European Union

Sixth Framework Programme

Mangrove Project

Developing knowledge-based approaches to reconcile multiple demands

Mulawarman University, Samarinda

Situation of the Mangrove Ecosystem and Related Community Livelihoods

in Muara Badak, Mahakam Delta, East Kalimantan, Indonesia.

Report of WP-1

Contract number: FP6 - 003697

University of Essex

WAGENINGEN UNIVERSITY WAGENINGEN UR

SEI STOCKHOLM ENVIRONMENT INSTITUTE

NAC

Kasetsart University

Mulawarman University

Vietnam National University

Content

Abstract

The Mahakam delta covers close to 1100 km^2 and is, except for it's land-side fringe, a collection of islands accessible by boat only. The original vegetation of this delta composed mainly of pure *Nypa*, mixed *Nypa-Avicennia*, pure *Avicennia* and *Rhizophora*, and some sparse *Sonneratia* populations, only remains on some sparse islands and inside concessions of oil&gas companies covering less than 10% o the delta. After the first cold storage company installed in 1970 farming of shrimp started in ponds dug manually or with excavators after 1990. During the economic crises of 1997 shrimp prices in local currency rose sky high and pond opening exploded. In 2001, 75% of the delta was covered with ponds of which around 1/3 was opened for speculation on future compensation by oil and gas companies. This stimulated extensive production methods in very large ponds in order to claim land. In 2003 the area of productive ponds was just above 45.000ha. Moreover in most cases the real pond size is must smaller than the actual area between the dikes as only the soil needed to make the dikes was excavated while the central plateau of most pond kept its' the original level. This might also explain the smaller productivity of the larger ponds. Since 2000 the white spot virus (WSSV) reduced pond productivity.

The 3 research sites are located in villages of the sub-district Muara Badak in the north of the delta. Site 1, Salo-Palai hamlet 2 and 3, includes about half of the island of Joppang, while site 2, Saliki hamlet 1, 2 and 3, includes the other half of Joppang; the third site regroups hamlet 7, 8 and 9 from Saliki and is located on the island of Taddutan. Except for an area of 1 ha, a small island and a narrow fringe of *Nypah* on the riverside, the mangrove cover in the research sites was replaced by fishponds. Farmers fear the consequences of erosion and abrasion on their pond dikes and on the water quality, and the reduced availability of seed for crab, fish and shrimp. The lack of breeding grounds and refuges for the fish is shared by the fishermen. Recently the land clearing for oil-palm plantation for the production of bio-fuel started. In 2007 a 10.000 ha plantation started in the district of Saliki.

In some hamlets located on the islands the population depends for 100% on the pond, but most others have a mixed population of workers for private companies, government officers, traders, land-less agricultural workers, fishermen and farmers. Only those households having a house on the mainland also farm dry land crops or keep livestock. Around 80% of the livelihood activities of the pond-farmers, pond care-takers, fishermen and farmers, is based on or related to the mangrove resource. The livelihood activities of the poorer households depends more the natural resource base. For pond farmers and care-takers, farming of shrimp, milkfish and collecting crab is the main source of income. The seasonality of the activities is relatively high as the ponds have 4 main harvests per year. Fishing and catching crab, give a more regular cash flow, but are only practised during high tide. Some started crab culture. The relative contribution of pond farming to livelihood is on average close to 50%, which makes the population highly vulnerable for decreasing pond productivity and for shocks in shrimp production like have occurred in the past. A main part of the population immigrated to make a livelihood and if pond farming does not provide this anymore they will, without any doubt, move again to replace still virgin natural resources with plantations or ponds. Improving and stabilising the shrimp production is of the greatest importance, also to reduce the dependency of the pond-farmers upon the products collectors that are at the same time input and credit providers as well as the main source of information on prices and new technologies.

In an attempt to re-establish the mangrove eco-system some pond owners started to replant mangrove, mostly on the pond-dikes which is probably not the best method. However this gives an opportunity to start action research with the farmers to establish the best ways to recover the mangrove eco-system and improve overall productivity. The main problem will be the involvement of the absentee owners that hire care-takers those that have non-producing ponds. These absentee owners of mostly larger ponds make the re-establishment of the mangrove more complex as they are not interested in a productive pond and are not aware of the eco-systems function. Re-establishing mangrove will bring forward the problem of ownership which is based on the area being a pond. Local authorities need to provide some kind of save-guard to secure the ownership or the right on compensation.

1. Introduction

The situation analyses was done in six steps: a preliminary survey for the selection of research villages, study of secondary data, a workshop to train staff involved in the project, pond farmer meetings for a rapid assessment (RA), individual interviews, focus group discussions, and a stakeholder workshop to cross-check the results. Three villages in one coastal district were selected on the bases of all year accessibility, readiness to collaborate, background in coastal zone management. After a description of the Mahakam delta and it's history in the following sections, this report will present an executive summary of the general findings in chapter 2 and the details of the rapid assessments in each village in chapter 3.

1.1. The Mahakam-delta

The Mahakam delta covers close to 110,000 ha (1100 km^2) and is, except for it's land-side fringe, a collection of islands accessible by boat only (Figure 1.1.). All weather or earthen roads are lead out on the northern and southern fringe leading to the villages from where boats allow reaching the islands that are poor in infrastructure. Numerous pipelines cross the delta and earthen roads are laid out for their maintenance by the oil & gas companies.

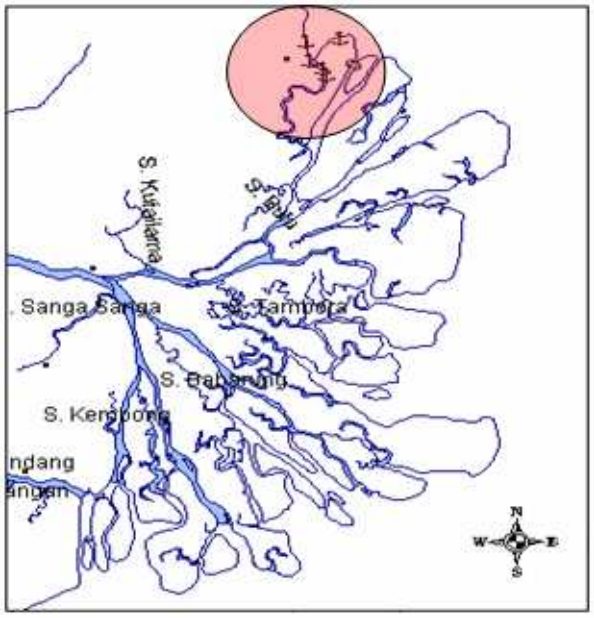


Figure 1. The Mahakam Delta and the location of the projects' research sites.

A rainfall of over 2.5m in an area larger than 25,000 km^2 provides water and sediments to the 900 km length of the Mahakam river flowing into the Makassar strait having a strong north-south current. The fluvial plain, where the river splits, is relatively small. The multi mouthed section of the Mahakam is a mixed fluvial/tidal delta where the sand-sized fractions deposit in the central and southern parts (Lambert, 2003). Erosion occurs on the north shores and sand deposits on the shores of the southern delta where the tidal and mud flats are very large (Bourgeois et al., 2001).

The original vegetation of this delta was composed mainly of pure *Nypa*, mixed *Nypa-Avicennia*, pure *Avicennia* and *Rhizophora*, and some sparse *Sonneratia* populations. The fauna is mainly composed of aquatic and flying creatures: birds, fish, crocodiles, and crustaceans. The fresh water dolphins (*Irawadi*) can still be observed. On the islands wild pigs and apes were observed in the past; at present pigs have disappeared.

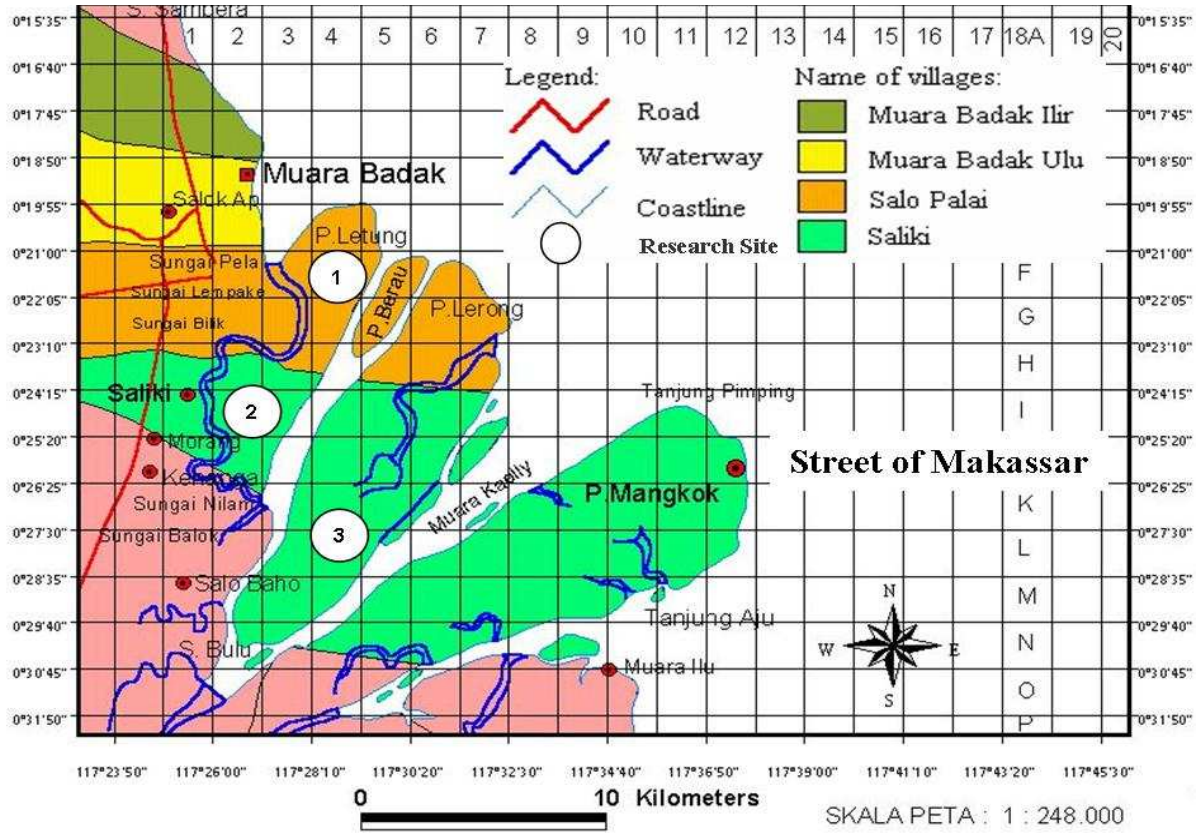
1.2. Settlement history of the Mahakam Delta.

The findings of the RA's confirmed the settlement history of the Mahakam delta described by Bourgeois et al (2001). From around 1890 to 1970 migrants from Sulawesi settled on the fringes of the delta to crop land and on its' shores for fishing; the natural habitat was hardly disturbed and fish, shrimp and crab sold locally. After 1970 the first cold storage company installed, fish export possibilities increased and especially fishing of shrimp took off. Also exploitation of oil and gas started leading to land speculation by wealthy people both from inside and outside Kalimantan. In 1984 trawl fishing was prohibited to protect the marine

biotope, especially the demersal species (aquatic species just living near the bottom). However mini-trawlers are used again since 1998 by lack of control.

Since 1970 farming of shrimp started in ponds dug manually or with excavators after 1990. During the economic crises of 1997 shrimp prices in local currency rose sky high and between 1997 and pond opening exploded. Between 1996 and 1999 36,000ha of *Nypah* mangrove and 5,500ha of freshwater mangrove were converted in ponds (Bourgeois et al, 2002). In 2001, 75% of the delta was covered with ponds of which 1/3 was opened for speculation on future compensation by oil and gas companies; those companies try to reinforce their land concessions leading to conflicts with the local populations In 2003 the area of productive ponds was just above 45.000ha (Noryadi et al, 2006). This stimulated extensive production methods in very large ponds in order to claim land for rent seeking. In most cases the real pond size is must smaller than the actual area between the dikes as only the soil needed to make the dikes was excavated while the central plateau of most pond kept its' the original level (picture on cover). This might also explain the smaller productivity of the larger ponds observed by Noryadi et al (2006). Since 2001 also, the impact of the white spot virus reduced productivity strongly.

