and an area of 643 square meters. Saguling Reservoir is one of three reservoirs in West Java that regulates the flow of the Citarum River. The types of fish cultivated in Saguling Reservoir include types of fish consumed by residents every day, such as tilapia, carp, and patin fish (Nuraeni *et al*., 2022). Floating Net Cage (KJA) cultivation has positive and negative impacts. The positive impact is an increase in the income of fish farmers and PAD, as well as the creation of various jobs. The negative impact is a decrease in water quality due to the use of feed and changes in the habitat of native fish species in the aquatic environment (Ombong & Salindeho, 2023). In addition to providing internal benefits such as the creation of jobs and increased income for KJA farmers and fishermen in Saguling Reservoir, this also has a positive impact on fish farming efforts. This approach certainly has the capacity to increase yields without incurring additional costs, because double-layer KJA nets have greater advantages than traditional KJA, namely that one cultivation area can accommodate two or more nets for various types of fish that support each other (Nasser, 2013). This study aims to examine the general characteristics of fishery

resources of double-layer net KJA in Bongas Village, Cililin District, and evaluate the technical performance of fish farming business of double-layer net KJA in Bongas Village, Cililin District. Therefore, it is necessary to conduct a study on a comprehensive study of fishery resources and the operational effectiveness of fish farming business of double-layer net KJA in Bongas Village, Cililin District.

RESEARCH METHODS

Place and Time

This research was conducted on floating net cage fisheries cultivation efforts in Saguling Reservoir, West Bandung Regency, West Java Province, from August to September 2024.

Tools and Materials

The instruments used in this study were stationery, mobile phones, computers, and questionnaire sheets. The materials used in this study were plastic, bamboo, iron, drums, styrofoam, wood, fish feed, and fish seeds.

Research Design

This study uses a case study technique as its research approach. The case study technique is a research approach that examines a case carefully and in depth. Case study topics include people, groups, institutions, and organizations (Ratna, 2020).

Data Analysis

The data analysis technique used is quantitative descriptive analysis. Descriptive analysis is a methodical, factual, and precise approach to characterizing data. Quantitative techniques attempt to describe variable data in its original form as it is (Sugiyono, 2020). The data analysis used includes the KJA business profile which includes a general description of the Saguling Reservoir, a general description of Bongas Village, demographic information categorized by gender and age, educational attainment, livelihood, and respondent characteristics based on age, education, occupation, KJA business experience, and social aspects. The second data analysis includes technical performance factors such as KJA Design & Construction, Location Selection, Fish Type, Stocking Density, Feed Management, Fish Health Management, Cage Maintenance and Care, Water Quality Management, Harvest and Post-Harvest, and Cost and Resource Efficiency.

RESULT

Overview of Saguling Reservoir

Statistical data from the West Bandung Regency Fisheries Service regarding the number of plots and KJA production in the Saguling Reservoir over the last five years are shown in Figures 1 and 2.

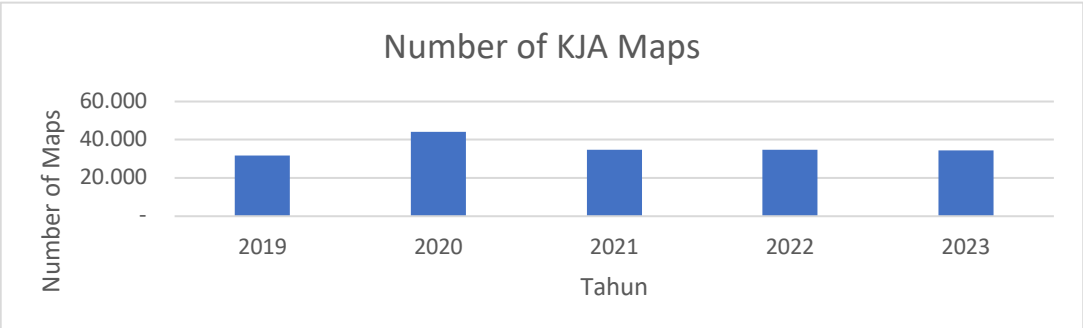

Figure 1. Number of KJA maps in Saguling Reservoir from 2019-2023
Source: KBB Fisheries Service

