An assessment of the impacts of the 26th December 2004 earthquake and tsunami on aquaculture in the Provinces of Aceh and North Sumatra, Indonesia

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Executive summary

Background

An assessment of the impacts of the 26th December 2004 tsunami on aquaculture in Aceh and North Sumatra was conducted by Agus Budhiman (Directorate General of Aquaculture) and Dr Michael Phillips (NACA) during two missions from 11th-24th February and 2nd-15th March 2005. The objectives were (in summary) to: (1) assess the impacts of the tsunami on aquaculture and the livelihoods of people dependant on aquaculture; and (2) identify follow up actions to support rehabilitation of the sector.

After a preliminary review of information available in Banda Aceh, priority aquaculture areas along the north and east coasts of Aceh (the districts of Aceh Besar, Pidie, Bireuen and Aceh Utara) were selected for detailed assessments. During extensive field visits to tsunami affected aquaculture sites in these areas, consultations were held with government, donor agencies, farmers, farmer organizations, NGO's and aquaculture trading businesses. Information from other tsunami affected areas, including North Sumatra province, was obtained through consultations with government and review of secondary material and FAO capture fisheries assessments.

Aquaculture sub-sector

Aquaculture in Aceh is socially, economically and environmentally important, and a significant part of the livelihoods of many coastal people. The main farming system is the brackishwater pond (locally known as a tambak) producing mainly milkfish (*Chanos chanos*) and shrimp (*Penaeus monodon* and other species), covering around 47,000ha. According to Provincial Government statistics in 2003, around 6,100 tonnes of milkfish were produced, destined for local domestic food and bait for tuna long lining; and an estimated 10,300 tonnes of shrimp harvested from tambaks, destined for export markets (via traders to Medan). A range of minor species are also produced in tambaks, including mullets, crabs and seabass. Apart from tambak farming, there is also some marine fish cage farming in Lhoksuemawe, and in Simeulue island, producing high value groupers for export. In North Sumatra province, aquaculture in the tsunami-affected districts on Nias islands, involves marine cage farming of high value groupers and other marine fish species to supply the live reef fish trade.

The total value of brackishwater farming makes a highly significant contribution to overall fisheries values in Aceh. Dinas Perikanan statistics give a farm-gate value of US$56.3 million, of which an estimated US$ 9.7 million is fish, and US$ 46.5 million crustaceans. Black tiger shrimp makes up the biggest proportion, providing US$41.8 million to total value. MAFF/World Bank figures give the fishery sector of Aceh a value of Rp 1.59 trillion, or US$176.67 million[1]. Based on these figures, the value of brackishwater aquaculture products is 32% of total fishery value. As these figures are based on farm-gate estimates, they under-estimate total value of production that will increase as product moves along the market chain.

1 Figures from the Strategy and Program for Rehabilitation and Reconstruction of the Fishery Sector in Aceh and Nias. Departmen Kelautauan dan Perikanan, Republik Indonesia.

Aquaculture in Aceh was also supported by mainly small scale private enterprises, including shrimp hatcheries, shrimp and fish nurseries and active trading networks that provided fish and shrimp seed, feed, fertilizer and the other inputs required for farming.

Shrimp and milkfish farms in Aceh are mainly operated as traditional, low input, farming systems producing shrimp and milkfish in polyculture and monoculture situated along the north-east coast. Semi-intensive and intensive shrimp farms are also present, but make up a small proportion (probably less than 20%) of the total numbers of ponds and area covered. The number of intensive and semi-intensive shrimp farms increases along the east coast towards Medan, and has started developing over the past 5 years on the west coast of Aceh, although total farm areas along this coast are still low.

Most traditional farmers are small-scale farmers (<2 ha). Land/farm ownership and employment patterns vary, and include owner-operated, rented, contract farming, labour, as well as some ponds owned by the village community. The varied ownership patterns and beneficiaries make post-tsunami recovery interventions potentially complex.

Aquaculture in Aceh was a highly significant livelihood activity for many people. According to Provincial Dinas Kelautan dan Perikanan statistics, there are 14,859 brackishwater farmers. However, these figures appear to include only farmer owners or operators and therefore significantly under-estimate the number of people involved as labourers, suppliers of inputs, traders, marketing and service provision. Each hectare of pond is estimated to provide direct employment of between 1 to 3 people/ha, depending on location and farming system. Subject to further verification, 94,000 or more people therefore may be directly employed in 47,000ha of ponds. Particularly along the north-east coast, tambak farming provides a high incidence of the employment in coastal villages. In Rhum Baru village in Bireuen district, for example, one of the communities visited during the present mission, 194 out of 251 households were involved full or part-time in tambak farming. With significant numbers of un-employed in north-east coastal areas following the tsunami, there is a strong social justification and increasingly urgent need for support to rehabilitation of aquaculture.

Tsunami impacts

The tsunami of the 26th December 2004 severely affected aquaculture in Aceh province, and the island of Nias on the west coast of North Sumatra province. The impacts include:

Aquaculture facilities:

- Extensive physical damage to ponds and associated infrastructure (dykes, water gates, farmer huts, machinery). Damage ranges from light damage to dykes, to complete loss of ponds. In the heavily affected district of Aceh Besar, for example 10's of hectares of ponds and canals have simply been lost to the sea.
- Debris and silt causing heavy sedimentation in ponds and irrigation canals. The damage to brackishwater irrigation canals has also disrupted water supplies and in

some areas effectively stopped brackishwater pond farming in undamaged tambak ponds behind the coast.
- Extensive losses of farmer crops, including fish (mainly milkfish), shrimp and some marine fish (fry/marketable fish). Dinas Perikanan statistics confirm the 4th quarter as the most productive time of the year, supporting farmer claims of loss of shrimp and milkfish crops close to harvest.
- Extensive damage to 193 of the 223 shrimp hatcheries in Aceh.
- Loss of marine fish and nets in cages in Simeulue island and Nias islands.

Our assessments suggest that at least 20,000 ha of tambaks have been damaged, with possibly another 5,000ha out of production due to damaged water supplies. Approximately, 9,000 ha of ponds (47%) are severely damaged or lost, a major loss of a significant source of income and employment for the province.

Households:
- Loss of life among farmers and employees, and households that depend on aquaculture.
- Loss of livelihood assets among surviving farmers and households dependant on aquaculture. This includes people who made a living from aquaculture and who totally lost their production assets and capacity to rehabilitate it.
- Loss of employment opportunities throughout the market chain.

Our assessments suggest that at least 40,000 people directly employed in aquaculture in Aceh have been directly affected, with significant knock-on effects in households dependant on aquaculture. Loss of life was most severe on the west coast, but the tsunami has destroyed a source of livelihood for many thousands of people living on the east coast where tambak farming was well established.

Public services:
Public services, including the Dinas Perikanan (Fisheries Department) at District and Provincial levels, the Ujung Batee Regional Aquaculture Development Centre and Universities in Aceh lost staff and facilities during the tsunami, severely affecting their capacity to support rehabilitation.

Private services:
Private sector organizations, including the tambak farmer associations, also lost members during the tsunami. Inputs suppliers, including shrimp/fish collectors, feed business and traders were also directly and indirectly affected. The business of aquaculture has effectively stopped in the major farming areas of the east coast, and disappeared from the severely impacted west coast.

Interventions are required for the rehabilitation of livelihoods of people dependant on aquaculture in the short, medium and long-term.

Short-term interventions

There is a need for significant short-term intervention to support the livelihoods of people dependant on aquaculture, and the recovery of the aquaculture sector. Not only is this urgent, but socially important due to the large number of people involved.

Assistance is needed to resume livelihood activities in priority areas where short-term rehabilitation is possible through:

- Cash for work schemes to provide quick income in communities and help to restore water supply infrastructure to aquaculture areas.
- Mechanical dredging of water supply and drainage systems where cash for work is not feasible, or a combination of the two as appropriate.
- Support to provision of pond inputs (seed, fertiliser), emphasising most vulnerable affected small-scale farming households.
- Technical and financial support to restart hatchery production to ensure newly rehabilitated aquaculture areas have sufficient shrimp and fish seed for stocking
- Starting to rebuild essential support services and capacity to support aquaculture rehabilitation

At the same time, some tambak areas have been severely damaged and require substantial investment in replanning and design. Further detailed assessments and planning is required in such areas for medium to longer-term recovery, including the need to re-establish green belts and protective mangrove cover as needed.

The needs over more than 20,000 ha of ponds are substantial, and therefore priority should be given to locations where support is most urgent. The mission suggests priority short-term interventions in aquaculture in the three coastal districts of Pidie, Bireuen and Aceh Utara, where the largest numbers of small-scale traditional tambak farmers are located. Farmers and labourers have few opportunities for other employment in these districts, with economies substantially dependant on aquaculture and fisheries.

The mission prioritized several sub-districts for rehabilitation assistance within these three districts; however, further prioritization is required to identify sub-districts, villages and beneficiaries where support is most urgent. Criteria for prioritization include areas of significant small-scale involvement, a high proportion of village households involved, areas where short-term recovery is possible and avoiding areas with potential for conflict with proposed government policy of green belt re-establishment. It is also essential to identify the most affected people, using livelihood approaches, and seek to provide the support necessary for the most vulnerable affected people in the community.

Following structural rehabilitation through cash for work schemes, support is required for inputs (seed, fertilizer, lime, etc), emphasizing lower risk and traditional farming systems for milkfish and shrimp.

Mechanisms for delivery of support include “cash for work” programs to dig out canals and ponds. In some areas mechanical digging of secondary and primary canals will be required, however, such mechanical interventions should be done carefully, and only following detailed planning. After resuming water supplies, production in tambaks can start, but assistance will be needed for excavation of silted ponds and damaged tambak structures. Some tambaks are so severely damaged (or lost) to make short-term start-up impossible. Alternatives and long-term planning needed in such cases. Wherever opportunities arise, rehabilitation assistance should seek to improve

pond design and water supply infrastructure, rather than repeat previous poor system design.

The delivery of rehabilitation assistance should, as far as possible, support recovery of capacity for self-help among farmers, farmer organizations and communities. The planning for aquaculture rehabilitation should be based on the fullest participation and ownership (eg local tambak farmer associations in planning and implementing interventions).

Rebuilding of local institutions should start with their active involvement in planning and rebuilding. Although rehabilitation is urgent, this should be done with environmental sensitivity and long-term planning in mind, taking account of proper design. There are a number of issues to be considered in short support for rehabilitation of aquaculture, including the need for effective targeting and prioritization, land ownership issues, identification of poor and the most vulnerable with least assets, options for unemployed labourers and others without access to productive ponds and the need to promote environmentally sound technology.

During the mission, several FAO activities were initiated: (1) a project proposal drafted for FAO/Government of Italy support to rehabilitate the Ujung Batee regional brackishwater aquaculture development centre; (2) an aquaculture component for an ECHO project "Emergency assistance for food security and restoration of livelihoods amongst tsunami-affected farmers, fisher folks, women and other vulnerable groups of Indonesia"; and (3) a pilot cash for work, and input support for small-holder tambak farms in Pidie district.

Medium-term interventions

Further detailed assessment and planning is required to develop medium and long-term requirements for aquaculture rehabilitation, but the following issues require attention:

- Better planning and rehabilitation of tambak ponds integrated within better coastal environmental planning and rehabilitation process at district, sub-district and village level.
- Replanning and rehabilitation of severely damaged tambak areas in Aceh Besar, the west coast and some areas along the north-east coast where there has been severe tsunami damage. In particular, attention should be give to replanning of overcrowded farming areas or where ponds are encroaching into green belt or sensitive mangrove habitats.
- The need for a major coastal planning and management initiative, including identification and zoning of areas suitable for aquaculture and green belts. Ideally, a masterplan should be prepared, identifying suitable aquaculture sites for long-term investment and rehabilitation assistance, and areas that should be returned to mangroves or a coastal protective green belt.
- Support to implementation of better aquaculture farming and management practices to improve brackishwater farm productivity and reduce risks to farmers.
- Development of infrastructure for brackishwater ponds within better planned aquaculture areas

- Rebuilding of institutions and public services to sustain recovery, including capacity building among public services and private sector organizations and financial mechanisms to support economically sustainable recovery. Particular attention should be given to farmer organizations, and supporting capacity building of farmers for local management of aquaculture.
- Development of appropriate policies and regulations to support sustainable recovery of aquaculture, emphasizing environmental sustainability and equity.
- Investigations of market chains and the potential for market access for aquaculture product from Aceh, promoting improved prices for Aceh farmers, incentives for adopting more sustainable farm management practices and generation of resources to support responsible aquaculture rehabilitation.
- Diversification of aquaculture and provision of alternative aquaculture livelihood options, for example the role of mariculture in new west coast brackishwater land and options for unemployed or landless pond labourers.

Program organization

There is a need for a structured and well coordinated program approach for rehabilitation of aquaculture in Aceh, which facilitates:

- Coordination of financial and technical assistance to supporting diverse needs for aquaculture rehabilitation across a large coastal area
- Effective mechanisms for delivering support
- Effective targeting of support based on needs
- Matches needs with the availability of technical and financial assistance.
- An approach based on a livelihood approach well integrated with other support.

The mission suggests establishment of a mechanism at National, Provincial and District levels to facilitate coordination and communication. However, the importance of establishing locally recruited teams working at District level with Dinas Perikanan to implement a delivery and results oriented district recovery program is emphasised. The principle functions of the District team should be:

- To assess needs and prioritise support
- To facilitate communities to develop and implement aquaculture rehabilitation plans
- To facilitate implementation (directly, or draw on support opportunities – eg NGO's, cash for work etc)
- To perform a strong communication function at district level and between district and provincial/national levels to share experience and facilitate coordination

The approach should as far as possible seek to support formal and informal village organizations and farmers to plan and implement recovery.

As far as possible, expertise available within Indonesia (including Acehnese students and staff working elsewhere in the country) should be drawn upon to build the district teams and support capacity and provide technical assistance, supplemented as required with external assistance.

Partnership between different agencies and donors should be promoted, for effective and coordinated support.

Recommendations

There are substantial needs of people dependant on aquaculture in tsunami affected communities in Aceh, and Nias. This assessment indicates that aquaculture rehabilitation is most urgent along the north-east coast districts of Pidie, Bireuen and Aceh Utara. The assessment identifies some priorities for urgent support and the following recommendations for supporting implementation:

1) To put in place the institutional and management arrangements to support an aquaculture rehabilitation program. The approach outlined in the report should be discussed with government and community stakeholders for refinement and adoption of coordinated program approach to aquaculture. Institutional strengthening will be required among institutions involved in the program

2) To organise trained District teams operating at District level to conduct assessments and implement rehabilitation programs for coastal communities in priority districts. Donor support should be provided to organize, train and equip these teams urgently in the priority three districts of Pidie, Bireuen and Aceh Utara.

3) To adopt a livelihood approach in rehabilitation of aquaculture, and develop support based on the needs of communities as expressed in a community formulated aquaculture rehabilitation plan. Special attention should be given to identifying most vulnerable tsunami affected people, and options to support their livelihoods.

4) To establish clear mechanisms for delivering support to communities for rehabilitation, including cash for work, input provision and technical support. Guidelines on the procedures and mechanisms for delivery of support to aquaculture rehabilitation should be prepared, including contact points to facilitate easy access to the different support mechanisms available in Aceh.

5) No one organization or donor can support the considerable and diverse needs for rehabilitation of aquaculture in Aceh. Several organizations, including FAO and donors, both private and public, have important and complementary skills and resources to offer. It is recommended to adopt a “partnership” approach, with partnership agreement agreed between government and major supporting donors and technical agencies to promote collaboration and communication in supporting an aquaculture rehabilitation program.

6) Further assessments should be conducted of impacts on aquaculture, and the need for aquaculture rehabilitation in areas not covered in detail by the present assessment (details are provided in the report). The mission is not supportive of stand along assessments, but ideally such work should be undertaken as part of a process of support, to identify village priorities and target groups, rehabilitation/livelihood and follow up support as appropriate required.

7) Capacity building and technical support is essential for district staff, NGOs and farmer and community organizations to plan and implement aquaculture rehabilitation.

8) Guidelines and tools should be developed to support rehabilitation (eg soil identification and acidity management, environmental management, resource planning, livelihoods approaches, and others as noted in this report).

9) A database and communications system should be established to share damage assessments, and rehabilitation experiences, with effective coverage of all affected communities where aquaculture rehabilitation is required. Communication can be improved by working groups, email discussions and promoting more dialogue on aquaculture.

10) Preparation of Provincial/District plans for medium and longer-term rehabilitation of the aquaculture sector, and its integration with coastal resources management should be prepared, building on the concepts provided in this report.

11) Plans should be developed for institutional rehabilitation, covering infrastructure and human skills and capacity building requirements needed to establish effective public institutions.

12) The possibility of creating special market access for aquaculture product from Aceh should be explored, used to encourage adoption of socially and environmentally sound farming practices during rehabilitation and generating private sector support to rehabilitation.

13) Detailed maps of affected villages should be prepared to assist in mapping, design and planning of aquaculture rehabilitation.

14) The social structure of the aquaculture sector is complex, with various degrees of ownership and participation, and different stakeholders and beneficiaries. Further careful assessment should be conducted as part of the process of developing aquaculture rehabilitation plans, to ensure positive social impact from rehabilitation activities.

15) To support socially and environmentally responsible rehabilitation of the aquaculture sector a set of aquaculture rehabilitation guidelines should be prepared, taking into account relevant international and regional agreements (eg FAO Code of Conduct for Responsible Fisheries) and experiences, to guide government, donor and NGO rehabilitation support. These should be prepared through multi-stakeholder inputs, encouraging wide ownership. When complete, training should be provided in their use to government/NGO/projects involved or considering involvement with aquaculture rehabilitation.

16) The need to explore ways to improve access of credit and grant funding for rehabilitation of aquaculture ponds by farmers.

