

Mud Crab Post-Harvest Fattening and Handling Manual

This manual was supported by grants from the Kerrest Johnson Family Charitable Fund and Blue Action Fund.

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Cover photographs (left to right): Mud crabs above minimum size, caught from the wild and ready to be sold. Completed mud crab pens in Tavea. Debris breaker in Bua Lomanikoro and Tiliva. Photographs: Unless stated otherwise, all photographs were taken by Ana Ciriyawa/WCS Layout and design: Kate Hodge

Citation: WCS (2021) Mud crab post-harvest fattening and handling manual. Wildlife Conservation Society. Suva, Fiji. 36 pp.

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Acknowledgements

We thank Karl Banamu, Trevor Boslogo and the WCS Papua New Guinea team for allowing the use of their materials in the production of this manual. We also thank Apenisa Maracava and Butch Juanga from The Crab Company (Fiji) Ltd for providing guidance on the content of this manual.

Contents

Introduction	4
Locating your mud crab farm	6
Designing your mud crab pen	9
Building the walkway	10
Building the mud crab pens	12
Installing the pens	16
Debris breaker	20
Crab stocking and handling	21
Packing and tying of crabs	31
Monitoring the success of your business	33

Introduction

Mud crabs¹, known locally as *qari dina* (Figure 1), are found in mangrove forests, seagrass beds and estuaries in Fiji. They are an important domestic fishery, harvested largely by women for food and to provide a source of household income.

Mud crabs have been marketed for decades for their high value. While prices can change, the selling price for mud crabs in the Suva market range from $20 - 25^2$ for medium-sized crabs, and large-sized crabs are sold at 30 - 40 each. A string of crabs vary in price from 65 - 140 depending on the size and number of crabs. Women fishers sell their mud crabs at the local markets, seafood retail shops, hotels, restaurants or by the roadside. The price of a crab depends on its size, weight, whether it is alive or dead and if it has all its claws intact. Local customers prefer to buy crabs live, and some prefer male while others prefer female crabs (Figure 2).

Mud crab fishers use different harvesting methods (e.g. hand, hook, scoop net, spear) and go on frequent fishing trips to cater for the increasing demand of this lucrative commodity. This can add pressure on the fishery and can easily lead to the overharvesting of mud crabs if unmanaged. To ensure that their habitats are protected and are not overfished, communities should have management rules or plans in place to ensure the long-term health of their mud crab fishery.

Purpose of manual

This manual has been developed to help guide and train mud crab fishers on the sustainable harvesting and post-harvest fattening and handling of their crabs to ensure a stable supply of mud crabs from the wild and help increase household income.

Mud crabs of legal size can be fattened in mud crab farms that are located in mangrove areas. The goal is for mud crabs to gain weight so they can be sold at a higher price to traders or at markets where consumers purchase crabs based on weight.

¹ Information on mud crab biology can be found in SPC factsheet: Information sheets for communities - Mangrove crab (*Scylla serrata*). Source: <u>https://coastfish.spc.int/home-pages/393-guide-and-information-sheets-for-fishing-communities</u>

² All prices are indicated in Fijian Dollars.



Figure 1: Parts of a mud crab.



Figure 2: Differentiating male and female mud crabs by checking abdominal flaps on the underside.

Locating your mud crab farm

Before deciding on the location of your mud crab farm, consider the following points:

- Select an area of the mangrove that is sheltered from strong winds and waves (Figure 3).
- Choose an area that is safe, secure and can be easily monitored to reduce the risk of theft (Figure 4).
- Make sure there is no pollution in the area, including runoff of fertilisers and pesticides from local farms or gardens (Figure 5).
- Keep the pens away from sources of freshwater or major runoff areas (Figure 5).
- Place pens where they can be partially submerged at low tide, and have good fresh seawater flow (Figure 6).
- Ensure the mud is deep enough for pen insertion and installation (Figure 6).





Figure 4: Locate the mud crab pens close to community village so they can be easily accessed, and will help deter residents from other communities who may wish to take some of the crabs.



