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PENGARUH PADAT TEBAR TERHADAP PERTUMBUHAN IKAN LELE SANGKURIANG (*Clarias gariepinus*) DALAM SISTEM BUDIDAYA IKAN DALAM EMBER (BUDIKDAMBER)

The Effect Of Stocking Density On The Growth Of Sangkuriang Catfish (Clarias gariepinus) In The Bucket Fish Cultivation System (BUDIKDAMBER)

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ABSTRAK

Lele Sangkuriang (*Clarias gariepinus)* merupakan salah satu jenis ikan air tawar yang kini banyak dibudidayakan di Indonesia. Tingginya produksi ikan lele tidak lepas dari peran pembudidaya yang mampu menghasilkan lele dalam jumlah yang cukup untuk memenuhi permintaan konsumsi yang terus meningkat. Salah satu metode budidaya ikan yang digunakan adalah sistem Budikdamber, yaitu budidaya ikan dalam ember dengan tingkat kepadatan yang tinggi. Penelitian ini menggunakan metode eksperimental dengan menggunakan Rancangan Acak Lengkap (RAL) yang terdiri dari 3 perlakuan penebaran kepadatan dengan 4 kali pengulangan yaitu : A (1 ekor/liter), B (2 ekor/liter), C (3 ekor/liter) selama 30 hari, ikan dipelihara dalam ember yang telah disiapkan untuk kegiatan budikdamber menggunakan kepadatan yang disesuaikan menurut masing-masing perlakuan dengan 3 kali pemberian pakan sehari. Kualitas air diamati sebanyak 3 hari sekali. Hasil penelitian menunjukan bahwa sampai dengan kepadatan 3 ekor/ liter benih ikan lele sangkuriang, tidak memberikan perbedaan nyata dalam setiap perlakuan tingkat padat tebar yang berbeda dan masih menunjukan performa terbaik. Perlakuan terbaik berada pada perlakuan C (3 ekor/liter) dengan tingkat kelangsungan hidup sebesar 77,25%, nilai rasio konversi pakan (FCR) sebesar 0,67, adapun nilai laju pertumbuhan spesifik (SGR) sebesar 3,28%.

ABSTRACT

Sangkuriang catfish (*Clarias gariepinus*) is one of the freshwater fish species that is currently widely cultivated in Indonesia. The high production of catfish cannot be separated from the role of fish farmers who are able to produce catfish in sufficient quantities to meet the continuously increasing consumption demand. One of the fish cultivation methods applied is the Budikdamber system, namely fish cultivation in buckets with a high stocking density. This study employed an experimental method using a Completely Randomized Design (CRD) consisting of three stocking density treatments with four replications, namely: A (1 fish/L), B (2 fish/L), and C (3 fish/L) for 30 days. The fish were reared in buckets that had been prepared for Budikdamber activities using stocking densities adjusted according to each treatment, with feeding conducted three times a day. Water quality was observed every three days. The results showed that up to a density of 3 fish/L of Sangkuriang catfish seed did not result in significant differences among treatments with different stocking density levels and still demonstrated the best performance. The best treatment was treatment C (3 fish/L), with a survival rate of 77.25%, a feed conversion ratio (FCR) value of 0.67, and a specific growth rate (SGR) value of 3.28%.

Kata Kunci	*Ikan Lele Sangkuriang, Kepadatan, Budikdamber*
Keywords	*Sangkuriang Catfish, Density, Budikdamber*
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INTRODUCTION

Sangkuriang catfish (*Clarias gariepinus*) is included as one of the freshwater fishery commodities that is currently widely cultivated in Indonesia because its demand continues to increase every year for consumption by the general public (Andri *et al.*, 2020). According to the Ministry of Marine Affairs and Fisheries (2020), data on catfish production in 2020 reached 347,511 tons, with fish consumption achievement in 2020 amounting to 56.39 kg/capita/year.