Further recommendations are provided in the final section of this report, supported by several annexes for further information, guidance on the approach to be adopted and the draft concepts developed during the mission.

Introduction

This report provides an assessment of the impacts of the 26th December 2004 tsunami disaster in Indonesia on aquaculture in Aceh and North Sumatra provinces. It was prepared by Agus Budhiman (Directorate General of Aquaculture) and Dr Michael Phillips (NACA), based on two field missions during the period 11th-24th February and 2nd-15th March 2005.

The objective of the assessment was (in summary) to: (1) assess the impacts of the tsunami on aquaculture and the livelihoods of people dependant on aquaculture; and (2) identify short term (priority) and medium-long term actions to support rehabilitation and reconstruction.

The detailed Terms of Reference for the mission are provided in Annex M.

Assessment methods

The mission made field visits to tsunami affected areas. On the basis of preliminary assessment of information available in Banda Aceh, the priority aquaculture areas along the north and east costs were chosen for detailed field work and consultations in the districts of Aceh Besar, Pidie, Bireuen and Aceh Utara. A short visit was also made to Meulaboh in Aceh Barat on the west coast.

The mission had consultations with government, donor agencies, farmers, farmer organizations, NGO's and business. Information from other tsunami affected areas, including North Sumatra province, was obtained through various consultations, a workshop on 9th-10th March, and review of secondary material and FAO assessments.

The preliminary findings from the mission were presented to representatives from the Marine Affairs and Fisheries (MAFF), Provincial and District government (Dinas Kelautan dan Perikanan[2]), donors and NGOs at a fisheries workshop organised by MAFF and FAO at Banda Aceh on 9th-10th March 2005. The workshop, that was intended to review the draft MAFF strategy and program for rehabilitation and reconstruction of the fishery sector in Aceh and Nias, provided an opportunity for incorporation of relevant aquaculture issues from the mission into the draft strategy.

The mission program, people consulted and some key documents and information sources are provided in Annexes A to D.

Pre-tsunami aquaculture in Aceh and North Sumatra

This section describes the aquaculture situation in North Sumatra and Aceh before the tsunami, with an emphasis on Aceh. The information comes from review of statistics (mainly 2003) and consultations with government, researchers and farmers in Aceh.

[2] Dinas Keluatan dan Perikanan is the Indonesian term used for the Departments of Marine Affairs and Fisheries, operaint at central, provincial and district levels. In this report, the term Dinas Perikanan refers to the same.

Aquaculture in North Sumatra

Aquaculture is well developed in the province of Sumatera Utara (North Sumatra), and the province is considered by government to have significant potential for future development. Medan, the provincial capital, is a major trading centre, and the centre for processing and export of aquaculture products from Sumatra, including shrimp produced by farms in Aceh.

According to data from the Provincial Dinas Perikanan in 2003, there were about 17,231 ha of freshwater pond culture and about 4,427 ha of brackishwater pond ("tambak") farming, in which the following species are cultivated: *P. monodon*, *P. merguiensis*, *Litopenaeus vannamei*, mud crab (soft shell for fattening), and tilapia. Tambaks, a traditional Indonesian term for brackishwater ponds, are found on both the east and west coasts. Marine fish cage culture of high value groupers is found in Langkat on the east coast, but mostly on the west coast in Nias and Central Tapanuli (Sibolga bay). On the island of Nias, the area of the province affected by the tsunami, groupers are cultured in floating net cages in the Pulau Telo archipelago in south Nias district and in small amounts along the west coast districts of Lahewa and Sirombu in Nias district. These areas have abundant coral reefs and cage culture here was based predominantly on wild caught grouper juveniles. Lobsters and marine ornamentals are also held in cages prior to export. The Provincial government recently built a marine fish hatchery in Lahewa district, but this had not started operating at the time of the tsunami[3].

Dinas Perikanan statistics for 1999-2003 are provided in Table 1 below.

Table 1: Aquaculture production (tonnes) in North Sumatra, 1999-2003

	1999	2000	2001	2002	2003
Coastal					
Marine cage culture	286.7	400.5	436	489.3	453.1
Brackishwater pond	15,170.2	19,133.9	19,933	22,651.2	21,649.5
Freshwater					
Freshwater pond	8,044.0	7,735.8	8,444	10,381.5	10,702.9
Rice-fish farming	7,054.4	6,388.1	6,388	6,234.8	5,748.4
Running water tanks	245.2	288.8	318	374.6	313.2
Floating net culture	1,786.0	2,267.4	2,673	3,496.7	3,489.0
Cage[4]	240.0	172.7	203	414.5	231.4
Total	**32,826.5**	**36,387.2**	**38,393**	**44,042.6**	**42,587.5**

Source: Aquaculture Statistic of Dinas Perikanan dan Kelautan, North Sumatera Province, 2004

The export of North Sumatra Fishery products was 28,217 tonnes in 2002 of which frozen shrimps were the main product, followed by live crab and fish, and other fishery products. Export markets for shrimp are Asia (mainly Japan), followed by the European Union, USA, and others. Groupers and other live reef fish and lobsters are exported from Nias island and Sibolga bay via live fish boat to Hong Kong.

[3] The hatchery was subsequently damaged seriously during the 28th March 2005 earthquake in Nias.

[4] The difference between "cage" and "floating net culture" is unclear

Medan is an important trading centre for processing and export of fishery products. All shrimps produced in Aceh are processed and exported from Medan. Informal reports from processors in Medan suggest that import of shrimps from Aceh has all but ceased since the tsunami, creating economic difficulties for the processing business in Medan.

Aquaculture in Aceh

Overview

Aquaculture makes an important contribution to the fish and shrimp production, food, employment and income of the province of Aceh. Farming of fish and shrimp takes place in brackishwater ponds ("tambaks"), freshwater ponds, cages and rice fields. In 2003, official government statistics prepared by the Provincial Dinas Kelautan and Perikanan[5] provide the following estimates (total and breakdown by sub-sector)[6].

Table 2: Aquaculture production in Aceh province in 2003

	Total	**Brackishwater ponds**	**Freshwater ponds**	**Marine cages**	**Rice-fish farming**
Number of households	26,442	14,859	5,992	39	5,552
Total area (ha)	43,173	36,597	2,086	1,137	3,353
Water area (ha)	37,885	31,996	1,399	1,137	3,353
Production (t)	30,573	19,282	7,034	1,681	2,576
Value (Rp, million)	637,042	506,757	81,226	22,535	26,524
Value (US$ million[7])	70.78	56.31	9.025	2.50	2.95

In freshwater, the main fish species cultured are common carp (ikan mas), *Puntius* (java barb), tilapias, kissing gouramy and catfishes. In brackishwater, the main species cultured are milkfish (bandeng) and shrimps (udang), with smaller quantities of mud crabs and brackishwater fish (primarily mullets and seabass) and tilapias.

As is clear from the table above, brackishwater farming makes up the major part of production and value, employment, area and production. It is also the sub-sector that because of its location in the coastal area of the province was most affected by the tsunami. The following descriptions therefore focus on brackishwater farming.

Brackishwater pond locations and area

Brackishwater ponds were found along the east and west coast of Aceh province, but the largest areas were on the north-east coastal districts of Pidie, Bireuen, Aceh Utara and Aceh Timur (Table 3).

[5] Statistik Perikanan Budidaya. Provinsi Nanggroe Aceh Darussalam, 2003. Published by the Dinas Kelautan Dan Perikanan, Banda Aceh.

[6] We report here the figures provided by the Provincial Dinas Perikanan. Our consultations with district government suggest these figures are under-estimates, with 47,621 ha of tambak area (including water and land)

[7] Converted at 1US$ = Indonesian Rupiah 9,000

Table 3: Brackishwater pond area and production by district (2003 data)

	Total pond area (ha)	Net (water) pond area (ha)	Pond production (tonnes)	% of total pond area by district	Yields (t/ha)[8]
North-east coast					
Kota Subang	28	25	514	<1	20. 6
Banda Aceh	724.3	651.9	1234	2	1.9
Aceh Besar	1006	855	1116.1	2.7	1.3
Pidie	5056	4298	1551	13.8	0.36
Bireuen	5146.7	4629	3757.1	14.1	0.81
Aceh Utara	10520	9514	3960.2	28.7	0.42
Aceh Timur	7822	6654	3658	21.4	0.55
Kota Langsa	2122	1803		6.0	
Aceh Tamiang	3858	3279	3367.7	10.5	1.0
West coast				0	
Aceh Jaya				0	
Aceh Barat	289	267	110.3	<1	0.41
Nagan Raya				0	
Aceh Barat Daya				0	
Aceh Selatan	25	20	10.9	<1	0.54
Aceh Singkil				0	
Simeulue			3	<1	
Total	36597	31996	19282		0.60

Ponds are located in coastal plains, sometimes occupying former mangrove land.

Tambak (pond) farming systems and species

The majority of ponds in coastal areas are so-called "traditional" ponds. These are low input ponds farming either milkfish or shrimp. Traditional farming practices involve polyculture of these two species, but many farmers now also practice monoculture of shrimp during part or all of the year. There is also some more commercially oriented semi-intensive and intensive shrimp farming, however, the proportion of farms operating such systems is quite low. Traditional farms tend to be operated as small-scale family businesses, whereas semi-intensive and intensive farms are more investment oriented.

Production levels are lowest in Pidie and Aceh Utara, reflecting the low level of intensification in these two districts. In other districts, yields are slightly higher, reflecting a mix of traditional and more intensive shrimp farming systems. Overall yields for the province are around 0.6 t/ha/year, which are indicative of the overall dominance of low yielding traditional farming systems (see Table 4).

Milkfish

Milkfish (*Chanos chanos*) were widely farmed in tambaks on the east coast of Aceh. The highest production is in Bireuen, Aceh Utara, Aceh Timur and Aceh Tamiang.

Larger size milkfish are sold in local markets for domestic consumption. They are usually grown for 4-6 months and harvested at a size of 300-400g. Fish are cultured in

[8] Based on annual production divided by water (net) area of ponds

fertilized ponds, sometimes in monoculture, but more often with shrimp. Yields from ponds are low, generally less than 500 kg/ha/year, reflecting low input traditional farming systems.

Milkfish were also farmed in the districts of Aceh Besar, Pidie, Bireuen and Aceh Utara as bait for tuna long liners. The fish were farmed for about 6 weeks, and then transported to Subang and Sibolga (along the west coast of North Sumatra) ports for use as tuna bait. Milkfish were transported in plastic bags, with ice, and then kept for up to a week in cages at Subang before use by tuna long liners. Yields in Kota Sabang are exceptionally high. These figures are made up of a mix of milkfish and possibly grouper, and appear to include milkfish held in the district for long-line bait. Farming of milkfish for bait has declined since 2003, due to security concerns and reduction in numbers of long liners docking at Subang.

Other brackishwater fish farmed in tambaks include mullets, some seabass (*Lates calcarifer* – mainly in Aceh Utara – 408 tonnes in 2003) and tilapia and others.

Table 4: Brackishwater pond production and yields by district (2003 data)

	Milkfish (tonnes)	Other fish (tonnes)	Fish (total)	Fish yields/ha	Tiger shrimp (tonnes)	Banana shrimp (tonnes)	Shrimp yields/ha	Other crustaceans (tonnes)	Crustacean yields/ha	Total (tonnes)
North-east coast										
Kota Subang	514		514	20.6						
Banda Aceh	425	142	566	0.87	563	105	1.02	0	0.16	667.7
Aceh Besar	220	179	399	0.47	301	245.7	0.64	169.9	0.49	716.9
Pidie	649	88	737	0.17	503	235.1	0.17	75.8	0.07	814.2
Bireuen	1127	282	1409	0.30	1879	187.8	0.45	281.6	0.10	2348
Aceh Utara	1058	1263	2321	0.24	846	241.3	0.11	552.1	0.08	1639.1
Aceh Timur	1081	133	1214	0.18	2232	21	0.34	191	0.03	2444
Kota Langsa								0	0	
Aceh Tamiang	1017	82	1099	0.33	2115	19.2	0.65	134.6	0.05	2268.5
West coast										
Aceh Jaya										
Aceh Barat	36	19	55	0.20	45	10.7	0.21	0	0.04	55.5
Nagan Raya										
Aceh Barat Daya										
Aceh Selatan	4	2	6	0.28	4	0.9	0.24	0.4	0.08	5.3
Aceh Singkil										
Simeulue								3		3
Total	**6131**	**2190**	**8320**		**8488**	**1066.7**		**1408.4**		**10962.2**

Shrimp

Shrimp were mainly farmed in brackishwater ponds, using low input traditional practices, and recently more intensive farming. The main species is *Penaeus monodon*, although farmers also harvest significant quantities of banana shrimp (*Penaeus merguiensis*), entering the ponds as wild seed. As far as the mission could ascertain, the exotic *Penaeus vannamei*, introduced elsewhere in Sumatra and Indonesia, has not been farmed in Aceh to date.

Traditional ponds involve stocking at 1-2 PLs/m2 and farmers sometimes feed to increase yields. Shrimp yields are low throughout the province, reflecting the use of traditional low input, extensive, farming practices. Shrimp disease, reported in districts throughout the east coast, may also be a factor in keeping yields low.

More intensive farming of shrimp, involving stocking densities of 25-30 Pls/m2, feeding and aeration is conducted in several districts, including Bireuen and districts closer to Medan. Some intensive farms were also located in the west coast. The west coast region has been identified as a suitable area for intensive shrimp farming, but development is still quite limited. Low yields indicate that the shrimp farming in Aceh is predominantly low input, traditional or extensive types, and not intensive.

Other crustaceans harvested from tambak ponds included *Metapenaeus* species and mud crab. Over 100 tonnes per year of mud crabs are reported from Aceh Utara, Aceh Timur and Aceh Tamiang. In Batee and Bandung Baru sub-districts in Pidie, mud crabs are fattened for 1-2 months in small bamboo pens located in tambaks, or tambak canals. Pens are 2-3m long, and 1-1.5m deep.

Historical changes

Information from Dinas Perikanan and Provincial government statistics[9] show an increasing area of brackishwater ponds over the past 5 years. Whilst the exact changes are uncertain due to inconsistency in the data, it appears that the brackishwater pond farming was expanding in area before the tsunami.

Estimates for 2004 (based on District government data) suggest a total pond area in Aceh province of nearly 47,000ha. Satellite imagery would be needed to provide exact figures on pre- and post-tsunami pond areas in the province.

Seasonality

From discussions with farmers along the east coast, stocking and harvesting of fish and shrimp from tambaks carries on throughout the year, with farmers reporting 2-3 crops of milkfish and shrimp per year. The main harvesting period is towards the end of the year, with Dinas Perikanan statistics showing highest yields in the fourth quarter, the time the ponds were affected by the tsunami.

9 Aceh Dalam Angka. Aceh in figures 2003. Katalog BPS 1403.11

Problems

Farmers reported several problems with tambak farming. In particular, shrimp diseases were noted on several occasions. The extent and impact of these diseases (probably white spot) is not known, but clearly a risk for shrimp farming in the province. Seed quality is also mentioned as a problem by farmers and government officials.

Marine fish cage culture

Marine cage culture was found in Simeulue and Sabang island. These include both floating and fixed marine fish cages. There were an estimated total of 65 units (each tentatively with 8-10 cages) located in Sinabang bay and Teluk dalam bay on Simeulue, culturing tiger grouper (*E.fuscoguttus*) and greasy grouper (*E. tauvina*).

In 2001, a project under the Government "Coastal Community Economy Empowerment and Aquaculture Intensification Program", introduced hatchery reared seed of mouse grouper from Bali and Situbondo to floating cages in Simeulue. However, these were not a success so far, due to mass mortality one week after stocking, and probably fish being stocked that were weak after long transportation. After this experience, farmers have not stocked mouse grouper and they prefer the more hardy tiger grouper. Seed of tiger grouper are bought from Medan and transferred by plane. Some seabass seed are also collected locally. Besides culturing finfish in cages, lobsters were also reared in cages based on wild caught animals.

There is one finfish and lobster collector/trader in Simeulue island. As in other parts of Indonesia, fish are sold to the live reef fish trade, with Hong Kong as a major market.

Aquaculture values

Although the total yields of brackishwater species may appear to be relatively low compared to capture fisheries volumes, the total value of brackishwater farming is a highly significant contribution to overall fisheries values in Aceh. The total value in 2003 has been estimated in Dinas Perikanan statistics as around US$56.3 million. These are based on farm-gate figures, and will under-estimate total value of production that will increase as product moves along the market chain.

Of this US$56.3 million, an estimated US$ 9.7 million is fish [milkfish estimated as US$7.2 million], and the major value of US$ 46.5 millions is crustaceans. Tiger shrimp makes up the biggest proportion, providing US$41.8 million to total value.

MAFF/World Bank figures suggest the fishery sector of Aceh provides produce with a value of Rp 1.59 trillion, or US$176.67 million[10]. Based on these figures, the value of brackishwater aquaculture products is 32% of the total value.

These figures probably under-estimate the value of the aquaculture sector to the economy of Aceh (and North Sumatra) before the tsunami and earthquake disaster, as

10 Figures from the Strategy and Program for Rehabilitation and Reconstruction of the Fishery Sector in Aceh and Nias. Departmen Kelautauan dan Perikanan, Republik Indonesia.

they are based on farm gate prices. Shrimp destined for export would increase their value as they moved through the market chain to processing and export.

Social aspects

Brackishwater pond farming in Aceh province is dominated by traditional, low input, farms producing shrimp and milkfish in polyculture and monoculture.

It appears from this assessment that most traditional farmers are small-scale farmers, with farm areas less than 2 ha. Land/farm ownership and employment patterns vary, including owner-operated, rented, contract farming, labour, as well as some community managed ponds[11]. The varied ownership patterns and beneficiaries make post-tsunami recovery interventions potentially complex. Figures from the Dinas Perikanan show that 49% of ponds in Aceh are below 2 ha in area, with the majority of small holdings found in Bireuen, Pidie and Aceh Utara.

