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Analysis of Fish Cultivation Productivity in the Bandung City through Buruan Sae Program

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Authors' contributions

This work was carried out in collaboration between both authors. Author AAHS designed the study, performed the statistical analyses, wrote the protocol, and first draft of the manuscript. Author MZFI managed to analyze the study and did literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

This research aims to analyze the production and productivity of fish cultivation in the Buruan Sae Program in Bandung City. Apart from the socio-economic characteristics of program implementers, there are several conditions and obstacles experienced by program implementers as complementary research data. The research method used is the case study method. This research was conducted in three groups of the Buruan Sae Program. The implementation will be carried out in October 2023 – March 2024. The respondents in this research were 46 people who were program implementers from three groups of the Buruan Sae Program. This research applies a saturated sampling method or census. The analytical method in this research uses quantitative descriptive analysis. The results showed that the Warnasari Mandiri Group produced 210 kg of fish, while the Jasmine Integrated Farm Group and the Belpas 15 Group produced 10 kg and 15 kg

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of fish respectively. Warnasari Mandiri Group with fish cultivation productivity per container of 0.2 kg/year/liter. Meanwhile, the Jasmine Integrated Farm and Belpas 15 groups fish cultivation productivity per container is 0.05 and 0.07 kg/year/liter. The R/C Ratio for the Warnasari Mandiri Group is 1.14, Jasmine Integrated Farm is 2.33, and Belpas 15 is 1.25. Based on the results of the analysis, it can be concluded that the fish production of the Warnasari Mandiri Group, the Jasmine Integrated Farm Group, and the Belpas 15 Group is in the medium category. The Warnasari Mandiri group has the highest fish cultivation productivity per container, while the Jasmine Integrated Farm and Belpas 15 groups have lower fish cultivation productivity. Overall, the R/C Ratio of the three groups shows favorable results, namely greater than 1.

Keywords: Production; productivity; socio-economic characteristics; buruan sae program.

1. INTRODUCTION

In order for humans to survive, the need for food is very basic. According to the 1945 Constitution of Indonesia, the state is responsible for maintaining food sovereignty, meaning ensuring that all people have access to sufficient, safe, high-quality and nutritionally balanced food. This concept includes key factors such as food availability, distribution and consumption. Food security refers to a system consisting of many different subsystems, including aspects such as availability, distribution and consumption. The main objective of this system is to ensure the stability of food supply, distribution and community access to food as well as food management at the household level, including food preparation, menus and food distribution in the home environment [1].

To prevent food shortages, guarantee food security, and ensure adequate food logistics, the government's role in developing regulations that support food security is very important. The Mayor of Bandung and his team through the Bandung City Food Security and Agriculture Service responded by launching an urban farming program called "Buruan SAE (*Sehat, Alami, Ekonomis*) (it means natural, healthier, economical)". The implementation of this program is based on the Bandung Mayor's Circular regarding the implementation of integrated urban farming activities. Buruan Sae is designed as a community empowerment program to help people become more independent in producing their own food needs. This is expected to make food consumption healthier, natural and economical, while creating positive environmental awareness [2].

Implementation of Budikdamber's idea is part of efforts to build infrastructure and provide facilities for each Buruan Sae group. Budikdamber is a fish cultivation technique that uses an aquaponics system in a container such as a bucket or bathtub [3]. This approach makes it possible to grow crops and raise fish simultaneously, thereby meeting the need for vegetable and animal protein in one place and optimizing space or land use [4]. Budikdamber is considered a potential solution for the future of agriculture and fisheries, especially in areas with limited water and land resources. Budikdamber can be applied effectively in various locations such as housing, urban areas, apartments, rental houses, and refugee centers [5].

In the budikdamber activity area in Pungkur Village, Regol District, Bandung City, it shows that the majority of implementers of fish farming activities in buckets experienced failure in the initial stages of fish farming activities in buckets. This is due to a lack of understanding by budikdamber implementers regarding how to raise fish, including a lack of attention to water conditions and excessive feeding, which resulted in around 300 fish fry dying [6]. If we refer to the concept of food security which explains that food must be safe, healthy and nutritious and that is also in accordance with the objectives of the Buruan Sae Program, it is necessary to analyze the production and productivity of fish farming and other problems found in the research location.