The high level of catfish production is supported by the role of fish farmers who have succeeded in producing catfish that can meet the high consumption demand. Nevertheless, not a few catfish farmers experience obstacles and even business closures due to a lack of understanding regarding proper maintenance procedures in catfish cultivation activities. Therefore, various efforts are undertaken to increase production, one of which is fish cultivation using the Budikdamber system or fish cultivation in buckets.

Catfish cultivation in buckets is a cultivation activity that can be carried out using high stocking densities. This increase in fish density must be balanced with appropriate feeding and improved water quality, considering that catfish are classified as cannibalistic fish or capable of consuming conspecifics. Therefore, optimal and appropriate feeding is a factor that needs to be considered. Another factor that must be taken into account in high-density cultivation activities is water quality. Although catfish are included in the category of fish that are tolerant of various water conditions, cultivation conducted without special treatment can be ascertained not to provide optimal results. Thus, water quality in Budikdamber activities also needs to be considered.

Based on the above description, it can be stated that analyzing the growth and survival of Sangkuriang catfish cultivated in a bucket-based fish cultivation system by considering the applied stocking density is an important aspect that must be taken into account in Budikdamber activities.

METHODS

Place and Time

The study on stocking density of Sangkuriang catfish in a bucket-based fish cultivation system (Budikdamber) was conducted for 40 days from January 2025 to February 2025, located in Ngamprah District, West Bandung Regency. The equipment used included buckets with a maximum volume of 80 liters that had been designed for Budikdamber activities totaling 12 units, rockwool, 16 oz PET plastic cups, a thermometer, a DO meter, a pH meter, an ammonia water test kit, a digital scale, airtight containers, a millimeter block, and a camera. The materials used included Sangkuriang catfish, commercial feed HI PROVITE 781, water spinach plants, *Nitrobacter* bacteria, fish salt, probiotic EM-4, and Red Bluedox.

Experimental Design

This study used an experimental method with a Completely Randomized Design (CRD) consisting of three stocking density treatments with four replications, namely:

A: 1 fish/L
B: 2 fish/L
C: 3 fish/L

Procedure

Research Preparation

The containers used were buckets with a volume of 80 liters. The buckets to be used first needed to be adjusted so that they could be used in the bucket-based fish cultivation system (Budikdamber). The buckets were perforated at the lid, and a drainage outlet in the form of a threaded fitting was made at the bottom. After adjustment, the buckets were washed thoroughly and sterilized by cleaning them until completely clean. After sterilization, the buckets were filled to three-quarters of their total volume. The fish were acclimatized for four days in containers that had been given fish salt and Red Bluedox as a preventive measure against diseases carried from the previous fish source. Acclimatization aimed to allow the fish to adapt to their new environment. The acclimatized fish were then transferred into the prepared rearing buckets with stocking densities adjusted according to the treatments, followed by re-acclimatization for one day. If after the acclimatization process any fish were found to be in poor health condition, the fish were transferred to a special container for quarantine until they showed a healthy condition.

Water spinach seeds were washed and soaked in warm water for 30 minutes. After soaking, the water spinach was dried and stored in a container, then lined with wet tissue at the bottom as a base and at the top as a cover. The container was then tightly closed and wrapped with black plastic and stored in a dark place. Checking and spraying were carried out until the water spinach appeared to germinate. The germinated water spinach was transferred to the top of the rockwool, followed by spraying and sun-drying until the sprouts developed leaves. After the water spinach had two leaves, it was transferred along with the rockwool into plastic cups with perforated bottoms and flannel cloth, then placed on top of the Budikdamber bucket. The maintenance of Sangkuriang catfish was conducted for 30 days with stocking densities adjusted for each treatment. Feeding was carried out three times a day at 08:00 WIB, 12:00 WIB, and 17:00 WIB. The amount of feed was adjusted according to the number of fish in each treatment, namely 3–5% of the total fish biomass. Water siphoning and replacement were carried out every three days to remove feed residues and metabolic waste to prevent ammonia accumulation. Water quality observations were conducted before and after water replacement to determine the content present in the water prior to and following the process. Spraying of water spinach seedlings was carried out three times a day. The parameters observed in this research activity included length growth and weight, which were measured every seven days, as well as the number and weight of dead fish during the study period. Data on length, weight, growth rate, FCR, and survival were tabulated in tables and graphs and analyzed using Analysis of Variance (ANOVA) at a 95% significance level. If significant differences were found, Duncan's multiple range test was applied. Water quality data, including temperature, pH, and DO, were analyzed descriptively.

