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OPTIMIZATION OF MUSTIKA COMMON CARP CULTURE TO INCREASE FISH FARMERS' INCOME IN BANGKINANG, KAMPAR: A PRODUCTIVITY AND ECONOMIC ANALYSIS

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ABSTRACT

A trial of common carp culture using a selected population was conducted in Bangkinang, Kampar Regency, Riau Province. This research aims to develop the socio-economic aspects of rural society, especially among common carp farmers in this area. The main material used was the Mustika common carp, a selected common carp population renowned for its disease resistance and fast growth. A local common carp population obtained from local hatcheries was used for comparison. The individual size of fish stocked was 10-15 grams. A total of six units of static net cages in the Kampar River and six units of floating net cages in the Kotopanjang Reservoir were used for triplicate culturing fish. The trial culture was conducted for 12 weeks. The results showed that Mustika common carp performed significantly better than local common carp, as indicated by high survival rates, growth rates, and individual harvested weights. The harvested yield, FCR, and productivity of Mustika common carp were also better than those of the local common carp. From an economic perspective, the used of Mustika common carp in both trial sites yielded higher margins and benefit-cost (B/C) ratios, faster in term of returns on investment (RoI) and payback periods (PP), and potentially increasing fish production by approximately 4.45% annually than local common carp. These results suggest that cultivating the Mustika common carp was more feasible for farmers in the area. The study highlights the need for high-quality fish seeds and advocates for collaboration between the government and private sectors to enhance common carp farming and improve the socio-economic levels of rural communities.

KEYWORDS: Aquaculture; *Cyprinus carpio*; economic analysis; net cages; productivity

INTRODUCTION

Aquaculture, the cultivation of aquatic organisms, has become an essential component of the global food system, providing a sustainable and reliable source of protein to meet the increasing demands of a growing population. As traditional capture fisheries confront challenges such as overfishing and habitat degradation, the significance of aquaculture in ensuring food security, promoting economic growth, and supporting environmental conservation has become increasingly evident (Mizuta *et al*., 2023; Verdegem *et al*., 2023; Bjørndal *et al*., 2024; Gul *et al*., 2024).

In Indonesia, common carp (*Cyprinus carpio*) farming has a long-standing history dating back to the 1900s. The initial cultivation model was developed in a backyard pond without feeding. In further developments, feeding was carried out using natural feed, followed by homemade and commercial feed for the industry. The cultivation model also developed from backyard earthen ponds (Bachtiar & Lentera, 2002), running water ponds (Jayalaksana *et al*., 2016), and floating net cages (Nugroho, 2012; Ardi, 2013) to the Recirculation Aquaculture Systems (RAS) (Samara *et al*., 2022). Among these, the most widely developed cultivation model is the floating net cage model, which is carried out in lakes and reservoirs. Common carp production centers are found in several regions, including West Java, West Sumatra, North Sumatra, North Sulawesi, and West Nusa Tenggara (Ariyanto *et al*., 2019).

The analysis in terms of common carp farming development in Indonesia showed that Riau Province, especially Kampar Regency, is one of the regions that has developed quite rapidly over the last two decades (Riza, 2017; Sadono *et al*., 2021). The

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local government, through the Fisheries Service of Kampar Regency, continues to develop the sub-sector. The production of farmed fish in Riau Province in 2016 reached 100,162 tons, and approximately 70%, equal to 70,336 tons, was produced by Kampar Regency (Karimi, 2018). Some models of common carp farming in the area include earthen ponds, static cages (made of nets, wood, or bamboo), and floating net cages. Static cages are widely applied in the Kampar River, and floating net cages are applied in the Kotopanjang Reservoir. The use of floating net cages in Kotopanjang Reservoir is the most developed culture system in the last decade (Siagian, 2010). The environment of the Kotopanjang Reservoir, including the physico-chemical and biological parameters, is still very suitable for fish farming, which is a driver of the development of floating net cages at this site (Siagian, 2012; Warningsih *et al*., 2016; Ferdiansyah *et al*., 2016).