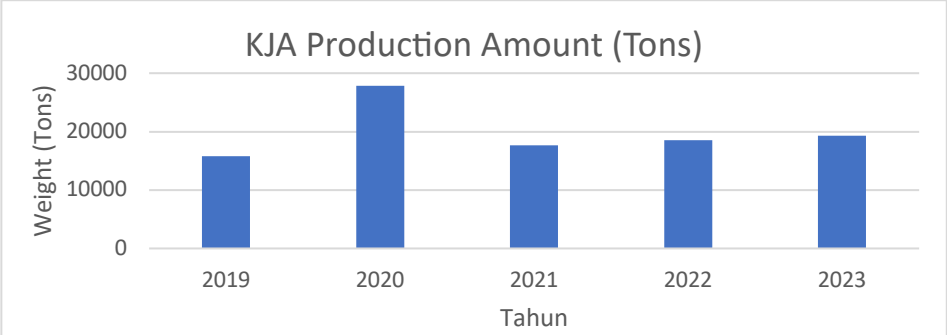

Figure 2. Total KJA Production of Saguling Reservoir from 2019-2023
Source: KBB Fisheries Service

Overview of Bongas Village

Bongas Village is located in the western part of Cililin District, about 10 km from the district capital. This village is one of 11 villages in Cililin District, West Bandung Regency, with an area of 324 hectares (1.25 square miles), with geographical coordinates of 6° 57'26.38" South Latitude and 107° 25'9.11" East Longitude. Bongas Village is a lowland bordering the Saguling Reservoir. Geographically, Bongas Village borders Budi Harja Village to the north, Rancapanggung Village to the south, Batulayang Village to the east, and Cipongkor Village to the west.

Social Conditions of Society

1. **Population by Gender**

Regarding the population until the end of 2024, the number of male residents in Bongas Village continues to exceed the number of female residents. See Figure 3 for a comparison of the population by gender in Bongas Village.

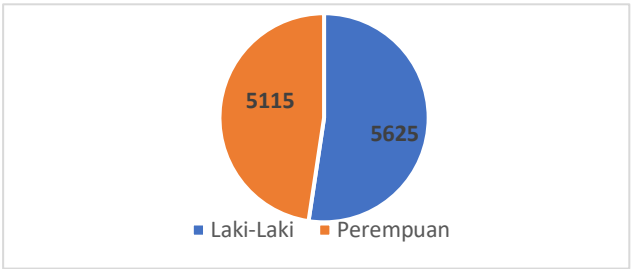

Figure 3. Population of Bongas Village Based on Gender

2. **Population by Age**

Bongas Village has a diverse age demographic, including young and old. The majority of Bongas Village residents are of working age, as seen in Figure 4.

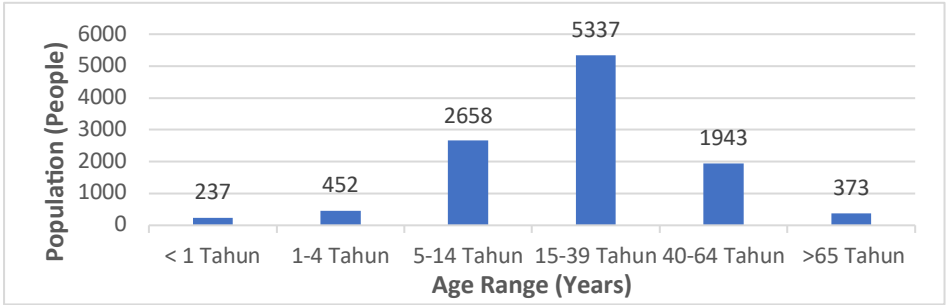

Figure 4. Population of Bongas Village Based on Age

3. Population Based on Education

The current level of education in Bongas Village can be seen in Figure 5.