Table 5: Size of brackishwater pond holdings

Total	<2ha	2-5ha	5-10ha	>10ha
14,859	7,292	6,205	882	480
100%	49%	42%	6%	3%

The number of people involved in aquaculture in Aceh is highly significant. According to Dinas Perikanan statistics, there are 14,859 brackishwater farming households[12]. However, these official statistics only include farmers and farm operators, excluding part-time and full time labourers, as well as hatchery operators and employees, feed suppliers and salespeople, and people involved in trading and marketing, and services. There are therefore considerably more people involved directly or indirectly dependant on aquaculture as part of their livelihood strategies.

The mission's consultations suggest each hectare of pond supports direct employment of at least 1 and sometimes 3 people/ha (Table 6). For an estimated 47,000ha of ponds in 2004, there may be 94,000-plus people whose livelihoods depended directly on aquaculture. If we include the number of dependants of people in households of people employed in aquaculture, it is likely the figure will rise considerably further.

Considering the total employment in the fisheries sector is estimated by MAFF as 89,300, it seems likely that the employment and livelihood significance of aquaculture has been substantially under-estimated.

Employment in tambak farming is unevenly distributed along the coast, with most associated with the larger farming areas along the north and east coasts. Whilst there is a lack of good data, the significance of tambak farming to the livelihoods of people in these coastal areas is likely to be highly significant. As one example, in Rhum Baru village in Bireuen district there are 251 households, of which 194 are involved in full

11 We were informed about community managed tambak ponds by WWF staff in Banda Aceh, but were not able to identify any.

12 Unfortunately, it is common throughout the region to under-estimate the employment generated in the small-scale fisheries and aquaculture sectors. The findings here, whilst requiring verification, are therefore not unusual

or part-time in tambak farming. With significant numbers of un-employed in north-east coast following the tsunami, there is a strong social justification for action to rehabilitate the tambaks on which many people's livelihood depend.

Table 6: Employment in tambak farming: an example from Samalanga sub-district of Bireuen district (1418ha of pond area).

Employment status	**Numbers**
Farmers	1,817
Labourers	2,000 (estimated by local Dinas Perikanan staff)
Hatcheries	150 people (6 persons/hatchery)
Shrimp collectors	25
Labourers for traders	25
Shrimp traders	20
Feed/chemical store	16 (owner, and 3 workers/store)
Total	4,236
Number/ha	3 persons/ha

During our mission we also made some preliminary analysis of the role of women. From feedback received, it appears that women have limited traditional roles in production tambak farming, although women do get involved in feeding and harvesting in some family owned ponds. Women appear to be more specifically involved in the area of handling upon harvesting, fish processing and trading for milkfish. Further analysis of the role of women in aquaculture, post-harvest and marketing activities would be useful though.

Pond ownership

Pond ownerships vary, and it was beyond the scope of this assessment to explore this in detail. It appears that most coastal land is under private ownership, although some developments in coastal green belts are almost certainly on what was previously government owned land, which may have been transferred to private farmers, perhaps without land title.

Data collected by Ujung Batee on four villages in Aceh Besar and Banda Aceh in Table 7 below show responses from farmers in four villages during this assessment mission.

Table 7: Farmer and ownership in four villages in Aceh Besar and Banda Aceh

Village	Number of farmers	Mean pond size (ha)	% owner-operator	Mean pond size of owner-operator ponds (ha)
Ladong	41	1.8	44%	1.9
Ruyung	16	1.1	100%	1.1
Dureung	6	1.2	33%	1.5
Ulee Pata	6	2.1	50%	2.0

The mission was informed that only some farmers may have land title papers, although they consider they do own the land, under traditional/customary ownership

rights. In some cases, land is owned by others and rented to brackishwater pond farmers. These issues should be explored in more detail, to help guide rehabilitation and targeting of beneficiaries during post-tsunami rehabilitation.

Input supplies (seed, feed, others)

Shrimp hatcheries

The shrimp stocked into aquaculture ponds come mainly from hatcheries located along the Aceh coast. Data collected during the mission from district government suggests a total of 223 shrimp hatcheries in Aceh, with most along the east coast as noted in Table 8 below.

Table 8: Shrimp hatcheries in Aceh, 2004

District	Hatcheries
Kt Sabang	
Kt Banda Aceh	4
Aceh Besar	10
Pidie	70[13]
Bireuen	99
Aceh Utara	38
Kt Langsa	2
Total	**223**

These data include small and medium scale shrimp hatcheries. With the assumption that each hatchery has 4-8 tanks of larvae, a 10 tonnes capacity per tank, and with each tank producing 200,000 shrimp PL per cycle, operating 6 cycles per year, the total capacity of hatcheries in Aceh will be 1,605,600,000 PL per annum[14].

Shrimp farmers may purchase shrimp directly from the hatchery, or through a shrimp seed trading network. There appears to be very limited quality control, or disease testing in operation. Not surprisingly, farmers report problems of shrimp disease and poor quality shrimp post-larvae.

Shrimp broodstock

Aceh has a surprisingly abundant supply of *Penaeus monodon* broodstock, and tiger shrimp broodstock from the province are well known and distributed to shrimp hatcheries throughout Indonesia. Because of bigger size (250 – 300 g) compared to other broodstock areas, Aceh is famous as a source of wild broodstock.

Broodstock are collected at various locations along the east coast. The areas with most abundant supplies of quality broodstock are in Peudada (Aceh Timur), Gandapura (Bireuen), Lamno (Aceh Jaya) and in Alue Naga (Aceh Besar). Broodstock of tiger shrimp are mostly collected using special trammel nets, made of monofilament filament, arranged in double layer, in which an outer and inner net have mesh size of about 3 inch and 1 inch respectively. Traditional small-scale boats without engines are commonly used for fishing shrimp broodstock inshore.

[13] Includes also one hatchery for milkfish

[14] Personal communication with Ujung Batee staff

Before the tsunami, Ujung Batee staff report that around 2500 fishermen were involved in shrimp broodstock fishing. Catching season varies between the sites, but the peak season in general is between March and May.

Upon capture, broodstock are placed in small tank with a battery operated aerator. The broodstock then are sold to hatchery or sold to other provinces in Indonesia through traders based in Medan. The price of shrimp broodstock varies depending upon the size and maturity. Gravid female shrimp are most costly, with pre-tsunami prices between Rp 250,000 to Rp 350,000, while non gravid females sell at Rp 75,000. During the early 1990's when there were less disease problems, the price of broodstock from Aceh reached up to Rp 600,000.

Milkfish

Milkfish are stocked into ponds at around 2-3 inches. These fingerlings come from two sources, local wild collection, or imported seed. There is one milkfish hatchery in Pidie, although this was not operating in 2004.

In districts along the east coast, milkfish fry are collected from the wild using small push nets along the shore mostly during the rainy season (July-December). In Muara Tiga in Pidie district, for example, there are reported to be around 500 families involved in collecting milkfish fry, selling to farmers through a trading network of 30-40 people. The recent price of 1 cm wild fry is around Rp50-70/pc. If wild fry are unavailable, as during dry seasons, then farmers will use hatchery reared milkfish.

Bali and East Java (Situbondo) are the major source of hatchery reared milkfish fry. Small fry (1 inch) are imported from Denpasar airport in Bali, mainly through traders in Medan. In Bali there are around 1900 back yard milkfish hatcheries producing milkfish fry. Traders from Medan purchase those fry and import them to Medan by plane. From Medan, fry are sold to Aceh, particularly to the districts of Aceh Timur, Aceh Utara, Kota Lhokseumawe, Bireuen and Pidie. Previously, Kota Sabang was a free-port zone, with many tuna longliner vessels landing at the port, and the business of milkfish nursing was very attractive. However, Kota Sabang suffered serious security problems and the port was closed to longliner fishing vessels, and the business of growing milkfish for bait fish has dropped drastically. A small amount of milkfish fry are sold to Sibolga fishing port in North Sumatra Province for use as tuna bait.

Milkfish fry imported to Aceh are nursed to stocking size in Aceh. Nursing of milkfish fry is carried out in fertilized brackishwater earthen ponds or hapas in ponds. The (March 2005) price of nursed-fish is Rp300 each for 2-3 inch fish.

Grouper nursing

An interesting activity found in Pidie and Bireuen is the nursing of grouper seed. This is undertaken mostly as a small-scale and less frequently as a larger-scale activity.

The mission visited one nursery in Juenib sub district of Bireuen. This nursery in 2004 sold 50,000 pieces of king grouper, and 300,000 pieces of tiger grouper, but also cultures greasy grouper and humpback grouper. The greasy, tiger and humpback grouper are imported as seed from Bali, by air to Medan. They are then nursed for 4-6

weeks until about 3 inch size, and then exported via Medan. King grouper seed were imported from Taiwan POC.

Feed is small fish collected from the wild. Fertility of ponds also helps with smaller fry. 1,000 pieces of 3 inch grouper will need around 2kg of feed, chopped trash fish purchased at Rp 2,500/kg. Prices in 2005 are in Table 9.

Table 9: Grouper nursing prices from Bireuen, 2005.

Species	Purchase price (Rp/piece)	Market price (Rp/piece)
Greasy grouper	1,000	2,500
Tiger grouper	2,500-2,700	5,500
Humpback grouper	10,000	25,000
King grouper	38,000 (1 inch)	Rp 80,000 (3 inch)

Problems faced by grouper nurseries in Jeunieb sub-district include low salinity during the rainy season (December – January), when salinity may drop to 5 ppt. At such times, farmers report that fish may experience spinal deformities.

Before market, fish are counted and then washed in clean (filtered) water. They are then transported direct to Medan (in plastic bags, oxygen, polystyrene containers), where there are 5 traders dealing in groupers. Traders export to Singapore (mainly), but also Penang and Hong Kong (king grouper). Some nursed grouper were also shipped to Simeuleu, and possibly Nias. Farmers interviewed during the mission reported no export problems; however a quarantine certificate is needed for export of fish to Singapore which is issued by the quarantine department in Medan.

There are several grouper nursing operations on a small-scale (6-10 nets) in other parts of Bireuen, with some capital provided by traders from Medan.

Feed and other inputs

Milkfish are fed using natural fertility, and only require fertilise to create blooming of plankton in the ponds or benthic algae (lab-lab).

Shrimp farming in traditional ponds is also based on fertilization, but farmers also use feed to increase the productivity. Shrimp feed is available along the north-east coast, through traders and small shops. There are no feed mills producing feed in Aceh, but feed is readily available from feed mills in Medan. Feed traders also provide farmers with feed on credit, as observed by the mission in a small shop selling feed and chemicals in Pidie district.

Preparation of ponds involves lime and several chemicals (see below) that are also widely available through small shops and traders along the north-east coast.

Markets and market chains for products from aquaculture

The visits provided some initial understanding of market chains as summarized in Table 10 below. Further research is necessary to map the market chains, identify the stakeholders involved, and better understand relations and marketing mechanisms.

Table 10: Market chains and markets for aquaculture products from Aceh, 2004

Commodity	Markets	Market chains
Milkfish	Domestic markets (local and nearby districts, including fish transported from coastal to inland areas/districts)	Small-scale collectors/traders Sold in local markets Previously some traded live for the tuna bait market in Subang, but now stopped
Shrimp (tiger shrimp)	Export markets (Japan, EU, US)	Shrimp collectors from farms. Trading businesses located in towns Store on ice or cold store Transport to Medan Processing in Medan, and then export
Grouper (fingerlings)	Export and some limited domestic	Traders (sometimes supply seed and) then collect fish from nursing farms Transport to and export from Medan
Grouper (market size)	Export and some domestic	Trader and export via air from Medan Live fish boat along the west coast collects fish for transport to Hong Kong

Milkfish appear to be mainly sold by farmer to collectors who come to the farm. Collectors involved in the milkfish trade are small-scale operators, trading fish by motorcycle to markets. Markets are small local village or sub-district markets, as well as the markets in the district capital or adjacent districts. Fish from the north-east coast are also traded to inland districts of Aceh. Women and men are involved in the sale and marketing of milkfish, and there are significant numbers involved. In Muara Tiga district, for example, the sub-district Panglima Laot informed the mission that there are 200 small-scale collectors involved in the milkfish trade.

A few shrimp may be sold in local district markets, but these are mainly low quality, or "emergency harvests". Shrimp are a valuable export product and most are sold for export through Medan. As in the case of milkfish, there is a network of collectors involved in procuring shrimp from farmers. The collectors may be working directly for larger traders based in major towns, or Medan, or may independently bring the shrimp to sell to the traders. The intensive shrimp farms along the north-east coast and west coast may have direct links (and possibly contracts) with larger traders. Small-scale traditional farmers produce small amounts of shrimp, and rely mostly on collectors who accumulate shrimp in sufficient quantities to then sell on or bring to traders located in or near the major towns.

Shrimp collectors and traders also provide credit to some shrimp farms (and also shrimp fishermen) to purchase inputs (seed, feed) during farming, forming a type of contract farming system.

Groupers are sold into the live reef fish trade. Ujung Batee staff estimate every week 6-10 tonnes/week of live groupers are sent to Hong Kong by live fish transport boat and plane from Medan (there are direct flights). Fish are collected from Sabang, Simeulue, Pulau Banyak[15] (in Aceh Singkil District), Nias and Sibolga bay (in North Sumatra).

Mud crabs are sold live in Banda Aceh but mostly to Medan where they are exported. Some are sold as soft-shelled crab for a higher value. There also is a network of collectors and traders involved in mud crabs. Pidie mud crabs were reported to be exported to Malaysia and Japan.

There was limited information on other commodities such as seabass or mullets but these are probably mostly traded and marketed on local markets.

Coastal resources and environmental issues

In general there are differences in the coastal substrate and contours between the east and west coasts of Sumatra. The east coast of Sumatra faces the Straits of Malacca, which is relatively shallow and narrow. As a result, the contours of the east coast of Sumatra tend to be flat and smooth with generally calmer water, with significant sedimentation in coastal areas. In contrast, the west coast of Sumatra faces directly to the Indian Ocean, which is deep and open. The coast normally receives large waves, particularly during the south-west monsoon, and much of the coastal substrates are sand. These features lead to marked differences in the coastal ecology, with mangroves being more abundant on the north-eastern shore[16].

Aceh coastal resources included open coasts, mangrove forests and estuaries. Mangroves have declined in recent years, in part due to pressures of coastal tambak pond development. Table 11 below provides existing data on mangroves in the provinces. Some limited information from WWF on quality of mangroves suggest the resource was significantly degraded in many areas, but detailed information on the status of the resource is limited.

Some of the causes and effects of mangrove resource degradation are reported in a 2002 workshop on rehabilitation of mangroves in Sumatra[17] as follows:

- Causes of mangrove loss – opening up of areas for pond aquaculture, fish harvesting in mangrove areas, mangrove cutting for traditional use and extraction by licenced operators, development of housing, and weak community participation and lack of understanding of mangrove values.

- Effects of mangrove loss – seawater intrusion and effects on groundwater supplies, loss of nursery habitat for aquatic animals, inequity in economic benefits from land use, and loss of protective functions.

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[15] There is no cage farming of groupers on Pulau banyak, just collection of wild fish that are held in cages until the arrival of the live fish boat.

[16] http://www.wetlands.org/Tsunami/data/TSUNAMI-INDONESIA-WIIP,English.doc

[17] Condition of mangroves in NAD province by Yayasan Pugor, presented at the workshop on strategic planning on the management of damaged mangroves in Sumatra, 21st-25th July 2002.

These problems as stated above are fairly typical of mangrove areas throughout SEAsia, indicating the need for substantially improved management.

Table 11: Mangrove resources in Aceh, based on 2003 data.

Districts	Mangrove area estimates (ha)
East Coast	
Kt Sabang	
Kt Banda Aceh	683.2
Aceh Besar	1,007.5
Pidie	5,012.4
Bireuen	5,146.9
Kt Lhokseumawe	1,027.5
Aceh Utara	9,337.0
Kt Langsa	51.2
Aceh Timur	12,590.0
Aceh Tamiang	8,855.0
West Coast	
Aceh Jaya	320.3
Aceh Barat	49.5
Nagan Raya	None?
Aceh Barat Daya	34.0
Aceh Selatan	12.0
Aceh Singkil	
Simeulue	
Total	**44,126.5**

Sources: Data Collected from Dinas Perikanan, Aceh Province.

Environmental issues

With the aquaculture sector, there are a number of environmental issues associated with aquaculture development in Aceh. A more detailed review of environmental impacts would be useful, but the following summarises current knowledge.

Mangroves and coastal wetlands

The development of brackishwater pond farming along the north-east coast of Aceh has contributed to the losses of mangroves. Many traditional ponds relying on tidal water exchange are located in inter-tidal areas, which were previously natural wetland habitat. In the post-tsunami rehabilitation, there are clearly opportunities to redress some of the mangrove losses through better planned and sited aquaculture operations.

Water quality and farm crowding

The water quality along the Aceh coastline appears to be mostly very suitable for aquaculture. In some areas along the north-east coast, many ponds are clustered around water supplies with limited water circulation. Such systems will lead to poor water quality where ponds are starting to intensify by feeding and increasing stocking densities. During rehabilitation, such problems should be identified and as far as possible addressed through better design of ponds and water supply systems,

Use of pond treatment chemicals

Some organochlorine and organophosphorus pesticides are used to remove predators and competitors in traditional aquaculture ponds before stocking of shrimp and fish. Some of these compounds (eg endosulphan, which is commonly used) represent a risk to humans (workers) and the environment, as well as contamination of final products. Saponin (tea seed cake) is one alternative. A major extension effort should be undertaken to reduce the use of harmful pesticides in pond aquaculture in Aceh.

Fishery interactions

There are interactions between aquaculture and the fishery sector, such as use of trash fish for feeding of marine fish in cages, and collection of grouper fry and milkfish fry from wild capture fisheries. Milkfish fry collection has potential to lead to damage to aquatic resources due to collection of by-catch. In Nias and Sibolga bay in north Sumatra, there are reports of use of cyanide to collect reef fish. Further investigations are warranted to better understand such issues, and identify better management practices.

