LIVELIHOOD LESSONS AND CONSIDERATION FOR PMMR IN KOH KONG, CMBODIA

BACKGROUND

Of the five component objectives for phase 1 of the PMMR project, livelihood options proved to be quite challenging. In retrospect, this makes sense, given how complicated rural livelihoods are and how there are no 'easy fix' solutions PMMR had undertaken some grouper and sea bass cage culture, which had not worked for various reasons', and were interested in further exploring ideas. One lesson the team had already learned was that Technical Experts and Advisors could give great sounding advice, that wouldn't necessarily work on the ground. For these reasons, the team welcomed the chance to have someone come down to Koh Kong, with significant field experience, to work with the team over several weeks.

Karen Vidler, an Australian mangrove and fisheries expert, had significant experience both in Australia and in the Philippines working with fishers and as an Advisor to various coastal projects. She was interested in coastal work in other parts of Asia, and volunteered to work with PMMR for several weeks. Having a young professional who could take the time to both facilitate classroom lessons and then carry out work in the field was exactly what PMMR needed.

OBJECTIVES

- to explore the idea of' livelihoods
- to explore potential livelihood options' for PKWS
- to draw upon lessons Karen has learned from the Philippines and Australia
- to consider which places in the Philippines would be useful for the PMMR team to do a local study tour.

LET THE LESSONS BEGIN

After time in the field and a discussion of PMMR, the team discussed four areas that they would like to learn more about:

1. Livelihood Options

- Review past experiences;
- Technical input into livelihood work

2. Mangrove nursery (field work)

3. Environmental Education (method/approaches used in Australia and the Philippines)

4. Habitat Assessment

- Mangroves
- Sea Grasses

Livelihood

Why is the there often a perceived lack of livelihood option for the rural poor in PKWS?

Causes

- Displaced populations
- Lack of knowledge to use and manage resources;
- Lower fish catches (population increase, mangrove cutting and environmental degradation)

Effects

- Low income

- Mobile population
- Illegal, destructive activities i.e. habitat destruction; leads to pressure for better management

Potential Livelihoods

1. Green Mussel culture **
2. Fish Cage (sea bass, grouper, and snapper)**
3. Crab culture (pond)*
4. Shrimp culture *
5. Fishing -sustainable methods***
6. Home gardening***
7. Home-base income generating activities***
8. Marketing with Community Cooperatives***
9. Eco-tourism*
10. Habitat protection***
11. Mangrove rehabilitation**
12. Health (water supply, sanitation/waste man't)** (other experiences)

*Low priority **

Medium priority **

High priority ***

Fishing Methods, and the Advantages of Sustainable Methods

Sustainable Fishing Methods	Unsustainable Fishing Methods
• hook and line • spear gun • fish traps • crab traps • gill nets-hand and large mesh size	many methods (dynamite fishing small nets, trawlers) destroy/degrade habitats (mangroves, sea grass, coral reef, water quality)i.e. in-shore trawling non-selective i.e. catch everything (esp. juveniles which affects breeding and spawning

Strengths and Weaknesses of Sustainable Fishing Practices	
Strengths	**Weaknesses**
• reduces habitat destruction • increases fish stocks • increases awareness through education • sustainable over long-term • fishers will have a long-term income source • if combined with enforcement very effect.	fishing gear is not as efficient lower short-term income difficult to change attitudes competing with middle-men who want them to use other gears

	expensive to switch gear may increase fishing pressures

How to Encourage Sustainable Fishing Practices:

a. Sustainable Fishing Fund

- Project Assistance
- Village chief supports (can provide old fishing gears. labor and some raw material)
- Provide some money to fishers and fishers will pay back during 6 months to 1 or 2 years, depending on the agreed time frame of the local committee

b. Education Program (project budget)

- Schools
- Village level
- Household level

c. Management Group

- Representative from Project/fund
- Village chief
- Fishers (men and women)
- Decision maker (who give assistance, how, what and why)

Alternative Marketing

1. Community Cooperative; and/or

2. Promote alternative markets/options.

Fish Cage Culture... Things to Think about

What Species are most Sustainable for the area? This Depends on:

- quality of locally found species;
- how water quality changes over the year;
- weather (tides, rainy season, storm season);
- suitable location (good current/flow, depth 5m-12m, security, no pollution);
- market value;
- access to market;
- local expertise/knowledge;
- seasonal calendar of fish catch;
- sedimentation type (i.e. type of sea bottom),

Example:

- 15 fishers work together, advised by IDRC/DANIDA;
- Group selects the fish species;
- Elect chief, treasurer, make rules and guidelines
    - Membership, who can join and fee
    - establish monthly savings scheme
    - appoint representative to sell to the market
    - decide how to use savings and how members can apply for a loan
    - Requires:

