

Identification and Exploration of the Potential to Control the Invasion of Red Claw Freshwater Lobster in Dumai City for Micro, Small and Medium Enterprises

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Abstract

Abstract. This study is part of a relay activity to explore local economic potentials, the discussion of which is focused on identifying and exploring the potential of a resource object selected based on the availability of the resource object and the minimal use of the resource from a business perspective by the local community. The resource object that will be discussed in this case is local fisheries resources in Dumai City, especially fisheries resources from the red claw crayfish commodity or also known as red claw crayfish (*Cherax quadricarinatus*) which is found in many natural environments in several waterways and river in Dumai City. Exploration of economic use by local communities in this study is also directed as an effort to control the spread of red claw freshwater lobsters which are feared to cause damage to native freshwater biota in Dumai City.

1. INTRODUCTION

The city of Dumai is an economic center that is developing with the growth of oil and gas, palm oil and international port industrial areas. The industrial areas and ports in Dumai City then encourage rapid population migration to this city from the surrounding areas, especially residents who are interested in the various opportunities to improve their standard of living from various economic activities in Dumai City. This then triggered an increase in the population of Dumai City from year to year until by 2022 it had reached 331,832 people.

The increase in population in Dumai City ultimately encourages the development of a variety of small and medium businesses, especially businesses that are oriented towards meeting the needs of the local population such as food, services, trade and others. Experimentation on types of business that suit local needs and are based on area management opportunities in the vast, untapped area of Dumai is increasingly being carried out by the local community. Due to the large potential area that has not been managed, food-based businesses are one of the community's priorities. Many types of food businesses have been tried out by local communities, especially new types of food commodities that were not previously available or produced in Dumai City. Some efforts to test new commodities were successful and some were not, but in the end many types of invasive species developed in the natural environment of Dumai City.

In the context of food, the cultivation of red claw freshwater lobsters (*Cherax quadricarinatus*) is one type of commodity that is being experimented with by local communities which later became an invasive species and spread widely in most of the inland waters of Dumai City. It is not known when the spread of the *Cherax quadricarinatus* species occurred, but based on information from local people, it is known that this species became known after major floods around 2011 to 2016 in several areas in South Dumai and West Dumai sub-districts. Most likely this species is a species that escaped from individual ponds in the Bukit Datuk sub-district area, South Dumai sub-district.

The *Cherax quadricarinatus* species then reproduced and became an invasive species whose impact on the stability of local biodiversity had not been anticipated by the community or local government in Dumai City. Apart from that, these invasive species are also not used further as commodities for the local economy which are useful for increasing community income as well as controlling the population of invasive species to prevent competition with local species.

Based on the conditions of the existence of the invasive species *Cherax quadricarinatus* as described above, this research is directed at finding an implementable solution regarding how to manage and protect the inland water environment of Dumai City based on the perspective of controlling invasive species through potential identification and exploration mechanisms to then be further developed as part of the activities local economy. The priority for identifying and exploring the potential for controlling *Cherax quadricarinatus* in the form of economic activity for this study is the development of business methods for small and medium enterprises related to *Cherax* sp specimens. as the main commodity but from the perspective of implementing effective management for use by small businesses in residential locations or locations with limited area native freshwater biota in Dumai City.

Commodity description

Red-clawed freshwater lobster (*Cherax quadricarinatus*, von Martens, 1868) is one of Australia's native freshwater fisheries commodities which is now widely cultivated by farmers in various parts of the world. Red claw lobsters are known to have the advantage of not being easily attacked by disease and easily adapting to freshwater environments with various temperature conditions and the height of the environment above sea level. This advantage has made many farmers in Indonesia interested in trying to

cultivate this species so that in the end the red claw lobster spread widely in various land waters and became one of the most invasive animals in Indonesia.

Due to the lack of intensive research, until now it is not yet known precisely what impact the invasive red claw lobster has on the environment it invades or what impact the presence of these animals has on local biodiversity. However, based on experience in various countries which are aware of the risk of an environmental and biodiversity crisis due to the invasion of red clawed lobsters, the presence and uncontrolled spread of red clawed lobsters in Indonesia will most likely have a negative impact on the stability of biodiversity and the local environment.

Freshwater habitat conditions that support the life of red claw lobsters referentially are in freshwater conditions with temperatures ranging from 26-29°C with a degree of acidity between pH (potential of hydrogen) 7-8 and dissolved oxygen content at around 4 ppm. However, based on the presence and distribution of red claw lobsters in the freshwater network in Dumai City, most of which is peat water, it shows that these lobsters are able to live in water conditions with acidity below pH 7.