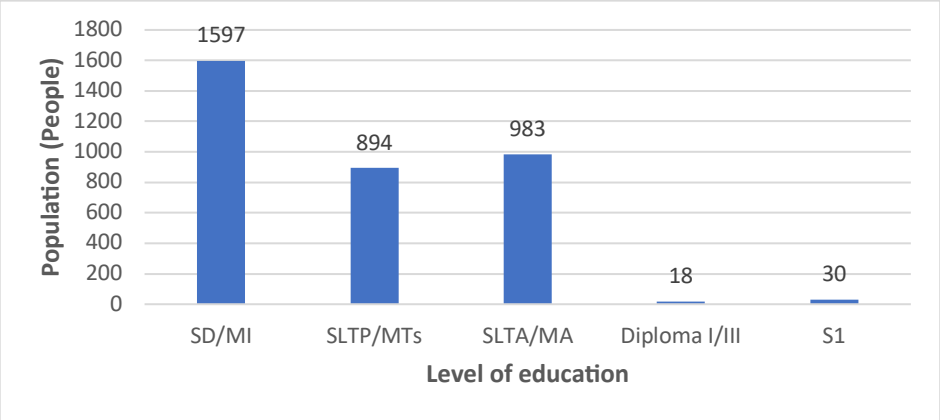

Figure 5. Population of Bongas Village Based on Education

4. Population Based on Livelihood

The residents of Bongas Village generally work as farmers, fishermen or KJA fish farmers, KJA laborers and traders as seen in Figure 6.

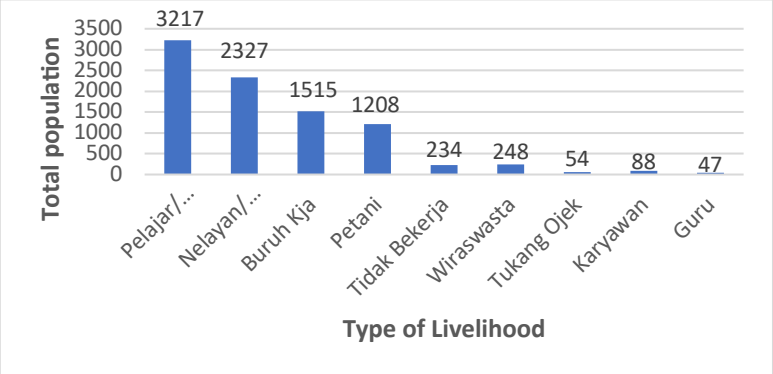

Figure 6. Population of Bongas Village Based on Livelihood

Respondent Characteristics

The selection of respondents in this study were floating net cage fish farmers (KJA).

1. Age Level

Table 1 shows that the age range of floating net cage fish producers in Bongas Village is 20–70 years.

Table 1. Age Levels of Double-Layer Net KJA Fish Farmers

No	Age Range (Years)	Frequency (People)	Percentage (%)
1.	20-30	2	6,45
2.	30-40	11	35,48
3.	40-50	12	38,71
4.	50-60	4	12,90
5.	60-70	2	6,45
	Total	31	100

2. Level of education

Table 2 illustrates the educational attainment of respondents, ranging from elementary school to bachelor's degree.

Table 2. Level of Education of Double Layer Net KJA Fish Farmers

No	Level of Education	Frequency (People)	Percentage (%)
1.	Elementary School	10	32,26
2.	Junior High School	2	6,45
3.	Senior High School	17	54,84
4.	College	2	6,45
	Total	31	100

3. Main Job

Respondents of floating net cage fish producers in Bongas Village include individuals with various main jobs, as seen in Table 3.

Table 3. Main Job Level of Double-Layer Net Cage Fish Farmers

No	Main job	Frequency (People)	Percentage (%)
1.	KJA Cultivator	17	54,84
2.	Farmer	10	32,26
3.	Entrepreneur	3	9,68
4.	Fisherman	1	3,23
	Total	31	100

4. KJA Cultivation Business Experience

Figure 7 shows the respondents' business experience as fish farmers using floating net cages.

