Coastal community empowerment through grow-out of the sea cucumber *Holothuria scabra* in Lombok, Indonesia

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Abstract

Lombok Island in Indonesia has suitable areas for the development of sea cucumber aquaculture, particularly for the species *Holothuria scabra*. Training, workshops, and supervision concerning the grow-out system of juvenile *H. scabra* in ponds and sea pens are parts of coastal community empowerment. Groups of fishermen can learn how to improve pond conditions and place rearing cages in the sea to increase productivity. Understanding the characteristics of the habitat and environment is important for determining the locations of suitable juvenile *H. scabra* rearing locations, as well as overcoming obstacles encountered are needed to support grow-out implementation. Introducing sea cucumber commodities and educating coastal communities on how to maintain *H. scabra* juveniles are expected to enhance the knowledge of fishermen.

Keywords: sea cucumber, *Holothuria scabra*, Indonesia, community empowerment, grow-out

Introduction

In Lombok, West Nusa Tenggara Province in Indonesia, only a few types of fishery products – such as grouper fish, pomfret fish and seaweed (*Kappaphycus alvarezii* and *Euchema cottonii*) – are produced in marine aquaculture. Lobster farming has the potential to be developed in Lombok's waters, although more research is still required. Shrimp culture (*Litopenaeus vannamei*) has been managed in ponds in semi-intensive and intensive systems. Additionally, salt production, milkfish (*Chanos chanos*) and seaweed (*Gracilaria* sp.) have all been traditionally cultured in earthen ponds.

One sea cucumber of commercial importance is *Holothuria scabra*, also known as sandfish. The overexploitation of *H. scabra* is caused by a rise in its demand and a subsequent high harvesting rate (Conand 2017), resulting in *H. scabra* becoming an endangered species (Hamel et al. 2013). Sea cucumbers may contribute to the health of marine ecosystems through their ecological role in bioturbation, nutrient recycling, improved sediment and water chemistry, energy transfer along the food web, and ecosystem maintenance (Purcell et al. 2016).

In Indonesia, sea cucumbers are not popular as either food or as a cultivation commodity. However, Lombok Island has an opportunity to develop sea cucumber aquaculture because it has suitable areas, particularly for *H. scabra*. The introduction of *H. scabra* aquaculture would provide an alternative livelihood for coastal communities. Accordingly, improving community empowerment necessitates the transfer of knowledge through training, workshops and monitoring.

Sandfish (*H. scabra*) juveniles have been successfully produced at the Research Center for Marine and Land Bioindustry (BRIN) in north Lombok. Since 2011, the center has developed an aquaculture system that includes broodstock collection, spawning, larval rearing and juvenile growth. BRIN has disseminated information about sandfish aquaculture to fishermen's groups and stakeholders in coastal communities, especially around Lombok Island.

Dissemination of sea cucumber aquaculture information

Training sessions, workshops and supervision were conducted as part of the dissemination process, not only to transfer knowledge about *H. scabra* culture to stakeholders and fishermen's groups, but also to build capacity in coastal communities. Participants received fundamental information about the biology, life cycle, optimal habitat, cage construction, predators and rearing techniques of *H. scabra*.

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Training sessions and workshops were held near the location of a particular fishermen's group, and most fishermen were from east Lombok (Table 1). The first training session took place in north Lombok to train the Pada Girang fishermen's group. A second training session was held in east Lombok, with the fishermen's groups Optimis, Segare Lauk and Maju Bersama. Two fisher groups – Sunsak Bareng Maju and Tarah-Tarah Maju Sukses – participated in workshops in east Lombok.

After receiving juvenile sandfish and field equipment, fisher groups practiced rearing *H. scabra* in the field (Fig. 1 and Table 2). The group Taruna maintained early juveniles in an earthen pond during the nursery phase. Other groups reared juveniles in coastal areas and applied a sea pen-based system using bottom cages. Supervision was provided on an as-needed basis; groups were directed to build cages (or *hapas*) in the coastal area and to care for juveniles until they were ready to be harvested.

Table 1. Training sessions and workshops on the grow-out of *Holothuria scabra*.