2. MATERIALS AND METHODS

2.1 Time and Place

This research was carried out in the Warnasari Mandiri Group located in Antapani Kidul Village, Antapani District, Jasmine Integrated Farm Group located in Antapani Tengah Village, and the Belpas 15 Group located in Sadang Serang District, Coblong District. The duration of the research will be carried out in October – March 2024.

2.2 Research Methods

The research method used is a case study method using a survey and using a previously prepared questionnaire as a primary data collection tool. This research applies a saturated sampling method or census, where all members of the population are sampled [7]. As case units are the implementers of the Buruan Sae Program in the Warnasari Mandiri Group, the Jasmine Integrated Farm Group, and the Belpas 15 Group.

2.3 Type and Source Data

The data in this research is quantitative data obtained from both primary and secondary sources. Primary data was collected through two methods, namely observation and interviews by filling in questionnaires. The primary data in this research are socio-economic characteristics which include age, education, experience, income, number of family members, and fish production implementing the Buruan Sae Program in the Warnasari Mandiri Group, Jasmine Integrated Farm Group, and Belpas 15 Group. Meanwhile, secondary data taken from various sources such as literature, journals, research reports, and relevant documents from related agencies to determine the general condition of the group, the number of program group members, and other supporting data.

2.4 Data Analysis Methods

The analysis used to explain the socio -economic characteristics of the families implementing the program and the fish production of the Buruan Sae Program are descriptive analysis. For data analysis, fish farming productivity is determined using quantitative analysis. Several analytical tools used in this research are presented as follows:

1. Fish Cultivation Productivity

   Σ Productivity (kg/year/m³) = (Σ Production (kg/year)) / (Σ Container (liter))

2. R/C Ratio

$$\frac{R}{C} = \frac{\text{Total Revenue (TR)}}{\text{Total Cost (TC)}}$$

3. RESULTS AND DISCUSSION

3.1 Socio-Economic Characteristics

The characteristics referred to here are socio-economic characteristics which include age, education, number of family members, income, and experience of members of the hunted sae group, namely members of the Warnasari Mandiri Group, the Jasmine Integrated Farm Group, and the Belpas 15 Group.

3.1.1 Age

The data obtained in the results of this study show quite a variety of ages from the respondents, details of which can be seen in Table 1.

The distribution of farmers based on the productive age range is divided into three categories, namely the 0-14 year old group who

Table 1. Respondent's Age

No	Age	Total (People)	Percentage (%)
1	Not Yet Productive (<14 years)	0 people	0
2	Productive (15-64 years)	42 people	91,3
3	Not Productive (>65 years)	4 people	8,7
	Total	46 people	100

Table 2. Respondent's Education

No	Education	Total (People)	Percentage (%)
1	Elementary (Elementary/High School)	12 people	26,1
2	Medium (Senior High School)	20 people	43,5
3	High (Diploma/Bachelor/ Master)	14 people	30,4
	Total	46 people	100

have not yet reached productive age, the 15-64 year old group who are productive age group, and the over 65 year old age group who have passed productive age [8]. Based on the data processing in the table, the majority of respondents are in the productive age group (15-64 years) with 42 people, with a percentage reaching 91.3%. The second position was occupied by 4 respondents belonging to the unproductive age group (>65 years), with a percentage of 8.7%. Meanwhile, there were no respondents under 14 years of age, so the percentage was 0%. The total number of respondents was 46 people.

3.1.2 Education

The data obtained in the results of this research shows quite a variety of education from respondents with details can be seen in Table 2.

Basic education is the initial stage of education which lasts for the first 9 years, consisting of 6 years in elementary school (SD) and 3 years in junior high school (SMP). Then, secondary education is a continuation of basic education with a duration of 3 years in senior high school (SMA). Meanwhile, higher education is an advanced stage of secondary education which includes various programs such as diploma, bachelor's, master's, doctoral and specialist courses held at universities [9]. From the data obtained as shown in the table above, the majority of respondents in the Buruan sae group belong to the secondary education level (SMA) as many as 20 people, with a percentage reaching 43.5%. Followed by 14 respondents with a higher education level (Diploma/Bachelor/Postgraduate), with a percentage of 30.4%. Meanwhile, there were 12 respondents with basic education (SD/SMP), with a percentage of 26.1%.

3.1.3 Number of family members

The data obtained in the results of this research shows quite a variety of respondents' family members, details of which can be seen in Table 3.

