Research Article
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Aquaculture Management of Blue Swimming Crab (*Portunus pelagicus*) in Boncong Bancar Marine Farming Facility, Tuban Regency, East Java Province, Indonesia

Juahir Juahir

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Abstract: This study was conducted at the Boncong Bancar Marine Farming Facility in Tuban, East Java, focusing on Blue Swimming Crab (*Portunus pelagicus*) aquaculture. As a high-value seafood commodity with crucial export markets, the study aimed to enhance knowledge and skills, providing valuable insights for students and stakeholders. It emphasized the need for sustainable aquaculture to reduce reliance on wild harvesting, as Blue Swimming Crab demand exceeds natural supply. The research adopted a descriptive approach, including biological characteristics, survival rates, behavior, water quality, and feeding techniques according to MFF Boncong standards. Water quality measurements resulted in an average pH of 6 to 8, temperatures not exceeding 33°C, dissolved oxygen levels between 5.0 ppm and 8.4 ppm, and salinity between 30–35 ppt. In summary, Blue Swimming Crab aquaculture offers a profitable business opportunity, contributing to the country's foreign exchange reserves, and warrants close attention from fisheries experts.

Introduction

Blue Swimming Crab (*Portunus pelagicus*) is Indonesia's highly economically valuable fishery commodity. It ranks third among export commodities in volume, following shrimp and fish. In 2011, Blue Swimming Crab exports reached 42,410 tons with a value of approximately IDR 978 billion (1). The high demand for Blue Swimming Crab has led to intensive exploitation of this resource, affecting both stock availability and a decline in productivity and recruitment capacity within the exploited populations (2). With high-intensity exploitation occurring in all its distribution areas, from shallow coastal waters to offshore regions, the availability of Blue Swimming Crab is progressively decreasing (3).

Direct harvesting of Blue Swimming Crabs from natural habitats appears insufficient to meet export demand. In countries such as the United States, Japan, Taiwan, and Australia, Blue Swimming Crab remains a significant dietary item, constituting a strategic export market (4). While aquaculture presents a potential solution to meet market demands, the scarcity of skilled human resources remains a primary constraint. Therefore, promoting Blue Swimming Crab aquaculture and providing training opportunities in suitable regions are essential (1). Given these challenges, this study was undertaken to gain firsthand experience and skills in Blue Swimming Crab aquaculture techniques at the Boncong Bancar Marine Farming Facility in Tuban Regency, East Java Province.

Experimental Section

Data Collection

The methodology employed in this study used a descriptive approach. Descriptive methodology involves gathering data directly from experts and relevant literature related to the case under investigation (5). It extends beyond data collection to encompass analysis and discussions regarding the collected data.

Data Collection Techniques

Data collection in this Internship Program incorporated two methods: primary data and secondary data. Primary data was obtained through observation, interviews, and active participation, while secondary data comprised information collected and reported by individuals for specific purposes or scientific knowledge.

Primary Data

Observation

Observation involved systematic data collection through observation and recording of activities related to Blue Swimming Crab aquaculture techniques at the Boncong Bancar Marine Farming Facility in Tuban, East Java.

Interviews

Interviews were conducted to gain in-depth knowledge about the subject matter, conduct preliminary studies, and identify research areas that require investigation. This technique relied on self-reports or personal knowledge and beliefs (6).

Active Participation

Active participation required the researcher to engage directly in activities related to Blue Swimming Crab aquaculture. This encompassed seed selection, water quality measurement, feeding, pest and disease management, harvesting, and packaging. tics

Secondary Data

Secondary data consisted of information collected from documents, journals, magazines, and articles. These data sources did not directly provide information to the data collector but served as valuable references for the research, aligning with the research topic and objectives (6). Combining primary and secondary data collection methods enabled a comprehensive exploration of Blue Swimming Crab aquaculture practices, making this research valuable for the aquaculture industry and fisheries experts.