Figure 5: Do not locate the crab pens close to areas where gardening takes place. Chemicals used on the plant crops, such as pesticides and fertilisers, may enter the water close to the pen and poison the crabs.



Figure 6: Positing your mud crab pen.

When locating your mud crab farm, make sure the pens are positioned in a location where they will be partially underwater during low tide. The pens can be partially exposed during low tide but there must be some form of seawater movement around the pens during high tide. Do not position the mud crab pens in areas of stagnant water. This is important as the crabs extract oxygen from fresh seawater through their gills.



Designing your mud crab pen

There are many ways to design crab pens for fattening. Taking into account crab behaviour, anatomy and the availability of resources for the communities, the following design is found to be most suitable in rural areas (Figure 7). The crab pen will have a length of 200 centimetres, width of 40 centimetres and depth of 80 centimetres. The pen length will then be divided into 5 sections, with each compartment measuring 40 by 40 centimetres. Half of the depth of the pen will be submerged into the mud leaving only 40 centimetres on the surface. The pen will have a lid to prevent the crabs from escaping.



Figure 7: Mud crab pen design.

Bamboo is the preferred material for building pens and walkways as it grows abundantly along riverbanks making it a good local resource easily available to villagers. Mature bamboo stems are strong and durable when properly dried prior to use.



Building the walkway

Tools

- Bush knife
- Hammer
- Handsaw
- Measuring tape

Materials

- Bamboo (according to the length of the walkway)
- Mangrove cross piece (to place across 2 bamboo/wooden posts for walkway)
- 3" nails (7.6 cm)
 4" nails (10.2 cm)
- 4. Rope (3 mm diameter)

Note: A walkway of approximately 10 metres will take roughly 2 hours to construct by 2 persons. Additional help will lessen the effort and time.

The walkway (Figure 8) should be installed first, before the mud crab fattening pens are installed. It is constructed from long bamboo and the amount needed will depend on the site and the number of crab pens to be installed. The bamboo must be long enough to be inserted into the mud to provide a firm hold for the rest of the long bamboo that will be used to form the walkway. The walkway makes it much easier to access the crab pens, without having to step into the mud and get wet. It also helps avoid injuries from debris during high tide or flooding. The walkway can be extended as the number of pens increases. **Clearing or cutting any mangroves to build the walkway and pens is strongly discouraged as this is an important habitat for mud crabs, and will only harm your fishery in the long-term.**





Figure 8: Planning the layout of the farm includes positioning of pens and walkway to ensure easy access.

Building the mud crab pens

Tools

- Bush knife
- Hammer
- Handsaw
- Measuring tape

Materials

- Bamboo (200 cm, 40 cm and 80 cm pieces) – allow 5 extra cm
- 2" nails (5.1 cm)
 3" nails (7.6 cm)
- Raffia
- Rope (3 mm diameter)

Note: Each pen of 5 compartments will take roughly 1 - 2 hours if made by 1 person. Additional help will lessen effort and time.

Instructions

- 1. Use a handsaw to neatly cut the bamboo into lengths of 200 centimetres (A), 80 centimetres (B) and 40 centimetres (C).
- 2. Slice the cut bamboo parts into strips of 5 centimetres width. (Drawings are not to scale)



3. To make the long wall, line 2 strips of **A** parallel to each other approximately 40 centimetres apart.

4. Place strips of **B** perpendicular to the 2 strips of **A** with a minimum space of 3 millimetres for seawater to flow in and out. Depending on bamboo thickness, use 2" or 3" nails to nail the strips together. Construct 2 of these walls.







5. To make the short wall, line 2 strips of **C** parallel to each other approximately 40 centimetres apart.



- 6. Place strips of **B** perpendicular to the 2 strips of **C** with a minimum space of 3 millimetres for seawater to flow in and out. Depending on bamboo thickness, use 2" or 3" nails to nail the strips together. Construct 6 of these short walls.
- 7. To build the pen lid, line 6 strips of **C** parallel to each other approximately 40 centimetres apart.
- 8. Place 4 to 5 strips of **A** perpendicular to the strips of **C** with a minimum space of 3 millimetres for light to pass through. Depending on bamboo thickness, use 2" or 3" nails to nail the strips together.