However, one of the obstacles to developing common carp cultivation in this region is the lack of availability of high genetic quality fish (Wahyudi *et al*., 2016). Therefore, providing a superior strain is one of the keys to successful common carp culture in Bangkinang, Kampar Regency. Empirically, the use of genetic improvement and selective breeding product in order to increase aquaculture production has been widely carried out on several commodities, both nationally and internationally, including tilapia (*Oreochromis niloticus*) (Tran *et al*., 2021; Setyawan *et al*., 2022), catfish (*Clarias gariepinus*) (Fatah *et al*., 2023; Kebtieneh *et al*., 2024), common carp (*C. carpio*) (Prchal *et al*., 2024), Atlantik salmon (*Salmo salar*) (Naeve *et al*., 2022), grouper (Family Serranidae, Subfamily Epinephelinae) (Glamuzina & Rimmer, 2022), black tiger prawn (*Penaeus monodon*) (Waiho *et al*., 2025), and whiteleg shrimp (*Litopenaeus vannamei*) (Dai *et al*., 2025).

The Ministry of Marine Affairs and Fisheries (MMAF) of the Republic of Indonesia has provided farmers with several types of superior common carp strains. One of the breeding programs for common carp has been conducted by the Research Institute for Fish Breeding in Sukamandi, West Java. The need for superior common carp, especially disease resistance and fast growth, has encouraged a breeding program based on phenotypic performance combined with molecular marker technology to create a superior fish. This program resulted in a superior common carp that is disease-resistant and fast-growing, namely the Mustika common carp. This superior carp strain has been available to farmers since 2016 (MMAF, 2016).

Based on laboratory challenge tests, the survival rate of Mustika common carp varies from 82.22 to 98.89%, which is better than its competitor common carp (53.33 - 81.11 %) (Syahputra *et al*., 2016). In multi-location and multi-cultivation system testing, Mustika common carp also had a survival rate of 31.67 - 75.00%. The specific growth rate of Mustika common carp reaches 3.62% of the weight per day, so the harvest time for consumption size is shorter, up to 2.5 months, especially for rearing in floating net cages. The Mustika common carp has an average productivity is better than its competitors up to 67% (Ariyanto *et al*., 2019). Ariyanto (2022) reported that the average feed conversion ratio of Mustika common carp is about 1.24, lower than that of other types of common carp, which is about 2.2. This low FCR minimizes organic waste and leftover feed in the water. Mustika common carp also has high tolerance to all types of abiotic environments (Palimirmo *et al*., 2019).

Although the Mustika common carp has been tested in some regions, its performance and economic viability in potential areas, such as in Kampar Regency, remain underexplored. By combining the potential advantages of Mustika common carp with the opportunities for its development in the newly established cultivation center, it is hoped that this can increase the productivity of common carp culture in the region. This study aimed to compare the growth, survival, productivity, feed efficiency, and economic feasibility of Mustika versus local common carp in Bangkinang, Kampar Regency, Riau Province.

MATERIALS AND METHODS

The main material for common carp culture development was the selected population, namely the Mustika common carp. Mustika common carp was produced at the Beringin Fish Seed Center (FSC) in the Rao District, Pasaman Regency, West Sumatra. This institution is the center for Mustika common carp development in the western region of Indonesia, especially in Sumatra and the surrounding areas. The number of broodstock spawned was 25 females and 50 males. Spawning was performed using an artificial method in accordance with the Standard Operating Procedure of Mustika common carp spawning (Suharyanto *et al*., 2020). The Mustika common carp seeds were reared until fingerling size in earthen ponds, and then were transported using container vehicles to the research location in Bangkinang, Kampar Regency, Riau Province.

As a comparison, a local common carp of the same size and age obtained from a local hatchery was used. Local common carp are common carp that have been cultivated and bred in the area for decades. In general, broodstock management at the local hatcheries does not follow operational standards for broodstock management, including relatively small broodstock numbers, which do not meet the effective breeding number (Ne), and the broodstock used are often closely related, resulting in inbreeding. This is thought to contribute to the low genetic quality of local common carp.

The common carp cultivation trial was conducted in two locations: the Kampar River and the Kotopanjang Reservoir (Figure 1). In the Kampar River, the culture medium used was a static net cage measuring 4×10 m with a water depth of 1.5 m. The number of stocked fish in each cage was 2,000, with an individual weight of 10-15 g. The trial was conducted in three replications, using three net cages for each population stocked, for a 12-weeks period. The feed used was a commercial sinking feed with protein and lipid content of 28-30% and 3-5%, respectively. The feed was given at satiation, 3-4 times each day. In the Kotopanjang Reservoir, the culture media used was a 5×5 m floating net cage with a water depth of 3.0 m. The number of stocked fish in each cage was 5,000, with an individual weight of 10-15 g. The trial in the second area was carried out in three replications using three net cages for each population stocked. During the 12 weeks of maintenance, the fish were fed the same pellet feed, feeding rate, and feeding frequency as in the Kampar River's research site. At the end period of the trial, all fish at the two locations were harvested and evaluated.