Shrimp disease

Shrimp disease problems are reported by shrimp hatchery operators and farmers. The occurrence of disease increases the risks of investment in shrimp farming, particularly for small-scale farmers. These risks can be reduce through adoption of better hatchery and pond management practices, including more widespread use of disease testing.

Soil acidity

Some regions of the north-east coast of Aceh are known to have actual or potential acid-sulphate soils, which can cause low pH in ponds, and water supply/drainage systems[18]. The use of ponds over a long period of time will have reduced the acidity problems, but disturbance following the tsunami, and movement of soils during rehabilitation, risks release of acidity to the pond and surrounding environment. Care will be needed during rehabilitation to reduce such risks.

Aquaculture regulations

The development (and rehabilitation) of aquaculture in Aceh and Nias is governed by a number of regulations and guidelines, some of which were reviewed during the mission.

Coastal regulations

The regulations governing the development of aquaculture in coastal mangroves are provided in a letter circulated from the Department of Forestry No. 507/IV-BP/1990 (Surat Edaran Departemen Kehutanan) regarding the determination of the green belt that states that the mangroves should be conserved in a 200m belt along the coast, and 50m along the river. This is a national regulation that should be followed in Aceh province.

"Adat" are traditional regulations and customary rights that are also important for management of coastal resources in Aceh. A more detailed analysis of their use and importance would be valuable in development of rehabilitation strategies.

[18] Jes Sammut, University of New South Wales, personal communication.

Aquaculture regulation

The Provincial Government has the authorization for licensing of aquaculture and fishing activities away from the coast (from 4-12 miles). The central government has responsibility beyond 12 miles, and District administration responsibility for developments less than 4 miles from the coast. All aquaculture activities therefore effectively fall under the licensing responsibility of the District government (except if they are foreign funded, or using a foreign expert, in which case a license is needed by the central government).

There is no overall aquaculture legislation in Indonesia, but Government has issued a number of decrees and regulations concerning aquaculture, mainly concerned with seed quality, seed movements and disease control as outlined in Annex Q:

Institutions

There are several public and private sector institutions involved with management and servicing of aquaculture in Aceh (and Nias).

National level

The Directorate General of Aquaculture is the main government institution responsible for aquaculture development in Indonesia. As part of the Ministry of Marine Affairs and Fisheries (MMAF), the Directorate General of Aquaculture (DGA) consists of 5 Directorates and the Secretariat of the Directorate General. The five Directorates are the Directorate of Seed Development, Directorate of Farming System, Directorate of Aquaculture Infrastructure, Directorate Fish Enterprise and Processing and Directorate of Fish Health and Environment.

The Directorate General of Aquaculture has established 12 Technical Implementing Units spread throughout Indonesia. Four TIUs (NFADC Sukabumi, FADC Mandiangin-South Kalimantan, FADC Tatelu-North Sulawesi and FADC Jambi) have responsibilities for freshwater aquaculture development; another four TIUs (NBADC Jepara, RBADC Takalar-South Sulawesi, RBADC Situbondo-East Java, and RBADC Ujung Batee-Aceh) involved with brackishwater aquaculture development; the remaining four (NMDC Lampung, RMDC Batam, RMDC Lombok and RMDC Ambon) are focused on development of marine aquaculture.

Ujung Batee Regional Brackishwater Aquaculture Development (RBDC) is one of the TIUs under the Directorate General of Aquaculture and is located near Banda Aceh. RBDC is split into two locations. The first in Durung Village, covering 2.3 ha of total area, consisting of housing complex, administration office, library, production area, and fish/shrimp disease laboratory. This site is more focused on finfish artificial propagation activities and extension, with lecture hall and dormitory facilities for extension purposes. Nearby in Neuheun villages is the second location, only 1 km away from the first site, with a total area of 6.3 ha. This second site is concerned with production of post larvae of *P. monodon, P merguensis*, and milkfish fry, mostly for distribution to shrimp and fish farmers in Aceh. Construction of this site was initiated in 1985 by ADB through the Brackishwater Aquaculture Development Project, consisting of hatchery facilities and brackishwater ponds set up to produce quality of *P. monodon* as well as milkfish broodstock. Post larvae production of tiger shrimp may reach to 50 million PLs per cycle, with a capacity to produce 300 million PL annually. Ujung Batee activities before the tsunami are as follows:

- Restocking of tiger shrimp juvenile along the coast of Alue Naga, milkfish juvenile at Simeulue island and Aceh Singkil, and juvenile of mud crab at the estuarine area along the river mouth of Sigli and Pidie District.

- Supplying quality post larvae of tiger shrimp to selected fish farmer to accelerate and motivate their business at Alue Naga area. Development of a Control and Surveillance System for wild shrimp brood stock collection at Alue Naga.

- Development of a domestication program for tiger shrimp.

- Disseminate best management practices for shrimp farming and demonstration of responsible aquaculture activities at Cot Paya, Ladong, and Ruyung villages in Aceh Besar district.

- Dissemination of farming practices for culture milkfish for live bait at Balohan village, Weh island.

- Training and education for shrimp hatchery operators and milkfish hatchery.

- Training for students from the fisheries high school Ladong, Syiah Kuala University, Abulyatama University and farmers.

- Surveys of potential aquaculture areas, with recent surveys of Simeulue island and the west coast of Aceh.

- Monitoring of distribution and incidence of shrimp viral diseases in brackishwater farming areas.

- Provide a PCR testing service for shrimp hatchery operators and grow-out farmer.

The other Technical Implementing units of the central government in Aceh are a Fish Quarantine Centre and Fisheries Vocational High School. The two TIUs are under the Secretariat General of the MMAF.

The Fish Quarantine Centre located in Banda Aceh was responsible for administering quarantine regulations for import, and issuing certificates for export as required. There were two parts to the centre; one near the airport (a small set of offices used for distributing certificates and one in town, the main office with laboratories. The centre was mainly involved in testing imports moving between provinces, but apparently had limited activities as most exports and product go directly through Medan. The centre also had a PCR system, used for testing of shrimp PLs and broodstock for white spot syndrome virus (WSSV).

The Fisheries High School is located at Ladong 23 km away from Banda Aceh. Facilities included a training boat (63 GT), shrimp hatchery, brackishwater pond and other facilities to support the process of teaching and study.

Provincial level

The provincial Dinas Kelautan dan Perikanan has tasks and functions similar to those at central government level, namely policy, planning and guidelines for aquaculture. In Aceh, the provincial Dinas had two technical implementing units; one TIU was responsible for extension of brackishwater aquaculture techniques, located at Gano, and a marine finfish hatchery located on Simeulue island in the subdistrict of Simeulue Timur. The latter station was still under construction, scheduled to produce grouper fingerlings in 2005. With recent regulations concerning local government autonomy, the role of Provincial Dinas Perikanan at Province has changed, with more responsibilities for development activities being devolved to the District government.

District (Kabupaten) level

The District government is increasingly responsible for support to aquaculture development, through the District Dinas Kelautan dan Perikanan. Responsibilities in aquaculture include

- Extension – supporting implementation at the district level (although with mixed capacity)
- Licensing/registration for brackishwater farms and hatcheries
- Monitoring and surveillance
- Aquaculture planning
- Raising funds through local taxes (eg on fish markets, or on production from tambaks (1% of product sold?).

The capacity for management of aquaculture and extension varies considerably between districts. In Bireuen district, for example, there is an aquaculture extension system (BPP) operating at the sub-district level through a "Centre for Extension Office[19]". In others, staff is very limited. For example, there was only one person reportedly responsible for aquaculture in Nagan Raya district.

In Aceh, the Dinas Perikanan dan Kelautan has responsibility not just to develop fisheries and aquaculture only, but also other sector, such as agriculture, livestock and sometimes forestry as well. Along the north-east coast, the departments have responsibilities for mangrove management.

Sub-district (Kecamatan) level

There are no autonomous fisheries and aquaculture institutions in each sub-district, but some district governments have representation at the sub-district level. The Balai Penyuluhan Perikanan (BPP) is present in some districts of Aceh, as an institution responsible for technology and information transfer. BPP is composed of extension workers who are under Dinas Perikanan Kabupaten/Kota management. Farmer groups (BMPT) at sub-district, particularly in District of Pidie and Aceh Utara, also fulfill a further extension function, although the organization is still weak. In future, this organization may become very useful for extension, similar to the fisher organization of Panglima Laut, and some Dinas Perikanan Kabupaten/Kota are planning to empower them.

Village level

[19] This is reflected in the relatively good quality and organization of the sub-district data collected in Bireuen District.

There are no government institutions specifically working on fisheries and aquaculture sector at the village level, with the BMPT farmer organization being the only formal organization.

Table 12 below provides a summary of pre-tsunami aquaculture institutions.

Table 12: A summary of pre-tsunami institutions in Aceh involved in aquaculture

Public institutions	**Responsibilities**	**Personnel**
Ujung Batee	Provide quality seed particularly shrimp fry and grouper, and services to farmers and District govt	49 personnel
Fish Quarantine	Testing of imports and fish exported from the province. General diagnostic services.	
Fisheries High School, Ladong	Vocational school for fisheries and aquaculture	
Provincial		
Dinas Perikanan	Prepare budget for development of aquaculture for demonstration farms and facilitating TIUs,	59 personnel
District		
Departments of (combined) fisheries, agriculture and livestock[20]	Implementation of either national or provincial programs for aquaculture development. Extension support.	The number varies considerably, up to 20 personnel in well staffed districts in Aceh, but usually with few staff solely working on aquaculture
Sub-district		
May have an extension officer assigned from the district level (BPP), but not separate fisheries office or department	Involved in direct extension and information exchange with farmers	Varies considerably among sub-districts, but at least 8 personal are working in Bireuen.

There are two universities engaged in providing fisheries graduates in Aceh. Owned by the provincial government, the University of Syiah Kuala at Banda Aceh has a Faculty of Agriculture that includes fisheries and aquaculture studies. The University of Abul Yatama has a Faculty of Fisheries, with graduate alumna mostly working in Dinas and RBDC and some are involved in aquaculture and fisheries businesses.

[20] Sometimes with only Agriculture (as in Aceh Utara district), sometimes including livestock (as in Pidie district) or mangrove forestry (eg Aceh Utara).

Coastal management institutions

There are several institutions involved with coastal resource planning and management, from national, provincial to district level. Due to shortage of time, the mission could not review the functions and activities of the different institutions involved, except at district level.

At the district level in Aceh, it is common for the Dinas Perikanan to have responsibility for management of coastal resources, including mangroves. The need to strengthen management of mangroves and more generally coastal resources is widely recognized. The District Dinas Perikanan of Aceh Utara provided the mission with the following recommendations for on improving management of mangrove in the district:

i. Prepare an inventory of tambaks (ponds) and mangroves for planning for mangrove conservation
ii. Build capacity of the local farmer associations (BMPT - Badan Musyawarah Pembudidaya Tambak) – elect a chairman, staff, make regulations for mangrove management (boundary of mangroves, procedures, what can be prohibited, conflict management, stop use of mangrove charcoal).
iii. Prepare a district program for conservation of mangrove
    a) Socialisation - produce brochures, muslim leader in mosque,
    b) Silvofisheries demonstration
    c) Study of other province which has success in silvofisheries
    d) Training for farmer
    e) Nursing for mangrove tree (third party or centre)
    f) Planting mangrove tree into protected area – river embankment and coastline
    g) Planting mangroves on dykes
    h) Ban for everyone to discard debris to the river
iv. Monitoring and surveillance.
v. Improve the capacity of institutions and services to support better mangrove management.

Private institutions and services

Private institutions have an important role in terms of financing and technical assistance.

Farmer organisations

The most important private institution is the BMPT (Badan Muswarah/Mufakat Petani Tambak). The BMPT is a tambak farmers association, which appears to be the tambak farmer equivalent of the fisher association (Panglima Laut). According to Mr Abdullah Rakhman, Director of the Dinas Kelautan dan Perikanan in Aceh Utara, the BMPT is not as widespread or well organised as the fishers association.

BMPT is reportedly presently operating only in three districts – Aceh Besar, Pidie and Aceh Utara. The organization has a district and sub-district chief, recognized by government, but formed by the farmers themselves. The chief's are appointed by election reportedly organized on democratic grounds. The mayor of each sub-district gives official recognition to the BMPT appointees. In Pidie District, the chairperson of BMPT is also the member of local parliament.

The BMPT has 1 representative at 1 personal in district level, and 1 personal at sub-district level, with many at village level.

Small-scale services

Other private services include businesses dealing with shrimp trading, feed distributor, shrimp buyer/collector and ice making plants. In Aceh, these appear to be mainly small-scale enterprises.

Table 13: Some pre-tsunami private sector services and institutions involved in aquaculture

Private institutions	Responsibilities	Personnel
Farmer associations (BMPT)	Representation of farmers to government, and local management of aquaculture. The BMPT also provides input to government policy making	1 representative at district level, and 1 at sub-district level, with many at village level. Only some districts
Seed supplier/hatcheries	Produce shrimp seed, sometimes on credit for repayment following shrimp harvest	Small-scale enterprises
Feed traders/shops	Sell shrimp feed to farmers, commonly on credit for repayment following shrimp harvest. Also a source of technical information to farmers	Small-scale enterprises, with relations to larger feed businesses in Medan

Financial services

From the consultations during the mission, it appears that most farmers access credit from informal sources, due to difficulties in obtaining loans from commercial banks. These informal sources include various contract farming arrangements, advances provided on seed and feed, and credit from shrimp traders and collectors.

The Government has promoted cooperation with two Banks to facilitate provision of credit to aquaculture farmers. These are the Bank Mandiri and Bank Bukopin, although the process of lending to farmers is reported to have run slowly. Banks require farmers to have collateral for a loan, a condition that many farmers cannot fulfill. As reported to the mission by farmers in Jeunieb sub-district, commercial banks are reluctant to give loan for aquaculture, a common issue for aquaculture throughout Indonesia.

Aware of these difficulties, the Directorate General of Small Island and Coastal Area (DGSIC) and Directorate General of Aquaculture (DGA) launched two programs for aquaculture development since 2001, namely Project of Coastal Community Empowerment (PEMP) and Aquaculture Intensification Program (INBUDKAN) respectively. Both programs aim to support small scale fishers and farmers increase their business by providing funds allocated by MMAF. The fund is intended to be used as a “revolving fund”. The PEMP has a broad scope of activities with the target

community not only limited to fishers and farmer, but also to other communities living in coastal areas and small islands. In the district level, the Project of PEMP is formed. Funds are provided directly to fisher/farmer in communities through the institution of farmer called LEPM3 (Micro Economic Institution or Lembaga Ekonomi Mikro) after getting a recommendation/approval from Dinas Perikanan Kabupaten/Kota. The fisher/farmer then should return their "loan" within a period of time to LEPM3 with special interest ranging from 9 – 12 % per annum. In the INBUDKAN program, the DGA has allocated budget for small-scale fish farmers to add farmer working capital in their operation. Funds will be given directly to the group of farmer upon approval from the District Dinas Kelautan dan Perikanan. Budget is provided only for demonstration on tilapia, shrimp, seaweed and grouper culture. With similar arrangements to PEMP, funds are also intended to be used under a "revolving fund" scheme, however the funds are kept in the account of the farmer group. Funds are supposed to be transferred again to other farmer group upon request as recommended by the District Dinas Kelautan dan Perikanan. PEMP and INBUDKAN are attempts of MMAF to give more a chance to small scale fisher/farmer to access fund from the government, although there are still many constraints including mismanagement and sustainability of projects. Nevertheless, such mechanisms offer useful learning experiences, and possibly potential mechanisms that might be reviewed and considered for funding post-tsunami rehabilitation.

Assessment of the impact of the tsunami

Overall situation

The earthquake and tsunami that struck on the 26th December 2004 caused unprecedented damage to communities and infrastructure in the coastal areas of Aceh, and to a lesser extent in Nias island of North Sumatra. Direct losses to the fisheries sector in Aceh, including capture fisheries and aquaculture have been estimated at Rp1.2 trillion. Lost fisheries production, including aquaculture, has been estimated by the Ministry of Marine affairs and Fisheries (MMAF) as Rp3.8 trillion. Of the more than 250,000 people dead or missing, fishers and households dependant on fishing and aquaculture make up a disturbingly high proportion of the losses[21].

Aquaculture

Aquaculture in Aceh was also severely affected by the earthquake and tsunami. This section provides the missions assessment of the impacts of the earthquake and tsunami on the aquaculture. The emphasis of the assessment is in Aceh, and on the brackishwater tambak farming activities, where impacts were most severe. The impact of the tsunami in North Sumatra was restricted to loss of marine fish cages (reported to be one cage unit of 30 cages) in Sirombu sub-district in North Nias district. As far as the mission is are aware, no brackishwater ponds were affected in this region.

Of the estimated 47,000 ha of coastal tambak ponds in Aceh 2004, a substantial proportion has been directly and indirectly affected by the tsunami. Aquaculture activities have been brought to a complete stop in the districts along the upper part of the west coast from Aceh Barat Daya to Aceh Besar, and along the north and east

[21] MAFF Strategy and Program for Rehabilitation and Reconstruction of the Fishery Sector in Aceh and Nias Post Earthquake and Tsunami Wave Disaster.

coast to and including Aceh Utara (see map), and extending to Aceh Timur[22]. The following describes the types of damages, as far as possible with available secondary data and field visits. A district-by-district analysis is presented in Annex G.

Brackishwater tambaks (ponds)

Tambak ponds

The earthquake and tsunami caused extensive physical damage to large areas of brackishwater ponds in the province of Aceh. The types of damage seen are described below. Annex P provides some satellite imagery of the coastal area of Banda Aceh, giving an indication of the seriousness of damage in some areas.

