Boosting the Responsible Stewardship of a Precious Fishery Resource: the blue swimming crab in Angkaol Village, Kep Province, Cambodia

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The ASEAN-SEAFDEC Conference on Sustainable Fisheries for Food Security Towards 2020 "Fish for the People 2020: Adaptation to a Changing Environment" in 2011 adopted the Resolution for SEAFDEC and ASEAN member countries to "*optimize the use of inshore waters through resources enhancement programs such as promoting the installation of artificial reefs and structures, encouraging coordinated and effective planning for coastal fisheries management programs, undertaking environmental impact assessment studies, restocking of commercially-important fish species, as appropriate, and give priority to human resources development for the implementation of such programs.*" In response therefore to such a provision, SEAFDEC/TD implemented in 2015-2019, the project "Promotion of Sustainable Fisheries Resources Enhancement Measures in Critical Habitats/Fishing Grounds in Southeast Asia" with funding support from the Japanese Trust Fund. The Project was aimed at gathering information for development of fisheries resources enhancement and habitat conservation measures in Southeast Asia; developing the capacity of human resources to implement the fisheries resources enhancement and habitat conservation measures; and promoting fisheries resources enhancement and habitat conservation measures suitable for respective countries in Southeast Asia. One of the major thrusts of the Project was to provide technical assistance and capacity building to target stakeholders on the rehabilitation of economically-important fishery resources as well as their habitats and fishing grounds. In this connection, one pilot activity carried out under the Project focused on the re-investigation of the management of the blue swimming crab resource in Angkaol Village in Kep Province of Cambodia, considering that more than 75 % of the local fishers in this Village depend mainly on blue swimming crab fisheries for their livelihood. This article describes the attempts made by SEAFDEC to assist the fishers of Angkaol Village not only in conserving their crab fishery resources but also in enhancing their capacity to sustainably manage such resources based on the EAFM concept.

Fisheries in Angkaol Village

Located in Damnak Chang'aeur District in Kep Province, Cambodia, Angkaol Village (**Figure 1**) has 189 fishers who are registered in the Angkaol Community Fisheries (CFi) in 2017, comprising 133 collapsible crab trap fishers, 16 crab gill netters, 34 fish gill netters, and 6 squid jiggers. Being a beach area, the Village also serves as a landing place for fishers upon returning from their fishing operations in the sea (**Figure 2**).

Figure 1. Location map of Angkaol Village in Kep Province, Cambodia *(Source: Google maps)*

Figure 2. Location of the pilot project site in Angkaol Village, Kep Province of Cambodia

In July 2018, a team from SEAFDEC/TD conducted the baseline fisheries survey in the Angkaol Village to gather the demographic information from the fishing households, and also on the gender's roles in fisheries and relevant data on blue swimming crab fisheries. From the total number of fishers in the Village, 60 fishers (11.7 % female and 88.3 % male) were engaged as respondents for the survey. The average age of the respondents was 35 years old and their ages ranged from 20 to 60 years old. In terms of educational level, 33.3 % did not attend school, 50.0 % finished elementary school, 15.0 % finished junior high school, and 1.7 % had finished their bachelor's degrees.

The major occupation of the village household is fishing followed by agriculture. Each household has on the average five family members, and earns an average monthly income of

around 357 US$, of which their average monthly expenditures could amount to about 143US$.

Gender roles in the fisheries of Angkaol Village

The reproductive and productive roles of women, men, girls, and boys were also investigated during the baseline survey in Angkaol Village, the results of which are shown in **Figure 3**. Reproductive roles encompass not only child bearing and child rearing responsibilities, but also include doing domestic tasks and household chores. On the other hand, productive roles are the activities carried out by women and men in order to produce goods and services either for sale, exchange, or to meet the subsistent needs of their families.