9. Secure the bamboo walls using double half-hitch knots as shown below. If the bamboo used is thick and does not crack when nailed together, this step is not necessary.



Installing the pens

The fattening pens should be installed during low tide or outgoing tide. Since a larger surface area of mud is exposed at low tide, it is easier to choose the ideal spot for the pens to be installed. The pens are then lined up along both sides of the walkway (Step 1). To make it easier for the pen parts to be inserted into the selected sites, use a spade to dig into the mud and remove any debris. One by one, the pen parts are installed until a complete pen Note: Installing the pens will take 2 – 3 hours. However, this is highly dependent on the number of people present to help in the installation.

is finished (Steps 2 and 3). To secure the pen unit, tie each wall panel to the adjacent panels at the corners with rope, using double half-hitch knots.

Steps

1. Install 1 long wall with strips **A** facing outwards near the walkway, if there is a walkway.





2. Install the 6 short walls perpendicular to the long wall, ensuring that the distance is approximately 40 centimetres apart from each other.





Mud Crab Post-Harvest Fattening and Handling Manual

3. Insert the second long wall with strip **A** facing outwards, to form the pen. Secure pen unit at the corners where the walls meet using double half-hitch knots.





Mud Crab Post-Harvest Fattening and Handling Manual

4. Place the lid on top of the pen and, using rope, tie one side of the cover to one of the long walls of the pen, preferably the wall away from the walkway to allow for easy access.



Debris breaker

Floods are common, particularly after heavy rain, and debris can be carried down rivers causing damage to crab pens. A *debris breaker* (Figure 9) installed along the site will protect the pens from logs, trees and other debris flowing down the river during floods. A debris breaker could be constructed from leftover bamboo, timber or logs and inserted into mud by the pens in the river.





Figure 9: A debris breaker.

Crab stocking and handling

Legal size limit

The Fiji Fisheries Act (Cap 158) states that **mud crabs cannot be harvested until their carapaces are over 12.5 centimetres wide**, and so it is illegal to harvest undersized crabs (Figure 10). This size limit is important to follow because mud crabs less than 12.5 centimetres are still young, and have not had a chance to reproduce. Only those above 12.5 centimetres are considered mature adults that can reproduce, and contribute to the next generation of mud crabs. This is why no mud crabs in your pens should have carapaces that are less than 12.5 centimetres wide.



Figure 10: Legal (left) and illegal (right) size of mud crabs that can be caught from the wild.

Measuring mud crabs

It is important to measure the mud crabs before they are collected from the wild and placed into the pens. To measure the crabs, place a ruler or measuring tape across the widest part of the carapace (Figure 11).



Figure 11: How to properly measure a mud crab.

Once it has been determined that the crab caught is larger than 12.5 centimetres, it can be brought back to be placed in the pen.

Follow the steps of acclimating and weighing before placing a crab into the pen.

Please note that crabs must be tied (Figure 19) while attending to these steps to avoid getting pinched.

Getting crabs used to freshwater

Where possible, collected crabs should be stocked in the same environment they were found originally. However, if you are collecting crabs from saltwater environments and moving them near rivers, they will need to be *acclimated* so the crabs get used to the freshwater that may come down the river. To help the crabs get used to their new environment, fill 1 basin with water from the crab farm site, and fill a second basin with water from the original habitat where crabs were collected. The crab is then put into the basin filled with water from its original habitat. After every 15 minutes, pour a cup of water from the crab fattening site into the first basin (Figure 12). Do this for 1 - 2 hours until the water is almost the same as the water from its new home. It is recommended that the crab catchers do this during high tide when it is easy to get water. Acclimation will reduce stress or shock to the crab and lower the cases of mortality.



Figure 12: Helping the crab get used to its new environment (acclimating).