The number of family members can be grouped into three categories. First, the low group (small family) consists of 1-3 people. Second, medium groups consist of 4-6 people. Third, the high group (large family) consists of more than 6 people [10]. From the data obtained as shown in the table above, the majority of respondents were 35 people with a percentage of 76.1%, belonging to the medium group with the number of family members between 4 and 6 people. Then there were 11 people with a percentage of 23.9% who were in the low group (small families), indicating the number of family members ranged from 1 to 3 people. There were no respondents who belonged to the high group (large family), which means no one had a family with more than 6 members.

3.1.4 Income

The data obtained in the results of this research shows quite a variety of respondents' incomes, details of which can be seen in Table 4.

Family income is divided into 4 groups based on the monthly income earned. The first group is low, with an income of less than IDR 1,500,000. The second group is medium, with an average income of between IDR 1,500,000 to

Table 3. Number of Family Members of the Respondent

No	Number of Family Members	Total (People)	Percentage (%)
1	Low (1-3 people)	11 people	23,9
2	Medium (4-6 people)	35 people	76,1
3	High (>6 people)	0 people	0
	Total	46 people	100

Table 4. Respondent's Income

No	Income	Total (People)	Percentage (%)
1	Low (<IDR.1.500.000)	0 people	0
2	Medium (IDR 1.500.000-2.500.000)	25 people	54,3
3	High (IDR 2.500.000-3.500.000)	16 people	34,8
4	Very High (>IDR.3.500.000)	5 people	10,9
	Total	46 people	100

IDR 2,500,000. The third group is high, with an average income of between IDR 2,500,000 to IDR 3,500,000. And the last group is very high, with an income of more than IDR 3,500,000 [10]. The majority of respondents, 25 people with a percentage of 54.3%, had a family income in the range of IDR 1,500,000 to IDR 2,500,000. Followed by 16 respondents with a percentage of 34.8% who had a family income in the range of IDR 2,500,000 to IDR 3,500,000. A total of 5 respondents with a percentage of 10.9% had a family income of more than IDR 3,500,000, which is classified as a very high income category. Meanwhile, there were no respondents who had a family income of less than IDR 1,500,000. These findings provide an overview of the distribution of family income in the Buruan Sae group, which is important for understanding the fish consumption patterns of each family.

3.1.5 Experience

The data obtained in the results of this research shows the length of experience of respondents as members of the Buruan Sae group, details of which can be seen in Table 5.

The recorded data regarding the length of experience as a member of the sae hunted group shows an interesting pattern. There are no members who are classified as less experienced (<1 year) or quite experienced (1-2 years). On the other hand, all members, namely 46 people or 100%, have experience that can be considered experienced, with more than 2 years of experience. These findings highlight the consistency and dedication of members in the Buruan Sae group over a long period of time. Analysis of these patterns can provide deep insight into the internal dynamics of the group, as well as strengthen understanding of the commitment and motivation of members.

3.2 Cultivation Profile

3.2.1 Seeds and feed

In this research, Sangkuriang catfish seeds were initially scattered into buckets and ponds to start the cultivation process. In the early stages of fish cultivation, the seeds stocked at the beginning have different characteristics between the Buruan Sae group. The size of the seeds and the number of seeds stocked at the beginning of the cycle are shown in Table 6.

The Warnasari Mandiri Group uses seeds with an average size of 9-10 cm, while the Jasmine Integrated Farm Group uses seeds with an average size of 10-12 cm, and the Belpas 15 Group uses seeds with an average size of 5-10 cm. The number of seeds stocked also varies between Buruan Sae groups. The Warnasari Mandiri Group has set a stocking density of 50 fish/bucket and 500 fish/pond with a total of 15 buckets and a total of 6 ponds. Meanwhile, the Jasmine Integrated Farm Group uses a stocking density of 25 fish/bucket with a total of 10 buckets, and the Belpas Group 15 sets a stocking density of 50 fish/bucket with a total of 10 buckets.

There are variations in the type of feed used by each Buruan Sae group. The types of feed used by each Buruan Sae group are shown in Table 7.