Figure 2.1. Map of the research villages; Taddutan is the island of which the coastal section is called P.Lerong, the research focusses on Saliki's section of this island (site 3); Joppang is the island of which the coastal section is called P. Letung; site 2 is in Saliki and site 1 is in Salo Palai village.



The agricultural sector, including fisheries and aquaculture represents less than 10% of the local economy (BPS, 2005). In Sanga-Sanga the fishermen and (pond-)farmers constitute around 15% of the population (Table 2.1), and in and around the urban areas like Samarinda this will be much lower. More diversification at a higher scale will hardly constitute an outlet for fishermen and pond-farmers that loose their livelihood based on the mangrove eco-system. Improving their income from agriculture, aquaculture and fisheries seems the best option.

2. Situation analysis

The situation analyses focuses on three sites located at the northern fringe of the Mahakam delta in the sub-district of Muara Badak (Figure 2.1.). Only a small portion of this sub-district is located in the delta like Muara Jawa, Sanga-Sanga and Samboja sub-district (Table 2.1). The sub-district of Anggana is located entirely in the Mahakam delta, explaining its' low population density.

Table 2.1.
Population and income distribution according to official statistics of the Mahakam delta sub-districts*.

Area	number of households	Total population	Persons /km^2	number of fisher & pond farmer households
Muara Badak	8305	34,437	36.7	1,864
Muara Jawa	6475	24,077	31.9	2,055
Sanga-Sanga	3,717	13,852	59.4	558
Samboja	12,977	45,157	43.2	2,358
Anggana	6,554	27,289	15.2	3,299

* Mahakam-delta is part of 5 sub-districts covering 4671 km^2, Muara Badak covers 939 km^2; Anggana is entirely located in the delta, and covers most of the delta.

The projects' research sites are located in Salo-Palai village and in the neighbouring Saliki village:

1. Salo-Palai's hamlet 2 and 3 exploiting ponds on Joppang island.
2. Saliki's hamlet 1, 2, and 3 sharing Joppang, hereafter called Saliki for convenience.
3. Saliki's hamlets 7, 8, and 9 on the island of Taddutan, hereafter called Taddutan for convenience.

Of the total number of households in these villages, about 22 % are registered as fishermen or pond-farmer, which is underestimated as for the pond-farming households. In Saliki's hamlets concerned by the research sites the number of households practising the two was officially 390, while Taddutan claimed to have over 200 more than registered. The percentage of households implied in pond-farming and fisheries is close to 100% in site 3, and around 50% in site 1 and 2, like in Anggana sub-district. The hamlets of the villages selected are also representative for the delta because owners live on as well as outside the islands.

Salo-Palai and Saliki have a mixed population of local residents and recent immigrants (mostly from Sulawesi), while Taddutan is entirely composed of recent immigrants. The family structure in the area is mostly nuclear, except when people get older. Elder people share their house with one of the married children and his household.

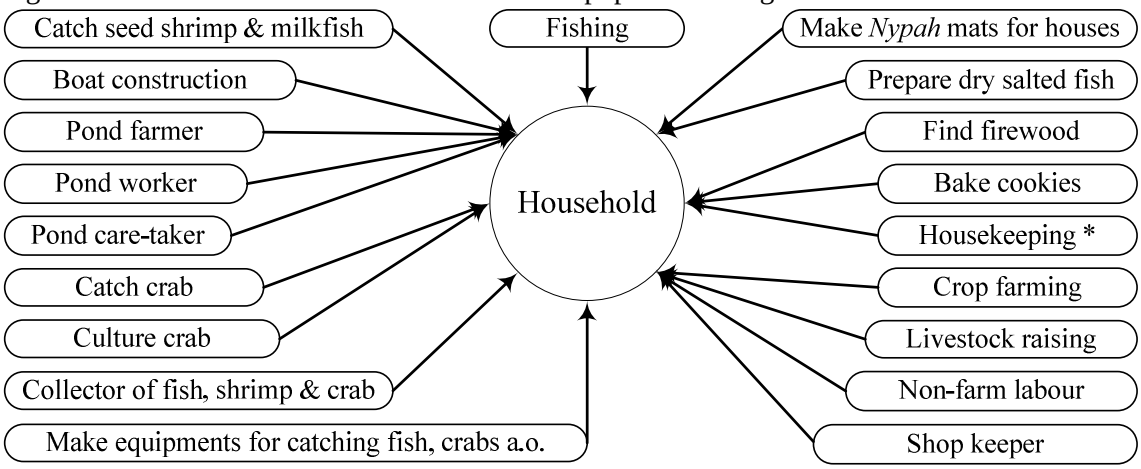
2.1. Livelihood activities and systems

The project addresses mangrove management and thus households basing at least part of their livelihood on this natural resource. Figure 2.2 shows that a large number of the activities households use for their livelihood systems are base the mangrove ecosystem.

2.1.1. Relative contributions to livelihood

In the three sites, about 40 % of the households' livelihoods resources is related to the mangrove forest; this relative contribution increases to 80% if the pond farming activities are included. The mangrove related activities include catching crab, collecting seed for pond farming, making crab traps, make *Nypah* roof covers, fisheries, making dry salted fish, and collect fire-wood. The pond farming related activities include the pond farmers, the pond care-takers, the pond workers and the collectors. The Taddutan site relies by far the most on pond farming as it has no main land section (Table 2.2.).

Figure 2.2. Overview of the various activities the populations might use for their livelihood.



* including: fetching water, raising children, cooking. sewing, washing, baking, accompany husband.

Table 2.2. The main livelihood activities in the 3 sites, their sex involvement and their relative contribution to livelihood (not representative sample size: 9, 12 and 8 households respectively).

	Sex task division*		Relative contribution to livelihood (%)		
Livelihood activities	♂	♀	Salo-Palai	Saliki-Joppang	Saliki-Taddutan.
Fishing	100	0	14	21	6
Make traps & roof covers	100	75	1	1	5
Prepare dry salted fish	42	83	7	1	6
Pond farmer	100	45	36	29	57
Pond care-taker	100	25		13	3
Off-farm pond worker	100	70	9	1	2
Collect fish for market	100	30	5	6	6
Catch mud crab	100	24	7	11	14
Bake (and sell) cookies	0	100	8	2	
Crop & livestock farming	83	50	5	5	
Non-farming **	86	30	9	10	2

* % of the male and of the female involved in the activity for the households doing the activity.

** Making boat, salaried labour, renting and trading for Salo-Palai and Saliki-Joppang but collect fire-wood for Saliki-Taddutan.

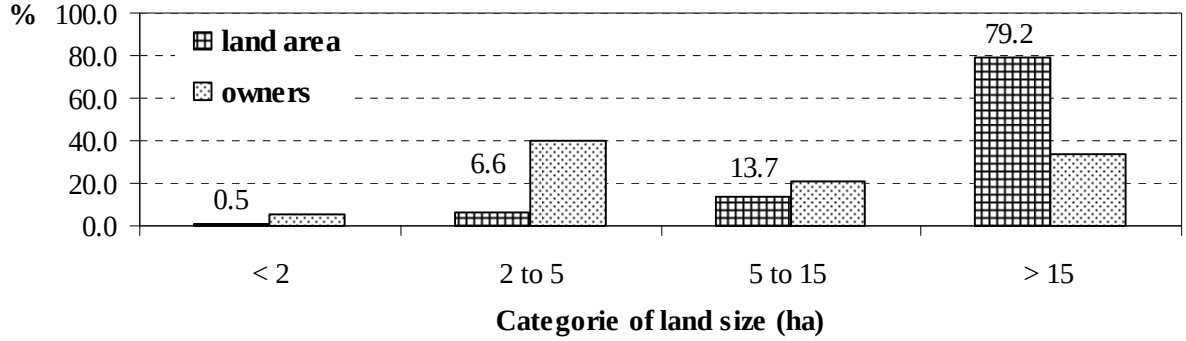
2.1.2. Vulnerability

The dependency of the poor on the intact natural resources is higher than for the medium and well-off wealth categories (Table 2.3). The well-off and medium households exploit as many livelihood activities related to the natural resources as the poor but have also other activities that generate cash or products for consumption. The correlation coefficients between wealth rank (well-off = 1, medium = 2 and poor = 3) and the mangrove related activities contribution to consumption is positive (0.39) but for the relative contribution to cash it is negative (-0.23).

Table 2.3. The dependency of three categories of wealth on mangrove resources for their livelihood.

		Relative contribution to livelihood of:					
Wealth		Mangrove related activities			Plus pond farming		
rank	n	**Total**	**Cash**	**Consum.**	**Total**	**Cash**	**Consumption**
Well-off	5	40	18	22	67	40	27
Medium	16	30	17	13	74	55	19
Poor	8	64	55	10	95	78	17

Figure 2.3. The distribution of the total land area (5000 ha) over 4 categories of land size and the frequency distribution of the number of land owners.



The total pond area in the three sites is close to 5000 ha of which the owners of 3000 ha have registered their presence in the village. Just over 400 ha are for ponds smaller than 5 ha owned by over half of the population (Figure 2.3). Most owners of a larger land area hire care-takers for pond surveillance, management, and harvest. Several financial relationships between owner and care-taker exist (Table 2.4). Most types of sharing arrangements discourage investments that could increase pond productivity, as from the benefits of every supplementary step done or Rupiah invested, more goes to the owner than to the care-taker. Only arrangement 8 and 9 seem fair. The rent is much higher in Saliki compared to Taddutan, probably because of the location (close to road network) but perhaps also because of soil type causing the average shrimp harvest being only half in Taddutan compared to Saliki.

Table 2.4. Nine types of relationships between pond owners and care-takers in Saliki and Taddutan.

Type of Cooperation		Production inputs (Seedstock, Fertilizer, Feed)	Type of harvest sharing
1	Owner	66%	Sharing of tiger prawn and spotted prawn identical to cost sharing. Crab all for care-taker
	Caretaker	34%	
2	Owner	80%	Sharing of tiger prawn and spotted prawn identical to cost sharing. Crab all for care-taker
	Caretaker	20%	
3	Owner	50%	Sharing of tiger prawn identical to cost sharing. Spotted Prawn and crab all for care-taker
	Caretaker	50% (incl. hire worker)	
4	Owner	land and seed 100%	Equal share of tiger prawn for both Spotted & crabs for caretaker.
	Caretaker	Hire worker	
5	Owner	land	Equal share of tiger prawn for both Spotted & crabs for caretaker.
	Caretaker	100% inputs & worker	
6	Owner	Land	Equal share of tiger prawn for both Spotted & crabs for caretaker.
	Caretaker	Own or ponggawa (100%)	
7	Owner	100 % capital & land	20% for caretaker, 80 % owner
8	Pond Repairing	Caretaker repairs pond and provide 100% of inputs.	Repairing pond and getting harvest for 2 year and then give the pond back to owner.
9	Land rent	All cost plus rent Rp. 2 to 4 million /ha/year.	100 % for land user

Note: In scenario x it is the responsibility of the owner pond to provide the caretaker with consumables like rice, coffee, fuel, expense for religious ceremony or to pay for medical cost.

The seasonality of the various activities increases this vulnerability. The sea-fisheries have two main seasons: the southern wind season starting in July and lasting until September and the northern wind season being dominant in January and February. The ponds have four main harvest seasons: March, July, September, and December. Crab collection and small harvests are done when the low tide falls in day-time; at stagnant tide in day-time the pond related activities are reduced. River fishing and crab collection are done at high tide.

The statistical data collected by the Fisheries Services and available at the Regencial Fisheries Services in Tenggarong showed no variation for the fisheries catches. Since 2000 the catches are estimated to be just above the 4,000 t/yr; the estimated catches for both Saliki and Salo-Palai were just below 800 t/yr (see 2.3.4 on data collection). As for the pond production a trend was apparent in the sub-district: between 2001 and 2003 the totals varied between 1100 and 1200 t/yr, but from 2004 to 2006 it fluctuated between 1650 and 1900 t/yr. We assume that the pond productivity losses caused by WSSV were compensated by opening new ponds and putting in production the areas that were cleared from mangrove but not used for shrimp farming yet.