Weighing

After acclimating the crabs and before stocking the crabs in the fattening pen, they first need to be individually weighed and their weight recorded (Figure 13). After that, the crabs are checked for *fat content* (meat) so all the crabs of the same weight are stocked in a graded system in pens. Use a scale to weigh the crabs and place them in their pens according to their weight. For example, all crabs between 400 - 500 grams that are 50% full of meat are kept in one row of pens, 500 - 600 grams in the next row of pens and so on. Once the crabs have been weighed, untie the crabs before placing them in the pens. Note that only one crab should be stocked in each compartment (1 crab: 1 compartment) to prevent them fighting and injuring themselves.



Figure 13: Weighing your mud crab.

To know how many times a crab needs to be weighed before sale, note down the target weight. Weigh the crab again after one week of feeding to determine how much weight the crab has gained in 7 days. Based on the weight gained in 1 week, the total number of weeks required for the mud crab to reach the target weight can be estimated. For example: A mud crab weighs 550 grams and the target weight is 800 grams. After a week of feeding, the crab has gained 50 grams and is now 600 grams. Therefore, it will take the crab approximately another 4 weeks of feeding to reach the target weight.

Initial Weight: Weight of newly caught crab from the wild	550 g
Target Weight: The weight at which the crab is to be sold	800 g
Week 1 Weight: Crab's weight after feeding it for 1 week	600 g
Calculate weight that was gained in 7 days (1 week) Week 1 weight – Initial weight = Weight Gained	600 g – 550 g = 50 g
Calculate weight that needs to be gained for sales Target weight – Initial weight = Weight Needed	800 g – 550 g = 250 g
Calculate total number of weeks needed to reach target weight Weight needed ÷ Weight gained = Total number of weeks to feed crabs	250 g ÷ 50 g = 5 weeks



Feeding mud crabs

Mud crabs are *scavengers* in mangrove environments and estuaries, meaning they will feed on a number of different food items they can find opportunistically. They feed on shellfish, fish matter, squids and shrimps. It is recommended to feed crabs fish scraps such as the fish guts from recent fish catches. These scraps should be chopped up nicely and freshly fed to the crabs. While mud crabs can eat plant matter, the animals will grow quicker with animal-based food items. Use kitchen waste and seafood scraps for feeding the crabs rather than catching juvenile fish in the wild, to avoid causing declines in fish populations.

Crabs are fed 6% of their *Average Body Weight* at each feeding session. For instance, if a crab is 1,000 grams by weight, they should be fed 60 grams of seafood scraps per feeding session. Crabs are fed twice in a day (24 hours) on every incoming tide, regardless of what time it is. They usually burrow into the mud when the tide goes down and when the tide comes up, they surface and scavenge for food. Crab feed should already be in their pens just as the tide comes up to ensure optimal feeding. Crab fishers are encouraged to consistently feed crabs kept in the fattening pen according to the tide.

Average crab weight x 0.06 = amount of crab food



1000 g (crab weight) x 0.06 = 60 g

60 g x 2 tides = 120 g

Crab food: 1st incoming tide = 60 g 2nd Incoming tide = 60 g

Figure 14: A balance scale showing weight of crab food required in relation to the crab's body weight.

Grading crabs (checking fat content)

Crabs should be checked for their *fat content* (meat) before stocking in pens, and before removing from pens for sale or consumption. A crab that has recently shed and replaced its shell (moulted) will be pale in colour. Male and female crabs are checked differently for their fat content. The crabs need to be monitored because some grow and fatten faster than others. This can be determined by doing a fat content check.

To check for fat content in a female crab, press the two points on the carapace as marked in Figure 15A. If it is flexible enough to move inward and make an audible sound when firmly pressed, the fat content is low in that crab and should be allowed to grow. For males, press the two points on the underside next to the abdominal flap as marked in Figure 15B. If it is flexible enough to move inward, that shows that fat content is low and the crab should be allowed to grow.



A. Female crab fat content check

Figure 15: Checking for fat content in mud crabs.