Figure 1. The locations of common carp development trial in Kampar District, Riau Province. (a) Kampar River; (b) Kotopanjang Reservoir.

The main parameters observed were survival rate, specific growth rate, average final body weight and length, harvested biomass, feed conversion ratios, and productivity. The final survival was calculated using the formula described by Effendi (1997), as follows:

$$SR = \frac{N_T}{N_0} x100\%$$

Note:

SR = Survival Rate (%); N_T = Total live fish at the end of the study; N_0 = Total fish at the time of initial stocking.

The specific growth rate was calculated based on body weight, following Effendi (1997), as follows:

$$SGR = \frac{lnW_T - lnW_0}{T} x100\%$$

Note:

SGR = Specific Growth Rate (%/day); W_T = Final weight of fish at the end of the research period; W_0 = Weight of fish at the time of initial stocking; T = Time period of the culture.

The final body weight and length were calculated by weighing and measuring 50 individuals randomly selected from each replication unit using a scale with an accuracy of 0.1 g and a ruler with an accuracy of 0.1 cm, respectively. The harvested biomass was calculated by weighing the total weight of the harvested fish using a scale with an accuracy of 0.1 g. The harvested biomass was used to analyze each population's feed conversion ratio (FCR). The FCR was calculated following Effendi (1997) as follows:

$$FCR = \frac{F}{(W_T + D) - W_0} x100$$

Note:

FCR = Food Conversion Ratios; *F* = Total weight of feed given during the experiment period; W_T = Total weight of fish at the end of the research period; *D* = Total weight of dead fish during the experiment period; W_0 = Total weight of fish at the time of initial stocking.

Statistical analysis of the main parameters was conducted using the t-test to compare the performance of Mustika common carp with that of the local common carp in each location. As supporting data, water quality analyses were conducted monthly at both test locations. The results of the water quality parameter's range, including temperature, dissolved oxygen, and pH, were descriptively presented in Table 3. The economic analysis used a quantitative approach, including the benefits/margin, break-even points (BEP) for price and production, benefit per cost ratio (B/C), return on investment (RoI), and payback period (PP) of the business of the farmers using Mustika and local common carp.

RESULTS AND DISCUSSION

The performance of common carp

The performances of harvested Mustika and local common carp were presented in Tables 1 and 2. The results showed that Mustika common carp had performed better than local common carp.

Statistical analysis showed that Mustika common carp has a better survival rate than local common carp in all culture locations ($P < 0.05$). This result indicated that Mustika common carp has higher disease resistance and more tolerant to environmental changes. Higher survival rates, better growth rates, and greater final body weight of Mustika common carp demonstrate the superiority of this strain. This result is in line with previous studies, which showed that an improved-quality fish has better performance than the local fish, especially in common carp farming. Ariyanto *et al*. (2020) reported that utilization of Mustika common carp in several culture locations, namely in running water pond in Tanjungsiang - Subang, and in floating net-cage pond in Cirata Reservoir - Cianjur, Jatiluhur Reservoir - Purwakarta, and Darma Reservoir - Kuningan, showed significantly better phenotypic performance compared to the local common carp. Mustika common carp is a population of common carp that has been genetically improved, especially in the character of growth rate and disease resistance. The superiority of these two crucial characteristics in cultivation activities results in the amount of harvested biomass of Mustika common carp being better than other common carp.

Table 1. Survival, specific growth rate, and individual weight of common carp culture using Mustika and local common carp

Site location	Type of common carp	Survival rate (%)	Growth Rate (%/day)	Final weight (g)	Length (cm)
Kampar River	Mustika	85 ± 2.88^a	3.06 ± 0.30^a	134.04 ± 33.37^a	15.26 ± 1.52^a
	Local	72 ± 1.75^b	2.70 ± 0.28^a	98.51 ± 23.99^a	10.91 ± 0.76^b
Kotopanjang Reservoir	Mustika	91 ± 1.45^a	2.84 ± 0.35^a	111.70 ± 35.09^a	12.34 ± 1.30^a
	Local	84 ± 3.22^b	2.73 ± 0.58^a	106.17 ± 43.22^a	12.68 ± 1.89^a

Note: The different superscripts in the same column at the same location showed the significant differences based on the t-test ($P < 0.05$).