In the first year after opening, the pond can produce between 100 and 300kg of shrimp/ha/year, which in 5 years gradually declines to 50 to 100 kg/ha/year according to farmers in the research sites. Since the appearance of WSSV and Red Gill in 2000, the farmers only have a good shrimp harvest once every four cycles and the average pond productivity is close to 45 kg/ha/year of tiger prawn (Noryadi et al, 2006). Farmers say they collect on average close to 40 kg of spotted shrimp, 20 kg of crab, and 125 kg of Milkfish per year; for the delta the averages are 49, 11 and 70 respectively (Noryadi et al, 2006). Some farmers make more income from crab (Bourgeois, 2002).

For the provision of capital needed for pond inputs and for livelihood in times of distress, the care-takers and resource poor farmers depend on collectors and their bosses. These last include the so-called “Punggawa”. Punggawa are (local) elite having a high social status and a huge capital mostly acquired through political influence.

Table 2.4. Gender analysis framework for three mangrove related activities and a livestock activity.

Activity		Labour input	Access to ownership	Decision-power	Access to benefit	Access to information
Pond farming (Saliki)	Husband	+ + +	+ + +	+ + +	+	+ +
	Wive	+ +	0	+	+ +	+
	Young*	+	-	-	+	-
Fisheries (Salo-Palai)	Husband	+ + +	+ + +	+ + +	+ + +	+ + +
	Wife	+	0	+	+ +	+ +
	Young*	+ +	-	+ +	+	-
Making dry salted fish (Salo-Palai)	Husband	+	+ +	+ +	+ +	+ +
	Wife	+ + +	+ +	+ +	+ +	-
	Young*	0	0	-	+	-
Raise chicken (Saliki)	Husband	0	+	-	+	0
	Wive	+ + +	+ + +	+ + +	+ + +	0
	Young*	0	+	-	+	0

Legend: - = not and never ; 0 = mostly not ; + = some ; ++ = good ; +++ = very high
* in one of the village a category of children replaced 'young' who were not very much present in the communities being at school or working outside the area..

2.1.3. Gender

The involvement of sexes in the activities is different between sites and types. Only boat fishing is an exclusive male activity (Table 2.2.), though women are involved in fishing related activities: making equipments and preparing dry salted fish (Table 2.4.). This

involvement of women partly explains the apparent contradiction between the labour division mentioned for fishing in Table 2.2, with the data mentioned for fisheries activities in the gender analysis framework (Table 2.4.). Moreover women and girls practise cane fishing. The material for the traps and the roof covers is mostly collected by the men, while both women and children assist in the making.

In Salo-Palai, compared to Saliki and Taddutan more activities are carried out exclusively by men. The women of Saliki and Taddutan are more involved in the farming than those of Salo-Palai. Women in Salo-Palai seem to focus solely on housekeeping activities which gives them less decision power on the pond-farming and farming related activities and less access to the benefits. The household activities are dominated by women; some bake cookies also for selling.

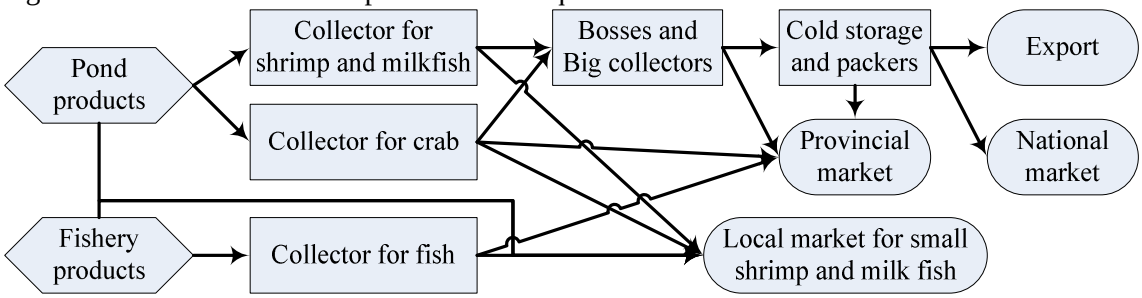
Though women have access to ownership of chicken, they do not have access to land (Table 2.4). The men have better access to information probably because they travel more.

2.2. Networks

2.2.1. Market networks

For the local producers, fishermen and pond farmers, the only part visible part of the market chain is the collector. Most farmers provide their harvest to a collector coming to their farms. The collectors are specialised for products (Figure 2.4.). Collectors can also be specialised for markets: e.g. some collect crab or shrimp for export only. Specialised fishermen are concentrated in specific villages, for the study area in case Saliki-Nilam and Salo-Palai. The specialised fishermen provide to a collector. The landing site of Saliki-Nilam is appropriate for larger trawlers and for landing sea fish. The catches of non-specialised fishing are primarily for household consumption and local market; supplementary fish are mostly salted and dried before selling to a collector.

Figure 2.4: Market network of products from aquaculture and fisheries in the Mahakam Delta



Seed of shrimp and milkfish is collected or bought from neighbours, vendors, or collectors. The vendors and collectors get the seed from local hatcheries, or from other islands and countries.

2.2.2. Institutional analyses

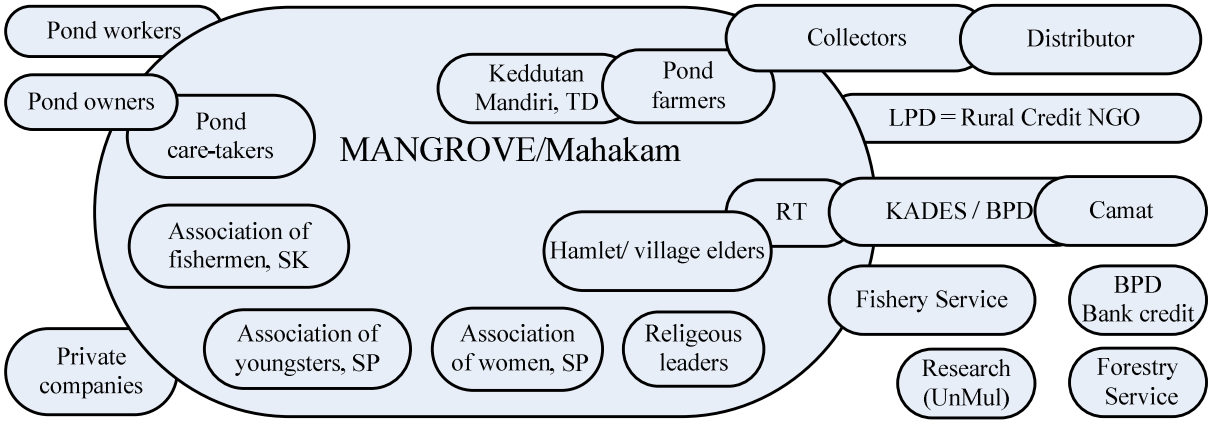
The state structure is quit well integrated in the villages and hamlets through the election of representatives in the village counsel, and the representation at the district level by the village head (Figure 2.4.). At village level the government officers are teachers and administrators only and no technicians. Most government services are weakly represented in the selected sites; the Fishery services only touches upon Saliki and has no contact with farmers on Salo-Palai or on Taddutan. The RA's confirmed that the credit from the state bank is not accessible for pond-farmers and fishermen (Bourgeois et al. 2002).

Community based organisations (CBO's) are not frequent: associations of youngsters and women in Salo-Palai, an association of fishermen in Saliki, and a pond farmers organisation (Keddutan Mandiri) in Taddutan (Figure 2.5.). Two NGO's are active in the region: one for rural credit in Salo-Palai and one for replanting mangrove trees. The last was not mentioned by the farmers, but known in Saliki by the Fisheries Service's agent accompanying UNMUL's team during the fieldwork.

On the other side of the delta, in the sub-district of Sambodja, the Fisheries Service experiments a rural credit system to make the pond-farmers more independent of the collectors. In fact the collectors are also input providers imposing their prices and interest rates to the farmers depending on them. A student of UnMul is monitoring the credit system.

A Management Counsel for the Mahakam Delta has been created in 2004 after the presentation of the report of Bourgeois et al. (2002) commanded by TotalFinaElf but it has never been called to meet. It demonstrates the existing conflicts of interest for many government officials, oil company workers, entrepreneurs, etcetera: many invested in land, be it only by the excavation of a pond or by establishing a plantation, for social security and to have a chance on compensation from government or a mining company.

Figure 2.5. The assembled institutional network of the research sites



SP= Salo-Palai; SK=Saliki; TD=Taddutan; RT = hamlet leader; BPD = counselor of KADES; KADES = head of village

2.2.3. Stakeholders' involvement

Former analysis showed that the pond farmers thought they had no active role to play in mangrove maintenance or recovery and all stakeholders pointed at the village heads and districts authorities (Bourgeois et al, 2002). At present, in Salo-Palai individual pond farmers take action: they plant mangrove and pond farmers in Taddutan created an association having the goal to replant mangrove.

The distribution of pond areas per owner is skewed: few people own most of the areas in (all/two/one) of the sites (Figure 2.5). Some of those are absent owners, sometimes coming each harvest from a local town like Samarinda, but others are living on different Indonesian islands. This makes any mangrove management option extremely difficult. One cannot expect of people exploiting only 1 ha to plant half of it in mangrove while this demands also investing in a new dike. On the other hand, the large owners are mostly absentee rent seekers more interested in increased value of land or compensation by oil & gas companies, than in pond productivity. We assume that the large owners would hardly feel the financial consequences if half of their land would be transformed in mangrove, but most are hard to touch and keep looking for rent.

In Saliki village the first large scale oil palm plantation started in 2600. In 2007 an area of 10.000 ha was covered. The state promotes large oil plantation to create labour but this effect is discussed (Purnomo, 2006).

2.3. Ecological Situation of the Mahakam delta

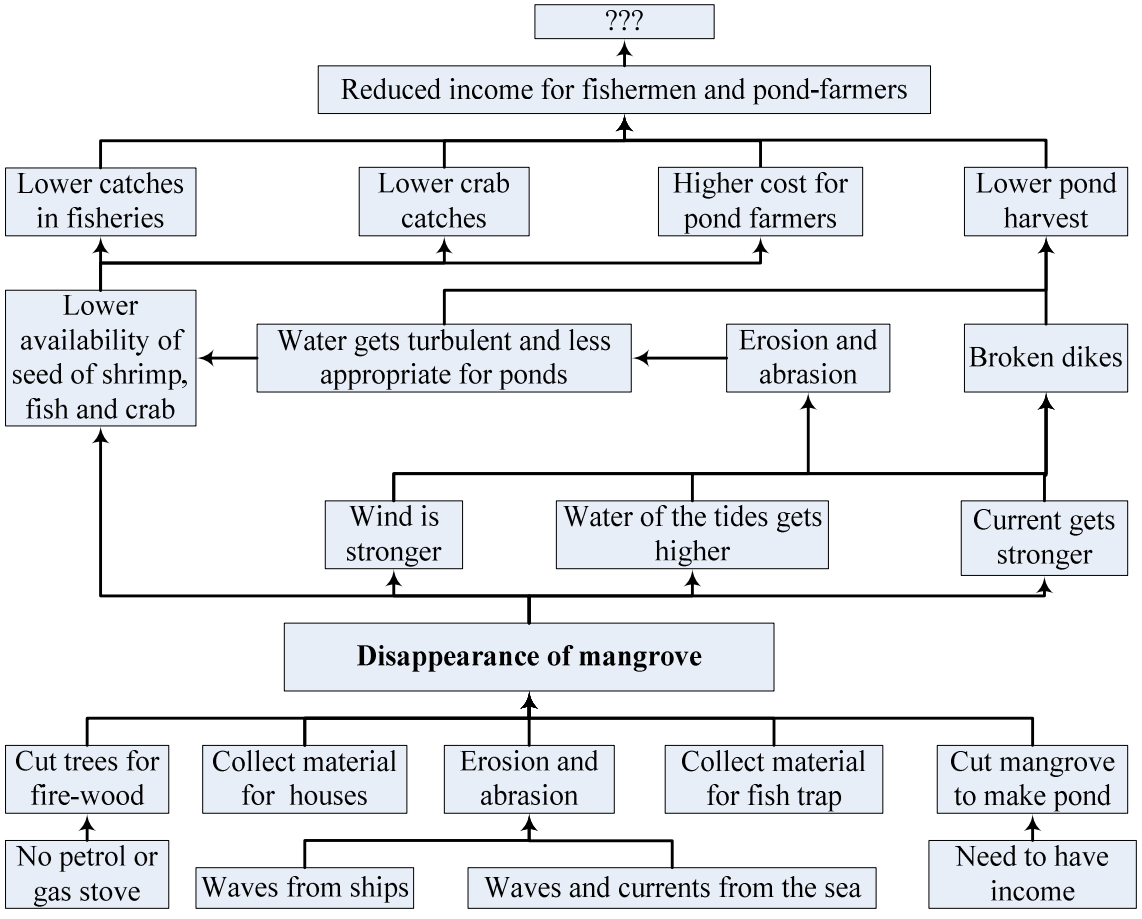
In all three sites the mangrove forests have quasi disappeared. Mostly only a narrow layer of *Nypah* has remained along the shoreline. The last huge mangrove trees suffer from lack of ecological bases. This gives also to think for the possibility of replanting mangrove trees.