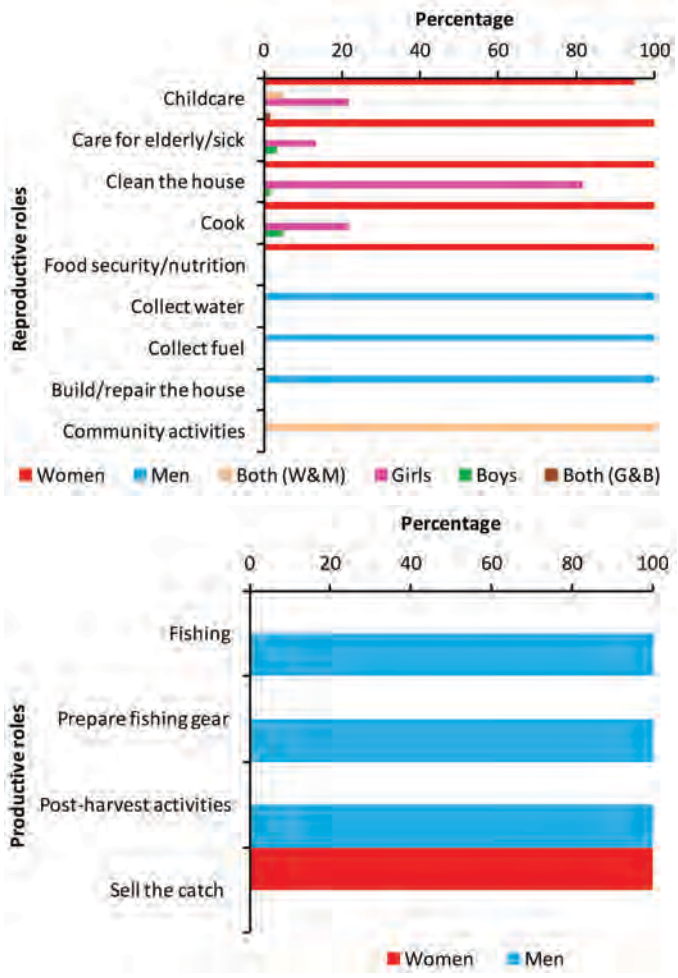

Figure 3. Reproductive *(top)* and productive *(bottom)* roles of women and men in Angkaol Village, Kep Province, Cambodia

For the reproductive roles, women, girls, and boys work for the household daily chores that include childcare, care for the elderly and the sick family members, cooking, cleaning, and maintaining food security and nutrition (*e.g.* home gardening, livestock raising, gathering shells and bivalves). While men usually do the heavy jobs such as water collection, fuel collection or energy production, and building/repairing the family's house. Even though a few women and men care for children together, both women and men participate in community events such as weddings and funerals, among others.

For productive roles, only men are involved in fishing at sea, fishing gear preparation, and post-harvest activities (remove blue swimming crab from the net at sea), while women peel and/or sell the fishers' catch of blue swimming crab. Looking at the gender roles using the gender lens in Angkaol Village, women focused on household chores while men were mainly engaged in fishing activities. Women did not recognize themselves as fishers and were not confident to provide the real information with respect to their fisheries-related activities. However, the Project considered it necessary to also record the productive roles of women in the fishing communities so that the women would also be given the chance to participate in the capacity building activities which is one of the Project's thrusts. Thus, the Project Team made sure that certain existing barriers were eliminated during the survey and the meaningful participation of women in fisheries is recognized as such role also contributes to food security and poverty reduction in the fishing communities.

Blue swimming crab fisheries in Angkaol Village

In Angkaol Village, the main aquatic species caught by fishers the whole year, is the blue swimming crab (*Portunus pelagicus*) using collapsible crab traps and crab gill nets (**Figure 4**). This makes the blue swimming crab the most economically important fishery resource of the Village. To catch the blue swimming crab, fishers use fishing boats that are made of wood with an average length of 11.0 m and equipped with out-board engines (**Figure 5**).

Figure 4. Crab traps and crab gill nets for catching the blue swimming crab

Figure 5. Typical gill net fishing boat in Angkaol Village used for catching the blue swimming crab

Figure 6. Elongated collapsible crab trap considered illegal fishing gear in Angkaol Village because it catches all sizes of crabs

Table 1. Blue swimming crab fishery in Angkaol Village, Kep Province, Cambodia

	Crab trap	Crab gill net
No (traps) or length (m) of fishing gear	200-5,000 traps	250-2,500 m
Average no. or length (m) of fishing gear	1,500 traps	1,500 m
Fishing season (months)	January-December	January-December
No. of fishing days per month	10-27	15-25
No. of fishing hours per day	6-14	8-10
No. of hauls per fishing trip	1-2	1-2
Ave. catch (kg) per fishing trip	16	16
Average cost (US$) per fishing trip	27.5	28.0

The specific fishing grounds for the blue swimming crab in Angkaol Village are located around Pou Island, Rabbit Island, and Ach Ses Island, where fishing is done all year round with the use of collapsible crab traps (by 85 % of fishers) and crab gill nets (by 25 % of fishers). The average catch of the blue swimming crab per trip from both fishing gear is 16.0 kg at an average fishing cost of USD 27.5 (**Table 1**).