The Warnasari Mandiri Group, Jasmine Integrated Farm Group, and Belpas 15 Group use floating pellets as the main artificial feed. However, there are differences in the use of

Table 5. Respondent's Experience

No	Experience	Total (People)	Percentage (%)
1	Less Experienced (<1 year)	0 people	0
2	Enough (1-2 year)	0 people	0
3	Experienced (>2 year)	46 people	100
	Total	46 people	100

Table 6. Seeds

Group	Seed Size (cm)	Total of Seeds Stocked
Warnasari Mandiri	9-10	50 fish/bucket 500 fish/pond
Jasmine Integrated Farm	10-12	25 fish/bucket
Belpas 15	5-10	50 fish/bucket

Table 7. Feed

Group	Artificial Feed	Natural Feed
Warnasari Mandiri	Floating Pellets	Papaya Leaf
Jasmine Integrated Farm	Floating Pellets	Maggot
Belpas 15	Floating Pellets	-

natural feed. The Warnasari Mandiri Group uses powdered papaya leaves as additional natural feed, the Jasmine Integrated Farm Group uses maggot feed, while the Belpas 15 Group does not use additional natural feed. The addition of papaya leaf powder has a significant impact on the growth of fish length and weight. Optimal treatment showed an increase in length growth of 2.69 gr and 3.51 cm. In addition, specific weight and length increased to 3.89 gr and 5.89 cm, while FCR was 0.517 [11]. The effectiveness of using maggots as additional feed to feed sangkuriang catfish seeds (Clarias gariepinus) can be used as an alternative in reducing the cost of purchasing commercial feed, because by providing additional feed maggots provide higher weight growth rates, provide good length growth rates, increase survival. Rate (SR), increases the feed efficiency value, and reduces the FCR value [12].

3.2.2 Mastery of technology

In the Jasmine Integrated Farm Group there are several discrepancies in mastery of technology. Among them are the protein content of the feed which is not paid attention to, the frequency of feeding which is only 2 times a day from the start of the cycle until harvest, the amount of feed which is measured manually until the catfish are full, pest control, and fish disease control which is not known how it works. In Belpas Group 15, there was a discrepancy in the amount of feed given according to the percentage of fish weight. In Belpas Group 15, the amount of feeding is still measured manually until the catfish are full. The Warnasari Mandiri group is very good at mastering technology.

For seeds measuring 10-12 cm, the best protein content in the feed is at least 30%. Then the frequency of feeding can be done 4 times a day for seeds that have just been sown for 2 weeks, then feeding is done 2 times until the catfish are harvested. Then the amount of feeding is done using a percentage or satiation method of 80%, which means the catfish are not 100% full and will be added or recalculated every 3 days. Pest control is carried out during pool preparation and during enlargement, including processing the bottom of the pool and drying it completely, so that all organisms die and improving the structure of the bottom soil so that toxic gases escape. Then to control the disease you can use hand dipping, short bathing, long bathing, and pond treatment [13].

3.3 Fish Production

Fish production here includes the production of fish for consumption and for sale within one year to the Buruan Sae group. The fish production in one year in the Buruan Sae group is presented in Table 8.

In the context of the number of fish produced, the harvested fish cultured in buckets from the Warnasari Mandiri Group, Jasmine Integrated Farm Group, and Belpas 15 Group are not intended for direct consumption by members or families implementing the program. However, the harvest is intended for sale. The Warnasari

Table 8. Fish production

Group	Fish Production for Consumption (kg)	Fish Production for Consumption (fish)	Fish Production for Sale (kg)	Fish Production for Sale (fish)
Warnasari Mandiri	-	-	210 (180 from pond dan 30 from bucket)	1.470 (1.260 from pond dan 210 from bucket)
Jasmine Integrated Farm	-	-	10	80
Belpas 15	-	-	15	105

Table 9. Fish Cultivation Productivity

Group	Fish Production (kg/year)	Σ Container (liter)	Productivity (kg/year/liter)
Warnasari Mandiri	840	4.200	0,2
Jasmine Integrated Farm	40	800	0,05
Belpas 15	60	800	0,07
Total	940	5.800	

Table 10. R/C Ratio

Group	Revenue (IDR/year)	Cost (IDR/year)	R/C Ratio
Warnasari Mandiri	16.000.000	14.000.000	1,14
Jasmine Integrated Farm	1.400.000	600.000	2,33
Belpas 15	1.500.000	1.200.000	1,25
Total	18.900.000	15.800.000	4,72
Average	6.300.000	5.266.666,67	1,57

Mandiri group produced 210 kg (equivalent to 1,470 fish), while the Jasmine Integrated Farm Group and Belpas 15 Group produced 10 kg (equivalent to 80 fish) and 15 kg (equivalent to 105 fish) respectively. This difference reflects the scale of production and focus of economic activities of each group, where the Warnasari Mandiri group is more oriented towards production for sale as a form of business activity. For the Jasmine Integrated Farm Group and the Belpas Group, 15 harvests are for sale, but the harvests are sold at below market prices in the context of community food security. The proceeds from the sale are used for operational fish farming activities in group buckets.