2.3.1. Soil type

Soil type in the sub-district Muara Badak is loamy varying from silt loam to clay loam, except for the coastline which is loam with sand. The southern part of the delta receives more sand and the soiltype will probably be clay-loam and sandy clay-loam. Subsoil of some of the islands is peat which makes them very sensitive to erosion and abrasion.

Some soils of the mangroves contain iron pyrite (FeS_2) which is stable in anaerobic conditions (Boyd, 1995). However, especially in acid soils, oxidation of iron pyrite and microbial processes produces sulphuric acid. Sulphuric acid dissolves various metals which can mix with the pond water with run-off from rains or through flooding after prolonged dry periods. To prevent coastal soils containing iron-pyrite to express acid-sulphide properties regular flushing and draining is needed ( ).

Figure 2.6. Problem tree composed from the 3 trees elaborated at Salo-Palai.



2.3.2. Mangrove derives goods and services

The functions attributed to mangrove forests are:

- Provide firewood, and material for roof cover and for traps (mainly for crab)
- Protection of land from high tide and from erosion of current and waves

- Shelter of aquatic animals from heat and predators
- Refuge for reproduction of mud crab, fish and shrimp
- Keep quality of water good
- Protection of dikes from ponds
- Source of food for fish and shrimps
- Keep production of ponds high.

These functions are also reflected in the problem tree (Figure 2.6). The last set of functions is not recognised at every site; the awareness seems higher among populations that reside longer in the delta.

2.3.3. Perception of the situation

Various discussions show that the farmers we met are aware of the problem that may arise if the mangrove layer at the riversides and the coastlines does not get stronger; they fear especially broken dikes and the loss of their harvest. The problem trees show that farmers do not always well distinguish underlying causes, causes, consequences, and final consequences. More awareness raising can be done by using the problem tree extensively.

the way of keeping and repairing pond produce according to villager is : giving more fertilizer, pesticide in pond

saliki villager need pond sample, and their have doubt what is mangrove decomposition good for shrimp and fish in pond or bad for organism cause their assumption decomposes of mangrove can be toxic to organism

Locally farmers started planting or are organising themselves to replant mangrove. The questions remain how the plantation should be done to re-establish the mangrove ecosystem and how can sufficient area be recovered to fulfil the functions attributed to this eco-system. Most farmers planted the trees on the inside of the dikes (see cove page). One may wonder if this may be of any use for pond productivity as planting trees on the dike may also weaken the narrow handmade dikes while farmers fear already a breach from erosion. In fact they should build a second dike at some distance from the river, create space for the mangrove and reduce their pond area. With the present production level the smaller farmers do not have the capital to invest at credit rates asked by the collectors.

2.3.4. Potential indicators for eco-system monitoring in the Mahakam Delta

According to the pond farmers and fishermen the following indicators can be used to monitor the effect of mangrove management:

- enough seed for fish and shrimp;
- easy to find mud crab;
- less mortality of shrimp;
- the presence of apes and wild pigs;
- less destruction of coastline from waves compared to the present narrow area at the riverside composed of *Nypah* mainly.

The number of trees planted and the area covered individually could be registered. To monitor the mangrove coverage the images from Google-earth can be used.

Further the Fishery Service collects data for the sub-district Maura Badak on the quantity of fish equipments and of fish produced by 3 types of cage cultures, by brackish and fresh water culture, and by marine fisheries but nor for open water fisheries. By lack of staff the annual data for fisheries from Saliki and Salo-Palai are based a one sample; the data on pond production are provided by the village head to the sub-district and the method of data collection is not standardised. In the sub-district the sampling is only regular and standardised for 2 of the 9 villages; this is probably the same for the other sub-districts related to the delta.

The data on Gross Provincial Product are based on the same figures provided by the Fisheries Services. The Provincial Bureau of Statistics (BPS) in Tenggarong had no detailed estimations on household income available; the number of households practising an activity as main source of livelihood is available.

2.4. Conclusions and recommendations

In the research sites the mangrove cover has almost been replaced by fishponds except for a narrow fringe of *Nypah* on the riverside. In the entire Mahakam delta close to 90% of the mangrove cover has disappeared; the 10% saved can mostly be found in concessions for oil & gas companies. Farmers fear the consequences of erosion and abrasion on their pond dikes and on the water quality, and the reduced availability of seed for crab, fish and shrimp. The lack of breeding grounds and refuges for the fish is shared by the fishermen.

Around 80% of the livelihood activities of the population of the research sites, pond-farmers, pond care-takers, fishermen and farmers, is based on or related to the mangrove resource. The livelihood activities of the poorer households depends more the natural resource base. The seasonality of the activities is relatively high as the ponds have 4 main harvests per year. Fishing and catching crab give a more regular cash flow, but are only practised during high tide. The relative contribution of pond farming to livelihood is on average close to 50%, which makes the population highly vulnerable for decreasing pond productivity and for shocks in shrimp production like have occurred in the past. A main part of the population immigrated to make a livelihood and if pond farming does not provide this anymore they will, without any doubt, move again to replace still virgin natural resources with plantations or ponds. Improving and stabilising the shrimp production is of the greatest importance, also to reduce the dependency of the pond-farmers upon the products collectors that are at the same time input and credit providers as well as the main source of information on prices and new technologies.

A huge part of the ponds is non-productive, and opened for speculation on high profits, on land value and on compensation by oil companies. These absentee owners of mostly larger non-productive ponds make the re-establishment of the mangrove more complex as they are not interested in a productive pond and are not aware of the eco-systems function.

In an attempt to re-establish the mangrove eco-system some pond owners started to replant mangrove, mostly on the pond-dikes which is probably not the best method. However this gives an opportunity to start action research with the farmers to establish the best ways to recover the mangrove eco-system. The main problem will be the involvement of the absentee owners that hire care-takers, and the owners of ponds that are not put in production. Re-establishing mangrove will bring forward the problem of ownership which is based on the area being a pond. Local authorities need to provide some kind of save-guard (cadastre or contract) to secure the ownership.

We recommend that the RESCOPAR projects carries out at least part of its' pond research on the MANGROVE research sites. If done in a participatory way this may increase farmers' know-how. The Dutch WSSD program from its' Ministry of Agriculture and Fisheries could be requested funding for training of farmers.

3. Participatory Rural Assessments (PRA)

The selected sites are all located at the northern fringe of the Mahakam delta in the district of Muara Badak (Figure 2.2). The district has a many oil and gas wells of which pipelines lead to a central locality. The existing road infrastructure is mostly laid out by Oil & Gaz companies; they construct earthen roads to limit access in order to reduce the risk for the numerous pipelines. The sites are located in Saliki village and in the neighbouring Salo-Palai village. Saliki has over 2,500 inhabitants and is composed of 9 hamlets (RT); hamlets 4, 5 and 6 are mainly composed of labourers for private companies and agents of government. Salo-Palai is located closest to the sea and has a population of mixed origin: local and recent immigrants, like Saliki. The population of Taddutan is almost entirely composed of recent immigrants from Sulawesi.

In Salo-Palai the research will focus on 2 hamlets out of 9: RT-3 and 2 exploiting ponds on Joppang island. The second site is composed by Saliki's hamlet 1, 2, and 3 (Saliki-Nilam) that share Joppang with Salo-Palai. Saliki's hamlets 7, 8, and 9 on the island of Taddutan compose the third site.

After presenting the methods used we will describe the results of the assessments in the three sites: Salo-Palai, Saliki, and Taddutan. Details from the description of the first site that are similar will not be repeated in the following sections but rather discussed.

3.1. Methods and tools

After studying secondary data and a pre-survey to identify the research site, a workshop was held to train the staff involved in the project and to increase awareness among stakeholders. At village level tools of the participatory rural assessments (PRA) were used for rapid assessment (i.e. data collection). At the start, the participation of the local stakeholders at a first meeting of pond farmers was not always representative for the community, which made the gender analyses difficult. Though each PRA becomes unique during the process an effort was made to use identical methods in each site in order to obtain comparable data.

In the first series of general meetings (see 3.2, 3.3, and 3.4) the participants in all villages made an inventory of their livelihood activities, a village resource map, a Venn diagram of the stakeholders involved or of institutions represented or active in the village, and a seasonal activity calendar. The Venn diagram of the market chain made in the first village was verified orally in the others. A problem tree focussing on the mangrove disappearance was composed in one village by three focus groups. A transect walk was superfluous due to the monotony of the village resource maps and of the natural resource base itself.

Individual interviews were held in all three villages to assess vulnerability of the poor. In principle we selected in each sites 3 of each category, but due to under representation of rich and poor at the meeting this was not possible (Table 2.1). As a consequence the sample distribution is relatively representative. Next the general characteristics of the households we asked next to the involvement of sexes in each activity, to score the labour frequency and intensity, cost and risk on a scale of 1 to 5. The importance of the natural resource base for the livelihoods was done by ranking of the relative contribution of each activity to the cash and consumption satisfaction of individual households, using 100 peanuts.

Focus group discussions were organised to complete the data on various subject and a stakeholder workshop to cross-check the results. To cross-check the collected data an identical set of diagrams (except for the map) were presented in each community.

3.2. Salo-Palai

Salo-Palai has close to 1160 inhabitants (about 640 male and 520 females) of which a large part are workers from the private oil & gas companies and from government. The sex frequency distribution is skewed because young women go working in town and get married. At present it is becoming more difficult for young man to find a wife.

Salo-Palai is composed of 9 RT's (hamlets). The inhabitants of four hamlets have activities related to the natural resource base: 1, 2, 3, and 7. Hamlet 3 has only pond farmers and is located on Joppang, the small island at the seaside between Taddutan and the mainland, and only accessible by boat. Hamlet 2 is on the main land and it's population is active in fishing, crop farming and pond farming. Hamlet 2 is the only hamlet with fishermen. Hamlet 3 is composed of 23 households (55 male and 36 females) and hamlet 2 of 27 households (54 males and 37 females). To cover all the activities related to the Mahakam delta's natural resource base we followed the advice of government officials to work both in hamlet 2 and 3.

Two general meetings were held; one during the training week and one to complete the data; the first meeting was held on the island (16 men) and the second on the mainland (12 men and 3 women).