B. Male crab fat content check

As the fattening process progresses, hold mud crab claw in front of a light source, preferably at night. A light source can be a battery powered torch. Fat content will be indicated by the shaded regions. This means the less of the light you see, the higher the fat content.



If you see no distinction of the meat through the shell, or that light is unable to penetrate the shell, it means that the crab is now full of meat.

An empty crab will show a clear distinction of meat through the shells (light is able to penetrate through).

To maximise income earned, crabs should be harvested from their pens and sold when their shells are full as this increases the weight of the crabs. The crab pens can then be restocked.

Harvesting from crab pens

When the mud crabs have a carapace width greater than 14.5 centimetres, and a weight that is greater than 900 grams, the crabs can be harvested from the pens. You will need to have a few materials ready for use when harvesting.

These materials include:

- a stick;
- twine to tie the mud crabs;
- a scale to weigh your crabs; and
- > a basin filled with seawater for the mud crab to clean itself in.

Careful handling of crabs is important to avoid loss of claws or legs, which can reduce income earned.

Harvesting at low tide: Pick up the crab from the rear and lift from the pen with the claws facing away from your body, yet not too close to another person to avoid them getting pinched.

Harvesting at high tide: Small scooping baskets constructed from chicken wire or a hand-net used for catching prawns can be used to remove the crabs when the pen is filled with water.



A mud crab will be hiding in the corner of the pen at low tide with its claws outwards. A stick can be used to guide the fisher to the crab. Once the crab is located, press on the carapace with the stick. Use the stick to guide your hand to the top of the carapace, clutch crab from rear and lift from pen with the claws facing away from your body.

Figure 16: How to catch a crab from inside the pen at low tide.

After you harvest a larger crab, you can add a new crab that has a carapace width wider than 12.5 centimetres into the empty pen, so you always have a continuous supply of mud crabs for sale.

Remember, **avoid taking female crabs from the wild that are carrying eggs** (Figure 17). You must leave the female crabs carrying eggs so that the eggs are released, which will mean more crabs in the future.



Figure 17: Do not harvest female crabs carrying eggs.

Packing and tying of crabs

Buyers prefer crabs that are alive with all their limbs and claws intact, ideally with their eyes and claws moving.



Figure 18: A crab with all its limbs attached (left) and a crab with missing limbs (right).

Use twine or a strip of fibrous forest vine or raffia to carefully restrain the crab, with legs and claws held beside and under the body. The crabs should be submerged in a basin of seawater for 2 - 3 minutes before packing, to remove any debris.

During packing, the crabs are arranged into cartons or neatly woven coconut leaf baskets with the swimmerets down and face and claws facing upwards. After crabs are arranged in this order, mangrove leaves and wet cloth are used to cover the crabs to maintain moisture. If the trip takes longer to deliver for sales, seawater must be



sprinkled every 2 - 3 hours. Submerge crabs in a basin of fresh seawater for an hour and then cover them in wet cloth to retain moisture if the pickup or delivery is delayed for more than a day.



Step 1:

Start with the rope on the underside of the crab and pull both ends between the swimmerets and the third walking leg towards the carapace.



Step 2:

Flip the crab over and wind each end of the rope around each claw of the crab twice and pull towards the swimmerets under the 3 walking legs of the crab.



Step 3:

Pull rope above swimmerets and tie a knot firmly.

Figure 19: Tying crabs securely and safely.

Monitoring the success of your business

It is important to track how well your mud crab farm is doing, and if the fattening and proper handling of your crabs are generating increased income for you and your household.

Tracking

Record the following information in detail:

- How many crabs were collected from the wild, and their sizes?
- How many crabs died in the pen, and what were the likely causes of death?
- How long did crabs stay in the pen before they reached the required size and weight?
- How many crabs were sold in a month, and how much money was made each month from selling crabs?
- Note down if prices were different when crabs were sold at the market, compared to individual traders.
- Were there costs associated with the business (for example, bus fares, nails and materials to fix pens), and how much was spent on these?