RESULTS AND DISCUSSION

Results

Based on observations obtained during the 30-day rearing period, the absolute length growth of Sangkuriang catfish seed ranged from 3.95 to 4.73 cm (Figure 1). Based on the results of ANOVA analysis at a 95% confidence level, it was shown that there were no significant differences among treatments; therefore, further testing using Duncan's test could not be performed.

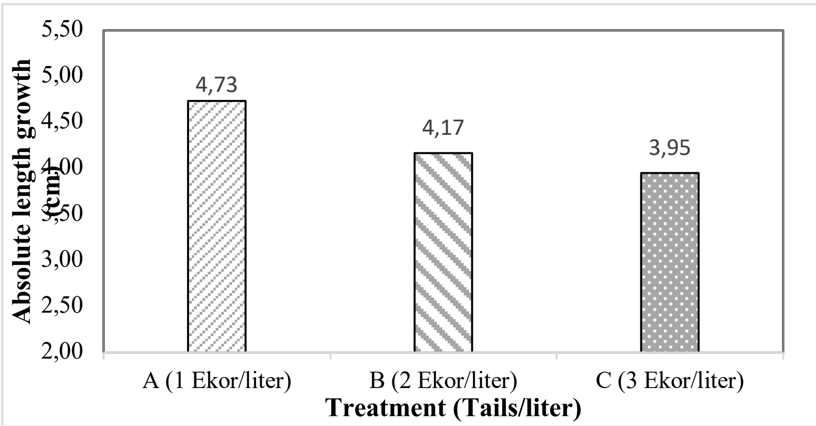

Figure 1. Absolute length growth

Based on the results of observations obtained during the research, the results of the absolute weight growth of Sangkuriang catfish seeds ranged from 10.15 - 12.90 grams within 30 days of maintenance, the results of the ANOVA analysis with a 95% confidence level, did not find any significant differences between treatments, so it could not be continued with the Duncan further test.

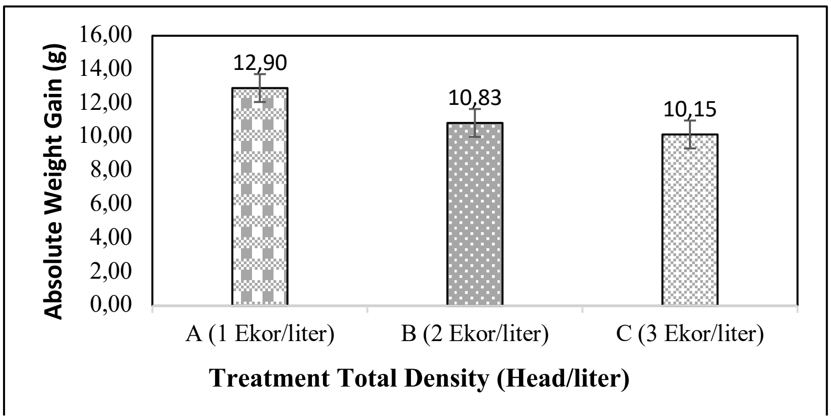

Figure 2. Absolute weight growth

Based on the results obtained during the research activities, the specific growth rate results obtained during the research ranged from 3.28 – 3.65% with a 40-day maintenance period. The stocking density used during the research activities did not show any real differences supported by the results of the ANOVA analysis at a 95% confidence level so that no further Duncan test was required.