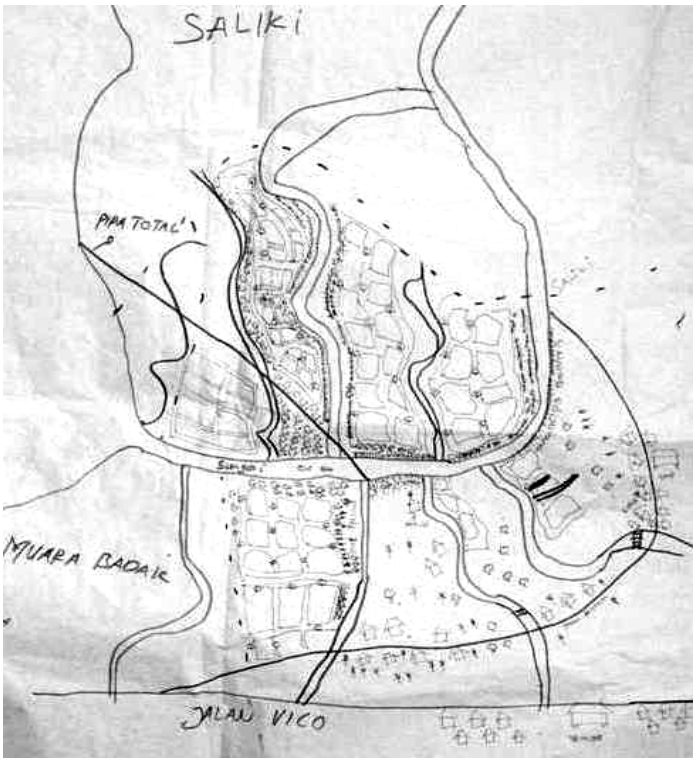


Figure 3.2.1.
The resource map of Salo-Palai, with the sea on left side of the figure (=north). On the east side Salo-Palai is limited by Saliki (dotted line); on the north side by the sea and Muara Badak village. The islands are located in the center of the map.

Legend:
Pipa TOTAL = pipelines;
Jalan VICO = company made road
The double lines leaving from that simple one are roads, other lines are creeks and rivers.

3.2.1. Livelihood activities

Households' livelihood activities in Salo-Palai are based both on natural resources, on brackish water and fresh water pond farming, and on dry land farming (Table 3.2.1). Some households depend on one source of income: salaried workers and government officers. For pond farmers, farming of shrimp, milkfish and collecting crab is the main source of income. From the brackish water ponds they harvest milkfish, and three types of shrimp (red, spotted and white); the milkfish and the shrimp are stocked with seed collected or bought in the neighbourhood, or bought from vendors or collectors. In the fresh water ponds they raise Nile tilapia. Crab is collected from the pond and its' vicinity. The catch of fishing is mainly composed of *Pangasius nasutus*, *Macrones nemurus*, *Collossoma macropomum* (all freshwater), *Lates calcalifer Bloch*, *Parastromateus niger Bloch* and *Pampus argenteus* (all brackish water). Fishing is done either with mini-trawlers (at sea), multiple hooked lines, set-nets, and traps (for crab mainly).

Pond farming is by far the most demanding activity, as well for labour and cost, but above all producers find it risky (Table 3.2.1). Also collecting aquatic products is considered risky, probably because of the hazard on spoiling of the ware.

Table 3.2.1. The main livelihood activities in Salo-Palai, their sex involvement, a score on a scale of 1 to 5 for the demand in labour (frequency and intensity), for the cost and the risk of the activity and their relative contribution to livelihood (sample size: 9 households only).

Livelihood activities	Sex task division* ♂	Sex task division* ♀	Labour freq.	Labour int.	Cost	Risk	Relative contribution to livelihood (%) Cash	Relative contribution to livelihood (%) Cons.
Fishing	100	0	2.7	2.6	2.5	2.6	8	6
Make traps & roof covers	100	100	2.0	2.0	3.0	4.0	0	1
Prepare dry salted fish	33	67	1.4	1.2	1.0	0.8	2	5
Pond farming	100	50	4.0	3.8	4.2	5.0	32	4
Off-farm pond worker	100	75	3.1	3.4	2.0	1.5	3	6
Collect fish for market	100	0	2.0	1.0	5.0	5.0	4	1
Catch mud crab	100	0	3.8	3.3	2.0	2.0	6	1
Make and sell cookies	0	100	2.0	1.9	1.6	1.3	1	7
Crop farming	100	50	3.5	3.0	3.0	4.5	3	2
Non-farming **	100	0	2.5	1.0	2.0	3.5	8	1

* % of the male and of the female involved in the activity for the households doing the activity.
** Non-farming in the sample includes: construction workers and salaried labourers.

Gender

Some activities are carried out exclusively by men (fishing, collecting crab, collector, non-farm), while other engage dominantly men (pond and crop farming). Baking cookies is an exclusive female activity though most for household consumption only, while preparing dry salted fish is dominated by women (Table 3.2.1.). Only making traps and roof covers seems to engage both equally.

If no petrol stove is available, the women collect firewood from the surrounding area; they feel it is quite difficult and time-consuming. On the island drinking water is collected from the rain or brought from a well on the main land.

The gender analysis framework for several mangrove related activities shows that the access of women to ownership of land and its' benefit is limited (Table 3.2.2). The men provide most of the labour input and have more power in decision-making except for making salt fish. The men have slightly better access to information.

Table 3.2.2. Gender analysis framework for several mangrove related activities.

Activity		Labour input	Access to ownership	Decision-power	Access to benefit	Access to information
Pond farming	Husband	+ + +	+ +	+ + +	+ +	+ + +
	Wife	+	0	+ +	0	+ +
	Children*	-	-	-	-	+
Fisheries	Husband	+ + +	+ + +	+ + +	+ + +	+ + +
	Wife	+	0	+	+ +	+ +
	Children*	+ +	-	+ +	+	-
Making dry salted fish	Husband	+	+ +	+ +	+ +	+ +
	Wife	+ + +	+ +	+ +	+ +	-
	Children*	0	0	-	+	-

Legend: - = not and never ; 0 = mostly not ; + = some ; ++ = good ; +++ = very high
* category replacing 'young' who were not very much present in the communities being at school or working outside the area.

Figure 3.2.2. Annual activity calendar, Salo Palai village (completed on 30 May 2007)

	Livelihood activity	1	2	3	4	5	6	7	8	9	10	11	12
1.	Pond farmers												
	a) Preparation of pond												
	b) Pond feeding and management												
	c) First harvest of shrimp												
	d) Harvest of shrimp and milkfish												
	e) Cleaning of pond												
2.	Fishermen												
	a) Fishing with northern wind												
	b) Preparation of fishing equipment												
	c) Fishing with southern wind												
	d) Off-farm pond worker (harvest)												
	e) Prepare dry salted fish												
	f) Fish with set-nets, wire, and canes												
3.	Collectors of products												
4.	Other mangrove related activities												
	a) Collect crabs												
5.	Other activities												
	a) Bake cookies												
	b) Crop and tree farming												
	c) Salaried labourer *												
	d) Trading, renting and shop keeping												

* some labourers in the oil and gas industry have jobs with 3 weeks up 1 weeks off.

Mangrove derives goods and services

In Salo-Palai, 35% of livelihood sources, including fisheries, depend on a good functioning mangrove. When including the pond and related activities this increases to 80%. Other livelihood resources are farming and various temporary and permanent jobs. Dependency on mangrove derived goods and services, is relatively high. The contribution of own capital to pond production is good: on average about 25% only is funded through the collectors, though especially the care-takers depend on collectors for 100%.

According to the inventories of 4 focus groups the functions of mangrove are:

- Protection of land from high tide and from erosion of current and waves
- Fish refuge/shelter: from heat and predators
- Prolific reproduction of mud crab, shrimp and fish
- Protection of dikes from ponds
- Source of clean water and food for fish and shrimps to keep production of ponds high.

Vulnerability.

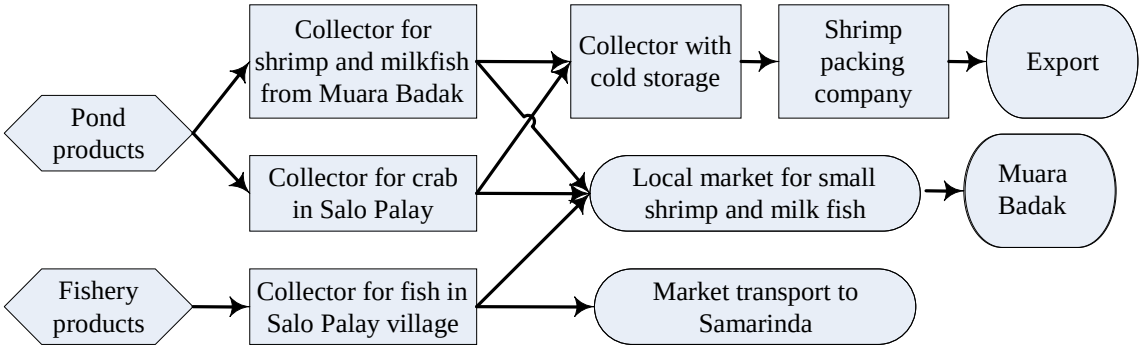
The high dependency on the pond and related activities makes the population vulnerable, which is reinforced by seasonality. The seasonality of most livelihood activities is high and depends either on season or on the tide (Figure 3.2.2.). The activities of pond farming and crab collecting are related to the tide and harvesting. Pond labourers are especially needed for the harvest, sometimes for cleaning and preparation, and for reparation of the dikes (December at spring tide), making land-less the most vulnerable category. The pond harvest period lasts about 14 days, when tides is rising and falling in day-time. The big harvest is four times a year: March, July, September, and December. Crab collection continues all year during high tide. While fishing at seas depends on the seasonal winds, the river fishing activities are permanent at high tide and allow the family to cover current expenditures.

Fishery catches decreased since 2005 when fuel price in local market high, so that some people was to do fishing as second job just for consumption not for sell. The shrimp production decreased sharply since 2000 and reached a bottom line in some ponds. Especially care-takers and specialised pond farmers wait desperately for a good year or a new technology. Pond farmer in Salo Palai have assumption they are remain to work as pond farmer, pond farmer didn't have mind to changes another job besides pond farmer, they are think nothing alternative work beside pond farmer, though their have low/failed harvest until 3 period, their still hope to get a good harvest just 1 periods.

3.2.2. Market networks and institutional analyses

The market network of the aquatic products is not very transparent for most farmers as they only meet the specialised collectors (Figure 3.2.3.). The collector is the only source of information for farmers on market prices.

Figure 3.2.3. Market network as perceived by the population of Salo Palai.,

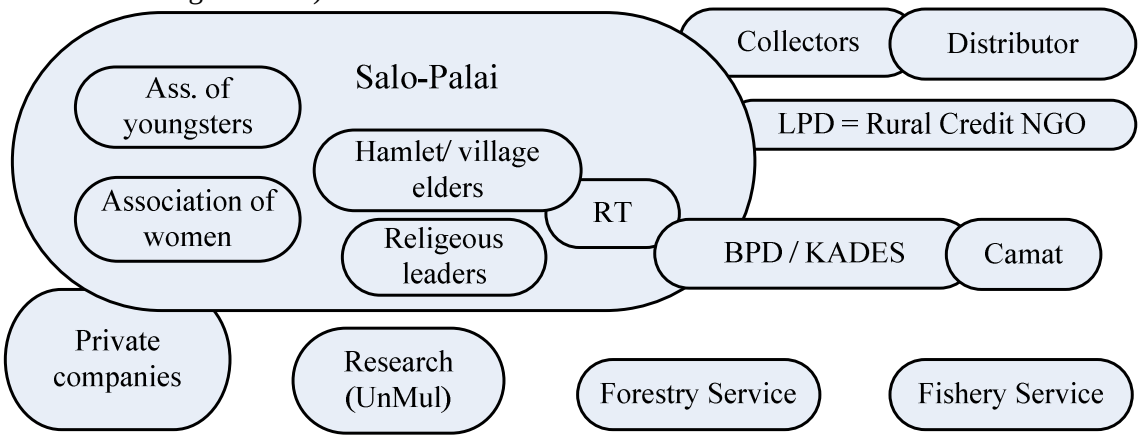


Salo Palai has two community based organisations (CBO's): the women association and the association of young (Figure 3.2.4.). One NGO is active in the field of rural credit. The religious leaders and village elders have influence but they are not formally organised. Other types of organisations are government related. The State Services for Fisheries or for Forestry do not intervene in Salo-Palai.

The private oil and gas companies provide a lot of labour, but were also a source of conflict as they claimed their concession on land in which no other activities are allowed late and unexpected.

The decentralised government institutions are well based in each hamlet (RT) and village. Each hamlet chooses a hamlet leader (the RT) and than a hamlet leader, village elder, religion leader, and leader of young association that sits in the village counsel (BPD). The village chooses a head of village (KADES) and a counsellor (BPD) that command the government officers at the village and that represent the village at district level.

Figure 3.2.4. Venn diagram of institutional relations of Salo-Palai village(RT = Hamlet leader = member of village counsel).