Issues and constraints

Although a quarter of the respondents did not mention any problems related to their fishing activities, the majority indicated that they experienced several issues and constraints including severe weather conditions (*e.g.* heavy rains, storms), lost fishing gear (stolen), destroyed fishing gear by trawls, and low amount of catch. In this regard, suggestions were made during the series of village consultations, for the sustainable management of blue swimming crab fisheries in Angkaol Village, which necessitated action through the implementation of the Project (**Box 1**) by SEAFDEC/TD.

Interventions of the Project for the sustainability of blue swimming crab resources in Angkaol Village

During 2017-2019, the Project through SEAFDEC/TD in collaboration with the Fisheries Administration (FiA) of Cambodia, provided technical assistance and supported the capacity building activities for the Angkaol CFi, particularly to revive the operation of its crab bank system as means of improving the livelihood of fishers and enhancing the blue swimming crab resources. This was a response to the request made by FiA Cambodia for SEAFDEC to assist the Angkaol CFi in reviving its crab bank operations (SEAFDEC, 2020).

Thus, the Project Team from SEAFDEC/TD organized series of meetings with FiA officers and the Community Fisheries (CFi) members in 2017, to discuss the ways and means of reviving the crab bank system in Angkaol Village (**Figure 7**). The Village used to operate a crab bank in 2015 but this activity did not succeed due to poor management and lack of commitment among the members of the crab bank group. Upon agreeing that the members of the CFi would voluntarily

Box 1. Towards the sustainable management of blue swimming crab fisheries in Angkaol Village

- Establishment of zoning areas for small- and large-scale fishing gears (collapsible crab trap, crab gill net, trawlers)
- Elimination of illegal fishing gears such as the elongated collapsible crab trap as it catches all sizes (**Figure 6**)
- Conduct of more frequent patrol activities, especially at night to monitor illegal fishing activities
- Preservation of habitat areas, *e.g.* sea grass beds
- Establishment of protected areas for blue swimming crabs
- Revival of crab banking

Figure 7. Meeting among Project Team from SEAFDEC/TD, FiA officers, and CFi members agreed on the revival of the crab bank system in Angkaol Village

Box 2. Agreed scheme for reviving crab bank system at Angkaol Village

- Each CFi member would provide gravid crabs (at least one (1) or two (2) per month) to Mr. Meas Va, former leader of the crab bank group, who volunteered to take care of the crab bank during the initial stage
- Transparency in the management of the crab bank should be maintained by recording the persons donating the gravid crabs and the number of crabs received, for the information of anyone who wants to check the status of the crab bank at any time
- After the eggs are released and the spent crab spawners are sold, the money from the sale should be properly recorded indicating how much money was earned and how much money was spent for the crab bank management
- Traders would be encouraged to participate in the crab bank by donating the gravid female crabs that they have in their possession

donate gravid female crabs in the crab bank until the eggs are hatched and the zoea crabs released to the sea grass beds at the Angkaol CFi conservation zone, the meeting came up with a management scheme (SEAFDEC, 2020) for its revived crab bank system (**Box 2**).

Crab bank is an activity aimed at enhancing the stocks of crabs by keeping the gravid crabs alive in cages installed at sea or in tank at shore with oxygen until the spawners release their eggs. After spawning, the spent crabs are sold for consumption or for processing while the zoea crabs are released to the sea (DOF, 2011). Realizing the potential that crab banks offer to enhance the blue swimming crab resources, the FiA first began to promote the crab bank system in Cambodia in 2007. Since then, crab banks have been established in several CFis with support from international organizations (Sopanha, *et al*., 2012; RFLP, 2013), although the crab bank at Angkaol Village did not progress due to management constraints.

Revival of crab bank system in Angkaol Village

Through the Project, a crab bank structure that includes a hatchery and net cage for the gravid spawners (**Box 3**) was constructed in November 2018, in a sea grass area located close to the fish landing site and at a water depth of approximately 1.0 m during low-tide (**Figure 8**). Electricity is supplied through a solar cell panel and also from a household electric supply when there is not enough power from the solar cell. In the revived crab bank structure in Angkaol Village, the gravid crabs are separated based on the color of eggs that indicates the development stage of crab eggs.