Red-clawed lobsters have the character of being omnivorous animals that are opportunistic in looking for food so they are able to adapt to various types of freshwater habitats with various biodiversity components that exist in these habitats. Apart from that, red claw lobsters also have the behavioral characteristic of wandering out of their original habitat to find new habitats that better support their living needs. When migrating, red claw lobsters are able to leave the water environment and can survive in the open air for several hours. When it finds the right habitat, the lobster will immediately look for a partner to mate and lay eggs, because red claw lobsters do not have certain mating seasons. These behaviors facilitate the spread of red claw lobsters in nature and are difficult to control.

The migratory behavior of red-clawed lobsters is also triggered by their territorial nature and tendency to cannibalize each other, especially cannibalistic behavior when other lobsters are molting. The moulting process causes the lobster to become weak and easily attacked by other lobsters. In the cultivation process, cannibalistic behavior is one of the causes of the decline in the lobster population in the habitat provided by the cultivator.

The maximum size of freshwater lobsters if cultivated for enlargement is known to reach a length of around 15 inches or around 40 cm. The selling price for consumption in the 20-30 cm size is very high and the value is no longer determined by the weight of the lobster but based on the number of units of the lobster. On the other hand, sales of lobsters for consumption in sizes under 20 cm are usually determined based on weight per kilogram.

Apart from consumption, sales of red claw lobsters can be done in the form of a package system for cultivation. In this package system, the lobsters are sold per head in sizes ranging from 1 inch (2.54 cm) and 2 inches (5.08 cm) as seeds for cultivation which focuses on lobster enlargement and sizes 3-4 inches (7.62 cm). -10.16 cm) as a parent that will be spawned to obtain new seeds.



Picture 1 Various sizes of lobsters that are marketable.

POTENTIAL IDENTIFICATION

Significance of population control

The origin of red claw lobsters in the freshwater waters of Dumai City is difficult to ascertain. Based on information from local residents in locations where lobsters can be found, the existence of lobsters was only discovered after major floods hit Dumai City several years ago. This large flood caused fish and shrimp kept in cultivation ponds and fishing ponds to be released and then spread to rivers, canals and ditches around these ponds. Apart from red claw lobsters, various types of invasive fish such as tilapia (*Oreochromis niloticus*), tilapia (*Oreochromis mossambicus*), freshwater pomfret (*Colossoma macropomum*), and other invasive species were also released. This event resulted in damage to local biodiversity so that many local species such as leaf fish (*Nandus sp.*), Sibam fish (*Anemathichthys apogon*), Sumatran fish (*Puntius tetrazona*), and many other unidentified species in the invaded habitat disappeared or were difficult to find again.

The distribution of red claw lobsters in Dumai City, based on a survey conducted by researchers, is known to be concentrated in a network of water channels connected to the Dumai River. At other river locations in Dumai City, based on surveys and information from local communities, no red claw lobsters were found. The concentration of distribution of red-clawed lobsters in the Dumai River water channel network is likely caused by the concentration of large floods and the location of the pools where the lobsters originate are in these two rivers.



Picture 2. Location of red claw lobster distribution in Dumai City

The absence of red claw lobsters in the water channel network in the form of canals, ditches and rivers outside the Dumai river water channel network shows that population control efforts to control the spread of these lobsters can still be carried out so that the stability of local biodiversity is not affected. However, in the absence of an intensive system and process for controlling red claw lobsters in Dumai City, the rate of spread of this species is still ongoing.

Apart from that, the increasing pollution in the Dumai River needs to be a point of concern, especially regarding the impact of pollution from a public health perspective because red claw lobsters in the polluted river are starting to be consumed by local communities around the Dumai River. Red claw lobsters are known to accumulate pollutants in their bodies, so consuming lobsters containing pollutants is very risky to health. Specific research is needed to find out more about this.

Population control through overfishing patterns

For efforts to control the presence of the red claw lobster species (*Cherax quadricarinatus*), optional concepts that can be considered in controlling this species in Dumai City include the following:

1. Biological control carried out by deliberately manipulating natural enemies with the aim of reducing or controlling invasive animal populations. This option requires special research to ensure that the target of the natural enemy is this type of invasive animal.

2. Chemical control is carried out with chemicals that are fatal to invasive animal life. This option is very risky for the lives of other animals that are not invasive animals and is dangerous for the stability of the local ecosystem.
3. Cultural control is carried out by changing the perspective and behavior of local communities regarding the risk of the spread of invasive animals. This option requires special policies from the local government and an education system that can encourage local community awareness of the risks of the presence and spread of invasive animals.
4. Mechanical control is carried out by building special infrastructure specifically designed to prevent the spread of invasive animals. This option requires special research to find appropriate and efficient infrastructure to control invasive animals and is usually expensive to implement.
5. Physical control carried out by hand or with special tools to capture and destroy invasive animals. If this option is carried out only in the context of control activities without objectives based on improving the local economy, then control activities require expensive labor and are less effective in the long term.