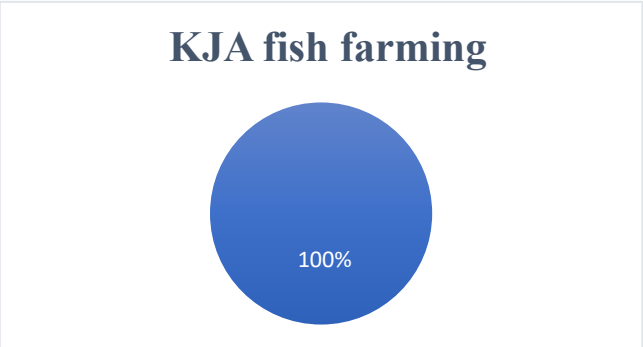

Figure 7. Experience of KJA Fish Farmers

Social Aspects

Based on the research results, fish farmers in the two-layer floating net cage system in Bongas Village have good social relationships. Building a social network strategy is also necessary because social networks are very valuable in terms of money and maintaining community welfare. Abdul Rahman (2009) emphasized that fish farming activities provide more sources of income for fish farmer families, which improves the standard of living of village communities. Social networks make it easier for them to do everything necessary to survive. This is undoubtedly based on empathy and affection among community members to support each other by fostering mutual respect and trust.

Technical Demonstration of Double Layer Net KJA Cultivation

1. **KJA Design and Construction**

The floating cages made of bamboo and polystyrene foam floats are the most ecologically sustainable option among the many floating cages. The distance between the floating nets is 10 to 30 meters, which allows water movement to facilitate the influx of fresh water into the nets. The two-layer floating net cages are designed to reduce the accumulation of leftover feed, which can pollute the aquatic environment (Rahardjo, 2010).

2. **KJA Location Selection**

The water level must be sufficient to prevent the cage from touching the bottom, but not too deep to hamper administration. Water depth is also influenced by the varying curve of the reservoir bottom. According to Wibisono (2005), bathymetry affects the depth of a water body. The luminosity of a water body is correlated with the depth of the place and the density of photosynthetic plankton. Hutabarat, (2000) stated that light intensity decreases with increasing depth. Variations in water pH levels are thought to be due to inconsistencies in measurement times. Test results show that the optimal pH for freshwater fish farming is between 6 and 8. The varying water currents in each reservoir greatly affect the KJA cultivation technique, with differences in current speed caused by the specific KJA location. KJA units can block water flow by wind, thereby weakening the current. The optimal current is a current that is not too strong or too weak. Excessive current speeds cause fish to be displaced by the current and damage the KJA structure.

3. **Types of Fish Cultivated**

In direct field investigations, the dominant fish species cultivated in KJA are carp and tilapia (both red and black), as seen in Figure 8, which also depicts catfish as a secondary commodity in KJA.

