Crayfish as Food in Indonesia

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Introduction

Fish and shellfish consumption per capita per year has been reported to increase around the globe, especially in developing countries. The increasing consumption per capita suggests that the fisheries sector provides a pivotal role in providing aquatic-based foods. In recent years, captured fisheries production has decrease due to overfishing and climate change, thereby seriously impacting the fish stock [1,2] Currently, the contribution between the fish culture sector and captured fisheries to the production of aquatic commodities is almost equal [3]. It is estimated that production from the aquaculture sector will surpass captured fish production for human consumption in the following years. Therefore, to meet the demand for aquatic commodities, aspects of aquaculture need to be evaluated thoroughly to improve efficiency and alleviate potential harmful impacts.

Indonesia is one of the top aquaculture producers, worldwide [3]. Referring to the "business as usual" scenario, aquaculture production in Indonesia, both for export and domestic consumption, is projected to continue with impressive growth [4]. Currently, the prioritized commodities include vannamei shrimp (*Litopenaeus vannamei*), Nile tilapia (*Oreochromis niloticus*), catfish (*Clarias* sp.), striped catfish (*Pangasianodon hypophthalmus*), gourami (*Osphronemus goramy*), common carp (*Cyprinus carpio*) and milkfish (*Chanos* sp.). Considering the diversity of commodity types, aquaculture production in Indonesia heavily depends on a limited number of species, especially in the case of freshwater finfish except for vannamei shrimp, which is considered the most valuable aquaculture product in this country. The development of potential commodities from freshwater crustaceans and mollusks seems to be hindered by technical and non-technical barriers. Therefore, it is crucial to foster more diverse aquaculture industries by identifying and promoting other promising aquaculture commodities.

Freshwater crustaceans can be a prospective item for human consumption among aquaculture commodities in Indonesia. Popularly known as crayfish, crawfish, or yabby, this crustacean is important as a food source in the United States [5]. Crayfish is reared in the earthen pond in both countries under either extensive or semi-intensive culture systems. In the United States, crayfishes are usually found seasonally during spring or early summer from February through May. Crayfishes are commonly cultured extensively in large areas of ponds or swamps. In this extensive system, feeding is rarely

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conducted thus the crayfishes depend on natural feed that is available in the pond. The crayfish is usually sold as boiled crayfish dishes with herbs and spices (Cajun or Louisiana styled spices) at the grocery stores at a relatively low price.

Development of intensive crayfish culture system

In Indonesia, freshwater crayfish is popular as ornamental fish, cultured in concrete ponds and aquaria with lower density. The density is low to avoid physical contacts between crayfish that possibly cause broken claws leading to economic loss. The use of concrete pond and aquaria is essential to maintain water clarity; the opaque water is an indicator of low crayfish quality, causing lower price. A low-density system applied in ornamental crayfish culture is economically impractical when applied in consumption crayfish culture since it raises production cost. Despite its potential as high-protein food for humans, several underlying problems can offset the development of crayfish in an intensive culture system. Firstly, the crayfish culture requires tremendous effort due to subsequent cannibalism when reared at high density in an intensive system. Cannibalistic behavior of the fish is also common among other crustaceans such as crabs and marine lobster [6,7]. Besides, crayfish culture under high density system in concrete cages or aquariums can be difficult without proper feeding management to overcome the territorial traits of crayfish. Crayfish showed territorial feeding activities and protected their feed against other crayfish [7]. Therefore, crayfish growth may differ greatly from each other, though reared in the same pond; resulting in their different sizes when harvested. To deal with these challenges, crayfish culture using the cellular system, wherein the crayfish is placed individually (or isolated), is proposed to be a better alternative solution. The system has been adopted to culture solitary species such as marine lobster and mud crab [8]. The use of cellular system in aquaculture focuses on how to determine system productivity and optimum density [9]. To fill the gap, this current study aimed to investigate the feeding aspects of the crayfish culture under the cellular system, while also considering interaction among crayfish. The cellular system allows to limit or eliminate social interaction visually or physically among the fish, and the impact of such system on growth and survival rate was investigated.