Referring to the condition of local community perception, the existence and distribution of red claw lobsters in Dumai City is not yet seen as a commodity that has value for improving the local economy. This can be proven by the absence of sales of red claw lobster as a commodity in local markets. On the other hand, many people do not know about the existence of red claw lobsters in the freshwater waters of Dumai City and exploitation is only carried out for self-consumption purposes or as part of fishing hobby activities.

Of the various optional concepts for controlling this species in Dumai City which have been previously discussed above, the concept of physical control has great potential if directed from the perspective of creating activities to control the invasion of red clawed lobsters as an economic activity for local communities. Researchers identified that the implementation of the concept of physical control can be carried out using a pattern that researchers term as a catch-and-raise pattern for micro, small and medium enterprises (MSMEs), namely catching red claw lobsters from the wild and then raising them as a consumption commodity. In this pattern, the presence of red claw lobsters is seen as a potential seed to be raised to a size that is economically valuable for consumption. In this way, prospective farmers do not need to spend special capital to buy seeds that will be grown as commodities.

The catch-and-raise pattern can also be used to obtain red claw lobster broodstock for further cultivation. However, if the direction of activities is carried out for cultivation, then the role of the local government and the awareness of cultivators regarding anticipating the risk of invasive species is very necessary to prevent further invasion into freshwater networks that are still not contaminated.

Based on empirical activities by researchers, catching freshwater lobsters in the inland waters of Dumai City does not require special equipment or skills, so fishing activities can be carried out by anyone with a variety of backgrounds. Tools that can be used can be nets, poles, traps or fishing rods. Meanwhile, bait for traps and fishing rods can use earthworms (*Lumbricus* sp.) or pieces of fresh fish meat.

The significant thing to note is that the effective fishing schedule is at night when lobsters are more active in looking for food. Based on observations, lobsters' activity in searching for food is usually not far from their hiding hole (shelter) and when there is bright light, the lobster tends to run away or return to its hiding hole. When the hiding hole is damaged, the lobster will escape and move to another, safer place. However, if the hiding hole is not damaged, when the lobster manages to escape when it is about to be caught, it will still return to its hiding hole and after some time it will return to its activities around the hiding hole area.



Picture 3. The research team caught red claw lobsters with fishing rods at night.



Picture 4. The research team caught red claw lobsters during the day.

2. METHOD

Developing population control through the catch-and-grow MSME pattern requires the right management concept in accordance with business needs from the perspective of micro, small and medium businesses. Each management concept is different from one another because each business has a different scale in capital, workforce and business facilities, as well as market share.

Efforts to catch and raise red claw lobsters on a micro scale

Business activities that fall into the category of micro-scale red claw lobster catching and rearing are businesses that use low capital with limited production capacity and the labor used is individual without requiring special skills. Therefore, this micro scale business can be carried out by all parties, especially those who have limited capital.

The management concept on a micro scale for the business of catching red clawed lobsters in this research is aimed at formulating activities to control the invasion of red clawed lobsters which can be carried out by middle to lower economic groups with minimal capital and generally oriented towards increasing daily income. Micro-scale red claw lobster fishing business activities in Dumai City will likely be more seasonal, especially when lobsters are easy to find during the dry season.

The implementation of micro-scale management in the business of catching and rearing red claw lobsters is more focused on resources and activities so that the concept of micro-scale management for this business is closely related to capital, hunting activities, rearing cultivation and marketing. Management functions related to POAC (Planning, Organizing, Actuating, Controlling) or planning, organizing, directing and monitoring are not implemented systematically. This is caused by the tendency for micro businesses to be carried out by economic actors who have many limitations both in terms of knowledge and capital.



Picture 5. Management concept for micro-scale red claw lobster farming.

The capital required to carry out a micro-scale red claw lobster fishing business will focus more on hunting equipment and cultivation equipment, land availability and operational costs related to hunting and cultivation activities as well as costs for sending commodities to the market.

Hunting activity

Fixed capital for hunting equipment consists of fishing tools in the form of tangguk, fish traps, fishing rods or nets and bait which usually consists of earthworms or pieces of fresh fish meat. Working capital in the form of costs is usually related to transportation costs and food costs if the hunting activity lasts a long time.