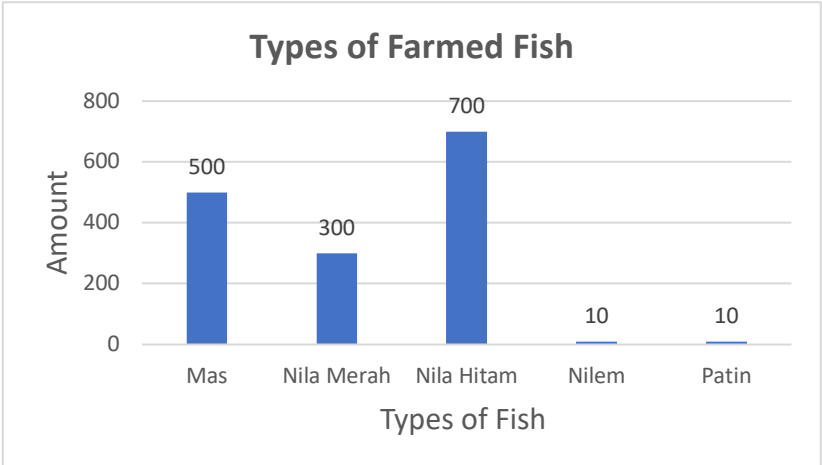

Figure 8. Types of Fish Cultivated in KJA

4. **Density of Distribution**

In KJA, stocking density is very important to reduce competition for food, space, and oxygen, and to ensure that fish remain undisturbed in stable conditions. Fish density is an important component that influences fish development, maturity, and culture, in addition to food availability and quality, genetics, and environmental conditions (Smith *et al*., Khattab *et al*., in Chaves, 2011). In KJA farmers in Bongas village, stocking density is often determined by the daily experience of farmers accumulated over several business cycles, which ensures that the optimal stocking rate is in accordance with local water conditions and the type of fish being produced. For example, tilapia are usually stocked at a density of 50-100 fish per cubic meter.

5. Feed Management

As stated by Hanief (2014), feed is a crucial aspect that affects the effectiveness of fish farming, in addition to water quality. Farmers in Bongas Village use commercial feed with a nutritional composition that is appropriate to the type of fish being farmed, namely tilapia, carp, and patin fish. KJA fish farmers in Bongas Village feed their fish 2-3 times a day or according to the needs of the fish.

6. Maintenance and Care of Cage

Net cleaning is carried out routinely to avoid blockage by moss or fish waste and to ensure that the cages are not perforated or damaged by currents or predators.

According to Situmorang, (2019) maintenance of floating net cages requires routine checks on the physical condition of the cages, including the structure of the nets and floats. Damage to the nets or floats can cause fish to escape or become trapped, which can reduce productivity.

7. Fish Health Management

Conduct routine monitoring by monitoring behavior, appetite and signs of disease. Fish farmers in Bongas Village usually use drugs or preventive techniques such as vaccination. Quarantine new fish to prevent the spread of disease.

Kusnadi, (2018) emphasized the importance of monitoring fish health and taking preventive measures so that diseases do not spread. Diseases such as bacterial, parasitic and viral infections can spread quickly in cages if not treated immediately.

8. Water Quality Management

Ensure good water flow so that oxygen is evenly distributed. According to Effendi (2003), water quality is one of the most important factors in fish farming, especially in floating net cages. Bad water can affect fish growth and reduce production quality.

9. Harvest and Post-Harvest

KJA fish farmers use careful harvesting procedures to minimize stress and injury to the fish. The optimal time for harvesting fish occurs when the fish reach marketable size, usually 10-15 cm for tilapia and carp, or when there is demand from buyers. In the case of catfish, harvesting sometimes depends on market demand because of its long growth period.

Harvesting is done in the morning to ensure the fish remain fresh and not stressed. Post-harvest fish handling includes placing the fish into designated drums, followed by sorting and transferring them into oxygenated plastic containers for distribution.

10. Cost and Resource Efficiency

Initial investment expenditures include building cages, procuring seeds, and procuring feed. Operational costs include labor, maintenance, and supervision. In addition, risk management involves predicting risks such as bad weather, disease, and market price volatility.

DISCUSSION

Overview of Saguling Reservoir

Saguling Reservoir is located at an altitude of 643 meters above sea level. The reservoir area is around 5,606 hectares and has an initial capacity of 875 million cubic meters of water. Saguling Reservoir is one of three reservoirs in West Java that dam rivers in densely populated industrial and residential areas. This reservoir is one of three reservoirs located in the Citarum River basin, namely at coordinates 6 ° 54′45 ″ S - 107 ° 21′58 ″ E. The reservoir, which was built in 1986, has a capacity of 982 million cubic meters and produces 700 megawatts of electricity. The sustainability of the use of this reservoir needs to be evaluated. Research by Bakhtiar, Hadihardaja, & Hadihardaja, (2013) shows that the average inflow to the Saguling Reservoir is around 90 m^3/s, the sedimentation rate is around 5 million tons per year, and the effective life is around 50 years. This reservoir functions as a water reservoir used for energy generation. This 5,600-hectare project was completed in 1984 and hampers the flow of the