Table 2. Biomass, amount of feed, feed conversion ratios, and productivity of the common carp culture using Mustika and local common carp in two locations

Site location	Type of carp	Biomass (kg)	Amount of feed (kg)	Feed Conversion Ratios	Productivity (kg/m^2/cycle)
Kampar River	Mustika	227.89 ± 56.73^a	504	2.33 ± 0.60^b	5.70 ± 1.42^a
	Local	141.85 ± 34.54^a	504	3.74 ± 0.84^a	3.55 ± 0.86^a
Kotopanjang Reservoir	Mustika	508.24 ± 159.68^a	1,260	2.65 ± 0.71^a	20.33 ± 6.39^a
	Local	445.93 ± 181.53^a	1,260	3.35 ± 1.79^a	17.84 ± 7.26^a

Note: The different superscripts in the same column at the same location showed the significant differences based on the t-test ($P < 0.05$).

In this study, Mustika common carp also had a better growth rate than the local common carp. This impacts the final weight of Mustika common carp being heavier than local common carp in all test locations. However, the trial culture in the floating net cages in Kotopanjang Reservoir showed that the local common carp was relatively longer than the Mustika common carp. This result indicates the influence of different environments being raised on the body shape of the common carp. Jawad & Mahe (2022) found evidence that the differences in aquatic environments, particularly DO level, temperature, and pH, affected to the body length of common carp in three different rivers in Iraq. Ali & Mishra (2022) further explained that the DO level in the cultivation environment of the freshwater fish significantly affects the respiratory rhythm, feeding activities, metabolic rate, and growth rate. This, in turn, is suspected of influencing the final weight and length proportions of the common carp in this study. The characteristics of the quality of the water in both trial locations were described in Table 3.

Table 3. Range of temperature, dissolved oxygen, and pH of waters at the common carp research location in the Kampar River and Kotopanjang Reservoir

Parameter	Kampar River	Kotopanjang Reservoir	Standard for common carp culture*
Temperature (°C)	27.3 – 30.3[a]	27.0 – 30.2[a]	25.0 – 30.0
Dissolved O_2 (mg/L)	2.5 – 3.5[a]	3.7 – 4.3[b]	> 3.0
pH (unit)	6.0 – 6.5[a]	6.0 – 6.8[a]	6.0 – 9.0

Note: The different superscripts at the same parameter between the locations showed significant differences. *Suharyanto *et al.* (2000).

As a genetically improved population, the superior performance of Mustika common carp compared to local common carp was clearly visible in this study. This result is in accordance with a previous study that reported that the provision of high-quality seeds increases the survival rate and production of common carp culture in the Kotopanjang Reservoir (Wahyudi *et al.*, 2016). This study explained that one of the problems in the development of common carp cultivation in the Bangkinang area is the availability of high genetic quality of seeds. Common carp cultivation in the area relies on the procurement of seeds from outside the area, such as from West and South Sumatra. The availability of seeds that depend on the supply from other areas results in the performance of common carp from cultivation being unable to be improved. The continuous availability of high genetic quality seeds is expected to increase the production of cultivated carp in the Bangkinang area, Kampar Regency. The Mustika common carp, which has proven to have higher productivity, can be used by carp farmers in the area to increase their production. It is hoped that the local government, through the local Fisheries Service Institution, can help provide Mustika common carp seeds by procuring broodstock and implementing proper common carp breeding training. This program ensures the availability of seeds to meet the needs of common carp farmers in the area.

The rapid growth rate of Mustika common carp also impacts the harvested biomass, feed conversion ratio, and productivity level, which is better than local common carp. Table 2 showed that common carp cultivation using floating net cages in Kotopanjang Reservoir produces better harvested biomass and productivity levels than static net cages in Kampar River. Based on these results, the development of common carp cultivation in Bangkinang, Kampar Regency, using Mustika common carp will provide better results if carried out in floating net cages in the Kotopanjang Reservoir than in static net cages in the Kampar River. The production of Mustika common carp compared to local common carp using static net cages in the Kampar River was more than 60%, while in the Kotopanjang Reservoir using floating net cages, it was only around 14%. Although the production increase in floating net cages in the Kampar River was lower, the productivity level in Kotopanjang Reservoir was much higher. This is thought to be due to the difference in carrying capacity at the two locations, which allows for a higher stocking density of common carp in the Kotopanjang Reservoir, so that the amount of harvested biomass obtained is higher than in the Kampar River. Ariyanto *et al.* (2024) explained that the fish stocking density at a location is determined by the carrying capacity level. This makes common carp cultivation in this location have better potential than static net cages carried out in the Kampar River.