3.2.3. Ecological setting

The dominant soil type of Salo-Palai is loam. The sub-soil of the island Joppang is probably composed of peat. Pond opening started since 1994 by Mr. Abidin; he opened a pond of 2 ha by hand. In the past the population of Salo-Palai succeeded to limit land distribution to a maximum of 4 ha per person, but this does not reflect any more in the land distribution (Table3.2.3). In most cases the real pond size is must smaller than the actual area between the dikes as only the soil needed to make the dikes was excavated while the central plateau of most pond kept its' the original level (Photo cover page).

Table 3.2.3 The estimated land and owners distribution on Salo-Palai's section of Joppang

	total land area (ha)	% land area	number of pond owners
2 ha and less	7.8	2	5
between 2 and 5 ha	75	24	25
between 6 and 15 ha	134	42	15
15 ha and more	101	32	5

Causes and consequences of the mangrove disappearance were analysed with a problem tree. Three focus groups composed very different trees that are partly complementary (Figure 3.2.6). To prevent mangrove forest from disappearing following actions were proposed by the local population:

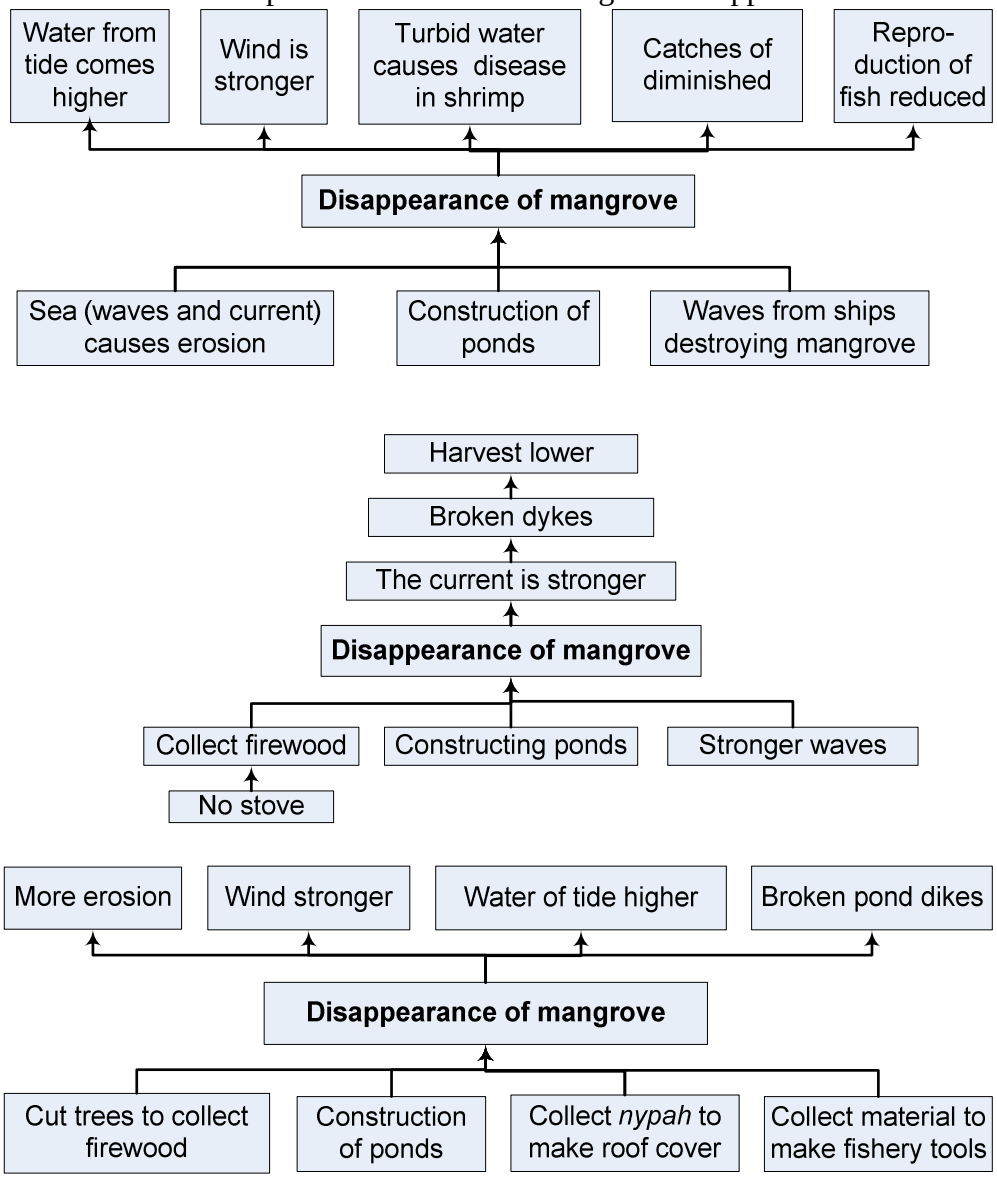
- Provide information on mangrove function and rehabilitation technology
- Stop cutting mangrove a.o. for pond opening
- Own initiative of pond-farmers to recover and replant mangrove.

One group estimated a specific organisation is needed for mangrove recover.

Most pond farmers are aware of the importance of mangrove for pond productivity and started replanting trees at the onside of the pond dike. An elder immigrant from Sulawesi whose wife and children already returned, almost completed the tour of his 2 ha pond (Figure 3.2.6). One may wonder if this may be of any use for pond productivity as planting trees on the dike may also weaken the narrow handmade dikes while farmers fear already a breach from erosion. In fact they should build a second dike at some distance from the river, create space for the mangrove and reduce their pond area. With the present production level they do not have the capital to invest at credit rates asked by the collectors.

The farmers' gave the following indicators for good mangrove coverage: enough seed for fish and shrimp; easy to find mud crab; less mortality of shrimp; less destruction of coastline from waves than the present narrow area at the riverside composed of *Nypah* mainly.

Figure 3.2.7. Three different problems trees of the mangrove disappearance



3.3. Saliki

Officially, the population of Saliki is mainly composed of (in decreasing order) workers of the company exploiting the oil & gas fields, shrimp farmers, pond workers, and farmers. The proposed research sites are RT-1, RT-2 and RT-3, mainly composed of fishermen and farmers having a pond on Saliki's section of Joppang, the small island between Taddutan and the mainland, that they share with Salo-Palai (Figure 3.3.1). RT-1 alone has close to 170 households, RT-2 has over 50 and RT-3 more than 80, together they unite over 580 female and 700 male.

Most of the households exploiting a pond on the island and originating from Saliki have two residencies: one on the mainland and one on the island on the pond-dike. Other inhabitants of the island are care-takers or watchman for large owners. The resource map shows that hardly any space is left for mangrove on this section of the island.

Two general meetings were held; one during the training week and one to complete the data; the first meeting was held on the mainland (6 men) and the second on the island (12 men and 3 women). In between data were collected by individual interviews.

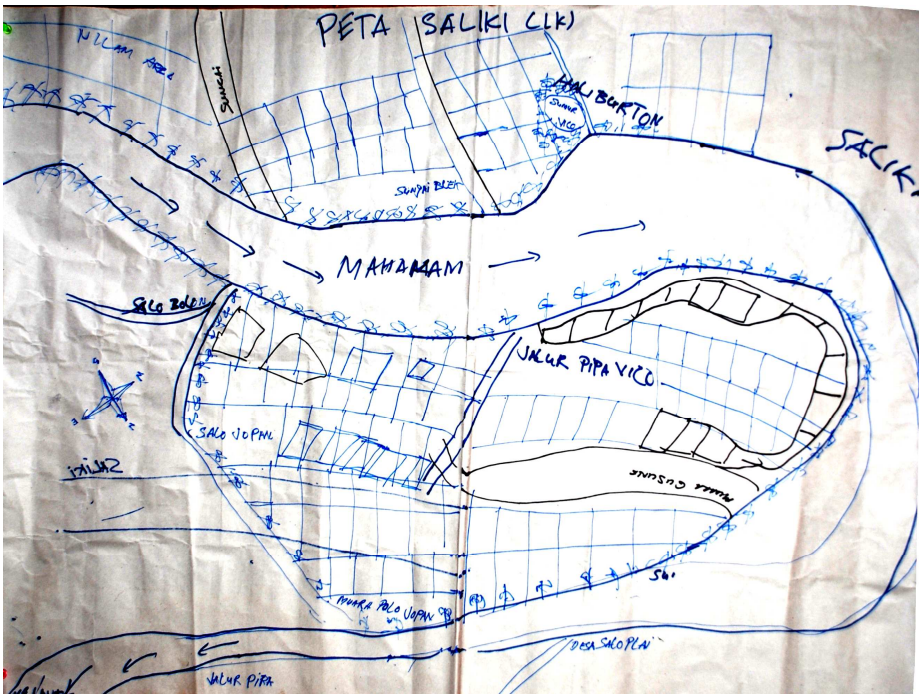


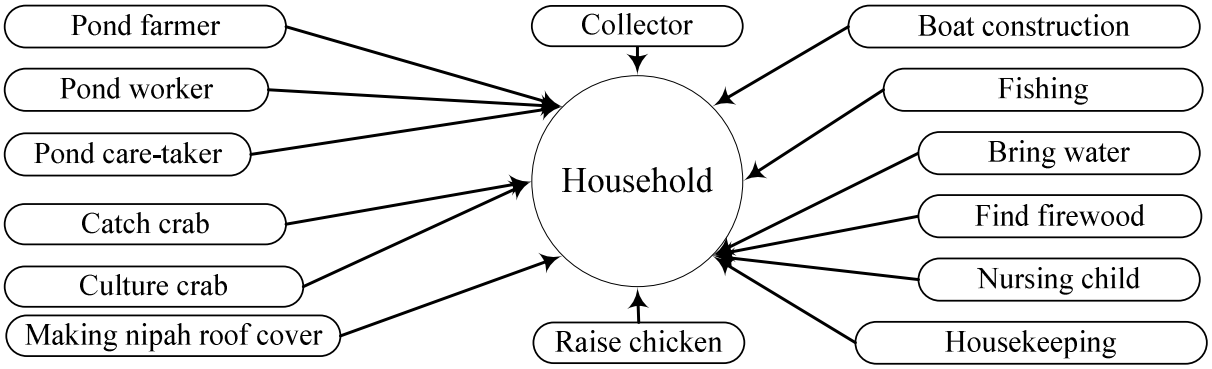
Figure 3.3.1.
The resource map of hamlet 1, 2, and 3 of Saliki, drawn by the men present at 01-06-2007; the left side (east) of the island Joppang in the centre of the map belongs to Salo-Palai.

3.3.1. Livelihood activities

Figure 3.3.2. shows the activities of the section of Saliki's population using the natural resources for their livelihood. Farmers of Saliki started to culture crab. On the mainland also fresh water pond could be found. The chickens are mainly kept near the house in the village; other households kept Bali cattle. In Saliki sufficient women were at the meeting to have a female focus group discuss gender related questions (See section Gender).

The drinking water for the households on the island comes from the mainland and all gender assist in collection and transport. Both men and women collect firewood for household consumption only and not for sale. Especially collecting fire-wood can be a constraining activity; some households estimated that collecting fire-wood took over 15 % of a persons' time (See section: Mangrove derived goods and services).

Figure 3.3.2. The livelihood activities mentioned by the people present on 01-06-2007.



* and bring child to school

** including: cooking. sewing, ,washing, baking, accompany husband

This figure resumes the activities given by a group of men and women separately.

Though the relative contribution of pond culture to the livelihood is important, fishing, crop and livestock farming and non-farm activities contribute more to consumption and provision of cash compared to the other sites (Table 3.3.1). Nevertheless in Saliki also, the activities related to pond culture, catching crab and the collection of aquatic products are the most labour demanding. Pond culture and collection of aquatic products are the most costly and risky. The high score for the labour demand for making traps and roof covers is not in agreement with the low frequency mentioned in the calendar (Figure 3.3.3, page 23).

Table 3.3.1. The main livelihood activities in Saliki RT-1 and 2, their sex involvement, a score on a scale of 1 to 5 for the demand in labour (frequency and intensity), for the cost and the risk of the activity and their relative contribution to livelihood (sample size: 12 households).