Citarum River, the longest and largest river in West Java. Statistical data from the West Bandung Regency Fisheries Service shows that in 2020, during the Covid-19 pandemic, the number of KJA plots was 44,065, with a production volume of 27,824 tons, making KJA cultivation the main livelihood for residents around the Saguling Reservoir. West Java Governor Regulation No. 37 of 2021 states that the rampant uncontrolled KJA is one of the factors causing pollution of the Citarum River and has a negative impact on fishery waste. This law is a strong legal basis for improving environmental management and encouraging the use of more efficient and environmentally friendly agricultural technologies.

The mass death of fish in KJA Saguling, Bongas Village, occurred at the end of 2023, resulting in the sudden death of thousands of fish in the aquaculture area of Saguling Reservoir, West Bandung Regency, West Java.

Overview of Bongas Village

Bongas Village is divided into 4 hamlets separated by a reservoir, namely the Saguling reservoir, and this division of the area is connected by a pedestrian bridge built to assist community activities, namely between hamlets 2.3 and 1.4. The population of Bongas Village is 10,380.

Changes in the era of independence also influenced the social and economic structure of this village (Social and Cultural Service of West Bandung Regency, 2012). Observation results show that the majority of people's livelihoods are fishermen, daily laborers, and teachers/honorary workers, reflecting diversity in sources of income. This is often reflected in social and cultural activities, such as traditional ceremonies, festivals, and the tradition of mutual cooperation in village development activities. This is in line with the concept of an agrarian society in Indonesia which has strong social ties and helps each other between residents (Suparlan, 2009).

1. **Social Conditions of Society**

Demographics by Gender and Age

The population of Bongas Village is 10,380 people and has stagnated for the past five years. In Bongas Village, the number of male residents is greater than the number of female residents, which is 5,625 male residents and 5,115 female residents (BPS, 2024).

Age can be an indicator of a person's physical condition. As a person gets older, their physical condition will start to decline. A person's work productivity is greatly influenced by age. Generally, individuals of productive age can earn a higher income compared to individuals of non-productive age. The demographic composition will affect the economic activities carried out by the related population (Setiawina & Putri, 2013).

The age range of the population of Bongas Village ranges from under 1 year to 65 years. The population of Bongas Village is mostly of productive age, namely aged 15-39 years, totaling 5,337 people, and the population aged 40-64 years, totaling 1,943 people. The working age population mostly works as floating net cage cultivators, floating net cage laborers, farmers and entrepreneurs.

2. **Population Based on Education Level**

Education is a means to improve the quality of human resources. Education can increase a person's knowledge, making it easier for them to acquire skills relevant to the world of work. Therefore, education can be seen as a development investment whose benefits can be felt in the future. As with progress in other sectors, education is a primary domain alongside health and the economy (BPS, 2013).

The majority of Bongas Village residents have basic education, as many as 1,597 people, followed by junior high school (894 people), and high school (983 people). The least represented group are those taking D1-D3 and Bachelor's programs, totaling 18 and 30 people respectively.

3. Demographics by Occupation

The main occupation of the population of Bongas Village, which numbers 2,327 people, is sea cage fish farming, which is associated with the abundant water and fishery resources in the area. Furthermore, there are 1,515 KJA workers. Farmers rank third, after KJA farmers and KJA workers, in Bongas Village. The majority of female residents of Bongas Village are housewives or run businesses in their own shops or family businesses. Farmers do side activities when the water level of the Saguling Reservoir recedes. The occupations of the residents of Bongas Village are shaped by its geographical position within the Saguling Reservoir area, which results in many local residents being involved in fishing or KJA fish farming.