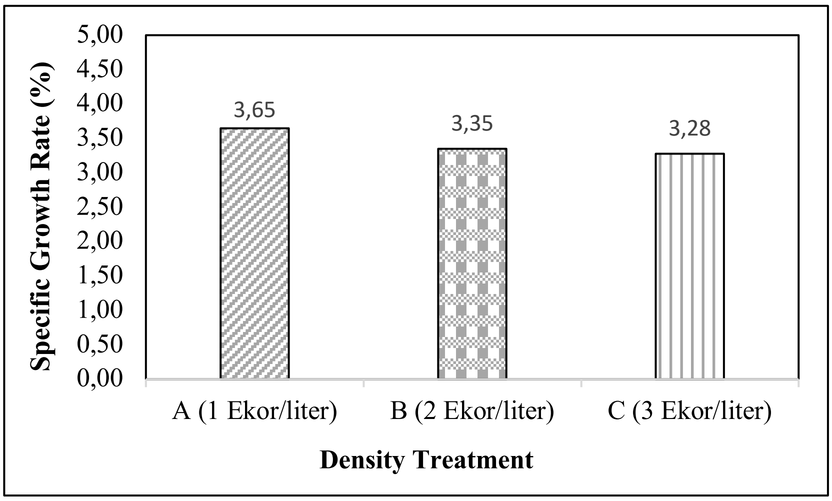

Figure 3. Specific Growth Rate

Based on observations in the research conducted, the feed conversion ratio of Sangkuriang catfish fry ranged from 0.63 to 0.67 within 40 days of cultivation. Based on the results of the ANOVA test with a 95% confidence level, indicating no significant differences in each treatment during the cultivation period, further Duncan's test was not necessary.

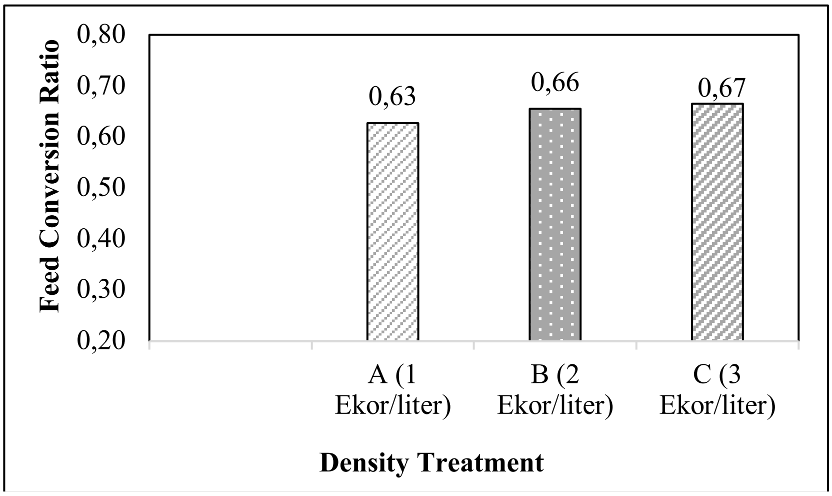

Figure 4. Feed Conversion Ratio

Based on observations during the research activities, the survival rate was obtained between 77.00 - 86.25% within 40 days of maintenance. Based on the results of the ANOVA test with a 95% confidence level, it showed that there was no significant difference between the treatments, so no further Duncan test was necessary.

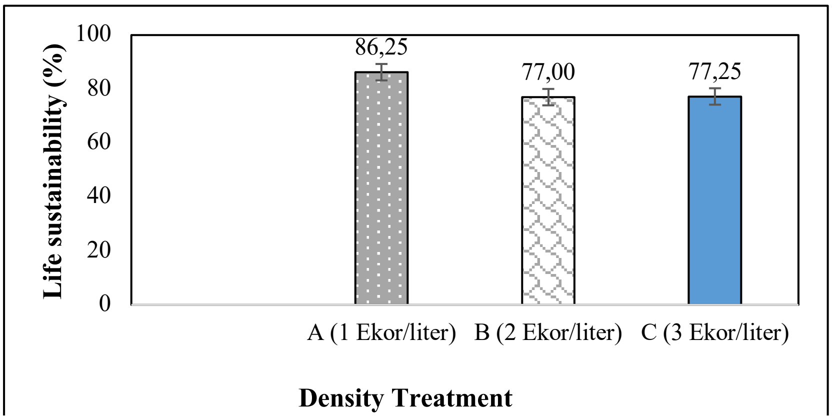

Figure 5. Survival Rate

Water parameter measurements during the rearing period showed varying results for each treatment. The results of water quality measurements during the 40-day rearing period of Sangkuriang catfish in the budikdamber system are presented in Table 1 below.