Name of fishermen's group	Date		Number of participants
Training sessions			
Pada Girang	8 August 2019	BRIN, Teluk Kodek, North Lombok	6
Optimis, Segare Lauk, Maju Bersama	15 August 2019	LPSDN, Jerowaru, East Lombok	25
Workshops			
Sunsak Bareng Maju	27 September 2018	LPSDN, Jerowaru, East Lombok	20
Tarah-Tarah Maju Sukses	29 August 2019	Telone, Sekaroh, Jerowaru, East Lombok	25

BRIN = Badan Riset dan Inovasi Nasional (National Research of Innovation Agency)
LPSDN = Lembaga Pengembangan Sumberdaya Nelayan (Fisher Empowerment Institute)

Table 2. Fishermen's groups and their locations.

Name of group	(Sub-Village, Village, District, Regency)	Remarks
Pond		
Taruna	Labuan Tereng, Lembar, west Lombok	- Revitalization of two ponds for nursery - Application of nursery using floating cages - Nursery of 78,072 juveniles
Sea pens		
Pada Girang	Teluk Kombal, Pemenang Barat, Pemenang, north Lombok	- Construction of bottom cages of sizes 10 x 10 x 2.4 m and 15 x 15 x 2.4 m - 1000 juveniles
Optimis	Mandar, Seruni Mumbul, Pringgabaya, east Lombok	- Construction of bottom cages of sizes 5 x 5 x 2.4 m and 20 x 30 x 2.4 m - 1000 juveniles
Segare Lauk	Ujung Betok, Pemongkong, Jerowaru, east Lombok	- Construction of bottom cages of sizes 5 x 5 x 2.4 m and 20 x 30 x 2.4 m - 1000 juveniles
Maju Bersama	Pelebe, Ketapang Raya, Keruak, east Lombok	- Construction of bottom cages of sizes 5 x 5 x 2.4 m and 20 x 30 x 2.4 m - 1000 juveniles
Sunsak Bareng Maju	Sunut, Sekaroh, Jerowaru, east Lombok	- Construction of bottom cages of size 10 x 10 x 2.4 m - 5000 juveniles
Tarah Tarah Maju Sukses	Telone, Sekaroh, Jerowaru, east Lombok	- Construction of bottom cages of size 30 x 20 x 2.4 m - 5000 juveniles

Nursery in earthen pond in west Lombok

According to Partelow et al. (2018), the construction of ponds in west Lombok has not been ideal for aquaculture. The authors stated that through training, groups of fishermen may learn how to improve pond conditions to increase productivity. Ponds were formerly used for keeping milkfish *Chanos chanos*, but the yield was not ideal because dike conditions were not workable. The Taruna group, based in Lembar in west Lombok, focuses on nursery stage activities. They revitalised the ponds, constructed floating cages, and sorted and harvested *H. scabra* juveniles before releasing them on the coast.

In 2015, the Taruna group implemented an integrated multi trophic aquaculture (IMTA) system in their pond through the Lombok Marine Technopark scheme, funded by BRIN. *Holothuria scabra*, *Chanos chanos* and the seaweed *Gracilaria* sp. were maintained in a similar pond at the same time. In 2017, this group possessed earthen ponds of 400 m^2 and 225 m^2 and contemplated focusing on nursery rearing using floating cages (Fig. 2). The ponds have been revitalised by repairing sluice gates and dikes, removing sewage and predators, and draining and fertilising.

During the nursery process, post settlement of *H. scabra* produced larvae that were 5–10 mm in length, which were then reared in a floating cage (1 x 1 x 1 m) constructed of net mesh size 0.5 mm and 2-inch PVC pipes (Fig. 2). In 2019, 78,072 juveniles were maintained and reared to sizes 10–20 g and prepared for release into the sea. Occasionally, moss grew on the surface of the water and stuck to the cages; therefore, routine cleaning was required in order to promote the growth of juveniles.