1. a group of fishers with a common interest/marketable product;

2. training/facilitation;

3. advice and technical assistance,

Cooperative Advantage

There are 15 fishers. If sell to middleman 80 B/kg; however, if sell directly to market 120 B/k.3 fisherman have 5 kg/day, 12 fisherman have 1 kg/day. Total is 27kg. Depending upon transportation costs to the market, it might be more advantageous to organize fishers together to sell directly to the market. For example, if sellers directly to the market, and transportation costs are 250B, then each person would pay an additional 9.25B per kilogram towards transportation costs. So, if fishers organize together and sell directly to the market, then the profit would be 110.5B/kg.

Consider who should be Involved? What will be the stocking regime?

i.e. which species, what size, fry finger hand/line caught fish, how many per m2

What are home based income generating activities?

GROUPER SPECIES

- Stock the cages with hook and line caught fish or fish trapped fish
- have 8 cages, plus one (center) to use as a guardhouse
- bottom type is mud, and *WQ is* good even at low tide
- minimum depth of 6.5 m
- the cage can be moved or removed if needed
- only use the cages during the dry season
- cages will be stocked with different sized fish, depending on what is caught
- the feeding regime needs to be calculated for each cage (what is the bottom type?)
- Management- men I women involved in marketing, feeding, stocking i.e. catching the fish to stock
- Supplementary livelihood activities
- can involve women or men and the elderly
- Not something hazardous/harmful/illegal
- Produce a marketable product/service
- 1 geally it uses locally available materials;
- Can be conducted at irregular times/opportunities.

1. Home gardening/bio-intensive backyard gardening;

2. Repairing fish-nets;

3. Making crab-traps and fish-traps;

4. Extracting crab and green mussel meat;

5. Shrimp paste processing;

6. Fish smoking -need research (species, method and demonstration);

7. Food making (sweets, snacks etc)

8. Nipa shingle making (roof walk);

9. Fresh water selling.

Home Gardening

- can be in a pot, tub, old broken container/boat or on land
- the size does not matter, the quality of soil does
- identify appropriate species 1/ will grow well, 2/ high nutrient value, 3/ that the family would normally to

buy if they had money
- can be grown for household use and the leftover/excess can be sold
- target the poorest families with young children
- Need to consider a market survey for production;
- Need a skills inventory;
- Raw material assessment (how much is available and can it be harvested and still be sustainable?)
- Look for opportunities that make activities more profitable i.e. how can an activity be more profitable, can more people be involved, is there a growing market need, are people interested?

Fish Attracting Devices

Gear description:

- line in water, rock holds to bottom and coconut husks are on top of the line with a raft on top to demarcate the area 30 meters plus.
- Anchovy sp. are attracted to the coconut area; also *mackerel* sp., migratory fish i.e. pelagic (not benthic or bottom feeders i.e. mullet, grouper) and other big fish are attracted to larger fish.
- Squid and cuttle-fish like to lay their eggs on the flower of the coconut husk another form of protection.

This method works well in the Philippines with many fishers using these devices. However, this only works when one or two fishers are using each attracting device. This method does encourage sustainable fishing and the small fish can be used for cage culture stocking. Such devices can also be used to mark boundary areas i.e. buffer zones, core zone areas.

Market Survey-linking to the moon

A key to thinking about any market survey involving fish species is, the moon times.

- Dark (new moon)
- Full (full moon)

Taking this into account helps to understand the market according to the supply.

The lengths between different phases of the moon varies throughout the year, depending upon where the moon is in relationship to the earth i.e. when moon is closer to earth, phases are closer; further away, phases are longer.

During a full moon there is a large tidal movement i.e. biggest difference between low tide and high tide. The moons force is also the strongest during full moons. During the new moon, movement is very small. One time per year there is the highest tide (king/spring tide) and one time per year there is the lowest tide. For an entire day there will be a high/low tide called a neap tide.

Different fish species are more active during different seasons. New moon-shrimp/prawns.

- shrimp spawn 30-50 in deep into the ocean at one years old-come into estuary i.e. post larvae or juvenile...then migrate to go to the deep water to spawn.
- Juvenile rests during the day -burrows in sand or mud during full moon is under the sand also so only moves at night on the dark moon-this is the best time to catch shrimp.
- Mackerel, mullet, snapper also spend part of their time on the ground crustaceans are most active during the dark move.
- 1 ha of mangroves is worth 15 000 to 20 000 per year in terms of fishery production in Australia.