	Sex task division*		Labour freq.	Labour int.			Relative contribution to livelihood (%)	
Livelihood activities	♂	♀			Cost	Risk	Cash	Cons.
Fishing	100	0	3.2	3.5	3.0	3.3	16	5
Make traps & roof covers	67	67	3.7	3.7	4.3	3.0	0	1
Pond farming	100	63	3.5	3.4	4.4	4.1	23	6
Pond care-taker	100	0	4.5	4.5	2.5	3.0	10	3
Collect fish for market	100	50	4.5	3.5	4.5	4.0	5	1
Catch mud crab	100	33	3.7	3.7	2.8	2.3	10	1
Household activities**	0	100	3.5	3.0	2.0	1.7	0	3
Crop & livestock farming	75	50	2.8	2.5	2.5	1.8	1	4
Non-farm activities***	100	33	2.5	2.0	1.5	3.0	9	2

* % of the male and of the female involved in the activity for the households doing the activity.

** Includes: making dry and salted fish

*** Includes: off-farm pond work, making boat, salaried labour, renting and trading.

Gender

In Saliki, compared to Salo-Palai, less of the activities are carried out exclusively by men (fishing, pond care-taker). However the labour for most activities is dominantly provided by men (Table 3.3.1). Preparing dry salted fish and baking cookies are included in the household activities dominated by women, because these activities did not contribute to the generation of cash by people in the sample. The material for the traps and the roof covers is mostly collected by the men, while both women and children assist in the making. This last and the strong involvement of women in making dry salted fish explains the apparent contradiction

between the labour division mentioned for fishing in Table 3.3.1, with the data mentioned for fisheries activities in the gender analysis framework (Table 3.3.2).

The gender analysis framework for several mangrove related activities shows that the men present at the meeting estimate the access of women to benefits very high compared to Salo-Palai. Though women have access to ownership of chicken, they do not have access to land as in the other sites (Table 3.3.2). For pond farming and fishing the men provide most of the labour input, but the women of a say on the benefits especially from fisheries, and chicken. According to the participants as the women of Saliki are more involved in the farming activities than those of Salo-Palai, the first have also higher decision power on the activity and access to the benefits; women in Salo-Palai seem to focus solely on housekeeping activities. The men have better access to information, probably because they travel more.

Table 3.3.2. Gender analysis framework for several mangrove related activities

Activity		Labour input	Access to ownership	Decision-power	Access to benefit	Access to information
Pond farming	Husband	+ + +	+ + +	+ + +	+	+ +
	Wive	+ +	0	+	+ +	+
	Children*	+	-	-	+	-
Fisheries	Husband	+ + +	+	+ +	+	+ + +
	Wive	++	0	+ + +	+ +	+
	Children*	+	-	-	+	-
Culture crab	Husband	+ + +	+ +	+ +	+	+ +
	Wive	+	0	+	+ +	+
	Children*	-	+	-	+	-
Raise chicken	Husband	0	+	-	+	0
	Wive	+ + +	+ + +	+ + +	+ + +	0
	Children*	0	+	-	+	0

Legend: - = not and never ; 0 = mostly not ; + = some ; ++ = good ; +++ = very high
* category replacing 'young' who were not much present in the communities being outside the area.

Mangrove derives goods and services

In Saliki (hamlets 1 and 2), the relative contribution to livelihoods from mangrove derived goods and services is 49%, which is higher compared to Taddutan and Salo-Palai due to a.o. the fisheries activities (Table 3.3.1.). When including the pond related activities this figure increases to 74%, which is lower compared to the other sites (scoring 85 and 80% respectively). The pond farmers themselves fund close to three quarters of their culture activities, the smaller part is provided by the collectors.

One of the mangrove derived goods is firewood. According to two pond caretakers living alone, collecting the wood may take up to 25 % of their resources at the present shrimp productivity and price. A focus group discussion with care-takers on contract arrangements, they are have 5 type on contract arrangement (Table 2.4: lines 1, 2, 3, 8 and 9). The cost of the rent of land is 4 million Rupiah per year.

Table 3.3.3. The estimated land and owners distribution on Saliki's section of Joppang

	total land area (ha)	% land area	number of pond owners
2 ha and less	10	2	10
between 2 and 5 ha	220	33	100
between 6 and 15 ha	275	41	20
15 ha and more	160	24	6

Most people whose livelihoods are related to pond-farming are either care-taker or owner of less then 5 ha. The care-takers are in charge of larger areas on behalf of either 2 persons living in the main village, of several others living in other villages/cities of Kalimantan, or living on Sulawesi.

Vulnerability

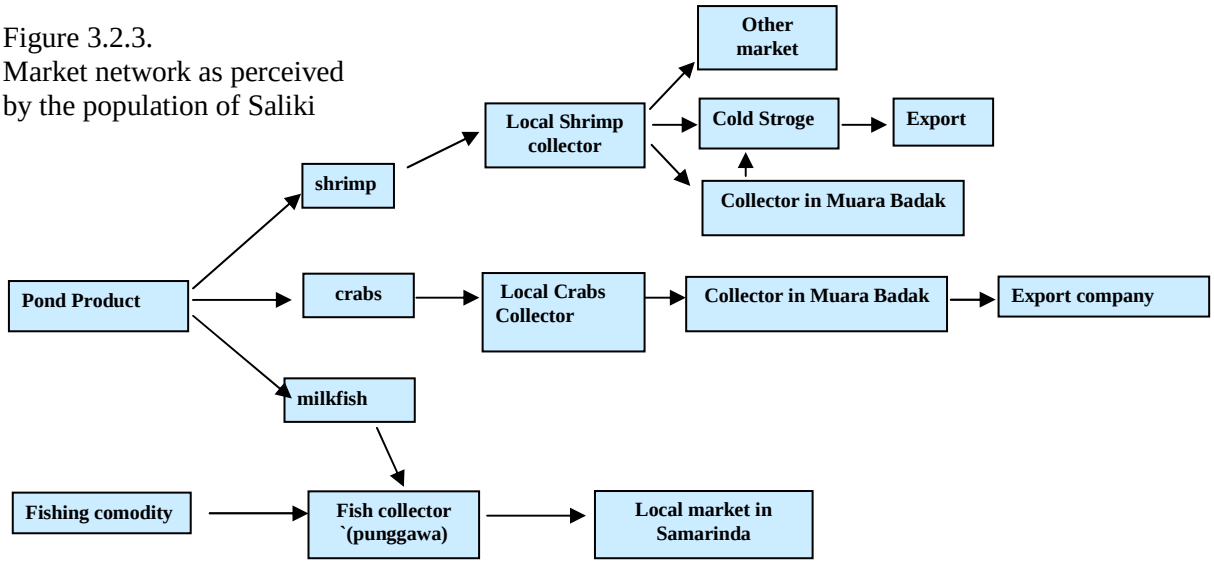
The main activities in Saliki seem influenced by the tides only (Figure 3.3.3, page 22). The people fish only in the river and this is not seasonal like in Salo-Palai where sea-fishing is practised. The fire-wood is collected seasonally and stored to dry.

The opening of ponds on this section of the island Taddutan started in 1992 only. Replacing mangrove with ponds was completed after the financial crises of 1997 that made extensive shrimp farming lucrative in local currency. Since 2004, 12 years after the first pond opening, the shrimp production sharply decreased due to the effect of the white spot shrimp virus.

3.3.2. Market networks and institutional analyses

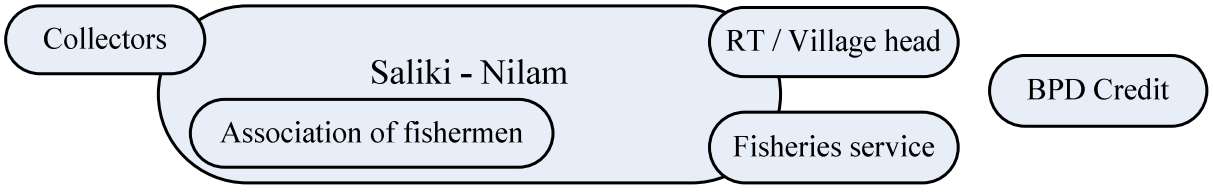
As in Salo-Palai and Taddutan most producers rely entirely on the collectors for the information on the prices. The Fisheries Services are present in Saliki but do not provide information on prices.

Figure 3.2.3.
Market network as perceived by the population of Saliki



The institutional framework of Saliki is poor in internal organisations: only the fishermen have an organisation (Figure 3.3.5). The pond farmers and fishermen of Saliki do not have access to the credit of the BPD as they cannot present a proof of regular income. The mainland of the village has regular contact with the Fishery Service though it is mainly for monitoring. The pond farmers have never been offered training on aquaculture.

Figure 3.3.5. The institutional framework has perceived by farmers and fishermen of Saliki-RT1,2&3.



On the island the proportion of pond farmers to care-takers is around 665 ha (Table 3.3.3). A majority of the pond owners has 1 or 2 ha on the riverside of the island. Most of the larger ponds are located at the interior of the island. Two large owners are from Saliki, the village head and Mr. Darmawan, and the two outsiders are hadj Ariff from Taddutan (Taddutan) and hadj Saha from Samarinda. One of the last is assumed to have claimed over 400ha of land. The village head obtains a good productivity from his ponds because he was have pond since 1992 and reaching top production at 1997 at the moment prawn got high price Rp. 250.000,-/kg, besides he knows the importance of mangrove function as shelter/refuge seed of shrimp and crab and can protection land from disaster from sea like tsunami.

3.3.3. Ecological setting

The main land Saliki-Nilam is located on loam. The island is probably a huge loamy mud-flats upon peat.

The first pond on this island was opened in 1992 by an inhabitant of Saliki. By 1997 50% of the mangrove was replaced by ponds, by 2000 90% and in 2005 all except 1 ha (see figure 3.3.6) and the borders of the river and creek. In the vicinity the only large mangrove area is a concession of an oil & gas company on the territory of Salo-Palai.

A NGO's is active in mangrove planting and these activities are known by the agent of the Fishery Service but most local pond farmers do not seem to be aware of the possibilities. One pond farmer planted over 100 mangroves but only 3 survived because he did not have information on the planting conditions. Planting on the central plateau of the pond did not succeed but planting on the dikes is successful.

According to the farmers the wild pigs have disappeared from the island but they still observe apes. Mangrove area is needed for the reproduction of fish, shrimp and crab. Indicators for good mangrove cover are:

1. Seed of shrimp, crab and fish got to much and easier was founded
2. Wild pigs and apes easier to founded
3. The land have never floods and dike never damage
4. High Productivity of pond and fishing.

Figure 3.3.6.
The resource map of Saliki drawn by the women who were present on June 1 2007.

The 1 ha of mangrove is located at the south of the island (right upper corner of the picture).

Piko= concession of VICO company.

Figure 3.3.3. Annual activity calendar of Saliki hamlet 1 (1 Juni 2007)

	Livelihood activity	1	2	3	4	5	6	7	8	9	10	11	12
1.	Pond farming												
2.	Collecting crab												
3.	Making and repairing boats												
4.	Pond care-taker												
5.	Catching fish												
6.	Renting boat												
7.	Labour for pond harvest												
8.	Culture crab												
9.	Collecting firewood												
10.	Raising chicken												
11.	Housekeeping& raising children												

Figure 3.4.3. Annual activity calendar of Taddutan (31 May 2007)

	Livelihood activity	1	2	3	4	5	6	7	8	9	10	11	12
1.	Pond farming												
2.	Pond care-taker												
3.	Pond worker												
4.	Collecting crab												
5.	Catching fish												
6.	Making *nypah* roof cover												
7.	Collector												
8.	Trading or keeping shop												
9.	Preparing dry salted fish												
10.	Collecting fish seed												

3.4. Taddutan

Taddutan is part of Saliki village but located at between 1 and 2 hours of boat travel from the village offices on a well separated island. It is composed of three hamlets: RT 7, 8 and 9 (Figure 3.4.1). According to the RT leaders these have close to 350 households, of which less than 250 are registered. Officially RT-7, 8, and 9 are composed of 67, 15 and 8 households with around 270 males and 170 females. Apparently the village offices of Saliki are strange to most people on Taddutan coming from and having part or all of their household living on the island of Sulawesi.