Result and Discussion

General Condition of MFF Boncong

MFF Boncong, established in 1981, underwent several name changes, initially PRUG (Pembenihan Rakyat Udang Galah) and later UPPB (Unit Pengelolaan Perikanan Budidaya) before adopting its current name, MFF, in 2015. The choice of cultivation commodities also evolved to meet market demand. Initially, it focused on freshwater prawns (*Macrobrachium rosenbergii*), shifting to tiger prawns (*Panaeus monodon*) in 2004 due to increased demand. Over the years, it diversified into *vannamei* shrimp, eel, tiger groupers, coral groupers, seahorses, mangrove crabs, blue swimmer crabs, and lobsters. These changes reflect MFF Boncong's adaptability in responding to market dynamics.

MFF Boncong Tuban, East Java, is at 111°44'39.33'' E longitude and 6°46'18.43'' S latitude. It is located along Jalan Raya Semarang Km 41, in Boncong Village, Bancar Subdistrict, Tuban Regency, East Java. The installation is on the northern coast of Java, characterized by relatively calm sea conditions and sheltered from the open sea. The surrounding environment includes a river to the west, aquaculture areas to the east, and a sandy northern shoreline. The facility's temperature averages around 30°C, and freshwater is sourced externally due to saltwater intrusion, with the location depicted in **Figure 1**.

Rearing Facility

Water Supply System

The water supply for aquaculture at MFF, sourced from the sea, utilizes innovative methods for seawater management. Seawater is conveyed through 20 cm diameter PVC pipes, harnessing the pressure of ocean waves and gravity. This sustainable water transport approach aligns with recent research findings promoting environmentally friendly aquaculture practices (7). The flowing water is collected in underground seawater reservoirs, where it undergoes treatment and sedimentation, following established water treatment principles in aquaculture (8). A dose of 10 ppm of calcium chloride and 5 ppm of thiosulfate is added to neutralize the water. After treatment, the water is pumped to a storage tank, ensuring the culture medium is optimized for crab rearing (9).

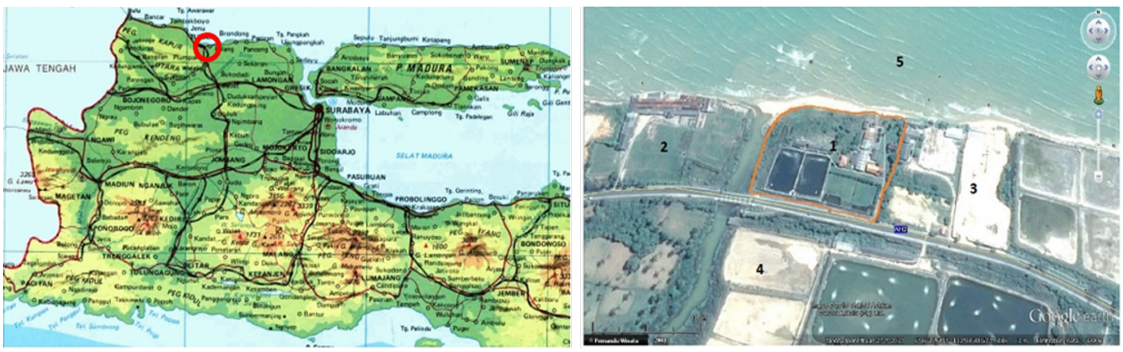

Figure 1. Location of MFF Boncong in Tuban Regency (A) and MFF Boncong by Google map (B).

Fresh seawater for crab cultivation is typically prepared at night to replace the morning water. This rotation helps maintain a cleaner and healthier environment for the crabs as the pond becomes soiled from residual feed and molting. The weekly requirement of approximately 3600 liters per pond.

In contrast, freshwater for other activities within MFF, including employee hygiene and reducing parasitic risks in grouper fingerlings, faces a unique challenge due to seawater intrusion. As described by (10), seawater intrusion into freshwater sources is a growing concern in coastal areas. The previous year, freshwater was sourced from a 5-meter deep artesian well. However, this source has been rendered unusable due to seawater intrusion, with the salinity reaching 26 ppt, underscoring the pressing need for alternative freshwater sourcing and management strategies in the region.