Grouper sp. are also more active during the full moon. When grouper spawn, the female releases her eggs during the full moon time. During this period, the tides are large, increasing the chance of the eggs and milk to mix together. Interestingly, the female quickly swims to the surface of the water, with the male in pursuit. This dramatic change in pressure causes the eggs to release. This happens at the low tide of the full moon around dusk.

Therefore, having an understanding of the moons and that different species react during full and dark moon, helps to understand when species are abundant. This is why it is useful to do build in the moon periods within a survey.

When understanding the demand supply of things notes must be taken of the weekdays. For example consider the differences within the market over a weeklong time period and also note the weather for the day.

Mangrove Rehabilitation

There are four ways to rehabilitate mangrove stands:

- natural recruitment;
- direct replanting;
- mangrove nursery;
- transplanting.

To decide where you are going to rehabilitate, you need to assess your options.

Mangrove Assessment:

- identify areas of disturbance;
- identify sources of recruitment/seeds;
- identify critical areas of mangroves;
- prioritize areas for protection;
- prioritize areas for rehabilitation.

If we have natural recruitment, will nature do its job? Should we try to protect instead?

Direct Replanting

For replanting mangroves, plant in a calm, shelter area. Make sure the area is stable. Can use stakes and barrier fences to protect critical areas. Rhizophora species have a good survival rate; all propagule species do. Survival increases with low crab numbers and few barnacles. For species such as Brugeria and Cyriops, one can use a stake when replanting.

It is important to match the species with the replanting location. Ideally, you should try to replant species that were there before; however, sometimes the substrate changes and then different species will have to be planted.

It is important to regularly maintain and monitor a replanted area, especially during its first three months. After this, monitor in the next six to twelve months. If a mangrove is knocked down, it can be replanted within the next few days and it will survive. Also, stakes have to be pushed back into the ground, leaves need to be cleared away and sometimes barriers need to be created or re-built.

When an area is dying, take notes as to why. The community should be doing the monitoring. Walk around or go with a boat. Measure every tenth mangrove, count the prop roots on the ground, the leaves, barnacles, crabs and make general observations.

Mangrove nursery

- we want to plant species that do not have large propugules;
- we want to rehabilitate critical areas some which are not sheltered;
- it will be useful as an environmental education tool:

Then, decide which species that you want to grow and how many. Consider who will manage and who will maintain the nursery and select the most suitable location.

Location:

- saltwater/marine environment/tidal;
- protected from strong waves;
- accessible/easy to reach;
- good soil and water quality (or access *to);*
- shade;
- not high number of predators;

- already cleared place.

Find out when and where the seeds can be collected.

Habitats and Ecosystems

An ecosystem is larger then a habitat. For example, a coastal ecosystem includes inshore coral reefs, mangroves and sea grasses.

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Habitat production

An ecosystem is larger than a habitat. Types of ecosystems include:

- marine-includes corals not mangroves;
- coastal-includes inshore coral reefs, mangroves and houses,
- lowland,
- upland.

In our work in Koh Kong, we mainly focus on mangrove habitats within the coastal ecosystem; however, do not forget about other habitats i.e. terrestrial, beach forest, sea grass and coral reef.

Within the coastal ecosystem, there are tidal areas. Consider the following:

- **inter-tidal** this area is sometimes exposed to the air (i.e. sometimes flooded, sometimes not). *This is the area that we work in,* and is unique because plants and animals must be very adaptable i.e. temperature, water, air. This is a highly productive area and high in nutrients because there is a constant movement of water and a constant change in temperature. Therefore, it is highly suited/or algae (small algae) to grow and die in this area. When the tide is out, it is exposed to oxygen (continues to grow) and to high levels of sunlight. It is the heat that will kill the algae. This happens everyday in a four to five hour time period. When the tide comes in, the fish come in to feed and feeding on the algae which is now floating around. This helps to explain how this is a dynamic, healthy, productive area. This is an area of high activity i.e. feeding, breeding, spawning, juveniles.
- sub-tidal never exposed to the air (always below the water);
- always exposed to the air.

How do different mangrove species adapt to their environment?

Why do the *Avecinnia sp.* roots stick out?

Roots of the *Avecinnia sp.* are designed like snorkels. Their purpose is to get air. Because the mud is so dense and sticky and because there are so many nutrients, it is hard to get oxygen. There is lots of dead material in mangrove mud, all these things (leaves, bark, fish) use up oxygen to break down. There is *low* or no oxygen i.e. anaerobic. Mangroves have a system by which the tree can get oxygen into itself, and roots are the best way to gather oxygen. This is why the roots go through the mud. This is just one example, Rhizophora also have large rootsabove the ground to gather oxygen. The roots are called nymatophors (specially adapted to gather oxygen in dense mud hence this name is given to dense roots).