Table 1. Water Quality

Treatment	Parameter				
	Temperature (^{o}C)	pH	DO (mg/L^{-1})	TAN (mg/L^{-1})	NH^{3} (ppm)
A	25-28	7,14 – 8	3,1-7,2	2	0.0197-0.118
B	25-28	7,14 -7.8	1,9-7,2	2	0.0197-0.0884
C	25-28	7,14 - 7.9	1,5-7,2	2	0.0197-0,11
Optimum Range	25 – 30 (Wulansari *et al.* 2020)	6,5 – 8,5 (Li *et al.* 2023)	4 - 8,6 (Indonesian National Standards. 2020)	0 - <2mg/l (Effendi *et al.* 2003)	< 1 ppm (Boyd *et al.* 2015)

Water spinach plants that were maintained for 40 days were harvested once on the 25th day after planting with the harvest results presented in Table 2 below.

Table 2. Growth of water spinach plants in the budikdamber system

Treatment	Average Stem Height (cm)	Average Leaf Length (cm)	Total Weight (g)	Leaf Color
A	36.5	9.0	73.5	Green
B	38.63	9.88	79.13	Green
C	37.88	9.13	76.63	Green

DISCUSSION

Absolute length growth in fish was calculated based on the difference between the average length at the end of maintenance and the length at the beginning of maintenance during the study. Fish length measurements were calculated from the tip of the head to the tip of the tail. Treatment C with a density of 3 fish/liter produced the lowest length growth of 3.95 cm during the maintenance period, while the highest length growth was produced by Treatment A with a density of 1 fish/liter of 4.73 cm. From several results that have been written as a comparison, it can be concluded in accordance with the statement of Islami *et al*., (2013) that lower stocking densities provide better catfish growth because competition for food is reduced, so that fish have more energy for growth.

Appendix 1. Fish Cultivation in Buckets

The increase in body weight of Sangkuriang catfish was calculated from the beginning to the end of the research period. The treatment with the highest average weight gain was Treatment A with a stocking density of 1 fish/L, amounting to 12.90 grams, whereas the treatment with the lowest average weight gain was Treatment C with a density of 3 fish/L. The increase in body weight of Sangkuriang catfish was influenced by several factors, one of which was the provision of feed with sufficient nutritional content to support weight growth in Sangkuriang catfish (Santoso *et al*., 2020). These results are consistent with Mulyani *et al*. (2020), who reported that lower stocking densities in the Budikdamber system resulted in better absolute weight growth of Sangkuriang catfish compared to higher stocking densities, indicating the presence of an optimal point at which fish have sufficient space and resources to achieve maximum growth.

The specific growth rate was obtained based on the difference between the initial weight and the final weight of the fish during the research period, which was then divided by the duration of rearing and expressed as a percentage. The lowest specific growth rate was observed in Treatment C with a density of 3 fish/L at 3.28%, whereas the highest specific growth rate was observed in Treatment A with a density of 1 fish/L at 3.65%. These results are in accordance with the statement of Harahap (2023) that high stocking density leads to increased competition among fish for space, oxygen, and feed, which directly affects the reduction of growth efficiency; when all these aspects are limited, feeding activity and movement are disrupted.

The feed conversion ratio (FCR) was calculated based on the comparison between the amount of feed consumed by the fish and the final weight of the fish, added to the weight of dead fish and subtracted by the initial weight of the fish under study. The feed conversion ratio indicates the amount of feed required to produce 1 kg of Sangkuriang catfish flesh. The highest feed conversion ratio was obtained in Treatment C with a density of 3 fish/L at 0.67, whereas the lowest feed conversion ratio was obtained in Treatment A with a density of 1 fish/L at 0.63. These results are consistent with the study by Ningsih *et al*. (2020), which stated that increasing stocking density beyond the optimal point leads to decreased growth and increased feed conversion ratio values. This condition may occur due to increased competition for feed and the accumulation of metabolic waste, which adversely affects water quality and subsequently causes stress in fish.