Aeration System

The supply of dissolved oxygen in the crab-rearing environment is crucial for various activities and the breakdown of organic matter within the ponds. Oxygen is primarily obtained through natural air diffusion and aeration hoses installed in each pond. Research by (11), highlights the critical role of dissolved oxygen in aquaculture, emphasizing its direct impact on the growth and health of aquatic organisms. Each crab-rearing pond is equipped with six aeration hoses. These hoses are installed in series within one pond and parallel across different ponds, facilitating control during feeding without disrupting aeration in other ponds.

Pond Construction

The construction of crab-rearing ponds at MFF Boncong entails rectangular ponds with a depth of 100 cm, a length of 2.5 m, and a width of 1.2 m. These concrete ponds are equipped with 3 cm inlet and 8 cm outlet PVC pipes. Additionally, a string is affixed at the top of each pond to suspend the aeration hoses.

The construction of the ponds necessitates consideration of water retention. A well-constructed pond retains water volume unless water loss is due to evaporation caused by elevated temperatures. Normally, increased temperatures have minimal impact on cultivated biota, as the evaporation rate typically results in only a 1 cm reduction in water level, prompting periodic water replacement.

Rearing Activities

Water Quality Management

The rearing of mud crabs places significant emphasis on water quality management. Dissolved oxygen levels, pH, salinity, and water temperature are meticulously controlled to ensure the well-being of the crabs. Water quality measurements are taken three times a day, specifically at 7 AM, 12 PM, and 5 PM, as these intervals coincide with expected changes in water quality. Although MFF typically conducts measurements twice daily, the additional measurement aims to capture fluctuations during these key timeframes.

During observations, pH levels range from 6 to 8, and salinity falls between 30 and 35 ppt. According to Juwana and Romimohtarto (2000), salinities between 25 and 35 ppt are suitable for crab survival. A temperature of 32°C aligns with recommended crab farming conditions, as Juwana and Romimohtarto (2000) suggested. Likewise, during this study, water temperatures ranged between 29°C and 33°C, in line with literature. Dissolved oxygen levels averaged between 5.0 ppm and 8.4 ppm over one month, which is considered favorable, as Suharyanto (2012) indicated that dissolved oxygen levels of 6 to 8 ppm are ideal for crab cultivation.

Feeding Management

At MFF Boncong, crab feeding is conducted three times daily, scheduled for 7 AM, 3 PM, and 9 PM. Feed is administered at a rate of 3-5% of the crab's body weight. Upon the arrival of live fish feed, it is immediately prepared, frozen, and provided during designated feeding hours. Any residual feed is siphoned to prevent contamination of the pond. Feeding is typically done by scattering feed near the crabs' shelters. It is imperative that feeding does not extend beyond the allocated time to prevent cannibalism and protect smaller or molting crabs.

Facilities Maintenance

Efficient rearing activities are contingent upon proper infrastructure maintenance. Routine maintenance of facilities and equipment is conducted at MFF. Pond cleaning is executed using high-pressure water spray whenever the pond appears dirty. Algal growth is the primary concern on shelter walls and pond surfaces. Tanks and equipment are thoroughly cleaned and dried. Aeration equipment is checked every morning, and any clogged aeration stones are replaced with clean ones while the soiled stones are cleaned and dried. This maintenance is essential to preserve the equipment's functionality and ensure it does not disrupt the growth of the cultivated crabs.

Disease Control

To date, there have been no serious diseases affecting mud crab rearing. Effective water quality management contributes to the crabs' health and growth. However, the mud and sedimentation culture of the crabs may result in sediment adhering to the crabs' backs, making them appear dirty and unattractive. This condition can attract other organisms if left unaddressed, especially when coupled with the inactivity of the crabs.

The primary method of control involves brushing the crabs' backs with a toothbrush when they become visibly dirty, as indicated by a dark, soiled appearance. Crabs that are uncomfortable with the accumulation of dirt exhibit behaviors such as scratching their bodies with their claws and pincers or rubbing their bodies against the shelters.