Mangroves are designed to gather oxygen and hence you have different root systems

Habitat protection:

There is a multitude of reasons to protect the following habitat:

Mangrove	Sea Grass	Coral Reef	Bare

produce high level of nutrients	protection/nursery ground	barrier/reduces strong waves feeding area for fish spp.	feeding area for filter spp. seaweed grows
breeding area and feeding area for birds and wildlife filters water/nutrient exchange (nitrites into nitrates i.e. toxic things into non-toxic things)	dugong feeding area (the only food that Dugongs eat) turtle feeding area	breeding area	
feeding area for fishery species protects the of land from erosion stabilize sub-strate	feeding area for fishery species filters water/nutrient exchange	high diversity	
protection/nursery ground - good for small fish to hide, good for feeding	can stabilities sub-strate		
considered to have high economic value	protects from erosion		

Scummy plants are considered to be algae. When algae species are bigger, macro-algae, then they become known as sea weeds i.e. sea weed are big algae. People eat sea weed. Sea weed looks like a plant even though they have the same cell structure throughout and don't go through the surface of the water.

Sea grass versus Sea weed

- sea grass is a vascular plant with a cell system (different cell structures: root, stem, leaf)
- sea weed is an algae (scummy plant) with the same cell structure through out (although looks like a plant) and a vascular system.

Dugongs can only survive on sea grass

In fact, sea weed kills Dugongs. They need sea grass, and cannot eat other animals or plants.

Dugong have specific species which they prefer. They get most of their nutrients of their roots. They dig up the entire plant and eat the entire plant. They consume huge amounts of sea grass per day. They eat sustainably: feeds in a zig zag trail that allows the sea grass to send up runners.

It is the stabilizing factor of sea grass that makes this plant far more important then sea weed. Sea grass is a true plant and has a longer life cycle. Sea grasses have long roots below the surface of the water that hold onto the soil i.e. extensive root systems. Sea grasses are seasonal i.e. at certain times they grow fast, other times not so fast. Although the leaves might die, the roots remain. They produce flowers and seeds: once per year many seeds are produced. These seeds can stay below the surface and can be triggered by an environmental change such as a change in salinity or temperature. Therefore, seeds can lie dormant below the surface if conditions are not right, only to be triggered into germination by an environmental change.

Depending on how much sea grass is killed during trawling, determines how much of the sea grass bed will grow back. The roots are only up to one foot grass to send up runners and to deep; however, push nets often take up the entire plant. Push nets do an entire area and destroy it in a complete line which does not allow for the sea grass to recover for a long time, and if there is a lot of push nets the entire area dies.

Because sea grass stabilizes the sub-strate, the soil is not eroding or moving around; in fact, it is gathering sub-strate. This assists in protecting the coastline.

Turtles only graze on the leaves and eat many other things besides sea grass.

Sea grass cannot live in pure fresh water. Live in mostly salt water, or lower reaches of brackish water. They are classified as a marine plant. There are fresh water plants that are grasses.

Juvenile shrimp species require sea grass. Fish species also require sea grass -there are epiphytes or

gastropods for the fish (shells) that the fish can feed on. Fish are there for the protection and for the food. The food is unique in the sea grass areas for the fish. They will hang around these areas and have a lower survival rate.

Sea grass grows in salt coastal, inter-tidal zone (three to four hours without air) or it can grow in the deep areas. Can be recorded up to 47m i.e. huge range that it can grow in. Will grow near corals, will grow near mangroves and can grow in deep water too. Depending upon the substrate (soil) depends on which species can grow there and it depends on the temperature. Sea grass beds will expand and contract: core area will be the same but can grow and shrink. Depends on the nutrients, and the weather may be rough so some years it might not be as good as conditions for growing as other years. IT IS NOT KNOWN HOW MANY SEA GRASS SPECIES EXIST IN CAMBODIA.

Looking at these habitats, corals and mangroves have long been recognized to have an important fishery value. Sea grasses are not so well recognized even though they are as important as sea grass areas. All three areas are equally important in terms of fishery production and habitat areas.

Often forgotten are the bare substrates. Very important in terms of fishery production also. Without them, there would be no buffering area. Without it, the other areas could not be productive. These areas are constantly changing in a natural ecosystem. Some mangroves grow, some sea grass increases: dynamic ecosystem.

We map mangroves, sea grass, coral reefs, however, we don't map seaweed areas or bare substrate areas as these areas are in constant flux i.e. change Quickly.

What are you assessing? This then determines what your assessment will entail?

Assessment- what is the habitat like now?