Physical damage

The first type of physical impact includes damage to individual ponds, such as destruction of dykes, water gates and loss of associated infrastructure (eg guard hut, pumps, machinery). Some of the damage is repairable, whereas some ponds have been completely lost. In extreme cases, such as on the west coast and Banda Aceh where the shoreline has been severely eroded, several hundred hectares of ponds have been totally lost to the sea. The mission attempted to categorise the physical damage to ponds and associated infrastructure as follows:

- Complete loss of ponds and infrastructure to the sea resulting from coastline erosion ("loss")
- Greater than 50% loss of dykes and pond infrastructure (gate, hut[23]), resulting in loss of the physical structure of the pond and associated infrastructure ("heavy damage")
- Partial loss of dykes (25-50%) and associated infrastructure (gate, hut) ("medium damage")
- Minor damage to dykes (<20% dykes destroyed, or eroded) and associated infrastructure (gate, hut) ("minor damage")

Nearly all the brackishwater ponds on the west coast have been lost or suffered extensive heavy damage. Ponds on the north-east coast ponds have suffered various degrees of damage from total loss to minor damage.

Sedimentation

The second type of physical impact comes from sedimentation caused by deposition of debris, silt, sand and mud into ponds (as well as irrigation canals). This is a widespread problem along the north-east coasts, filling even ponds without structural damage. The type of sediment deposited by the tsunami varies, probably reflecting its varied origin. The amount of sedimentation ranges from complete filling of ponds to a light covering of sediment. Organic matter associated with debris and organic sediment in some ponds has led to heavy smell caused by organic breakdown in some ponds, and will need to be removed before farmers can resume production.

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[22] Farmers have started some rehabilitation, but the situation during the mission was almost total stoppage of brackishwater aquaculture.

[23] In semi-intensive and intensive farms this would include paddlewheel aerators, walkways for feeding, pumps and other machinery

Debris (such as bamboo poles, corrugated iron, and house debris) washed into ponds and is a considerable problem in some areas, but is probably relatively easy to remove. Concern has been raised that some of the material originating from houses, worksheds and other sources may contain toxic compounds

In the analysis and field visits, the mission attempted to categorise the physical damage to ponds and associated infrastructure as follows:

- Heavy sedimentation (50-100% of pond volume filled with sediment)
- Medium sedimentation (25-50%)
- Minor sedimentation (<25%)

Estimates of pond damage

Building on information collected from the Dinas Perikanan, ongoing surveys being conducted by FAO, and the missions own field visits, preliminary estimates of damage to ponds throughout the coastal areas of Aceh, categorized from lost to light damage are shown in Table 14 below. The following section and tables in Annex G provide more information on a sub-district basis. The findings can be summarized as follows:

- Of the estimated 47,620 ha of tambaks prior to the tsunami, and estimated 20,429ha (42.9%) were physically affected by the tsunami.
- Due to the severity of the tsunami on the west coast, all ponds on the west coast have been lost severely damaged, or lost. However, the total loss in terms of total area is relatively small on this west coast.
- The largest area of damaged ponds is found on the north-east coast from Aceh Besar to Aceh Utara. Ponds further east, and further from the origin of the tsunami, appear to be less affected.

All ponds classified as damaged are also affected to varying degrees by sedimentation. It should be noted that the even ponds without physical damage or sedimentation may now be inoperable, because of water is unavailable due to sedimentation of irrigation systems. In Pidie and Bireuen districts, for example, ponds some distance from the coast were not operating due to lack of water supplies. This indirect impact will extend the area affected beyond 20,000 ha, possibly up to 25,000ha (see notes in Table 14).

Due to the extensive area affected, the figures should be verified as soon as possible through satellite imagery, and village level maps prepared to assist in replanning and rehabilitation support.

Table 14: Pond damage estimates (figures are in ha) (an unknown proportion of non damaged pond area marked with an asterisk (*) may be unusable due to disruption of water supply systems)

District	Pre-Tsunami	Post Tsunami						
		Level of Damage				Total damage	No damage	% damage
		Light	Moderate	Heavy	Lost			
East Coast								
Kt Sabang	42.17	-	-	-	-	42.17		100
Kt Banda Aceh	975.4				687.3	687.30	288.10	70.5
Aceh Besar	1,105.4	-	-	823.00	-	823.00	282.40	74.4
Pidie	5,073.8	1,002.42	1,465.81	1,538.86	17.55	4,024.64	1,049.2*	79.3
Bireuen	4,961.7	211.00	538.00	1,540.00	-	2,289.00	2,672.74*	46.1
Kt Lhokseumawe	1,027.6	726.10	-	-	-	726.10	301.50*	70.7
Aceh Utara	10,418.9	2,205.18	1,653.89	1,653.89	-	6,536.61	3,882.3	62.7
Kt Langsa	4,647.5	-	-	-	-	-	4,647.5	0
Aceh Timur	12,382	1,714.30	1,469.40	1,714.30	-	4,898.00	7,484.0	39.6
Aceh Tamiang	6,583.50		-	-	-		6,583.5	0
West Coast								
Aceh Jaya	317.30	-	-	-	317.30	317.30		100
Aceh Barat	60.50	-	-	-	-	60.50		100
Nagan Raya	12.90	-	-	-	-	12.50		96.9
Aceh Barat Daya	-	-	-	-	-	-		
Aceh Selatan	12.00	-	-	-	-	12.00		100
Aceh Singkil	-	-	-	-	-	-		
Simeulue	-	-	-	-	-	-		
Total	**47,621**	**5,859**	**5,127**	**7,270**	**1,022**	**20,429**	**27,191**	42.9

Lost capacity

The total loss of 20,429 ha of ponds represents a significant loss of production capacity. Using the average pond production of 0.6 tonnes/ha/yr from Dinas Perikanan statistics (see Table 4) as a guide, production capacity equivalent to around 12,000 tonnes of aquaculture product per year has been affected, or around US$35.8 million[24]. Of this, around 7,000 ha is severely damaged or lost, equivalent to 4,200 tonnes, and will not be recoverable in the short-term.

Lost crops

Extensive losses of farmer crops, including fish (mainly milkfish), shrimp and some marine fish (fry/marketable fish) were reported by farmers to the mission in all the affected districts along the west and north-east coasts. Provincial aquaculture statistics from Aceh confirm the 4th quarter as the most productive harvest of the year, providing support to farmer claims of loss of shrimp and milkfish crops close to harvest. Assuming around 0.2 tonnes/ha in tsunami affected ponds (one crop, with 0.6 tonnes/year from ponds, with an average 3 crops/year), the loss in 20,429ha of ponds is around US$11.9 million.

Irrigation systems and infrastructure

The earthquake and tsunami had serious physical impacts on the brackishwater canals supplying and draining brackishwater farming areas. In Aceh Tamiang, an area without significant tsunami damage, district fisheries officials report damage to canals caused by the earthquake. The types of tsunami damage seen are described below.

Physical damage

As in the case of ponds, brackishwater irrigation canals have also been physically damaged to various degrees. In extreme cases on the west coast and in parts of Aceh Besar and the north-east coast, the tsunami has swept away the irrigation system with the ponds.

Sedimentation

As in the case of ponds, sedimentation caused by deposition of debris, silt, sand and mud into irrigation canals is a widespread problem even where these is limited physical damage to structures. The sedimentation of canals has significant implications for brackishwater aquaculture over a wide area, particularly in the districts of Pidie, Bireuen and Aceh Utara. Even though ponds further away from the shoreline may not have been physically damaged, farmers are unable to re-start farming because they are unable to access water due to siltation of water supplies.

Damage estimates

Building on information collected from the Dinas Perikanan, ongoing surveys being conducted by FAO, and the missions field visits, preliminary estimates of damage to irrigation systems throughout the coastal areas of Aceh, categorized from lost to light damage are shown in Table 15 below. The findings can be summarized as follows:

24 Calculated from Dinas Perikanan figures of US$2.92/kg of production (see Table 4)

- Of the estimated 1,212 km of brackishwater irrigation canals prior to the tsunami, and estimated 809.5 km of irrigation canals (66.8%) were physically affected by the tsunami.
- As in the case of ponds, due to the severity of the tsunami on the west coast, all irrigation systems on the west coast have been severely damaged, or lost. However, the total loss in terms of canal length is relatively small.
- The largest length of affected canals is found on the north and east coast from Aceh Besar to Aceh Utara. Canals further east, and further from the origin of the tsunami, appear to be less affected.
- These figures probably underestimate the total length of canal system made inoperational by the tsunami.

Table 15: Estimates of damage to tambak irrigation systems (units are in km)

District	Pre-Tsunami	Post Tsunami					
		Level of Damaged				Total	No Damage
		Light	Moderate	Heavy	Lost		
East Coast							
Kt Sabang							
Kt Banda Aceh	240.00	-	-	-	240.00	240.00	-
Aceh Besar	45.65	-	2.00	18.16	-	20.16	25.49
Pidie	3.00	-	-	2.92	-	2.92	0.08
Bireuen	376.90	54.50	81.20	82.00	-	217.70	159.20
Kt Lhokseumawe	13.30	13.30	-	-	-	13.30	-
Aceh Utara	507.03	284.00	38.12	10.14	-	289.25	217.77
Kt Langsa	-	-	-	-	-	-	-
Aceh Timur	8.79	8.79	-	-		8.79	-
Aceh Tamiang	2.38	2.38	-	-	-	2.38	-
West Coast							
Aceh Jaya	-	-	-	-	-	-	
Aceh Barat	12.00	-	-	-	-	12.00	
Nagan Raya	2.20	-	-	-	-	2.20	-
Aceh Barat Daya	-	-	-	-	-	-	-
Aceh Selatan	0.80	0.80	-	-	-	0.80	-
Aceh Singkil	-	-	-	-	-	-	-
Simeulue	-	-	-	-	-	-	-
Total	**1,212.04**	**363.77**	**121.32**	**113.22**	**240.00**	**809.50**	**402.54**

Shrimp and fish hatcheries/nurseries

Physical damage

The tsunami caused extensive damage to shrimp hatcheries, and milkfish nurseries found in Aceh. Of the 223 shrimp hatcheries in Aceh before the tsunami, a total of 193 were extensively damaged (Table 16). Hatcheries along the east coast districts of Aceh Besar, Pidie, Bireuen and Aceh Utara were severely affected. The extent of damage ranges from total loss of the hatchery and associated equipment (blowers, generators, pumps etc) to damage to the roof and infrastructure and some loss of equipment. In some beachside hatcheries visited by the mission in Pidie and Bireuen districts, tanks remained largely intact, and some hatchery operators were starting to rebuild at the time of the visit.

The economic losses caused by physical damage to hatcheries and loss of equipment have been estimated by Ujung Batee RBDC as Rp 42.5 billion (US$4.72 million).

Lost crops

Hatchery operators in Bireuen, Pidie, Aceh Utara and Aceh Besar report loss of shrimp crops at the time of the tsunami. MMAF estimates (prepared by Ujung Batee?) estimate loss of shrimp larvae/post-larvae as Rp 13.6 billion (US$1.5 million).

Lost capacity

With a total hatchery production of 1,605,600,000 PL per annum[25], the damage to the hatchery sector has reduced capacity by approximately 86%, or 1.4 billion. This loss will have severe implications for the recovery of aquaculture in Aceh, a significant loss of seed for stocking of shrimp ponds that needs to be rectified as part of the support to rehabilitation of tambak aquaculture.

The mission only found one milkfish hatchery (in Pidie district) (which was not operating before the tsunami). It appears that milkfish seed either comes from Ujung Batee, or from outside the province, and has not been interrupted by the tsunami. Rebuilding of small earthpond nurseries for milkfish fry would be a relatively easy task.

[25] Personal communication with Ujung Batee staff

Table 16: Estimates of losses to shrimp and fish hatcheries (units are number of hatcheries)

District	Pre-Tsunami	Post Tsunami						% damage
		Level of Damages				Total	No Damages	
		Light	Moderate	Heavy	Lost			
East Coast								
Kt Sabang								
Kt Banda Aceh	4	-	-		4	4	-	100
Aceh Besar	10	-	-	10	-	10	-	100
Pidie	70	-	16	46	8	70	-	100
Bireuen	99	17	8	20	26	71	28	72
Kt Lhokseumawe								
Aceh Utara	38	-	-	38	-	38	-	100
Kt Langsa	2	-	-	-	-	-	2	0
Aceh Timur	-	-	-	-	-	-	-	
Aceh Tamiang	-	-	-	-	-	-	-	
West Coast								
Aceh Jaya		-	-	-	-	-	-	
Aceh Barat		-	-	-	-	-	-	
Nagan Raya	-	-	-	-	-	-	-	
Aceh Barat Daya	-	-	-	-	-	-	-	
Aceh Selatan	-	-	-	-	-	-	-	
Aceh Singkil	-	-	-	-	-	-	-	
Simeulue	-	-	-	-	-	-	-	
Total	**223**	**17**	**24**	**114**	**38**	**193**	**30**	86

Grouper nurseries

In the several districts that practice grouper nursing in tambak ponds, nets and grouper fingerlings were lost as a result of the tsunami. There are no estimates of the total loss of infrastructure (mainly small hapas) and stocks from the tsunami. Dinas Perikanan figures from Bireuen district report that 75 farmers[26] losing grouper nursing stocks during the tsunami.

The loss of grouper nurseries has disrupted exports of grouper fingerlings, however, the overall impact will be quite small compared to total losses of aquaculture products and infrastructure. In several places in Bireuen the mission noted that grouper nursing has started again, and indeed may be a good short-term, low risk, income generating activity for farmers. Investment to restart the grouper nursing appears to have originated with traders from Medan, presumably keen to restart the business, without the need for major infrastructure investment.

Marine fish cage culture and mariculture

Physical damage and crop losses

The tsunami caused damage to the cage culture in Kota Subang and Simeulue island in Aceh province, and in Nias island in North Sumatra. Losses include nets and floating and fixed cage structures. It is estimated that all 80 cages were lost on Kota Subang (100% loss), and 57 out of 65 units on Simeuleu island (88% loss). As with other forms of aquaculture, crop losses were reported from marine cage culture.

In Simeulue, all the floating and fixed marine fish cages on the island, a total of 65 units (each tentatively with 8-10 cages) located in Sinabang bay and Teluk dalam bay, lost crops. Cages were culturing tiger grouper (*E.fuscoguttus*) and greasy grouper (*E. tauvina*) and lobsters that were also lost during the tsunami. Of the floating nets used for grouper culture on the island, 2 were lost, two seriously damaged, and two with light damage. Estimates are Rp 15 million per unit for lost, 8 million for damaged, and 2.5 million for light damage, giving a total damage estimate of Rp50,000,000. Fixed nets suffered severe damage. 26 units were lost (8 million/unit), 27 units were seriously damaged (Rp3,000,000 /unit) and 6 lightly damaged (Rp1,000,000/unit), giving an estimated Rp 305 million damage.

Stock losses include grouper and lobsters; an estimated 237kg of marine fish (grouper) seed lost, with a unit value of Rp50,000/kg and value of Rp 11,850,000; and an estimated 152 kg of lobster, with a unit value of Rp 120,000 and value of Rp 18.24 million.

On Kota Sabang, some cage culture (2 units, each unit with 40 cages [total of 80 cages] was lost, used for grouper and previously keeping milkfish for tuna long line near Pulau Klah in Sukakarya sub-district. Using an estimate of Rp 1.5 million/cage (raft and net), plus two huts (total Rp 1 million) the infrastructure loss is Rp 121 million. The stock losses were grouper in 80 cages (100 grouper/cage, 0.5kg, valued at Rp90,000/kg) estimated at Rp 360 million.

[26] 19 operators and 82 units in Jangka; 56 operators in Samalanga, with unknown number of cage units

In Nias, an estimated 12 marine fish cages (one cage unit) were lost during the tsunami in Mendrehe district, containing an unknown quantity of groupers and other high value marine fish. The estimated cost of replacement is around Rp 36 million (3 million/cage).

Shrimp broodstock supply

Aceh is well known for quality *Penaeus monodon* broodstock, supplying hatcheries in Aceh and elsewhere in Indonesia. The collection of broodstock has been significantly affected by the tsunami, and there are reports from elsewhere in Indonesia of increased *P.monodon* broodstock price.

Other input supplies

The supply of feed, fertilizer, chemicals, dolomite and lime has not apparently been disrupted by the tsunami and earthquake, as these products originate from outside of the tsunami coastal affected areas. The materials needed to re-start farming are therefore readily available through existing trading channels.

An unknown number of small-scale traders and shops have been affected by the tsunami, both directly (probably particularly in the Banda Aceh, but the mission has no information) and indirectly.

The mission met with a feed/chemicals shop owner (Ir H. Salahuddin) in Ulee Glee village of Pidie district. Mr Salahuddin is a sales agent for Mabar shrimp feed (a Medan feed company), and seller of pond chemicals. He reports a 99% drop in business activities as a result of the tsunami, and a large debt to the feed company (Mabar). Mr Salahuddin provided about 65 million Rp/crop as advance to farmers for feed and chemicals, to be paid after the shrimp harvest. He had over 100 farmers, of which some died during the tsunami, and others have difficulty paying back due to lost crop. He is presently in negotiation with the feed company to extend his credit.

Ice and cold storage

On the west coast, these services have been severely disrupted, but on the east coast it appears that ice facilities are available. In Pidie district, shrimp traders expressed confidence that shrimp trading could be resumed without difficulty provided shrimp product is available. Further assessments of cold storage facilities would be necessary.

On the west coast, there has been severe damage. For example the mission was informed in Meulaboh that there were no ice plants or cold storage facilities available in Aceh Barat or Nagan Raya, with ice being imported from Blangpidie in Aceh Barat Daya district.