Strategies to manage costs and increase income

- Ensure proper mud crab farm maintenance to avoid unnecessary expenses on repairs;
- Protect farm from damage with regular checks on farm surroundings;
- Increase the number of mud crab fattening pens;
- Reduce mud crab mortality through careful handling and consistent feeding of crabs;
- Increase mud crab yield through proper fattening process and harvesting procedures;
- Maintain regular restocking of pens when crabs are sold.

Indicator of success

Disciplined farming practices will ensure consistent production of mud crabs at a good size and weight. This will in turn result in customers who value the reliable delivery of good quality mud crabs.

Your customers require consistency in the quality and delivery of your product. When a restaurant sells mud crab on their menu, their patrons will expect the same quality every time. Good and standard farming practices will allow you deliver this consistency to your customers and keep them returning to you to supply them with good quality mud crabs.



Examples for keeping mud crab records

Mud crab fattening records

sefore sale	Fat content										
	Weight (g)										
Ξ	Length (cm)										
eek 3	Fat content										
	Weight (g)										
3	Length (cm)										
7	Fat content										
leek	Weight (g)										
3	Length (cm)										
1	Fat content										
leek	Weight (g)										
3	Length (cm)										
TARGET WEIGHT (g)		800	006	850	850	850	006	950	950	950	006
	Fat content	Т	Σ	Т	Σ	Т		Т	Σ	Т	_
	Weight (g)	400	530	430	425	440	580	605	677	550	430
	Length (cm)	13.5	14	13	13.7	14.2	15.2	16	17	15	13.5
	Gender	Σ	Σ	ш	Σ	Σ	Σ	ш	ш	Σ	Σ
At Capture	Pen	. 	. 	2	з	4	2	. 	2	с	£
	Row	A	۵	A	A	A	ш	ပ	ပ	۵	A
	Crab #	-	7	с	4	5	9	7	ω	ი	10
	Date	01/05/2021	01/05/2021	01/05/2021	02/05/2021	02/05/2021	02/05/2021	02/05/2021	02/05/2021	03/05/2021	04/05/2021

FAT CONTENT (MEAT): L=less than half; H=half; M=more than half; F=full; D=died

GENDER: M=male; F=female

Mud crab feeding records

Date	Time	Rows & Pens	Name
20/06/2021	4 a.m.	A1-5, B1-5, C1-5	Mere
20/06/2021	4.45 p.m.	A1-5, B1-5, C1-5	Vili
21/06/2021	4.15 a.m.	A1-5, B1-5, C1-5, D1-5	Mere
21/06/2021	5 p.m.	A1-5, B1-5, C1-5, D1-5	Vili

Mud crab sales and expenses records

Date	Description	Expenses	Income	Balance	Payment method	Remarks
03/06/2021	Sale: 3 x 900 g + 2 x 1100 g Crab #: 1, 3, 5, 7, 8		\$ 180.00	\$ 180.00	MyCash	Market
18/06/2021	Sale: 2 x 1000 g Crab #: 15, 24		\$ 80.00	\$ 260.00	Cash	Vendor
18/06/2021	Bus fare	\$ 4.00		\$ 256.00	Cash	
29/06/2021	Repair pens: B3, B4, B5	\$ 2.50		\$ 253.50	M-Paisa	
30/06/2021	Sale: 1 x 900 g + 3 x 1100 g Crab #: 2, 4, 9, 10		\$ 200.00	\$ 453.50	Cash	Market
30/06/2021	Bus fare	\$ 6.00		\$ 447.50	Cash	

PAYMENT METHOD: Cash; M-Paisa; MyCash

Founded in 1895, the Wildlife Conservation Society (WCS) saves wildlife and wild places worldwide through science, conservation action, education, and inspiring people to value nature by conducting wildlife research and conservation projects in more than 60 countries.

As part of the Melanesia Program, WCS Fiji Country Program (WCS Fiji) has supported land-sea planning and management across Fiji since 2001. WCS Fiji focuses on supporting community-based natural resources management and building of local capacity within the Vatu-i-Ra Seascape, covering four Provinces: Bua, Ra, Tailevu and Lomaiviti.



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