- area i.e. size;
- diversity i.e. number of species;
- productivity i.e. how valuable is this in terms of producing leaf litter.

Can form the base line for monitoring activities or can be a one time only assessment i.e. this distinction is important as this affects how you do it. Sometimes you only need to do something once.

Things which change are the variables. Things which don't change are the constants.

Habitat assessment

- what information do you have. How reliable, how usefu1 is the information. How old is the information;
- what information do you need to prepare a habitat management plan?
- which techniques do you use
- how detailed will the assessment be (depends on constraints)

Management plan the environment does its own management i.e. nature. When humans do it, we call it management.

Management Plan

- people;
- natural resources/environment.

We can make a generalization from mangrove research done elsewhere i.e. productivity is the similar in Thailand and in Cambodia. Area and diversity are localized for this area. i.e. what area do we have of mangroves and other habitats and what is the diversity.

Constraints i.e. bits of information, limited technical resources, limited time, limited budget and a difficult area.

Techniques the basics

- Habitat map PMMR team only has the basics;

- Species Inventory -refer to PMMR reports.

In a map format, a habitat map needs to tell us what there is, where it is, how much it is.

- Decide where you will do a map, define the area with a boundary;
- Decide what detail do you want to map;

Habitat map

A habitat map will consist of a series of habitats, specific to your ecosystem. In a mangrove area like PKWS, the following habitats would be considered:

- mangrove-undisturbed
- mangrove-disturbed
- *coastal/*beach forest (casurina species, exposed areas of the coastline, frontier vegetation that is not mangrove) -disturbed, undisturbed
- riverine vegetation (vegetation growing in fresh water along the river banks) -disturbed, undisturbed
- swampland (maleluca, not salt water, brackish to fresh water, not a mangrove)- disturbed, undisturbed .
- sea grass beds
- coral reefs
- sand/mud flats (major areas, more than $3m^2$)
- terrestrial forest -disturbed, undisturbed
- rivers, creeks

Additional information relating to wildlife is important. For example

- nypa -planted nypa, natural nypa
- replanted mangroves
- known bird nesting sites
- known bird breeding sites

What do I need to do a good habitat assessment?

- base map (recent/good scale);
- trace map (basic outline including north direction, scale, source, reference: lat, and long
- compass
- measuring tape
- GPS (optional)
- list of habitat types
- marker
- metal plate and nail
- pencil, eraser and notebook

Don't forget to include human impacts. Consider the following:

- political boundaries
- protected area boundary
- villages/houses (more than five houses)
- agricultural area
- cleared areas
- livelihood activities
- fishing effort by gear type and by season
- fresh water source
- temples
- access to motor fuel

Within your assessment, you can make many footnotes. For example, if you are in the

disturbed mangrove category, then you can add notes about when that is a shrimp pond, or where mangroves are cut for more than 50 %. The key is to realize what is disturbed and what is undisturbed. This will give us an indication of what should be the monitoring site. Can also do a footnote for a species zonation transect site and a monitoring quadrate site. Always include the area. In a management you would then have more details

that would refer to these sites.

Doing a habitat assessment

What should I write down?

1. mangroves list the mangrove species. If you don't know the type of species, then try finding them in your guide book;
2. mangroves list what percentage have been cut, notice if there are new seedlings;
3. other relevant points for example, perhaps you see wildlife in the area or perhaps this area has been recently cut. Make notes

Try to record ever 100 m or so; however, if there is a change in species, then you should make a note of this i.e. change in species, small hill with coconuts growing.

When you record your transect, include:

- species type
- direction of the transect
- length of the transect
- description of each zone
- substrate
- observations i.e. mud crabs, barnacles**.**

From this exercise, one learns about areas that are disturbed, areas that are heavily used, and areas that are in critical condition. This gives helps to understand PKWS as a whole and where individuals use resources within PKWS.

Habitat Monitoring

We monitor to measure changes and the status of a given area over time.

1. What do we expect to monitor?

- areas/location
- species
- habitat

2. What do we expect to change?

- area (# ha/abundance/quality)
- diversity
- productivity
- human activity

ONE MUST RECORD/DOCUMENT BECAUSE MONITORING INFORMATION MUST BE:

- comparable;
- repeatable.

ONE RECORDS THE:

- results 10
- method

MONITORING IS USEFUL BECAUSE:

- provides clear & accurate information for management of the area;
- for people outside;
- for people in the community;

- helps us to not make the same mistake twice;
- helps us to better understand our resource or activity that we are monitoring;
- can be used as environmental education tool.

3. What level of change do we want to be able to detect?

4. What factors/things could cause change?

5. Decide what/when and how to do it - action plan.