Hunting activities using tangguk can be carried out day or night. However, based on fishing trials carried out by researchers, catching large lobsters measuring over 5 inches is difficult using a tangguk because the lobster moves very quickly to avoid the tangguk.

Catching using fish traps can be done using fresh fish meat as bait. Setting this trap should be done at night when the lobsters are more active in looking for food and then take the trap in the morning. Bubu traps are effective for catching lobsters of various sizes, however due to the length of time of catching which generally reaches more than 12 hours and the difficulty of monitoring there is a risk that the traps installed can be stolen and lost.

The fishing process using a fishing rod can be done at any time using worm bait. However, fishing with fishing rods tends to leave lobsters injured or disabled with a high risk of death.

Then, catching using nets is only effective if the lobster is far from its nest or hiding place (shelter). If the lobster is close to its nest, then when it is netted, the lobster can crawl quickly back to its nest which is under the net.

Enlargement cultivation activities

In terms of cultivation, fixed capital requirements consist of water containers, shelters, air pumps (aerators) along with air hoses, and land. The water container can be in the form of a bucket, tarpaulin pool or other container according to the size of the space that will be used as a place for enlargement cultivation. To reduce the impact of cannibal behavior, especially during molting, the water container where the lobster lives should be accompanied by a shelter made of PVC pipe, tile, bamboo or other tubular materials. Then, an aerator and air hose must be provided to ensure the availability of dissolved oxygen needed for lobster breathing in the water. Land for cultivating lobsters can use the space in the house or yard.



Picture 6. Example of a hiding place for red claw lobsters using PVC pipes.

The working capital required in the enlargement cultivation process consists of costs for purchasing water if well water or rainwater does not allow the lobster to survive, electricity costs, and feed costs consisting of artificial feed (pellets) or natural feed. The cost of artificial feed or pellet feed can still be reduced if the lobster feed is completely natural food such as worms, vegetables, carrots, fresh fish meat and others.

The process of growing red claw lobsters is not difficult to do. The main key in the process of rearing red claw lobsters is closely related to water quality, food and the availability of shelter to reduce cannibal behavior. Therefore, the implementation of the red claw lobster cultivation process for micro business scale can be carried out by economic actors themselves without requiring special workers.

Marketing activities

The fixed capital needed for marketing activities for the micro-scale red claw lobster farming business is a place or container to move the lobsters from cultivation areas to consumers or markets. This lobster transfer container can be provided by micro businesses or partners or consumers. The container can be a Styrofoam box filled with ice and banana leaves or papaya leaves.

Working capital during marketing activities is more related to the transportation costs required during the transfer of lobsters. These costs can be incurred by the micro business actor or the buyer depending on the agreement before the purchase.

3. RESULT AND DISCUSSION

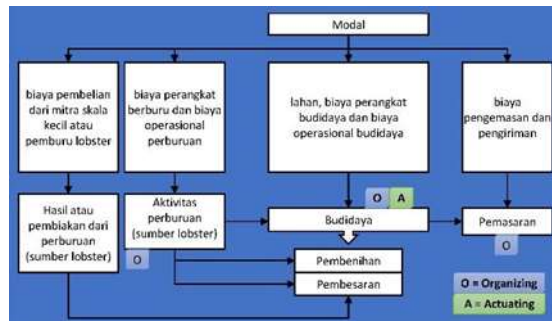
Small-scale red claw lobster fishing business

The category of small-scale red claw lobster fishing business is determined based on production capacity, capital, and the management system that has been implemented as well as market share.

Small-scale business actors have been able to breed lobsters that have been caught from the wild, but production capacity is still limited, there are still many obstacles in capital, especially capital for business development, and the management applied still revolves around organizing and directing (actuating). In addition, the market share of small-scale businesses is still limited or the product marketing distribution network has not been established due to the inability of business actors to meet market demand stably or continuously.

Small-scale red claw lobster fishing business activities are still focused on managing lobster commodity production in accordance with the availability of raw materials which can come from purchases with partners or hunters and from the results of their own hunt. Operational implementation on a small scale is not carried out in a well-planned manner but is only based on rough estimates and is more likely to be based on trials or empirical knowledge obtained based on experience while carrying

out business activities. Apart from that, small scale does not prioritize supervision of business processes specifically, especially product quality control, but is more focused on the quantity of production results.

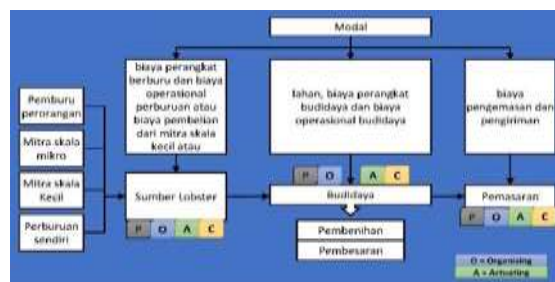


Picture 7. The management concept for the small-scale red claw lobster fishing business with management functions still revolves around organizing and actuating.