Freshwater aquaculture

In Nagan Raya, district government officials report some limited damage to government freshwater fish hatcheries and ponds. In Muara Batu sub-district if Aceh Utara there was a small amount of damage to a freshwater pond (0.3ha), the only recorded damage to freshwater fish farming (nile tilapia, gouramy) in the district. There were no other reported direct or indirect effects of the tsunami on freshwater aquaculture production.

Impacts on post-harvest and market chains

Before the tsunami, estimates from the FAO fisheries post-harvest team from consultations in Medan suggested over 10,000 tonnes of shrimp was sent from Aceh province to Medan per year, for processing and export. Since the tsunami, export from the north-east affected districts to Medan has nearly, if not completely, stopped. Although there had been some limited re-stocking of shrimp ponds at the time of the second mission in the first week of March, consultations in Aceh Utara, Bireuen, Pidie and Aceh Besar suggest no shrimp trade has taken place since the tsunami.

Consultations with a private shrimp depot and farming business in Bireuen revealed that 6 depots in Bireuen had stopped trading since 26th December. Of the 2 in Jeunieb sub-district, both employing around 20 people (all men), have stopped trading. The average of 15 tonnes/day exported from Bireuen to Medan has dropped to zero.

The company staff interviewed in Bireuen estimate a loss to business of 2 billion Rp, including loss of shrimp ready for harvesting (2 trucks going to tambaks to collect shrimp were also lost in the tsunami). However, the depot was not damaged, and workers confirmed they could start collecting/trading again once shrimp become available. Ice is available, and damage to equipment (ice boxes, boxes for transporting shrimp can be replaced).

Further studies would be necessary to estimates the economic loss through trading based on estimates of the number of traders involved in the different sub-districts and districts.

Social impacts include the loss of employment in the post-harvest sector, from collector, depot workers, and transport of shrimp to Medan. Downstream effects in Medan include reduced economic activities in processing plants, and likely impacts on employment of women in processing.

Milkfish are sold in domestic, mainly local, markets. Traders consulted in Bireuen note shortage of milkfish.

The key to recovery in the processing sector (at least in the north and east coast) will be to bring tambaks into production. On the west coast, the missions brief analysis suggests the market chains have been more seriously affected. In Meulaboh, at least one shrimp trading business has been lost and ice is not available, having to be imported from Blangpidie.

In Nagan Raya and Aceh Barat, the prices of cultured freshwater fish have increased, probably due to continued concerns among some consumers over eating marine fish. In Meulaboh fish market, traders were selling freshwater and marine fish, but freshwater fish prices were significantly higher than pre-tsunami rates[27].

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27 Prices for freshwater fish in Meleuboh market on 12th March – Rp 20,000/kg nile tilapia (compared to Rp12,000/kg pre-tsunami); Rp 30-35,000/kg for Clarias batrachus (catfish) (Rp 15,000/kg pre-tsunami); Rp 22,000/kg for common carp (Rp 12,000/kg pre-tsunami)

Household impacts

As is obvious from the severe physical damage, lost crops and present limited farming activities, the tsunami has had a significant effect on the people whose livelihoods depend on aquaculture.

Loss of life

District governments have prepared figures of loss of life among farmers that is repeated in the Table 17 below.

These data appear to include only farm owners or operators, and do not to include labourers, or provide information on the households affected. As in the case of the "official" statistics on farmers, they are therefore likely to be a considerable under-estimate of the number of people lost in households where aquaculture is an important part of the livelihood strategy.

Table 17: Estimates of loss of life among farmers [from District Dinas Perikanan figures]

District	Pre-Tsunami	Post Tsunami (Lost or Dead)
East Coast		
Kt Sabang	53	Na
Kt Banda Aceh	396	249
Aceh Besar	731	8
Pidie	2716	0
Bireuen	6629	110
Kt Lhokseumawe	2366	1
Aceh Utara	5,071	Na
Kt Langsa	2308	Na
Aceh Timur	2124	16
Aceh Tamiang	6897	0
West Coast		
Aceh Jaya	239	0
Aceh Barat	82	17
Nagan Raya	22	9
Aceh Barat Daya	77	0
Aceh Selatan	22	0
Aceh Singkil	0	0
Simeulue	0	0
Total	**29717**	**404**

For example, our discussions with Dinas Perikanan officials in Nagan Raya, a severely affected west coast district provide one example of the underestimates in official data.

There were 22 "farmers" in the district, however, these are operated by farm households with an average of 5 people/household. Of the number of farmers recognized in official statistics, 9 died in the tsunami. Of the remaining 13 farmers still alive, all were reported to have lost family members.

Discussions held with farmers in Pidie and Bireuen also reveal unfortunately reveal several tragic examples (of which there are many) where farmers survived, but family members were lost.

However, it is equally clear that there are now large numbers of people still dependant on the sector, and significant physical damage to the pond and canal infrastructure. The implication of these figures is that there is now a situation where there are large numbers of farmers and households without a means of livelihood.

Effects on livelihoods

Among the survivors, the tsunami has created substantial impacts on the livelihoods of farmers and households involved with aquaculture in coastal areas.

The affects vary from people and households who have lost all assets and capacity to rehabilitate them to those for whom damages caused was limited, and fish/shrimp ponds can be reclaimed. The types of people and particularly the most vulnerable need to be properly identified during assessments.

Pre-tsunami, there is a lack of data on the livelihoods of aquaculture households, making it very difficult to properly assess impacts and needs, and design appropriate supporting interventions. The types of people need to be identified during assessments, and interventions targeted accordingly. Different people will require different approaches, therefore emphasizing the importance of effective targeting of the most vulnerable, and ideally use of livelihoods approaches. Loss of livelihood assets can be categorized in very general terms in Table 18.

Table 18: Impacts on tambak farmers livelihoods [some examples derived from consultations with farmers during the mission, specifically relating to the livelihoods of farmers involved with aquaculture]

Livelihood assets	Impacts of the tsunami
Human resources	Loss of life, loss of employment (full and part time) throughout the market chain from broodstock collector to shrimp traders Loss of employees
Social resources	Community-based associations (eg farmer associations) weakened, loss of family networks, trauma
Physical resources	Loss and damage to ponds and infrastructure and households, including complete loss of all household assets in some cases.
Natural resources	Lost water supplies, access to seed and other natural pond inputs and damaged mangroves/coastal buffers
Financial resources	Loss of financial resources in households. Debt to informal lenders from loss of crops, increased difficulties in accessing credit due to lack of assets, land title documents as required for collateral or disrupted social networks.
Vulnerability	Increased vulnerability due to lack of productive assets, means to earn an income and loss of household

Number of people affected

It is not possible at the present time to have any precise information on the number of farmers and households in the aquaculture sub-sector who are affected by the tsunami. The number of "farmers" affected in District/Provincial statistics includes only owner/operators, and not labourers, family or hired, or other workers.

Estimates made using the areas of damaged tambak ponds and numbers of hatcheries are shown in Table 19. From this analysis, we estimate that the number of tambak "farmers" affected is around 12,000. If we use a figure of 2 people/ha, together with the area of ponds, then the total number of *directly* affected people is around 40,000.

The number of people in households reliant on aquaculture will be substantially more (with an average of 5 people per household, the total numbers affected may reached 200,000).

Table 19: Estimated number of people affected by damaged aquaculture

District	Pre-tsunami (ha)	Damaged/disabled ponds post-tsunami (ha)	Total pre-tsunami "farmers"	Estimated total tambak "farmers" affected	Number of people affected in hatchery sector[28]	Estimate based on 2 persons/ha
East Coast						
Kt Sabang	42.17	42.2	53	53		84
Kt Banda Aceh	975.4	687.3	396	279	32	1375
Aceh Besar	1,105.4	823.0	731	544	80	1646
Pidie	5,073.8	4,024.6	2716	2154	560	8049
Bireuen	4,961.7	2,289.0	6629	3058	568	4578
Kt Lhokseumawe	1,027.6	726.1	2366	1672	-	1452
Aceh Utara	10,418.9	6,536.6	5,071	3181	304	13073
Kt Langsa	4,647.5		2308		-	
Aceh Timur	12,382	4,898.0	2,124	840	-	9796
Aceh Tamiang	6,583.50		6897		-	
West Coast					-	
Aceh Jaya	317.30	317.3	239	239	-	635
Aceh Barat	60.50	60.5	82	82	-	121
Nagan Raya	12.50	12.5	22	22	-	25
Aceh Barat Daya	-		77?		-	
Aceh Selatan	12.00	12.0	22	22	-	24
Aceh Singkil	-		0		-	
Simeulue	-		0		-	
Total	47,621	20,429	27,191	11,665	1,544	40858

The mission also estimates 1,544 people in the hatchery sector affected by the damage to hatcheries caused by the tsunami. In addition, employment has been lost in trading, shops supplying aquaculture inputs and in part-time employment. The mission is

[28] This estimate is made based on an average of 8 persons working per hatchery (6-10 people). Figures in the above table have been rounded, therefore, the sum may appear different from the total.

unable to quantify these losses at the present time due to lack of data, but these figures are substantially more than estimates provided in official data. This emphasizes the need for further socio-economic data on the aquaculture sector.

Table 20: Summary estimates of numbers of people affected by damaged aquaculture

Tambak farms	40,858
Hatcheries	1,544
Part time labour, traders and services	Unknown at present
Dependant household members	Possibly 4-5 times the number of tambak farmers and workers

District priorities

Although the communities most severely affected by the tsunami are on the west coast, the above analysis shows that the districts with most affected tambak farmers are in Pidie, Bireuen, Aceh Utara and possibly Aceh Timur. The mission was unable to visit Aceh Timur during the mission and the information received needs further verification. These districts should be a priority in follow up support.

Data availability and livelihood approach

The information available on the impacts of the tsunami has been by and large physical, together with estimates of the number of people who have died. These data have used these data for this report. However, whilst such data provide useful understanding of the physical damage, they do not provide understanding of the impacts of the tsunami on people's livelihoods, or a basis for easy classification or prioritization of the support needed for people to start to rebuild these livelihoods. Ideally, there should be a more livelihood oriented approach to assessment and recovery support for the sector, ie understanding the impacts on the livelihoods of farmers and their households first, and then the needs for assistance. Without such information, just rebuilding a pond may not be sufficient, if other assets are not available (eg financial assets for buying seed or access to credit, etc).

For recovery support to be sustainable, there is a need also to look at delivery mechanisms and ways to build the services and institutions that can sustain livelihoods. As Aceh is one of the poorest provinces in Indonesia, these institutions were weak before the tsunami, and have been further impacted by the tsunami.

Differential effects on women

There is growing evidence that the victims of the tsunami include more women than men, a fact that has been highlighted in a recent OXFAM report. This will have many significant implications for affected households and communities, creating problems for women survivors and men. There is a need therefore to give special attention to the needs of women survivors in the post-tsunami rehabilitation work. More information is also required of the role of women in aquaculture, and associated supply and market chains.

Impacts on public services and institutions

The earthquake and tsunami has severely affected the government and private services and institutions supporting the fisheries and aquaculture sector. The Provincial and District Dinas Perikanan have lost staff and facilities, and have been severely affected directly and indirectly by the tsunami. The mission outlines below an analysis of the impacts on different services and institutions. A visit would be needed to North Sumatra to better understand the conditions of institutions in this province, but the mission understands the impacts have been limited. The analysis below is therefore focused on Aceh.

Loka Budidaya Air Payau (BBAP) Ujung Batee

The tsunami had a serious impact on the Ujung Batee Regional Brackishwater Aquaculture Centre, including loss of staff, infrastructure and fish and shrimp stock. Although staff of the centre have been active in providing support to rehabilitation efforts, including this FAO aquaculture assessment mission, the tsunami effectively brought the normal operations of the centre to a complete stop. Nine staff were lost at the centre including tragically six wives and 16 children.

The main site in Durung village has received extensive physical damage, including:

- Part of the housing complex, with extensive damage to houses close to the shore.
- Hatchery facilities, including spawning facilities, nursing tanks, water reservoir, infrastructure and nursing tanks for fish (milkfish, grouper and shrimp). The losses mainly relate to marine finfish hatchery and nursing.
- Laboratory facilities – the fish disease laboratory and [Agus, please insert some information on labs affected]
- Damage to the road and erosion of the seafront at the centre.

The upper part of the site, consisting of some staff houses, offices and guest house was not damaged by the tsunami. However, checks should be made of their structural safety following earthquake damage.

The second site in the nearby Neuheun village was also extensively damaged, including:

- The housing complex and offices close to the shore.
- Tambak ponds used for milkfish and *P.monodon* and *P.merguensis* broodstock suffered major damage, and a large part (around 6ha,) of the pond area has been lost to the sea due to coastal erosion. The loss of shoreline is also a constraint to rehabilitation of the ponds at the site.
- The shrimp hatchery that was previously developed with ADB assistance has been extensively damaged. Although some concrete tanks remain, the hatchery facilities require extensive rebuilding.

During the tsunami, stock of *Penaeus monodon* broodstock (including some second generation stock from a new domestication program), groupers and milkfish were lost from the Durung and Neuheun village sites. The loss of broodstock is a particular blow to the centres work on broodstock development and seed production.

The Government of Italy, through FAO, has allocated US$2.2 to the rehabilitation of the centre, including support to reconstruction, purchase of equipment and broodstock, and training of staff. The Government of Indonesia has also allocated some funding to support rehabilitation. During this mission a concept for support was prepared, including support for Ujung Batee staff to implement three outreach projects to support villages affected by the tsunami (see Annex K).

The Ujung Batee centre also operated four demonstration ponds in Ladong village (in Aceh Besar close to the centre, intensive shrimp), Alue Naga (Banda Aceh, semi-intensive and intensive shrimp), Lambada (Aceh Besar, intensive shrimp) and Lamjame village in Banda Aceh. The site at Ladong suffered moderate damage, and is under renovation again. The other three sites have effectively been lost and there are at present no plans for renovation. The centre plans future demonstrations for the three districts of Pidie, Bireuen and Aceh Utara

The loss of staff at the centre, and trauma among some surviving staff, has affected the capacity of the centre to deliver services to the province. These services are urgently needed to support the rehabilitation of aquaculture in the province. Along with the post-tsunami rebuilding of facilities at the centre, there will also be a need for capacity building among staff. Skills development will also be needed in new skills to meet the needs during the post-tsunami rehabilitation. Table 21 below outlines present divisions and future staff needs based on discussions with the Director.

Table 21: Planned staff development requirements at of Ujung Batee RBDC (based on discussions with the Director)

Divisions	**Present**	**Future needs**
Disease and environment	Coordinator (Ms Endah Soetanti)	3 new staff
Plankton	Coordinator (Ms Yayuk Srirahayu	2 new staff
Finfish breeding (grouper, milkfish)		2 new staff, including coordinator
Shrimp hatchery	Coordinator (Hendro Wahyudi)	2 new staff
Feeds	Coordinator (Sanani)	1 new staff
Tambak	3 staff (including coordinator Hasanuddin)	2 new staff
Two staff are studying Masters degrees in IPB, Bogor in reproduction and management		

All new staff will have a bachelor degree. According to the Director, future training priorities are:

- tambak aquaculture
- grouper hatchery
- shrimp broodstock management
- disease and environment

During rehabilitation, careful attention should be given to capacity building and skills development along with the physical reconstruction of facilities, developing a centre with the staff skills and capacity to effectively service sustainable aquaculture development in the province.

Quarantine centre – Station Karantina Ikan

This institute was located in Banda Aceh under the central government (Under Secretary General of MMAF). The mission could not visit this centre, but it was reported to be damaged by the earthquake and tsunami.

There are two parts to the centre; the one near the airport was reported to have sustained some earthquake damage, but the main office with laboratories in the two of Banda Aceh was completely destroyed. The central government wishes to rehabilitate and develop the centre, with estimated costs for buildings and facilities of Rp 8.458 billion[29][30]. No staff were reported lost during the earthquake and tsunami.

As in the case of Ujung Batee, planning for rehabilitation of this centre should consider carefully its roles and responsibilities for supporting the private sector, sustainability of future operations, and staff skills and capacity required to fulfill those roles.

Fisheries Vocational Education Centre

This "Fishery High School" under the Secretary General of the Ministry of Marine Affairs in Ladong, was affected by the tsunami. The training vessel was lost, as were (approximately 3ha) of demonstration tambaks in Ladong. The building is still in good working order as it was located on higher ground. A total of 4 people out of 22 staff were lost (total of 15 including family members).

MMAF have estimated a budget of Rp29.5 billion for rehabilitation of the centre over the period of 2005-2009. This budget should be carefully reviewed.

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[29] From the "Strategy and program for rehabilitation and reconstruction of the fishery sector in Aceh and Nias post-earthquake and tsunami wave disaster". The figures includes Rp8.051 billion for fish quarantine/quality control facilities; Rp0.225 billion for training of staff; and Rp0.182 for monitoring and evaluation. The costs are spread over the period 2005-2009 under the responsibility of the Directorate General of Fish Quarantine.

[30] The director of the quarantine station, Miss Erita recently informed NACA staff that the Indonesian Govt are rebuilding the station. They have a budget to replace approximately 60m2 of building area, but the Director said that at least twice 150m2 (or more) is required. The Director would also like to rebuild the centre out at the airport for reasons of efficiency - offices and labs, however this will require securing sufficient land. She is planning to begin rebuilding in August with a completion date of October. Japan is supporting replacement of some equipment but more is required.

Provincial (Dinas Perikanan)

The Provincial Dinas Perikanan and the services offered by the Department were severely affected by the tsunami. The staff before the tsunami was 59 persons, of which 36 died (the total loss of staff and family is 133).

Services provided by the Dinas Perikanan that include the following have been significantly affected:

- Extension
- Licensing for brackishwater farming (only intensive shrimp farms), but small-scale farms do not need to obtain at the provincial level.
- Quality control
- Monitoring and surveillance
- Planning
- Budget allocation from centre to district fisheries office

The extension sub-division's so-called "Provincial technical implementing unit (UPTD)" on Gano (Ule ule sub-district) and Simeulue island were both badly affected by the tsunami. The UPTD shrimp farming demonstration at Gano was lost in the tsunami, although it was apparently not working in 2004. Dinas Perikanan has estimated Rp5 billion for "equipment" for rehabilitation of Gano, but this is considered an overestimate. Considering that Gano was not operating before the tsunami, careful consideration is needed of its future role and responsibilities.