Harvesting

Mud crab harvesting is typically carried out when the crabs reach an age of 4 to 5 months, with a size of 1 kg, containing 3 to 4 crabs per kilogram. This corresponds to individual crab weights ranging from 250 to 330 grams. The harvesting process is straightforward and involves a one-day fasting period to empty the crabs' digestive tracts. Subsequently, the water level in the pond is reduced to 25%. The crabs are then caught in nets and placed in refrigerators or freezers at a temperature of 20°C. Once the crabs become semi-immobile or deceased, they are ready for sale.

Marketing

The matured crabs are marketed to various consumers, including restaurants in Tuban and middlemen. In restaurant-scale sales, prices can reach Rp. 150,000 per kilogram, while middlemen typically purchase at rates around Rp. 95,000 per kilogram. Crab farming appears to have favorable marketing prospects, with demand increasing in Tuban. However, natural production levels have not yet met this growing demand. In conclusion, the future of mud crab aquaculture seems promising, with effective demand creation indicating continuous growth in marketing.

Production and Business Analysis

Production

In the context of mud crab aquaculture, the measure of success lies in the production volume over a given timeframe, coupled with market pricing. Survival Rate (SR) for Mud crab is typically around 95%, indicating a harvest of 608 crabs. Given that the size of a Mud crab after 5 months is approximately 1 kg with 3 crabs per kilogram, each harvest generates 155 kg or 15.5 quintals for 16 ponds.

Business Analysis

After harvesting the swimming crab, the business and determination of the Break Even Point (BEP) is analysed. There are 16 pools for the swimming crab business, with each pool measuring 1.2 x 2.5 meters. This setup yields a production of 15.5 quintals or 155 kilograms per cycle. Selling this at a rate of Rp.95,000 per kilogram to middlemen results in a total revenue of Rp.465,719,000 per cycle.

BEP represents the minimal time required to recoup the initial investment in a business venture. The BEP equation can be derived as follows:

Upon totaling the expenditure requirements and the initial capital needed over a period of 5 months, which amount to Rp. 298,290,917, the break-even point is reached within a single production cycle. Moreover, a profit of Rp167,428,728 is achievable.

Business Development in Mud Crab Cultivation

Challenges

One of the challenges encountered in Mud crab cultivation is the cannibalistic nature of these crabs. This behavior can reduce the Survival Rate (SR) when ponds lack sufficient shelters and inadequate feed supply. Maintaining water quality to ensure crab health and sustained growth is also a significant concern. Another challenge lies in controlling the electricity supply to run aerators, a crucial factor in ensuring adequate oxygen levels through aeration.

Future Business Prospects

Considering the Break-Even Point (BEP) and the monthly profit, Mud crab aquaculture holds significant potential for the future. This potential is substantiated by the unmet demand for Mud crab in Tuban, which remains unsaturated. Advancements in technology and research can potentially mitigate challenges such as cannibalism, offering solutions to enhance productivity. As such, local, national, and international demands for Mud crab can be satisfied over time.

The increasing demand for this crab delicacy and technological advancements position mud crab aquaculture as a promising venture with significant growth potential. This supports the local market and creates potential for expansion into regional and international markets.

Conclusion

In summary, mud crab cultivation is a relatively straightforward and disease-resistant marine aquaculture. Routine water quality management enhances growth with minimal disease risks. Challenges include cannibalistic behaviors, particularly during low feed availability and molting, but these can be mitigated by providing adequate shelter for the crabs in the ponds. The ease of mud crab farming and the unmet demand to date make it a promising business venture, especially in Tuban, where demand remains unfulfilled due to the seasonal dependence on wild catches.

Declarations

Author Informations

Juahir Juahir ✉

Affiliation: Department of Aquaculture, Faculty of Fisheries and Marine Science, Brawijaya University,

Malang – 65145, Indonesia.
Contribution: Conceptualization, Formal analysis, Investigation, Methodology, Project administration, Writing - Original Draft.

Conflict of Interest

The author declares no conflicting interest.

Data Availability

The unpublished data is available upon request to the corresponding author.

Ethics Statement

Not applicable.

Funding Information

Not applicable.

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