Survival rate was calculated based on the percentage comparison between the number of fish alive at the end of the research period and the number of fish alive at the beginning of the research period. According to Mustofa *et al*. (2018), fish survival refers to the percentage comparison between the number of fish alive at the end of the rearing or research period and the number of fish at the beginning of the rearing or stocking period. The highest survival rate was found in Treatment A with a density of 1 fish/L, with a survival rate of 86.25%, followed by Treatment C at 77.25%, and Treatment B at 77%. These results are consistent with the research conducted by Mutia *et al*. (2020), which stated that the lower the stocking density of catfish, the more efficient the utilization of feed for catfish survival.

Water quality plays a very important role in the cultivation of Sangkuriang catfish in buckets. Cultivation activities using high stocking densities depend on good water quality to support growth and survival during the rearing period. The results of water parameter measurements during the rearing period showed varying results for each treatment. The water temperature values obtained in the bucket-based fish culture system during the study ranged from 25–28 °C; according to Wulansari *et al*. (2020), a temperature range of 25–30 °C is optimal for Sangkuriang catfish culture in buckets. Although Sangkuriang catfish can survive within a temperature tolerance range of 20–30 °C, their growth rate is not as optimal as that of Sangkuriang catfish living at temperatures between 25–30 °C. The pH values measured in this study ranged from 7.14 to 8.00; according to the study conducted by Li *et al*. (2023), Sangkuriang catfish living in waters with pH values ranging from 6.5 to 8.5 can grow optimally with good physiological conditions and a well-functioning immune system. The measured dissolved oxygen content ranged from 1.5 to 7.9 mg/L. According to the Indonesian National Standard (2020), Sangkuriang catfish have a minimum tolerance limit for dissolved oxygen content of below 3 mg/L. The measured total ammonia nitrogen (TAN) concentration showed a value of 2 mg/L. This value reaches a highly dangerous level, which is in line with the research conducted by Effendie (2003), who stated that TAN levels must be maintained as low as possible to prevent high mortality caused by the risk of free ammonia (NH_3) toxicity. Ideally, TAN concentration values should be greater than 0 mg/L, indicating healthy water conditions and effective nitrogen waste decomposition (Effendie, 2003). The measured concentration of un-ionized ammonia (NH_3) ranged from 0.0197 to 0.11 ppm. Based on the research conducted by Boyd and Zhou (2015), it is stated that for catfish culture, un-ionized ammonia (NH_3) levels in water should be maintained at no more than 1.0 mg/L.

The growth of water spinach plants in this Budikdamber activity resulted in relatively good water spinach growth. Water spinach plants were observed based on stem length growth, leaf length, and leaf color. According to Prinajati (2018), water spinach plants that are ready for harvest have a plant height of 15–20 cm and have not yet flowered.

Appendix 2. Water spinach plants in budikdamber

The average growth of water spinach plants in each treatment did not differ substantially. The average stem length of water spinach ranged from 33–41 cm, while the average leaf length ranged from 8–11 cm, with leaves exhibiting a green coloration; the average total biomass of water spinach ranged from 45–116 grams. According to Vasia (2019), water spinach characterized by abundant and fibrous root systems as well as green-colored stems and leaves indicates that the plants are in good condition.

CONCLUSION

The best treatment was Treatment C (3 fish/L), with a survival rate of 77.25%, a feed conversion ratio (FCR) value of 0.67, and a specific growth rate (SGR) of 3.28%. Water quality during the research period showed suboptimal conditions, as indicated by the high total ammonia nitrogen (TAN) level of 2 mg/L and relatively low dissolved oxygen concentrations, with the lowest value reaching 1.5 mg/L, which was attributed to the higher stocking density.

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