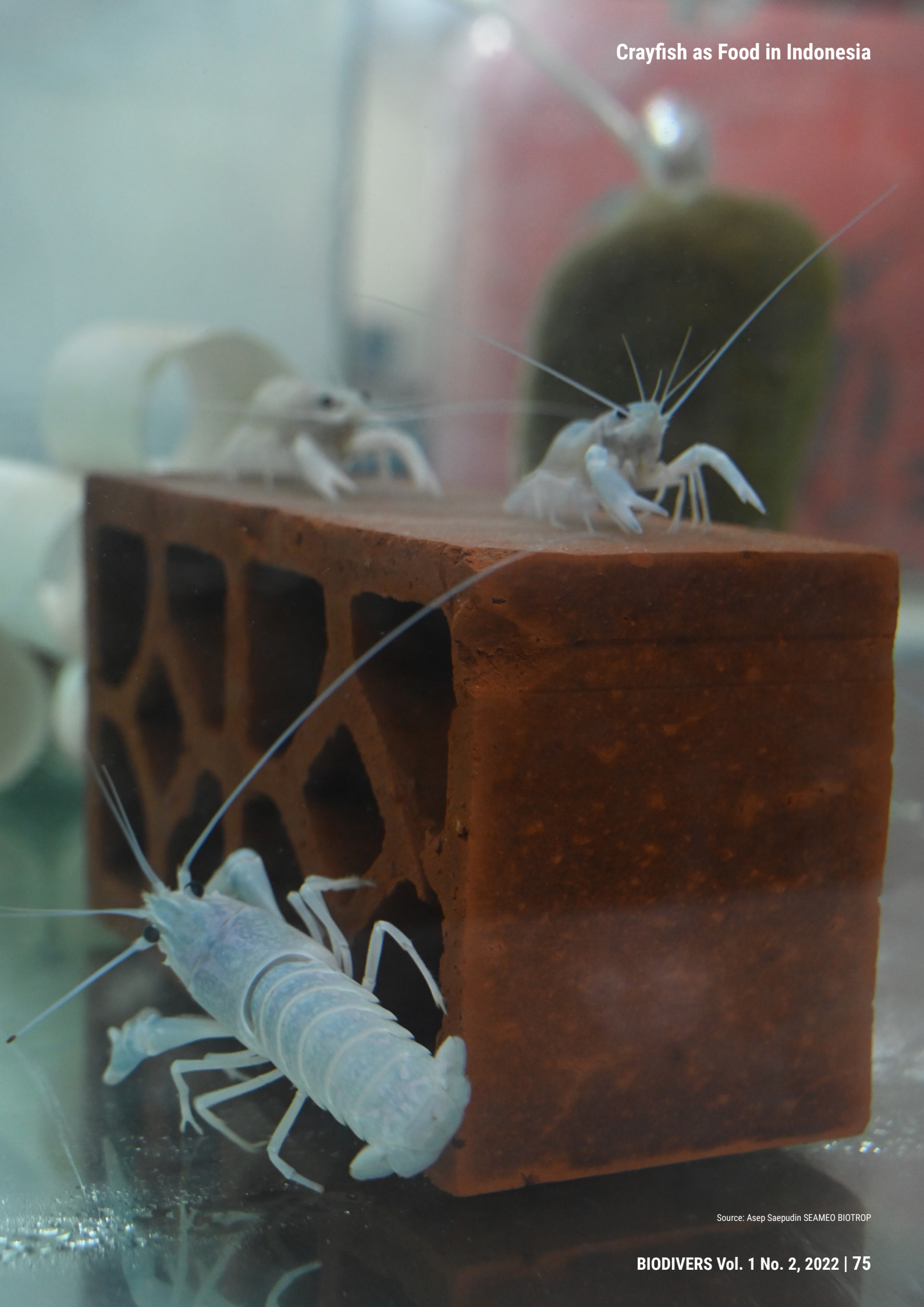
To cope with the above problems, the cellular system was proposed to culture crayfish without provoking economic loss [8,9]. It was previously applied for mud crab, and often combined with recirculating aquaculture system or placed beside rivers [8]. The use of cellular system has altered the social interaction of the cultured fishes [10]. The isolation due to the application of cellular system potentially hindered their growth rate. Hence, in this work, the growth and survival rate of freshwater crayfish cultured in cellular system were also investigated.

Providing quality feed for crayfish

Another problem that can hinder the development of cultured crayfish is the availability of feed in the intensive culture system. Among the important characteristics of an intensive culture system, as opposed to an extensive culture system in the aquaculture field, is high stocking density, high dependency on commercial feed to support optimum growth, and technology intervention to ensure optimal growing conditions. Thus, the production cost of intensive culture will be significantly higher than extensive or semi-intensive culture. One factor that contributes to the increase of production cost is the feeds cost. It is common in intensive aquaculture systems to have feed cost up to 60% of production costs. The total feed cost can even reach 80% of the total production cost in some freshwater species. The high amount of feed cost in the intensive aquaculture system is unavoidable since the principal aim of intensive culture system is to maximize the weight gain of the species in a short time. However, the pond natural productivity will not be enough to provide feed for all the crayfish that are reared.

In its natural habitat, crayfish is considered as an omnivore that can utilize various food sources such as macrophytes, detritus, small invertebrates, and fishes. In the culture condition, crayfish can be fed using commercial or homemade fed with protein content at around 25% and lipid content of 8% [11]. Specific commercial feed that is intended for crayfish is not available in Indonesia. Thus, farmers may use commercial shrimp feed that contains protein at 25-28%. Shrimp feed is the most appropriate amount since crayfish and shrimp have similar feeding behavior; nibbling the feed little by little using their modified appendages, thus, the feed needs very high stability under water to minimize leaching that may affect nutrients intake by the crustaceans and also to minimize pollution of the surrounding water.

In the development of suitable feed for crayfish, one common obstacle is the availability of locally based ingredients for the fish and shellfish feed. Currently, most of the ingredients needed for aquaculture feed are imported from other countries. Soybean meal, wheat, meat and bone meal are not available at the local source or at least not available at sufficient amount to fulfill requirements for aquatic and terrestrial feed. Thus, to overcome this dependency on imported ingredients, local feed raw material should be further explored. Some local alternative feed ingredients that have already been



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evaluated and known to be suitable for use as the feed ingredients are palm kernel meal [12], cassava meal [13], rice bran [14], and rubber seed meal [15, 16]. Furthermore, in its aquatic laboratory, SEAMEO BIOTROP tried to utilize the local byproduct ingredients such as watermelon rind for crayfish feed and the preliminary results demonstrated that there was no growth difference when this ingredient was used in the feed.

The use of solitary system along with development of commercial feed for crayfish can be a solution to diversify a long-established crayfish aquaculture as ornamental commodities into food commodities. Furthermore, off-farm aspects such as a thorough market evaluation and a comprehensive marketing strategy could also support this diversification. Finally, it is of utmost importance to further elevate the aquaculture industries in Indonesia into more diversified products so that the need to import fish or shellfish commodities from abroad, is minimized if not totally stopped.

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