Since then, gravid female crabs have been donated by members of the Angkaol CFi in the crab bank. All donations are reported on the whiteboard, while the monthly record indicating the fisher's name and number of gravid crabs donated, is updated regularly and kept by the CFi Leader in a logbook.

Figure 8. Crab bank structure in Angkaol Village *(left)*, comprising a hatchery *(upper-below)* and net cage *(lower-below)*

Box 3. The crab bank structure in Angkaol Village comprises a hatchery and net cage for stocking of gravid crab spawners

1. Hatchery comprises 10 aerated plastic tanks, are used for stocking gravid crabs with grey and black eggs (**Figure 9**) at a stocking rate of one gravid crab per tank. These gravid crabs usually take one or three days to release their eggs, thus, saving on electricity (DOF, 2011). Powered by an electric supply, the tanks are aerated to keep the gravid crabs alive while waiting for the eggs to be released and subsequently hatched then released to the sea.
2. The net cage installed below the hatchery is two-thirds submerged in the water, and is meant for gravid crabs with yellow-orange and brown eggs (**Figure 9**). These gravid crabs usually take more than three days to release the eggs (DOF, 2011), and once the eggs are hatched these could be dispersed naturally to the sea. Upon seeing that the gravid crabs in the cage were eaten from outside the cage by predators (*e.g.* "old woman" octopus *Cistopus indicus* Férussac & d'Orbigny, 1835), the fishers agreed to put the gravid crabs in covered plastic baskets (**Figure 10**) and placed in the net cage.

Figure 9. Gravid female blue swimming crabs with grey eggs *(above)* and orange eggs *(below)* for hatching at the crab bank in Angkaol Village

Figure 10. Covered plastic baskets for stocking of gravid crabs and placed inside the net cage to prevent predation mainly by octopus

Shown in **Figure 11** is the list of seven fishers who donated in February 2019 and 13 fishers in May 2019, indicating increased interest and strengthened the cooperation among the fishers in Angkaol Village in sustaining the crab bank. This has improved the management of the crab bank system which the CFi members agreed to sustain to enhance the crab resources in their Village.

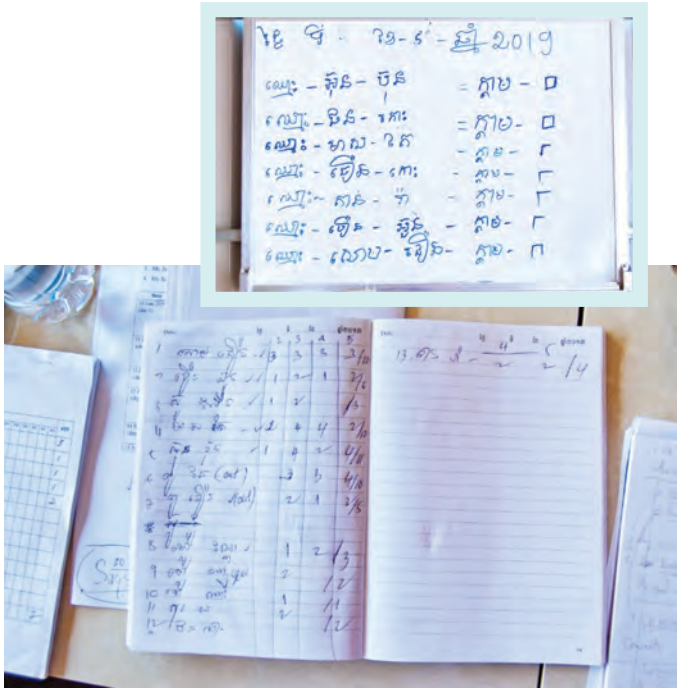

Figure 11. Report of daily donations of gravid crabs indicating the fisher's name and the number of gravid crabs donated on whiteboard *(inset)* and monthly recording of gravid crab donations in logbook for transparency of the management of the crab bank system in Angkaol Village

The members of the Angkaol CFi in one of their meetings established their own regulations (**Box 4**) for the successful operation of the crab bank. Moreover, the Angkaol CFi also promotes the conservation of blue swimming crabs by enforcing the regulation that prohibits the catching, selling, and buying of undersized crabs or more than 20 pieces/kg.