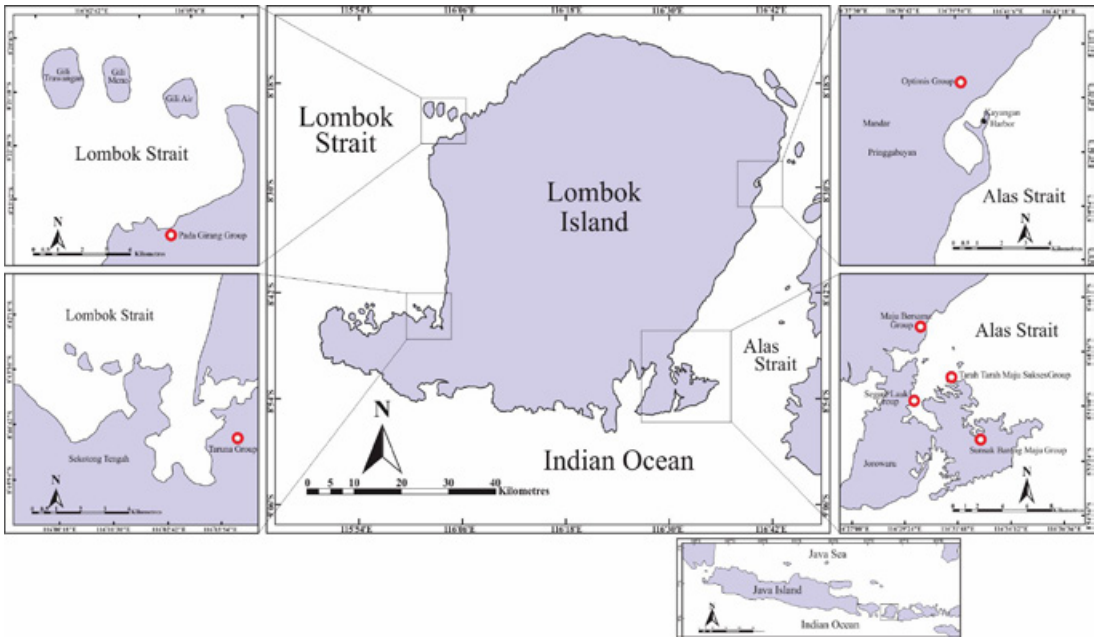

Figure 1. Location of the nursery and grow-out area for *Holothuria scabra* by fisher groups.

Figure 2. Juvenile sea cucumbers, *Holothuria scabra*, being reared in an earthen pond in west Lombok. ©Lisa F Indriana

Grow-out in north Lombok

The fisher group Pada Girang from Teluk Kombal in north Lombok, reared juveniles in Teluk Kombal waters, which is a natural habitat for sandfish due to its muddy-sand substrate and seagrass bed (Fig. 3). Two bottom cages with dimensions of 10 x 10 x 2.4 m and 15 x 15 x 2.4 m were installed, and 1000 juveniles were released in the cages. The fisher group faced an obstacle when big waves destroyed the cages, leading to predators (crabs) getting into the cages, and juvenile *H. scabra* escaping from the cages. The big cage was modified into 10 smaller bottom cages, each measuring 2 x 1 x 0.3 m in order to reduce wave damage. Another concern was that the density of the seagrass (*Syringodium* sp.) was too high, which prevented juveniles from reaching the substrate, thereby stunting their growth due to inadequate nourishment from the sediment.

Grow-out in east Lombok

Training and supervision were provided to local fishermen's groups in east Lombok to introduce juvenile grow-out in sea pens. In 2019, through the Prioritas Nasional project, 1000 juveniles of *H. scabra* (5–10 g) and numerous pieces of equipment – including a net with a mesh size of 3 mm, bamboo poles, pegs and snorkel masks – were distributed to three fishermen's groups –Optimis, Segare Lauk and Maju Bersama – to support the grow-out of juveniles in the sea.

Group Optimis is in Mandar, Seruni Mumbul in east Lombok. This group set up two small cages (5 x 5 x 2.4 m each) to grow juveniles with an initial weight of 10 g until they reached 50 g, and then transferred them to a larger cage (20 x 30 x 2.4 m) until they reached a harvestable size (Fig. 4).

The muddy sand substrate, surrounded by mangroves – the natural habitat of *H. scabra* – is characteristic of Seruni Mumbul. The primary constraints identified by the fisher group were predators. To address this issue, they added mesh extensions at the bottom of the cages to keep out crabs, and installed nylon nets on the top to keep out birds.

Group Segare Lauk is in Ujung Betok in east Lombok. This group installed a small cage (5 x 5 x 2.4 m) to maintain juveniles weighing 10–50 g before transferring them to a larger cage (20 x 30 x 2.4 m) until they reached commercial size (Fig. 5). During the rearing period, the group did not discover any problems. With characteristics such as a muddy-sand substrate, seagrass bed, mangroves, and calm coastal waters, the waters of Ujung Betok were suitable for the grow-out of juveniles.