Business activities on a small scale do not have much difference from those on a micro scale, but on a small scale the source of lobster comes from the results of one's own hunting or the results of work partners on a micro scale or parties who hunt specifically for sale without being raised first. Apart from that, on a micro scale there is a cultivation process to obtain seeds that will be bred further or sold as product variants.

Medium scale red claw lobster fishing business

Medium-scale red claw lobster farming business actors are basically actors whose business activities have implemented a systematic management system but are still limited in production capacity and stability which is still determined by the availability of seeds both from nature and those that have been bred themselves. Apart from that, medium-scale businesses still have difficulty meeting new market demands and developing downstream variants of their products. If a business actor has been able to meet new market demands and develop downstream variants of his product, then the business can be categorized as a large-scale business.



Picture 8. Management concept for medium-scale red claw lobster fishing business.

The implementation of medium-scale red claw lobster fishing business activities has implemented management with POAC functions (Planning, Organizing, Actuating, Controlling) or systematic planning, organizing direction and supervision in each activity. However, the scope of production is still focused on fulfilling demand from the market network it already has.

Medium scale businesses require collaboration with external parties, especially with individual hunters, partnerships with micro and small businesses. This collaboration is needed to ensure the availability of raw materials in the cultivation process. Apart from that, cooperation also needs to be built with consumers, including buying partners for consumption purposes or partners who buy specifically for seeds that will be bred further.

OPPORTUNITIES AND CHALLENGES

Opportunities

The existence of red claw lobsters which have invaded several areas of the water channel network in Dumai City is an opportunity for local economic actors on an MSME scale to increase their income. However, this opportunity requires government support in the form of socialization or counseling regarding lobster rearing technology to increase the chances of success in lobster rearing cultivation carried out by the community.

Apart from that, the existence of local economic actors based on lobster farming patterns on an MSME scale also opens up new job opportunities while reducing poverty in the local area. Success in developing lobster farming with the aim of controlling invasive animal populations can also encourage continued efforts and local creativity to apply the same control concept to other types of invasive animals.

Challenges

The main challenge in implementing lobster-fishing-based MSMEs from the perspective of the local government is the regional policy concepts and mechanisms to support these MSMEs, including the following:

1. There needs to be an effort by the local government to develop local policies that can support MSME activities based on lobster fishing carried out by local communities, especially in terms of financial guidance and technology transfer appropriate to the needs of business actors.
2. Establishment of permits or policies to control invasive species that are appropriate to the interests of business actors, especially in situations of lobster scarcity after hunting by the public.
3. Regional governments need to prepare special policies regarding whether or not these invasive lobsters may be managed as one of the local fisheries sectors and at the same time prepare appropriate policies regarding the indicative impact on ecosystem stability and local biodiversity if these lobsters can be bred by the community or the economic and economic impacts. social if these lobsters are not allowed to be bred.

In the context of MSME sustainability, the main challenge that business actors will experience is the availability of lobster resources in nature. When the lobster population in nature has decreased due to hunting, MSMEs need to carry out independent breeding to ensure the continuity of their business. The breeding carried out, based on the concept of controlling invasive animals, is aimed at ensuring the availability of cultivation materials to fill the shortage of raw materials from nature.

4. Conclusions

The existence of the red claw lobster species in the inland waters of Dumai City is an illustration and warning of the risk of invasion by foreign species which needs to be a point of attention for further anticipation by the government and local communities. For this reason, local government efforts are needed that can encourage the community's active role in preventing the spread of foreign species of red-clawed lobster or special controls to reduce the negative impacts that may arise from the spread of this species.

The development of controlling the invasion of foreign species based on an economic perspective through the creation of micro, small and medium enterprises (MSMEs) based on the activity of hunting foreign species as seeds in the grow-out cultivation process is one solution that can be considered by the government and local communities. This economic benefit-based solution can be used as part of building local community motivation to hunt foreign species to increase additional income which is also beneficial to the local ecosystem and control the population of these foreign species.

In the process of implementing the MSME concept based on overfishing control which aims to control the existence of the red claw lobster population, there is a need for sustainable synergy between

the active role of the community as agents of population control and government policies that are relevant to this goal. Synchronization of interests between parties needs to be a point of attention for regional governments, especially when indicative conflicts that might occur when MSMEs based on catch-and-large control for lobsters have developed but the availability of lobster sources in nature has decreased.

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