Box 4. Regulations for the successful operation of the crab bank at Angkaol Village

- Zoea stage of crabs should be released to the Angkaol CFi conservation zone
- All records of the crab bank should be transparent including:
  - names of fishers and number gravid female crab donated
  - income from selling spawned crabs
  - expenditures
- Income from selling spawned crabs should be allocated to the following:
  - 10 % for savings of the crab bank
  - 20 % for crab bank committee
  - 70 % for operation costs (revolving money) of the crab bank
- Funds should be spent only for the development and management of the crab bank
- Revenues received from other sources should be kept in the crab bank account
- Promote the conservation of blue swimming crabs and prohibit the catching, selling, and buying of undersized crabs which are more than 20 pieces/kg

Raising awareness on the conservation and management of fishery resources

To make the Project activities known to the whole Village as well as its surrounding areas, and to enhance the awareness of fishers and other stakeholders on the need to conserve and sustainably manage the fishery resources, signboards indicating the conservation and management activities were put up in strategic areas in the Village. The signboards that contain the information on the conservation zone as well as that of the crab bank system, were so designed that it would be easy for the stakeholders to notice and the information

Box 5. Signboards with the information on conservation zone and crab bank system

- **Signboard for conservation area (Figure 12)**
  - Any fishing activities are prohibited in the conservation area of the CFi
  - Prohibited fishing includes the use of modern fishing gear, new fishing gear, new fishing method or other fishing gear which are not listed in the Regulation issued by MAFF and destructive fishing practices which may affect to fishery resources or fisheries ecology system
  - It is prohibited to catch, buy, sell, stock, transport the small or eggs of fish and aquatic animals
  - It is prohibited to catch, buy, sell the blue swimming gravid crabs
  - It is prohibited to fish or do any activities that affect the sea grass beds and coral reefs
- **Signboard for crab bank system (Figure 13)**
  - Please donate gravid crab
  - We need your cooperation: No catch, No sell, No buy under sized crabs (>20 pieces/kg)

Figure 12. Signboard for the conservation area

Figure 13. Signboard for the crab bank system

are written in the Khmer language (**Box 5**). The signboard for the conservation area bears the name: Angkaol Fisheries Community Conservation Area, includes the list of regulations on fishing in Angkaol CFi (ref: Agreement of Angkaol Fisheries Community, 2012), and also the motto: "Conserve Marine Resources for the Prosperous Future." On the other hand, the signboard for the crab bank dubbed as Enhancement of the Sustainable Management of the Blue Swimming Crab Fisheries in Angkaol Community Fisheries, Angkaol Village, Angkaol Commune, Domnak Chang Eur District, Kep Pprovince, includes the Key Message: "together donate one gravid crab, increase by the thousands the crabs in the sea."

Capacity building for relevant stakeholders in Angkaol Village

The Angkaol CFi has established a conservation area that covers an area of approximately 100 ha (1.0 km^2) which had been declared by the local government authorities as a protected area for fishery habitat restoration of fisheries resources including the blue swimming crabs, sea grass beds and others. All fishing activities are prohibited in the conservation area. Angkaol CFi had installed buoys to demarcate the conservation area and make it easily identifiable from a distance.

Installation of buoys for the conservation area

The Project also provided technical support by training the members of the Angkaol CFi on the fabrication of the buoys (**Figure 14**), as well as the materials used for the 12

Figure 14. *Clockwise from top left:* Angkaol CFi conservation area (green area), training to construct buoys, installation of buoys to the conservation area, and buoy installed in Angkaol CFi conservation area in Kep Province, Cambodia

conservation buoys made of 100 liters capacity plastic drums filled with mixed cement and painted in white so that these could be easily seen from the sea. The buoys were fixed in the sea by sinkers made of 35×40×30 cm cement blocks that approximately weigh about 100 kg/block.

Study trip to Thailand

A study trip to Thailand was organized by the Project on 6-12 October 2019 for three FiA officers, two Fisheries Administration Cantonment (FiAC) in Kep Province, and two CFi members. The participants of the study trip visited five fishing villages in Thailand, namely: 1) Tong Tom Yai Village in Chumphon Province, 2) Phru Jood Village in Trang Province, 3) Lampho Community in Chai Ya District, Surat Thani Province, 4) Pak Nam Pran Village in Prachuap Khiri Khan Province, and 5) Lam Phak Bia Crab Bank Group in Phetchaburi Province. The purpose of the study trip (**Figure 15**) was to enhance the knowledge of the Angkaol CFi members on the management measures for the conservation of the blue swimming crab resource as well as exchange views and experiences with the fishers' groups in Thailand on the sustainability of the crab bank system.