The government hatchery (Balai Benih Ikan Pantai – BBIP - operated by Provincial Dinas Perikanan), already with an investment of Rp 1.2 billion, located at Busung village in Simeulue Timor sub district was partly destroyed. The hatchery was newly built and not yet operating. The damage is estimated by Dinas Perikanan as Rp 850 million. No staff were lost.

The Provincial Dinas Perikanan quality control laboratory at Lampulo was also lost The laboratory was active before the tsunami offering a service for testing, including proximate analysis, taste, microbiological testing, mussels and oysters toxins and cyanide testing. The laboratory had planned to develop facilities for chloramphenicol in aquaculture products, but this was not yet operational. The costs of rehabilitation of the quality control laboratory are estimated as Rp 25.625 billion[31].

As in other institutes, rehabilitation will also require capacity building. During discussions with Dinas Perikanan in Banda Aceh, staff requested training in the following:

- fish/shrimp disease
- shrimp and marine fish hatchery operations
- shrimp farming
- grouper farming

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31 From the "Strategy and program for rehabilitation and reconstruction of the fishery sector in Aceh and Nias post-earthquake and tsunami wave disaster". The figures includes Rp11 billion for building and equipment; Rp1.5 billion for processing facilities; and Rp5.25 billion for processing equipment; and 7.875 billion for "cold boxes". The costs are spread over the period 2005-2009 under the responsibility of the Directorate General of Capture Fisheries.

The costs of such capacity building appears not to be included within the "Strategy and program for rehabilitation and reconstruction of the fishery sector in Aceh and Nias post-earthquake and tsunami wave disaster", but should be included when detailed plans are prepared for the Dinas Perikanan rehabilitation. A costed-staff development plan should be prepared.

District (Dinas Perikanan)

The District Dinas Perikanan have also been severely affected by the tsunami. On the west coast in particular the district fisheries departments have been severely impacted, with loss of staff and facilities. On the east coast, impacts have been less severe, although people and facilities and demonstration sites have been lost.

It is not possible to make a detailed assessment of the effects of the tsunami on the district Dinas Perikanan due to insufficient time. However, it appears that the district departments were already limited in capacity, and the tsunami has further eroded the capacity of the district and sub-district government to deliver services for aquaculture. Capacity building in aquaculture and aquaculture extension should be given attention at the District level.

Universities

There are two Universities in Aceh. The University of Syiah Kuala (government university) and University of Abul Yatama (private university). There is a Faculty of Fisheries in the University Abul Yatama, but not the University of Syiah Kuala. The mission was unable to conduct any assessment of the effect of the tsunami on University facilities and capacity, but we are aware of a major loss of staff. This will impact on the community because the university was involved in community development projects, including aquaculture. There was also cooperation with Ujung Batee centre. Key GIS and Remote Sensing staff from the University are deceased. The mission suggests a more detailed assessment of the University[32].

Private and community services and institutions

The community services and institutions supporting aquaculture households and production have been affected by the tsunami. As such services will be critical in delivering support to rehabilitation, further investigation of the private/community services and institutions supporting aquaculture is recommended. The missions understanding of this is summarized below.

BMPT (Badan Muswarah/Mufakat Petani Tambak)

The BMPT is a tambak farmers association, which appears to be the tambak farmer equivalent of the fisher association (Panglima Laut). According to Mr Abdullah Rakhman, Director of the Dinas Kelautan and Perikanan in Aceh Utara, the BMPT is not as widespread or well organised as the fishers association.

BMPT is reportedly presently operating only in three districts – Aceh Besar, Pidie and Aceh Utara. The organization has a district and sub-district chief, recognized by

32 An ACIAR mission visited the University in mid-March 2005, and the report when avail able would provide further details for planning purposes.

government, but formed by the farmers themselves. The chief's are appointed by election reportedly organized on democratic grounds. The mayor of each sub-district gives official recognition to the BMPT appointees.

Although there is not complete coverage of coastal districts, the organization could have an important role in organizing and implementing rehabilitation of the tambaks. Members of the BMPT have been lost in the tsunami, weakening the organization, and a meeting was held recently in Lhokseumawe among the BMPT members in Aceh Utara, to discuss the post-tsunami situation. The main points from the meeting (as related by Mr Abdullah Rakhman, the Director of Fisheries in Aceh Utara district):

- The need to develop BMPT regulations and a better system of organisation, including how to solve problems among farmers
- The involvement of BMPT in zonation, green belt issues, environmental issues, canal restoration
- The development of farming technology
- The culture and development of the organisation

The BMPT should be involved in the rehabilitation process, with capacity building support as necessary. In districts or sub-districts/villages without a BMPT, the possibility of supporting the development of the organisation should be explored.

Other services/institutions

The effects of the tsunami and role of other village institutions and services for aquaculture rehabilitation remain to be investigated.

Coastal environmental conditions

The tsunami has in places had a severe affect on the coastal environment. Along the west coast and around Banda Aceh in particular there has been severe erosion and loss of coastal land. The following table summarises preliminary information on shoreline erosion obtained from district Dinas Perikanan, providing an indication of the extent of coastal change in different districts.

Table 22: Data on coastal erosion at district/sub-district level as provided by District Dinas Perikanan

District	Coastal erosion (m)
BANDA ACEH	Severely affected by coastal erosion, with losses up to 500m in the sub-district of Meuraxa
ACEH BESAR	Also severely affected by coastal erosion, with losses up to 300m on the west coast (Lhoong sub-district) and major changes extending to the eastern part of the district
PIDIE	Generally less severe throughout the district, but up to 200m in the coastal sub-district of Kb Tanjung. Batee and Simpang Tiga sub-districts also with significant coastal change
BIREUN	Some changes, notably in Samalanga and Jeunieb sub-districts with losses up to 100m
ACEH UTARA	Erosion has been recorded in all sub-districts, with most severe losses in Maura Batu (up to 200m), T.Jambo Aye and Nisam
LHOKSEUMAWE	Coastal erosion recorded in Blang Mangat, Muara Dua and Banda Sakti.
ACEH TIMUR	None reported
KOTA LANGSA	None reported
ACEH TAMIANG	None reported

SABANG	None reported
ACEH JAYA	Erosion widely reported in all sub-districts, between 50 and 100m
ACEH BARAT	Erosion widely reported in all sub-districts, between 50 and 100m
SIMEULU	None reported
NAGAN RAYA	Minor erosion reported in all coastal sub-districts (up to 50m)
ACEH BARAT DAYA	Minor erosion reported in all coastal sub-districts (up to 10m)
ACEH SELATAN	None reported
ACEH SINGKIL	None reported

The west coast from Banda Aceh to Calang and Meulaboh has been severely affected by the tsunami. Satellite imagery available from FAO[33] and the mission's travel by helicopter from Banda Aceh to Meulaboh show extensive damage to this region. Even this cursory view of the coastal situation shows there have been major environmental changes in this coastal region. The shoreline has been extensively eroded in many places[34], there appears to be saltwater intrusion into previous rice farming areas and coastal forests have been flattened several km from the shoreline, including few remaining mangrove trees. Peat stained or acid stagnant looking water is also commonly seen along the coast, and peat swamps on the coastal plain but some distance from the coast appears to have been inundated with seawater. Occasional damaged tambak ponds can be seen but these are mostly difficult to discern from the surrounding landscape.

Estimates made by the FAO agriculture assessment team suggest that there may be 2-3,000ha of agriculture land now underwater, mainly between Meulaboh and Calang (estimated as a 500m coastal belt, along a 60km coastline). The coastal land is also reported to have subsided or eroded into the coast in several areas with new sand bars formed creating new coastal lagoons along the coastline in this region. In Aceh Barat and Nagan Raya, Dinas Perikanan staff report that these new lagoons now have abundant stocks of milkfish fry that are being fished by local people[35].

In some places along the west coast, creation of brackishwater lagoons or very saline rice fields might be used for brackishwater or marine aquaculture as an alternative livelihood option through for local people. However, more detailed environmental surveys should be conducted in this region to better understand the environmental and ecological changes that have occurred, identify appropriate land uses and explore the options needs for future medium to long-term aquaculture development in the region.

The damage to the east coast is less severe than the west coast, although there is extensive damage to ponds and water supply canals mentioned above, some localised erosion of the coastline, and loss of some coastal habitats including mangroves. In some locations visited by the team, the coastal estuaries and rivers have changed course, with significant implications for the supply of water to aquaculture areas.

[33] FAO tsunami atlas

[34] This is evident in several places where the pillars of the bridges of the coastal road can be seen in what is now sea.

[35] These are apparently now been caught by local people for food. Capture of milkfish (if it can be done in a responsible way without using destructive fishing gears) might provide an income for local people if they can be kept and sold for stocking of tambak ponds [markets most likely on the east coast, so there will be transport issues to be addressed]

More detailed local level environmental assessment would be needed to plan aquaculture rehabilitation at the local level, taking account of such changes.

Some information is available on impacts on mangroves from initial Wetland International-Indonesian programme surveys[36]. This report estimates damage to mangroves covering 25,000ha, mainly on the east coast. The report emphasises that this information is preliminary, and the need for further assessment. WWF is conducting a survey of coastal environments during March that could provide more detailed information on coastal environmental changes.

The Wetland International-Indonesian report also notes that damage to seagrass ecosystems, coral reefs and sandy coasts has occurred, and gives some preliminary priorities for environmental rehabilitation. The report emphasises the need for more quantitative assessment of environmental changes and development of rehabilitation priorities.

Overall assessment of economic damage

Aquaculture in Aceh province, and the island of Nias, remains in a seriously degraded condition. Estimates from the Ministry of Marine Affairs and Fisheries suggest direct damage from the tsunami to brackishwater aquaculture as Rp586 billion (US$65 million), and an estimated cost for rehabilitation and reconstruction of Rp952 billion (US$106 million), including rebuilding of institutions and services. Although the total impact of the tsunami on aquaculture in Aceh is not large compared to overall Indonesian aquaculture production and value, the impact on the economy of Aceh province and Nias and the livelihoods of people involved it has been severe. The lack of shrimp product from Aceh has also reduced economic activities in shrimp processors in Medan, the main processing and export centre for Aceh shrimp.

District-by-district damage to aquaculture

More detailed information on damage at district and sub-district level is provided in Annex G.

Identification of support actions

Since the 26th December 2004, support provided to the people of Aceh and North Sumatra has mostly focussed on emergency relief activities, but attention in March is gradually shifting to rehabilitation.

According to the Master plan released by the State Minister for National Planning Development/Bappenas[37], the emergency relief phase ended on 26 March 2005 and the country will enter the rehabilitation phase starting from April 20 to December 2006, with the reconstruction phase starting on July 2006 to December 2009.

This section identifies the support required for rehabilitation of aquaculture, providing short-term, medium and long-term actions in line with the overall schedule for rehabilitation planned by the government. Further, it provides information on suggested implementation mechanisms which are not yet well covered in existing plans.

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36 http://www.wetlands.org/Tsunami/data/TSUNAMI-INDONESIA-WIIP,English.doc

37 http://acehreconstruction.bappenas.go.id/

General overview of the response and plans related to aquaculture

Government plans

The Government of Indonesia has initiated a process for planning of rehabilitation and recovery of tsunami affected areas in Aceh and the Nias islands. The following table provides some information on responsibilities of government agencies involved in post-tsunami rehabilitation as related to aquaculture and fisheries.

Government agency	Ongoing/planned activities
Office of the Vice-President	Overall coordination of Government response to the earthquake and tsunami
BAPPENAS	Government agency with responsibility for preparing a masterplan ("Blueprint") for rehabilitation of all sectors. The masterplan was released on 25th March. Agency with responsibility for land use planning and zoning, including policy for the "green belt".
Bureau of Planning and Foreign Cooperation, of the MMAF	Coordination and preparation of fisheries and aquaculture rehabilitation plans, including small island and coastal area development. Responsible for preparing of rehabilitation budget estimates. Coordinate with donors for support to rehabilitation of the fishery and aquaculture sectors. Main focal point for coordination with BAPPENAS, Ministry of Finance and parliament
Directorate General of Small Islands and Coastal Areas	Responsible for formulating coastal zoning for fisheries and aquaculture, providing technical input to BAPPENAS in overall coastal planning and zoning. Managing the coastal community empowerment project (PEMP) through Bank Bukopin that may allocated to support rehabilitation.
Director General of Aquaculture	Responsible for aquaculture rehabilitation with MMAF. Budget allocated for rehabilitation of aquaculture (Manages the INBUDKAN program that provides funds for aquaculture demonstration of aquaculture that may be used for post-tsunami recovery)
Central Research Centre for Aquaculture, Agency for Marine and Fisheries Research	Design, assessment and technical assistance to aquaculture rehabilitation.
Task Force for Rehabilitation and Recovery for Aceh and North Sumatra	MMAF coordinated task force supporting recovery efforts in Aceh and North Sumatra (Nias). Distributed food, other essential items and transport immediately after the disaster. Raised funds to support rehabilitation in aquaculture and fisheries.
Working groups	BAPPENAS has established working groups for development of sectoral rehabilitation plans, including fisheries and aquaculture. The fisheries working group

	is chaired by the Bureau of Planning and Foreign Cooperation, of the MMAF.
Provincial government	Vice – Governor office is responsible for monitoring and evaluation of emergency and rehabilitation responses, planning and implementation of programs.
Dinas Perikanan of Aceh	Coordinator for assessment in fisheries and aquaculture, disbursement of budget ("Deconcentration fund" from Government of Indonesia) and monitoring and evaluation.
District government	Responsible for development and implementation of rehabilitation programs. Limited local budgets available (through the office of the mayor) and reliant on support from Province and Government of Indonesia, or donors.

The Government of Indonesia through BAPPENAS has prepared a comprehensive rehabilitation strategy for Aceh and Nias islands ("Blueprint"), that was issued on the 26th March 2005. The fisheries component of the rehabilitation plan is outlined in a draft document prepared by the Ministry of Marine Affairs and Fisheries entitled "Strategy and Program for Rehabilitation and Reconstruction of the Fishery Sector in Aceh and Nias Post-Earthquake and Tsunami Wave Disaster". The document provides a general framework for rehabilitation of fisheries and aquaculture based on the following guiding principles and strategies:

- Key guiding principles for rehabilitation and reconstruction of the coastal area of Aceh and Nias islands. These include:
    - Focus on alleviation on poverty
    - Be market led and economically sustainable
    - Consider environmental sustainability throughout
    - Be integrated and holistic, as such approaches are considered particularly important to the coastal zone and for poorer coastal communities.
    - Need to be participatory and consider the real needs and capabilities of local people.
- Overall strategies for rehabilitation and reconstruction. These emphasise the need to assist people and communities to rebuild their assets and restart economic activity, whilst also not recreating poverty and unsustainable activities. Specifically:
    - Restoring private assets through building assets of coastal communities and households, introduction of new technologies and giving communities a leading role in management of the resources and implementation of activities
    - Rebuilding public goods through improving support services, creating efficient and transparent regulatory mechanisms and rehabilitating and protecting environmental resources with community ownership.

The fishery and aquaculture plan divides rehabilitation activities into short-term activities during 2005 and 2006, and longer term reconstruction to be implemented over the next 5 to 8 years. Indicative budget estimates are also provided for major items over the years 2005-2009.

The plan also provides a preliminary assessment of the needs for aquaculture rehabilitation and an outline of the approach. Also included is further information, but with limited detail, on the implementation strategy, start up and expansion strategy, financing procedures, and monitoring and evaluation. The draft plan was presented at the workshop on 9th and 10th March, for comments from district offices and Panglima Laut[38] where there was a general consensus among participants on the approach.

During this workshop, preliminary findings from the mission's aquaculture assessment were presented to participants. Based on feedback received, the mission has developed further the process and major activities required for rehabilitation and recovery of the aquaculture sector. The activities identified below are intended to provide the basis for development of a detailed government strategy for the aquaculture sector.

The mission also suggests a further meeting be organized with aquaculture stakeholders in Aceh to discuss this aquaculture strategy. This meeting should include Provincial District Dinas Perikanan and representatives from tambak farmer organizations, the latter being noticeably absent from the 9th-10th March meeting, as well as donors and NGO's with an interest in support to livelihood recovery in households dependant on aquaculture households.

Donor plans

Donors have implemented or pledged wide ranging multi-sectoral support to the rehabilitation of Aceh and Nias island, that also includes support to the fisheries and aquaculture sectors. The following is a preliminary list of donor plans that the mission is aware of relating to aquaculture. It will be important to update this list with details as projects are prepared and implemented, and to maintain effective coordination and communication of experiences as these emerge.

Donor	Ongoing/planned activities and issues
UNDP	Major cash for work program, presently increasing activities in rural coastal areas of the north-east. Good potential for partnership – UNDP (cash for work), and FAO (technical support)
ADB	Has allocated a grant for rehabilitation of aquaculture as part of overall support to the fishery sector. Details under preparation.
ACIAR	Presently developing plans for assistance to the fishery/aquaculture sector
Japan	JICA expressed an interest to support aquaculture rehabilitation in Banda Aceh and surrounding district of Aceh Besar, through the Directorate General of Aquaculture
France	Expressed an interest to support aquaculture rehabilitation
Netherlands	Expressed an interest to support a pilot project on environmentally sound rehabilitation of shrimp aquaculture through WWF

[38] Interestingly representatives of the tambak farmer association BMPT – did not take part, possibly missing an important aquaculture stakeholder, and risking bias.