However, the use of static net cages in the Kampar River also resulted in higher production when using Mustika common carp compared to local common carp. The growth ability and resistance of Mustika common carp, both to environmental conditions and diseases, were proven to outperform the growth rate and resistance of local common carp. This was indicated by better survival rates, growth rates, and individual weights at harvest at both trial locations. In addition, the effectiveness of Mustika common carp in utilizing feed was also seen from the better FCR value compared to local common carp at both test locations. This relatively low FCR had a significant impact on the feed costs incurred by farmers had to spend during fish culture.

Feed is the most significant component of the operational costs of fish cultivation, including common carp culture. The tendency of increasing feed prices in the Sumatra region will result in higher feed costs that must be incurred by fish farmers (Hakim & Eriyanti, 2019). The FCR value obtained from the use of Mustika common carp in static net cages in the Kampar River was 2.33 compared to 3.74 if using local common carp. This result shows a feed efficiency of 60.51%. Meanwhile, the cultivation of Mustika common carp using floating net cages in the Kotopanjang Reservoir resulted in an FCR of 2.65, compared to 3.35 when using local common carp, equivalent to a feed efficiency of 26.41%. If projected to the value of money spent by farmers in the Kampar River and Kotopanjang Reservoir for feed, this efficiency value is equivalent to IDR 2,287,278 and IDR 2,495,745, respectively. The existence of feed efficiency in common carp cultivation using Mustika carp will reduce the cultivator's expenses, so that the margin received at harvest time will be greater.

The higher growth rate of Mustika common carp resulted in a heavier final weight compared to local common carp in both test locations. However, body length observations of harvested fish in the Kotopanjang Reservoir showed that Mustika common carp had a shorter body length than local common carp, whereas in the Kampar River, Mustika common carp had a longer body length than local common carp (Table 1). There are several possibilities as to why the Mustika common carp kept in Kotopanjang Reservoir are shorter than those in Kampar River. (1) The density of Mustika common carp in Kotopanjang Reservoir is higher than in Kampar river, so that the space for fish' movement is more limited. (2) There are variations in the aquatic environment that influence the development of body shape, especially the standard length, of common carp. This finding is in accordance with the report that genetic (G) and environmental (E) factors significantly affect the performance of common carp at different locations (Ariyanto *et al.*, 2018). However, the effects of these two factors and the interaction between genetic and environmental factors, especially the differences between reservoirs and rivers, on the development of the body shape of common carp seem to be deeply observed in the future.

The results of water quality measurements as a culture medium for common carp study in the Kampar River and Kotopanjang Reservoir, including temperature, dissolved oxygen, and pH, were presented in Table 3.

A significant difference in water quality was observed between the Kampar River and Kotopanjang Reservoir in terms of the dissolved oxygen content, whereas the temperature and pH of the two locations did not differ significantly. The lower DO in the Kampar River is thought to be due to the location of the static net cages used in this research, which are located on the river's banks, which have a relatively low flow. The minimal water mass turnover (water current) at this location causes the DO content to be low. Meanwhile, the floating net cages used in the Kotopanjang Reservoir are located in the middle, so the diffusion of oxygen from the air into the water is relatively high. In addition, strong winds over the vast surface of the reservoir increase the amount of dissolved oxygen in the water. Ali & Mishra (2022) explained that DO levels in water are influenced by several abiotic and biotic factors, such as diffusion and aeration, photosynthesis, respiration, and decomposition. As explained previously, the dissolved oxygen content in freshwater fish cultivation significantly affects respiratory rhythms, feeding activity, metabolic activity, and growth. The difference in water quality, especially the DO levels, in these two locations is thought to cause differences in growth rate, final weight, length, and the proportion of weight-length of the common carp obtained in these two experimental sites.

The socio-economic impact

As an economic business, aquaculture needs to be analyzed in terms of its economic viability, including the margin obtained, the return on investment, and the sustainability of the culture activities. Economic analysis of common carp cultivation was conducted to evaluate the business prospects of common carp farming in an area (Hossain *et al.*, 2022). The results of the economic analysis include profit/ margin, break-even point (BEP) for production and price, benefit per cost (B/C) ratio, return on investment (RoI), and payback period (PP) of common carp culture in this study were presented in Table 4. This analysis assumed that one farmer has one unit of net cage.