Except for a small island in the vicinity, all land has been transformed in ponds. The first opening pond by H. Arif and H. Saha with wide of 20 ha, the first by hand and later with machines. Mangrove and *Nypah* populations can only be found at the coast line of the islands. The sea-side of the island belongs to the district of Muara Badak and is separated from Taddutan by oil & gas pipe-lines. Hamlet 7 is separated from hamlet 8 and 9 by a large creek.

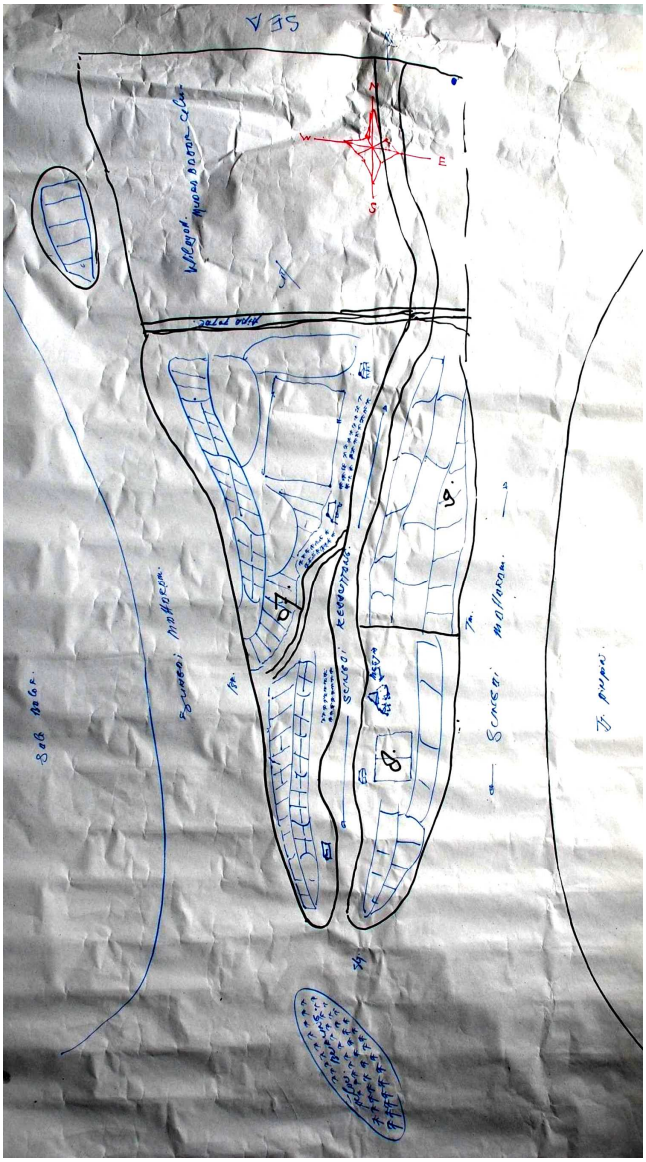


Figure 3.4.1. The resource map of Taddutan; on the right the island Pimping.

3.4.1. Livelihood activities

The livelihood activities of the population of Taddutan focus around the ponds (Figure 3.4.2) contributing by far most to the livelihood (Table 3.4.1). Some activities are for household consumption only; other household related activities have been omitted: carry water and collect fire-wood. In Taddutan the pond related activities dominate the labour demand and carry the highest risk (Table 3.4.1.). Only the collector estimates his activity is more costly, which seems justified.

Figure 3.4.2. The livelihood activities of the population of Taddutan

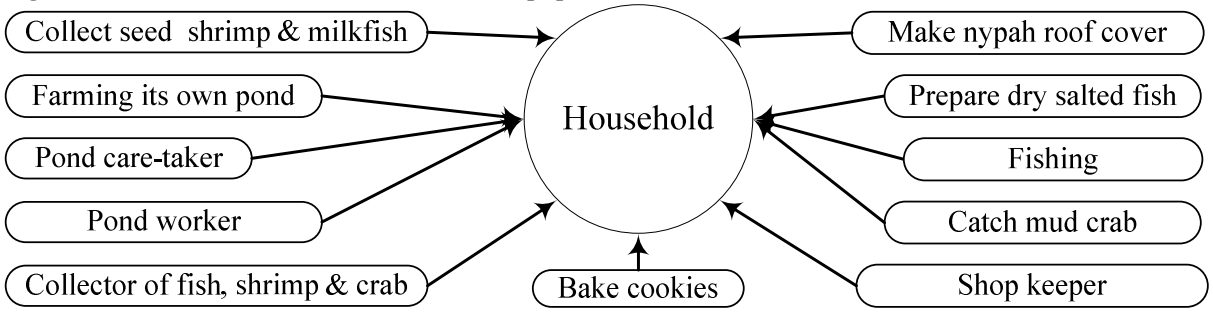


Table 3.4.1. The main livelihood activities in Taddutan, their sex involvement, a score on a scale of 1 to 5 for the demand in labour (frequency and intensity), for the cost and the risk of the activity and their relative contribution to livelihood (sample size: 8 households only).

Livelihood activities	Sex task division* ♂	♀	Labour freq.	Labour int.	Cost	Risk	Relative contribution to livelihood (%) Cash	Cons.
Fishing	100	0	3.0	2.0	1.5	1.5	3	2
Make traps & roof covers	100	25	2.0	1.8	2.3	2.5	1	4
Prepare dry salted fish	67	83	2.7	2.2	1.5	1.7	4	2
Pond farming	100	25	4.4	3.1	3.5	3.5	47	10
Off-farm pond worker	100	0	4.0	3.0	1.0	3.0	1	1
Pond care-taker	100	50	5.0	5.0	2.5	2.5	2	1
Collect fish for market	100	25	4.0	3.5	3.8	3.0	5	1
Catch mud crab	100	29	3.9	3.1	2.4	2.1	11	3
Collect seed for pond	100	0	5.0	4.0	3.0	3.0	1	0
Collect fire-wood **	0	100					0	2

* % of the male and of the female involved in the activity for the households doing the activity.
** Omitted during assessment, are from a household activity not using a natural resource.

Gender

In Taddutan, compared to Salo-Palai, less of the activities are carried out exclusively by men (fishing, pond worker). However, men dominantly provide the labour for most activities, except for preparing dry salted fish that is dominated by women (Table 3.4.1). Men collect the nypah material for the roof covers, while both women and children assist in the making of the small mats (Table 3.4.2).

The gender analysis framework for several mangrove related activities shows that the men present at the meeting estimate the access of women to benefits very high compared to Salo-Palai. Women's access to ownership of land is limited (Table 3.4.2). The men provide most of the labour input and have more power in decision-making especially for collecting seed. The men have better access to information on pond farming because they travel more.

Table 3.4.2. Gender analysis framework for several mangrove related activities

Activity		Labour input	Access to ownership	Decision-power	Access to benefit	Access to information
Pond farming	Husband	+ + +	+ +	+ + +	+	+ + +
	Wife	+	0	+	+ + +	0
	Young	+ +	-	0	+	0
Fisheries	Husband	+ + +	+ +	+ + +	+ + +	+ +
	Wife	0	0	0	0	+ +
	Young	+ +	+ +	0	0	0
Collect shrimp and fish seed	Husband	+ + +	+ +	+ + +	+	+
	Wife	0	0	0	+ +	0
	Young	+	+	+	+	+
Making roof cover	Husband	+ + +	+ + +	+ + +	+ + +	+ + +
	Wife	+	+ +	+	+ +	+ +
	Young	+	0	+	+	0

Legend: - = not and never ; 0 = mostly not ; + = some ; ++ = good ; +++ = very high

Mangrove derives goods and services

In Taddutan, 31% of livelihood sources, including fisheries, depend on a good functioning mangrove. When including the pond and related activities this increases to 85%, which makes the population extremely vulnerable. Other contributions to livelihood are household related activities, various temporary jobs and trading.

Vulnerability

The pond related activities are governed by the tides: when raising and falling tide are in daytime farmers harvest shrimp (Figure 3.4.3., page 23). When the tide is stagnant the pond related activities are less intensive. The effect of season is lower compared to Salo-Palai because fishing activities are limited to the river at high tide. Also catching crab is done at high tide. Four times a year the pond is emptied for the main harvest. In December a pond worker is needed to repair dikes that are damaged by spring tide.

The trend of lower pond productivity due to the high disease frequency also reached Taddutan since 2001. High productions have become rare: disease has become normal and acceptable productivity a good event. Most farmers have little idea on the fundamental causes, on the relation with disappearing mangrove forest and do not dispose of any technological solution.

The contribution of own capital to pond production is excellent: on average about 12% only is funded through the collectors, though especially the care-takers depend on collectors and punggawa for 100%. Some of the contract arrangements between care-takers and pond-owners in Taddutan are slightly different from the other site (Table 2.4: line 4,5,6,7, 8 and 9). The cost of land rental is Rp. 2.000.000/ha/year only. About 50% of the pond area is not registered and a relative huge proportion of the ponds covers over 15 ha each (Table 3.4.3.)

Table 3.4.3: The estimated land and owners distribution in Taddutan

	total land area (ha)	% land area	number of pond owners
2 ha and less	4.5	0.1	3
between 2 and 5 ha	25	0.6	10
between 6 and 15 ha	260	6.7	34
between 15 and 30 ha	452	11.6	14
30 ha and more	1170	30.9	13
Non registered (average 26.2 ha)	1941	50.0	74

3.4.2. Market networks and institutional analyses

The information on the market only reaches the farmers of Taddutan through the collectors. The collectors come to the farmers' house located next to the pond-dikes, agree the price with the farmer and select and weigh the presented production. If farmers are in short of cash for whatsoever they mostly turn to these same collectors or through the collectors to their bosses or punggawa for a credit.

Figure 3.4.3. The stakeholders of the livelihoodsystem in Taddutan.

The care-takers are in charge of larger areas on behalf of persons living in other villages/cities of Kalimantan or on Sulawesi. Except for the local government representation, the institutional network of Taddutan is limited to the stakeholders of the pond farming (Figure 3.4.3). When pond opening started an organisation in charge of the distribution of land was active: *Fajar terbit*; since all land has been distributed this organisation had become de-facto non-functional. Recently the pond farmers of the 3 hamlets created their own organisation: Keduttan mandiri, having 27 members, which is less than 10% of the households living in the 3 hamlets. The goal of this organisation is the maintenance and replanting of mangrove.

3.4.3. Ecological setting

The subsoil of the islands is peat covered with up to 1 m of fluvial loam depositions. Pond opening started in 1990 and almost all mangrove forest had completely disappeared in 2001. The nypah fringe at its' coast line has become very narrow. The rare large mangrove trees that can be seen on the island also seem to lose their vitality, probably by lack of ecological basis.

The negatives effects of mangrove disappearance mentioned by the farmers are: erosion by the tidal currents and the waves and lower seed production of fish, shrimp, and crab. They have the feeling that the water level raises (it may well be that the weight of the dikes compress the peat). The strength of the water and the narrow layer of *Nypah* worries them because the dikes of their ponds are relatively narrow because they were hand-made. Besides, according to farmers the cutting of mangrove results in bad water quality (dark and bad smell). Newly cleared areas need to be washed for 3 month before being appropriate for shrimp production.

Indicators for a good mangrove cover are plenty of young fish, shrimp, and crab. When there were still mangrove forests on the islands people from Samarinda came to fish.

References

Bourgeois R, Gouyon A, Jésus F, Levang P, Langeraar W, Rahmadani F, Sudiono E, Sulistiadi B, 2002. A socio economic and institutional analysis of Mahakam Delta stakeholders. Report to Total-Fina-Elf. 1xx pp.

Boyd C.E., 1995. Bottom soils, sediment, and pond aquaculture. Chapman and Hill. 347 pp.

BPS, 2005. Annual report of the East Kalimantan Provincial Bureau of Statistics.

Noyadi, Bambang I Gunawan, Afie Maidie, Iwan Suyatna, A Syafei Sidik and Suripno, 2006. A study on pond productivity in Mahakam delta, East Kalimantan. FPIK/UNMUL.

Purnomo Henry, 2006. New forest and employment. Forest, People and Governance. Governance Programme Bulletin, Vol. 7 No 3, pp 2-3.