Figure 15. Representatives from Angkaol Village on study trip to Thailand organized by the Project to learn on resource management of blue swimming crab and crab bank system

Through this study trip, the fishers from Angkaol Village were able to directly obtain information on the measures for blue swimming crab conservation and management system in Thailand. Such management measures would be taken-up and applied in Kep Province for the sustainable utilization of the blue swimming crab resources in the future. The fishers also learned that the Crab Bank System in Thailand serves not only as crab resource enhancement but also as means of generating alternative job for the fishing communities. The results of the study trip had confirmed that the fisheries of blue swimming crab is important for the livelihood of villagers at Kep Province especially in Angkaol Village because it is the main livelihood that can provide an income US$ 357 per month.

Conclusion and Recommendations

Members of the crab bank group in Angkaol Village have the obligation to voluntarily provide gravid blue swimming crabs. In case there would be sufficient numbers of gravid blue swimming crabs donated, these could be sold and the proceeds should be fully accounted following the regulations shown in **Box 6**.

Finally, the lessons that had been learned from the implementation of the activity at Angkaol Village in Kep Province, Cambodia are shown in **Box 7**.

Box 6. Financial regulations for the crab bank system

- Budget management should adopt the proper accounting procedures
- Revenues received from other sources must be kept in a crab bank account
- Every expenditures and relevant transactions must have invoices and properly accounted for
- Funds should be disbursed only for the purpose of management, conservation, and development of the crab bank
- Crab bank committee shall receive 20 % of the proceeds from the sale of the crabs
- 10 % of the proceeds from sale of the crabs should be saved
- Operation cost for crab bank should be 70 % of the proceeds from the sale of the crabs

Box 7. Lessons learned from the implementation of the activity to revive the crab bank system in Angkaol Village

- Collection of qualitative and quantitative data, such as those on the biology of particular fishery resource in focus and the socioeconomics of concerned communities, is important throughout the implementation of any fishery resources enhancement effort, as precautionary approach to protect and conserve the resources, while the information collected would serve as baseline data for planning any project activity, and as indicators for monitoring and evaluation of the activity.
- Sustainability of the project activity is essential to prove the success of any fishery resources enhancement efforts, therefore it is necessary to engage the villagers in the planning and implementation of any activity, as partnership is very important to ensure that the project activities could be sustained.
- It is necessary to minimize the impact of any activity on the fishery resources while maintaining the livelihoods of fishers, which should be the goal of any fishery resources enhancement and management efforts. Hence strengthening the capacities and awareness of local officers, fishers, villagers (women and men, elderly, and youth) should be part and parcel of any resources enhancement efforts, as their participation and willingness to be engaged with the fishery resources enhancement and management efforts would boost the sustainability of the efforts.

Way Forward

The achievements of the Project would support the Policy Recommendations and Strategic Plan of Action for the Implementation of Fisheries Resources Enhancement Activities in the Southeast Asia Region, which were adopted by the ASEAN Member States in 2015.

References

Sopanha, C., Kiman, M., Chansothea , T., & Joffre, O. (2012). Crab Fisheries in Cambodia and the Development of Crab Banks. WorldFish. Cambodia. 31 p. *https://hdl.handle.net/20.500.12348/1001*

Department of Fisheries. (2011). Manual of Crab Bank. Upper Gulf Fisheries Research and Development Center, Department of Fisheries. Samut Prakan, Thailand. 32p

Cambodia Investment. (2014). Municipality and Province Investment Information. Kep Province. Retrieved from *http://www.cambodiainvestment.gov.kh/wp-content/uploads/2014/03/Kep-Province_eng.pdf*

RFLP. (2013). Using crab banks to enhance resource management and livelihoods in Cambodian coastal communities. Regional Fisheries Livelihoods Programme for South and Southeast Asia. Retrieved from *http://www.fao.org/3/a-ar462e.pdf*

SEAFDEC. (2020). Report of the Regional Workshop on Fisheries Resources Enhancement and Habitat Conservation Measures in Southeast Asia.

SEAFDEC. (2020a). Report of Enhancement of Sustainable Management of the Blue Swimming Crab Fisheries in Kep Province, Cambodia

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