The average harvest of catfish in bucket fish farming is 1-2 kg/bucket [4]. The Warnasari Mandiri Group has 15 buckets of cultivation buckets with the number of fish produced from a total of 15 buckets being 30 kg or 2 kg/bucket. Then the Jasmine Integrated Farm Group has 10 buckets of cultivation buckets with the number of fish produced from a total of 10 buckets being 10 kg or 1 kg/bucket. For the Belpas Group, the 15 buckets for cultivation are 10 buckets with the number of fish produced being 15 kg from a total of 10 buckets or 1.5 kg/bucket. This means that if you look at the aspect of the number of fish produced, the Warnasari Mandiri Group, the Jasmine Integrated Farm Group, and the Belpas 15 Group are in the medium category.

3.4 Fish Cultivation Productivity

The fish cultivation productivity per container (kg/year/liter) in the Buruan Sae group is presented in Table 9.

Analysis of fish cultivation productivity per container is an important aspect in evaluating production efficiency and performance at a specific farming unit scale. From the data presented, the Warnasari Mandiri Group stands out with a productivity of 0.2 kg/year/liter, indicating optimal use of containers with relatively high fish yields, namely 840 kg per year in a total container of 4,200 liters. On the other hand, the Jasmine Integrated Farm Group and the Belpas 15 Group have lower productivity, respectively 0.05 kg/year/liter and 0.07 kg/year/liter. Overall it is categorized as low because productivity is below 0.5 kg/year/liter.

This could be due to the level of fish density being too high, especially in the tarpaulin pond cultivation media of the Warnasari Mandiri Group. The death of catfish fry can be caused by high competition between individual fish for food, space and oxygen. This results in some fish seeds being unable to adapt and losing in competition, resulting in death [14]. Then the low productivity of fish cultivation in bucket cultivation media can be due to irregular feeding. Because the average frequency of feeding for group members is only 2 times a day and also the amount of feeding at the time of feeding is excessive (until the catfish are full) [15].

3.5 R/C Ratio

Farmers or breeders can be considered as profit-oriented business people, where the main goal is to achieve maximum profit. Economic efficiency is achieved when available resources are utilized

optimally to achieve these goals [16]. The total revenue, total costs, and R/C ratio in the Buruan Sae group are presented in Table 10.

If R/C > 1 means the farming is profitable, if R/C = 1 it means the farming is breaking even, and if R/C < 1 means the farming is making a loss [17]. The Warnasari Mandiri group produced an R/C Ratio of 1.14. This shows that fish farming businesses in this group are able to achieve profits. On the other hand, the Jasmine Integrated Farm Group and the Belpas 15 Group showed more profitable performance with an R/C Ratio of 2.33 and 1.25 respectively. The R/C Ratio of the three groups is above 1 because the costs incurred for cultivating fish in buckets are low and maintenance is simple. Cultivating fish in buckets does not require a large amount of capital, is simple to maintain, and does not take up space [18]. The devices and equipment used in budikdamber are also simple, easy to obtain, and can use second-hand, unused items, thereby reducing operational costs [19].

4. CONCLUSION

The Warnasari Mandiri group has a fish cultivation productivity per container of 0.2 kg/year/liter, indicating optimal use of containers with relatively high fish yields, namely 840 kg/year with a total container of 4,200 liters. Then the Jasmine Integrated Farm Group and the Belpas 15 Group have lower productivity, respectively 0.05 kg/year/liter with fish yields of 40 kg/year with a total container of 800 liters and 0.07 kg/year/liter with fish yield 60 kg/year with a total container of 800 liters. In the R/C Ratio analysis, overall of the 3 groups the R/C Ratio is >1, which means it is profitable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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