Respondent Characteristics

The data shows that the age group of floating net cage fish farmers in Bongas Village is mostly 40-50 years old, which is 12 people or 38.71%. The proportion of floating net cage fish farmers in Bongas Village is at least 62-68 years old, which is 6.45% or 1 person. Farmers aged 30-40 years are the majority of fish farmers in Bongas Village, this is because they have extensive experience and a deep understanding of agricultural business practices (Hasibuan, 2019). In Bongas Village, the education level of floating net cage fish farmers in Bongas Village is mostly high school, which is 17 people or 54.84%. On the other hand, the education level of floating net cage fish farmers is at least junior high school and high school, each with 2 people or 6.45%. The mentality of the community that prioritizes work over education is an internal factor that causes low levels of education. Farmers with higher education have a higher awareness of solutions to problems related to floating net cages, including disease control in floating net cage systems. The answers are sourced from news and periodicals accessed online (Agustang, 2021).

The results of the study showed that the dominant occupation of respondents was floating net cage fish farmers, namely 17 people or 54.84% of the total respondents. The main occupation of the fewest respondents was fishermen, namely 3.23%.

Respondents chose fish farming using the floating net cage method because the capital required was low, the harvest was fast (harvest within 60-90 days), easy maintenance, stable selling prices, and did not require land acquisition or land rental costs. As a result, several floating net cage fish farmers have been involved in this KJA business for more than five years.

Social Aspects

Positive social factors can increase the productivity and performance of KJA fish farmers in Bongas Village. A harmonious and conflict-free social atmosphere will improve farmer performance. An inadequate social environment will reduce farmer performance and have a negative impact on their work motivation. The social environment significantly affects work motivation, farmer performance, and production results (Ilham *et al.,* 2016).

Technical Demonstration of Double Layer Net KJA Cultivation

1. KJA Design and Construction

KJA is a floating net cage consisting of nets and frames that are often made of rafts and iron, with consistent dimensional characteristics or rectangular configurations. One KJA unit has four sections (pools) and is built from several frame sections equipped with two layers of nets. The KJA section measures 7 m long, 7 m wide, and 4 m deep. In each KJA section, one layer of initial net measuring 7 m x 7 m x 4 m is installed. In addition, one layer of secondary net (basic net) measuring 14 m x 14 m x 9 m is also installed in the KJA unit.

2. KJA Location Selection

The KJA type requires a fairly deep water location, namely 5-8 meters, to optimize water exchange and maintain the cleanliness of the bottom of the cage from the substrate below. Mahyuddin, (2010) stated that if the water depth is less than 12 m, the base of the floating net is too close to the substrate, where organic matter and dirt collect, including waste from KJA.

Freshwater clarity in fish farming facilitates the natural feeding process. Water clarity in all KJA locations greatly affects the acceptability of fish, especially those requiring brightness above 0.45 m. Kordi, (2005) stated that the ideal brightness range for freshwater is 0.30-0.45.

The pH concentration in water shows a daily cycle. The pH of water in the Saguling Reservoir area ranges between 6 and 8. Kordi, (2005) stated that the ideal pH range for freshwater fish farming is 6.5 to 8.5. Tatangindatu *et al*., (2013) stated that very low pH increases the solubility of metals in water, making them toxic to aquatic animals; Conversely, high pH can increase the ammonia content in water, which is also detrimental to aquatic life.

The optimal current is not too strong or too weak. Inadequate current speed results in inadequate oxygen supply. Mahyuddin, (2010) stated that the location prerequisites for freshwater KJA production require waters that are protected from large waves and storms, with a current speed of 20-40 cm/second.

3. Various Cultivated Fish

The main types of fish raised in floating net cages in Bongas Village include tilapia, carp, and catfish. The selection of these fish is in line with the aquatic ecological characteristics of the Saguling Reservoir, which is mostly calm, showing a variety of depths and constant water temperatures between 22-28°C. Conditions that support the existence of various freshwater fish species. Tilapia, carp, and catfish are the dominant fish species produced in the Saguling Reservoir, with significant market demand making these three commodities a priority for floating net cage aquaculture in the area.