The economic analysis showed that Mustika common carp cultivation in floating net cages at Kotopanjang Reservoir has a higher margin than others and has the fastest return on investment. However, the capital used in this system is also the largest. When viewed from the benefit/cost ratio and payback period, Mustika common carp cultivation in static net cages in the Kampar River is the most promising. In general, the results of the economic analysis of common carp cultivation in Bangkinang, Kampar Regency, showed that the culture in the Kotopanjang Reservoir has better prospects than that in Kampar River. This can be observed from the higher productivity and margin values. However, the capital outlay, especially for feed, is greater. This causes the benefit/cost ratio and return on investment to be lower, especially in cultivation using Mustika common carp. Fish cultivation with static net cages in the Kampar River using local common carp has very low business prospects and even has the potential to cause losses. This can be seen from the negative margin and return on investment, so the benefit/cost ratio is less than 1 (one). For farmers with small capital, Mustika common carp cultivation in this location is a promising alternative business. This is because the margin generated is quite large, with a high benefit/cost ratio and return on investment value. If the farmers have more capital, Mustika common carp cultivation in floating net cages in Kotopanjang Reservoir can be chosen because of its good prospects with a relatively large margin and the shortest payback period (Saha *et al.*, 2022).

Table 4. Economic analysis for common carp culture using two types of common carp in two culture trial sites

Parameter	Kampar River		Kotopanjang Reservoir	
	Mustika common carp	Local common carp	Mustika common carp	Local common carp
Investment (IDR)	10,000,000	10,000,000	10,000,000	10,000,000
Number of fish (Ind.)	2,000	2,000	5,000	5,000
Fish price (IDR)	300	200	300	200
Amount of feed (kg)	504	500	1,260	1,260
Feed price (IDR)	7,500	7,500	7,500	7,500
Operational cost (IDR)	4,680,000	4,480,000	11,250,000	10,750,000
Harvest yield (kg)	228	142	508	446
Selling price (IDR)	30,000	30,000	30,000	30,000
Income (IDR)	6,836,111	4,255,642	15,247,323	13,377,970
Margin (IDR)	2,156,111	-224,358	3,997,323	2,627,970
BEP production (kg)	156	149	375	358
BEP price (IDR)	20,538	31,582	22,135	24,107
B/C ratio	1.46	0.95	1.36	1.24
RoI (%)	-31.64	-57.44	52.47	33.78
PP (year)	1.55	-14.86	0.83	1.27

Explanation: BEP = Break-Even Point; B/C = Benefit / Cost; RoI = Return of Investment; PP = Payback Period.

The Fisheries Services of Kampar Regency reported that the number of freshwater fish farmers in Kampar Regency was 7, 748, with a production volume of 70,336 tons. Of that amount, approximately 27,064.07 tons were produced in floating net cages, with a total of 7,572 units (KFS, 2020). Assuming that each farmer has an average of four floating net cage units, the number of net-cage farmers is approximately 1.800 people. The results of this study provide hope for the development of freshwater fish farming, especially common carp, in the Bangkinang area of Kampar Regency. With almost 2,000 farmers and a very large cultivation area, the use of Mustika common carp can potentially increase the production of static and floating net cages in the area by almost 400 tons per cycle annually. With a cultivation time of approximately 4 months, it can produce 1, 200 tons of fish per year, equivalent to an increase of 4.45%. Increased fish production, followed by increased farmer income, will impact their socio-economic status. The role of the government, together with the private sector in the field of cultivation and other related parties, such as seed availability, feed cost volatility, technical training, post-harvested processing, transportation, and marketing networks, is needed to follow up on the results of the development of common carp cultivation in this area.

CONCLUSION

The opportunity to develop Mustika common carp in Bangkinang, Kampar Regency, Riau Province, especially in the Kampar River and Kotopanjang Reservoir, is very large, resulting to production increase of 4.45% annually. Mustika common carp cultivation in Bangkinang significantly contributes to increasing farmers' income. The study revealed that Mustika common carp not only has faster growth and higher survival rates compared to local common carp but also offers better yields in terms of weight and productivity. Economic analysis shows that cultivation with Mustika common carp results in higher margins and faster return on investment. Thus, the implementation of Mustika carp cultivation can potentially improve the economic welfare of rural communities in Bangkinang, Kampar, Riau Province.

The results of this study suggest the need for support from the government and related parties to ensure the availability of superior seeds, stabilize feed costs, provide training in best cultivation practices and post-harvest processing, and provide transportation and marketing networks in the area.

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CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest in this research and manuscript.

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