In addition, Pelebe in east Lombok was where the group Tambak Maju Bersama was from. Like other groups, 1000 juveniles weighing 5–10 g were reared in small cages (5 x 5 x 2.4 m) before being transferred to large cages (20 x 30 x 2.4 m) until they reached a marketable size (Fig. 6). Conditions at Pelebe included calm water, a muddy-sand substrate, seagrass and macroalgae – an ideal habitat for rearing juveniles. However, juveniles were lost during the maintenance period, possibly due to predators.

The Sunsak Bareng Maju and Tarah Tarah Maju Sukses groups were in Sekaroh, east Lombok. These areas had

Figure 3. Bottom cages broken due to waves (above), and modified bottom cages (below) with the Pada Girang fisher group.
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Figure 4. Bottom cages of the Optimi fisher group (left) and muddy sand substrate as the natural habitat of the sea cucumber *Holothuria scabra* (right). ©Sigit AP Dwiono

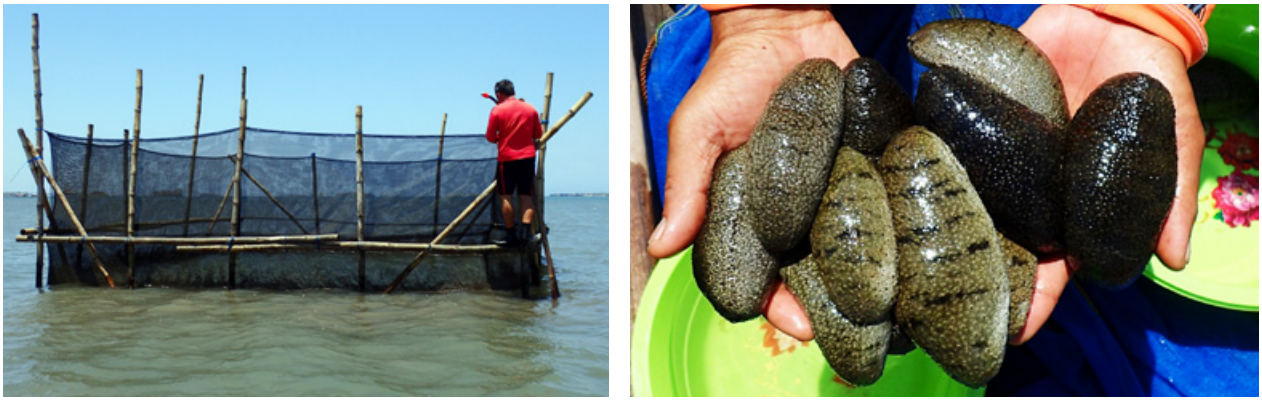

Figure 5. Bottom cage of the Segare Lauk group (left), and sea cucumber (*Holothuria scabra*) rearing in Ujung Betok (right). ©Sigit AP Dwiono

Figure 6. Bottom cage of the group Tambak Maju Bersama in Keruak, east Lombok. ©Sigit AP Dwiono

Figure 7. Bottom cages of the Sunsak Bareng Maju group in Sunut (left) and Tarah Tarah Maju Sukses group in Telone, east Lombok (right). ©Sigit AP Dwiono

particularly favourable habitat characteristics for *H. scabra* growth, including semi-closed bays, sluggish currents, a muddy-sand substrate, a variety of seagrasses and macroalgae species, and mangroves (Fig. 7).

Group Sunsak Bareng Maju distributed 5000 juveniles among five bottom cages, each 10 x 10 x 2.4 m. The problem was that the cages had been destroyed and needed to be rebuilt. Group Tarah Tarah Maju Sukses released 5000 juveniles in a bottom cage (30 x 30 x 2.4 m). To protect the juveniles from predators such as birds, the cage surface was covered with nylon mesh. Sea urchins (*Brissus* sp.) were discovered on the sea floor, a situation that could cause injuries to the skin of sea cucumbers. Mesh nets were installed on the bottom of the cage and then covered by sediment to overcome this circumstance.

Conclusions

Introducing sea cucumber commodities and educating coastal communities on how to maintain *Holothuria scabra* juveniles through training, workshops, and supervision is one strategy for empowering coastal communities. On this basis, it is envisaged that coastal communities will gain knowledge about proper farming techniques, which will allow them to earn supplemental revenue and increase their income.

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