4. Population Density

Research by Handjani and Hastuti (2002), Telaumbana (2018), and Sihite *et al*., (2020) showed that high fish density affects the behavior and physiology of fish in their movement space, resulting in decreased growth, feed utilization, and fish survival rates. In KJA Bongas Village, tilapia are usually supplied with a density of 50-100 fish per cubic meter. Carp are often supplied with a density of 50-80 fish per cubic meter.

Azhari *et al*., (2017) stated that the physiological and behavioral conditions of fish can be negatively affected by increased stocking density, which causes the health and physiological conditions of fish to decline, which in turn has an impact on decreased feed utilization and survival rates. Hidayati *et al*., (2018).

5. Feeding

Feed is a crucial element because it functions as a source of energy for growth (Efrizal *et al*., 2020; Lubis *et al*., 2021). Artificial feed has a more complete nutritional profile and is in accordance with the needs of fish. In the context of KJA fish farming in Bongas Village, the dominant and most sought-after feed is floating feed coded 788, and sinking feed coded S-99. Hanief, (2014) said that the larger the size of the fish, the less daily feed will be. Conversely, the smaller the size of the fish, the more feed is needed. Soediro & Iskandar, (2014) said that effective feed management can reduce pollution and optimize fish development. Excessive feeding can cause a decrease in water quality due to uneaten feed residue.

6. Cage Maintenance and Care

Periodic inspection of the cages must be carried out to ensure that there is no damage that could result in fish leaks or spills. Zainuddin, (2010) suggests that the cages be cleaned of dirt, leftover feed, and attached organisms to avoid infection or blockage.

Safety of the cage structure. Muliadi, (2017) said that to protect the cages from damage due to large waves or bad weather, the cage construction must be checked regularly and reinforced as needed.

In the case of cages in Bongas Village, water quality management often only involves pH assessment, because not all fish farmers have the technology needed for comprehensive water quality analysis.

7. Harvest and Post-Harvest Process

Fish harvesting is often done when the fish reach a marketable size, such as tilapia and carp measuring 10-15 cm, or after there is a buyer's request. In the case of catfish, harvesting generally depends on demand because of its long growth period. Harvesting is done in the morning to ensure that the fish remain fresh and are not stressed.

In the case of KJA in Bongas Village, after harvest, the fish are immediately packed in plastic bags filled with oxygen on top of the KJA. After all the fish are packed, the fish are transported by ship from the KJA to the pier, where vehicles from traders or collectors are usually waiting. Furthermore, the fish packaging is arranged systematically in a kolbak car or open truck. Hartoyo, (2017) explained that post-harvest KJA fish require special attention in fish processing to maintain product quality.

8. Economic and Resource Optimization

For KJA in Bongas Village, the initial investment cost for farmers ranges from 25 million to 50 million. KJA owners often assign one person to supervise up to 10 KJA units. KJA maintenance costs fluctuate based on the materials used and the quality of maintenance provided. To mitigate adverse weather conditions, especially approaching the rainy season, farmers often reduce fish stocking density to minimize losses due to fish mortality due to high currents associated with this period.

Prakoso, (2016) advised KJA fish farmers to choose high-quality and cost-effective feed and adjust the feed dosage based on fish needs to increase cost efficiency. Uncontrolled or excessive feed utilization can increase operational costs and reduce profits.

CONCLUSION

A study on the general characteristics of fishery resources for floating net cage fish farmers using double-layer nets shows that fishery resources in Bongas Village have quite large potential, especially through floating net cage fish farming with double-layer nets which are the main livelihood choice for most of the population. The technical performance of Floating Net Cages (KJA) in Saguling Reservoir shows that the design and environmental conditions greatly influence the success of cultivation. Key factors include sturdy KJA construction, optimal water location, clear water, stable pH levels, appropriate current speed, and types of fish suitable for cultivation.

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