NACA	Requested by Government of Indonesia to assist in aquaculture rehabilitation.
FAO/Italy	Support for rehabilitation of Ujung Batee and pilot farm level project in three districts (details to be prepared)
FAO/Germany	Proposed support for aquaculture rehabilitation as part of a fisheries and aquaculture recovery program in 2-3 districts (not identified, details to be worked out)
FAO/EU	Proposed support for provision of inputs for 1,000ha of small-scale ponds ("ECHO" project, details to be worked out)

NGOs

Unlike the fishery sector where there is significant NGO interest in boat building and similar such support for fishers and rebuilding the wild capture fishery, there is so far limited NGO involvement in aquaculture rehabilitation. However, this will probably change as more focus attention on supporting the rehabilitation of livelihoods in tsunami affected north-eastern districts.

The mission compiled below an initial list of NGOs active or considering support to aquaculture from the Working Group on Fisheries meeting held on 10th March in Dinas Perikanan. Contact details where available are provided in Annex B.

NGO	**Ongoing/planned activities and issues**
Terre des Hommes	Cash for work program in Bireuen, including digging of tertiary tambak irrigation canals. Unaware of support beyond this phase.
OXFAM	Supporting cash for work programs in coastal areas that may include (on north/east coast) tambak canals. Plan to conduct a market analysis, including fisheries. Presently developing policy for fisheries/aquaculture sector. Requested the development of guidelines for aquaculture rehabilitation interventions, as concerned to ensure aquaculture interventions are sustainable
Indonesian Red Cross	Expressed an informal interest to support DGA in cash for work programs in tambak areas [personal communication of NGO to A. Budhiman]
World Wildlife Fund (WWF)	Presently surveying tsunami impacts on coastal ecosystems and livelihoods. Planning programs on 1) Marine/coastal resource rehabilitation, including mangroves 2) Empowerment of fishers and coastal communities 3) Spatial planning. Interested to collaborate in promoting responsible aquaculture practices in post-tsunami Aceh
World Aquaculture Society	No presence in Aceh, but expressed an interest to support aquaculture rehabilitation

Coordination and partnership

Close and careful coordination will be particularly important given the limited capacity of local government and local institutions within Aceh to "absorb" donor and NGO support. Donor and NGO coordination is being promoted through working groups, including operational working groups on fisheries, spatial planning and livelihoods. The Working Group on Fisheries is coordinated by FAO. Email discussion groups have also been established for discussion on rehabilitation issues, presently with most discussion in English. The need for coordination will become increasingly evident, with increasing interest in support from the donor and NGO community as the damage to aquaculture and its importance as a livelihood for north-east coast people become more apparent. Most focus has been on fisheries to date, a focus that is not yet balanced when considering the relative importance of aquaculture to the livelihoods in coastal communities.

As there is increasing interest in supporting aquaculture rehabilitation, a partnership approach should be adopted whereby different agencies and donors work together to share experiences and work plans, to ensure effective and coordinated support for the sector.

Urgent response actions - 6 month time frame

Introduction

During the next six months, a number of urgent short-term rehabilitation activities are required for rehabilitation of aquaculture:

- Urgent livelihood support through cash for work schemes to create employment and help restore water supply infrastructure to aquaculture areas.
- Assistance to communities to restart aquaculture in priority areas, where short-term rehabilitation is possible. This will be through support to infrastructure rehabilitation and critical pond inputs, emphasising small-scale disadvantage and vulnerable farmers.
- Restarting hatchery production to ensure newly rehabilitated aquaculture areas have sufficient shrimp and fish seed for stocking
- Starting to rebuild essential support services and capacity to support aquaculture rehabilitation
- Making further detailed assessments and planning for medium to longer-term recovery.

The needs over more than 20,000 ha of ponds are substantial, and therefore it is important to identify priority areas where support is most urgent. The mission has attempted to make some initial priorities for short-term support to districts based on the following criteria:

- Large numbers of small-scale (traditional) tambak farmers and households wanting and needing support to re-start farming
- Districts where tambaks make an important contribution to the overall village/sub-district/district economy
- Districts where tambaks are inoperative as a result of the tsunami, requiring rehabilitation support

- Districts where rehabilitation of tambak ponds back to productive ponds with income generating capacity is possible within a six monthly period.
- There are limited other alternatives for income generation and employment.

The preliminary analysis in Table 23 below suggests the priority districts in terms of number of affected people involved with aquaculture, and possibility to support short-term rehabilitation, are Pidie, Bireuen and Aceh Utara, and Aceh Besar. The latter would be a slightly lower priority using the above criteria because of the existing availability of cash for work schemes.

Table 23: Prioritising districts to support

East Coast	Pre-tsunami	Pond area damaged	% light and moderate damage	Number of affected "farmers[39]"	Priority for short-term support
Kt Sabang	42.17	42.2	0	53	Low
Kt Banda Aceh	975.4	687.3	0	396	Low
Aceh Besar	1,105.4	823.0	0	731	Medium
Pidie	5,073.8	4,024.6	61	2716	**High**
Bireuen	4,961.7	2,289.0	33	3058	**High**
Kt Lhokseumawe	1,027.6	726.1	100	1672	**High**
Aceh Utara	10,418.9	6,536.6	59	3181	**High**
Kt Langsa	4,647.5				Low
Aceh Timur	12,382	4,898.0	65	840	**High**/Medium
Aceh Tamiang	6,583.5				Low
West Coast					
Aceh Jaya	317.3	317.3	0	239	Low
Aceh Barat	60.5	60.5	0	82	Low
Nagan Raya	12.9	12.5	0	21	Low
Aceh Barat Daya	-				Low
Aceh Selatan	12.0	12.0	0	22	Low
Aceh Singkil	-				Low
Simeulue	-				Insufficient data
Total	**47,621**	**20,429**	**54**		

The consultations with farming communities in these districts suggest that farmers give a high priority to rehabilitation in this area. Pidie, Bireuen and Aceh Utara districts as particularly urgent because of the large numbers of farmers and fewer employment alternatives in these coastal areas for work (eg cash for work schemes provide significant alternatives in Banda Aceh).

The analysis shows that out of 20,000 ha, approximately 46% of the damaged ponds suffered heavy damage or were lost. These will require more investment in time and financial resources to rehabilitate, in the medium to long-term.

Within, the three priority districts, Table 24 ranks the sub-districts based on pond areas. Although, some further analysis of the number of farmers in each sub-district would be useful, the table identifies the highest priority districts to initiate support.

[39] These figures do not include labour, dependant households, or other off-farm aquaculture employment. However, they do provide an indication of relative social importance.

These priorities can be adjusted accordingly when more information becomes available to focus on the most socially beneficial rehabilitation.

Table 24: Prioritising sub-districts (from highest priority at the top, to lowest priority) for support within Pidie, Bireuen and Aceh Utara.

Pidie		Bireuen		Aceh Utara	
Sub-district[40]	**Pond area damaged**	**Sub-district**	**Pond area damaged**	**Sub-district**	**Pond area damaged**
Bandar Baru	1023	Samalanga	1418	Baktiya Barat	2,347.50
Kembang Tanjung	830.4	Jeumpa	364	Seunuddon	1,290.0
Batee	500.1	Gandapura	230	Tanah Jambo Aye	894.6
Simpang Tiga	276				
Glumpang Baru	203.3	Jeunieb	83	Baktiya	719.3
Trenggadeng	191.6	Jangka	80	Tanah Pasir	375.8
Ulim	185	Peudada	72	Syamtalira Bayu	209.2
Muara Tiga	173.05	Pandrah	42	Dewantara	206.85
Jangka Buya	170.4	Peusangan	0	Samudera	189.0
Pidie	132.2			Lhoksukon	142.35
Kota Sigli	119.0			Syamtalira Aron	85.0
Pante Raja	105			Muara Batu	42.85
Meureudu	94.7			Nisam	34.15
Meurah Dua	20.7				

Consultations and analysis recognize that the west coast requires substantial humanitarian support, but at the present time aquaculture would be not an urgent priority for short-term rehabilitation due to the following reasons:

- There were fewer aquaculture farms on the west coast before the tsunami.
- Communities are severely affected, and many farmers and fishers are still traumatized.
- Coastal tambaks have been severely damaged, and major rehabilitation is required that will take time.
- A major coastal re-planning is required in the medium term, within which aquaculture will have an important role.

The mission suggest a visit to Simeulue and Nias islands[41] to assess aquaculture rehabilitation and recovery requirements in these two islands, to further knowledge of the losses to marine cage culture, and ways and which mariculture can support recovery. Further assessments are needed to determine the extent of damage and

[40] Priorities for support based on benefit "to a significant number of affected small-scale farmers" according to Dinas Perikanan are Bandar Baru, Kembang Tanjung, Pantee Raja and Batee.

[41] Support to the recovery of marine cage culture on Nias islands is already planned within an approved FAO project, that is expected to be implemented soon.

support required in Aceh Timur and Aceh Tamiang (insufficient data were available to the team), and the lower west coast from Nagan Raya south.

The approach outlined below does not preclude interventions in other districts, sub-districts, or villages on east or west coast, however, at this stage a focus of short-term support on the key districts where aquaculture interventions are likely to create the most significant social and economic benefits for the largest number of tsunami affected people.

Starting off and building experience

In line with overall strategy prepared by MMAF the mission suggests to start in selected high priority villages with some pilot scale activities, then gradual expand the approach to new villages, sub-districts and districts as experience and capacity is built. This approach allows:

- Rapid testing of approaches to rehabilitation of livelihoods of people dependant on aquaculture
- Practical learning experiences for teams involved with aquaculture rehabilitation at district level
- Building capacity for rehabilitation among supporting agencies and rehabilitation teams
- Provides lesson's in environmentally and socially responsible rehabilitation that can be widely shared.

Once activities have been started, the process can then roll on to other villages, building experience among the support team and farming communities as the process proceeds.

Prioritise villages for support

In each of the three districts there is a need for more focused work to prioritize sub-districts and villages for rehabilitation. A follow up action for each sub-district is to identify villages in each district where rehabilitation of aquaculture is important for people's livelihoods, and also practically feasible within the next few months. Criteria for deciding on villages for support should include:

- Villagers wish to re-start aquaculture
- Benefits are high to a large number of small-scale farmers
- Small-scale farmers form a high proportion of beneficiaries
- There is a high proportion of ownership by small-scale farmers
- High dependence in the village on aquaculture for livelihood (food/income)
- Ponds and water supplies can be rehabilitated without major engineering work.
- Ponds are not in priority area for reforestation or the green belt.

The identification of villages may come from various sources, including district government, or even other NGO or donor projects active in the district. For example, there are several ongoing or planned "cash for work" schemes in coastal districts, for cleaning debris from villages and water supply systems. Close coordination with such ongoing projects (often involving UNDP or NGOs) would provide further opportunities for support to aquaculture rehabilitation.

The need for further prioritisation of villages has been emphasised and discussed with District Dinas Perikanan officials during the 9th-10th March workshop, and a questionnaire developed and provided to the Dinas Perikanan for follow up action (English version is provided in Annex N).

The information on villages and supporting activities, once available, should be maintained in an easily accessible database for subsequent follow up, as well as monitoring and evaluation.

Tambak rehabilitation process

The process of rehabilitation of tambaks requires rehabilitation of infrastructure (canals and ponds), access to inputs (seed, lime, fertilizer, and feed) and rebuilding of services to help villagers plan and manage the rehabilitation process in an environmentally and socially sensitive way. In all cases, the process of rehabilitation should be based on the needs of villagers, and particularly the most vulnerable people.

Village planning

Once priority villages have been identified in key districts, the process for planning of support for rehabilitation of aquaculture activities in the village can begin.

In our consultations with villagers along the east coast, generation of employment through cash for work schemes was given a high priority. Mechanisms are available to support such schemes, creating quick employment in the village community, and helping to start off the process of the rehabilitation of aquaculture. Cash for work schemes are also appropriate to start to clean up the water supply and drainage systems needed to start essential water flowing into the tambak farming areas again. In some causes, they will be insufficient, if major primary and secondary water supplies are silted up, where mechanical excavation will be required.

Cash for work activities can then be followed by further support, as appropriate, for rehabilitation of aquaculture ponds, provision of inputs and other support required to rehabilitate aquaculture and support livelihoods. During this process, it is also important to keep in mind the longer-term rehabilitation needs (eg for restoring green belt, avoiding water and soil quality problems, minimizing risks of resource conflicts).

The organization of the cash for work, and follow up support should be prepared as a village aquaculture plan, in a participatory way with and by villagers, in an inclusive process involving local farmers, fishers, and village authorities. As far as possible a livelihood approach should be adopted throughout to ensure that planning, and supporting interventions are based on and appropriate to the needs of villagers.

A process is suggested below, for further discussion and development.

- *Preliminary assessment of needs*

Villagers must be consulted to determine the extent of the needs for rehabilitation of aquaculture[42]. A livelihoods approach should be adopted, also ensuring the consultations include and identify the needs of the most vulnerable and poor groups.

The assessment of needs should be conducted by a well-trained local (district) team (see below), in the early stages provided with external support for supervision and capacity building.

- *Assessment of aquaculture damage and options for rehabilitation*

If the need for rehabilitation of aquaculture is prioritized by the village, a rapid assessment should be conducted by the district team with farmers of the aquaculture damages in the village, and options for rehabilitation [If aquaculture is not prioritized, the team should also communicate urgent needs to other supporting organizations active in the district].

The damage assessment should consider the needs for desilting of canals (primary, secondary and tertiary) and ponds.

At the same time, a rapid assessment of soil conditions in ponds and canals (including acidity, origin of sediment and necessary precautions needed for cleaning up canals, dumping sites etc) should be included, and environmental issues and precautions noted (particularly acid sulphate soils, mangrove wetlands).

- *Preparation of aquaculture rehabilitation plan and identification of beneficiaries*

Information from the damage assessment should be used to prepare with villagers a short-term plan for rehabilitation of aquaculture. This should be prepared by and with villagers, based on the needs of the villagers, and consider the following items:

- Cash for work proposal. This should be a clear plan (with objectives, outputs and inputs required) for restoring water supplies in the short-term, including identification of canals needing urgent work for restoring water supplies. As far as possible this should emphasise "cash for work" thus providing short-term employment and cash benefits to the community. It should include an estimate of the work required in the short-term to restart aquaculture activities.

- Cash for work may not be suitable for larger canals, and mechanical excavation should be used in such cases.

- Identification of beneficiaries and clear strategies to ensure the plan is inclusive of the most vulnerable and affected groups. This may lead to different activities for

[42] It is also important that the process of planning should be linked to the process of support. One should not undertake any significant planning without access to resources and/or mechanisms to be able to respond to the needs of villagers. Thus, teams involved in this planning should be able to coordinate with support mechanisms (eg cash for work schemes, provision of input supplies etc depending on needs). It is inevitable also that by adopting a livelihoods approach support needs other outside the aquaculture sector will emerge. Again, teams involved need to be able to coordinate with other mechanisms to ensure access to the necessary support or services required.

different people, such as nursing activities for landless labourers, traditional ponds farming, and may also include non-aquaculture activities (see also footnote 25).

- A clear plan (with objectives, outputs and inputs required) for restoring productive aquaculture activities, including farm plans, inputs required, management practices, and sources of inputs, and delivery mechanisms.

- Roles and responsibilities for plan implementation agreed, including as necessary the formal agreement by the community or village chief (keichiek?).

- The plan should as a principle be as ***inclusive*** as possible, emphasizing the most vulnerable people and households, but also creating a community wide impact.

Draft formats for a cash for work proposal, and elements for consideration in an aquaculture plan are provided in Annex E.

- *Identification of support mechanisms*

When preparing the aquaculture plan, it will be ***critically important***[43] to ensure that the necessary supporting mechanisms have been clearly identified and arrangements made to ensure their timely delivery. This might include the following:

- Cash for work schemes – how this will be organized and who will be responsible to support its implementation (eg UNDP, government, OXFAM, FAO, ADB, other donors). The supporting donor should be identified early in the process, as different formats may be required.

- Input provision such as seed, lime, fertilizer, and also how this will delivered and to who (eg as inputs, vouchers, credit etc).

- Responsibilities, timing and mechanisms for delivery as agreed with the community and supporting agencies.

- An agreement on training and technical assistance required to support the implementation of the cash for work and rehabilitation plan. Technical support (eg technical supervision, monitoring, training, who and when, need for eg soil test kits and other tools for farmers to implement successful rehabilitation etc)

- *Identification of responsible institutions*

Village planning should identify responsibilities and support required for implementing the plan. The emphasis should on supporting the village to take responsibility to plan and implement the rehabilitation plan, with an appropriate level of technical support and monitoring.

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[43] The mission emphasizes this point because the mission had – upon request from FAO - found itself in the embarrassing situation of having facilitated a discussion with villagers on a pilot village "cash for work" scheme to be subsequently informed that FAO had no mechanism to support the project.

In Pidie and Aceh Utara districts, the active involvement of the village BMPT (tambak farmer association) in planning and management of rehabilitation is recommended.

In Bireuen, where there is no BMPT, the sub-district extension officer should be involved to support villagers organize and manage the rehabilitation. The exact responsibilities at the village level for rehabilitation of aquaculture should be assessed during the planning process in this district.

In the capture fishery, emphasis is being given to revitalizing the Panglima Laut and delivery of goods and services through that organization to rehabilitate the fishery sector. Apart from the presence of the BMPT in some districts, there is no parallel organization in aquaculture. Thus, the assessment should explore the existence of any informal groups, or other mechanisms of support.

The longer-term aim of aquaculture rehabilitation should be to build capacity among farmer and village organizations to institute better management arrangements for aquaculture. Therefore, at all stages of rehabilitation, support should be provided for capacity building among village organizations, which in the case of aquaculture may also involve building of new village tambak farmer organisations.

- *Implementation of aquaculture rehabilitation plans*

The aquaculture rehabilitation plan should be implemented following the agreed plan, with appropriate training and technical support from the local district teams.

- *Monitoring and evaluation*

Monitoring and evaluation of the implementation of aquaculture plan should be provided. The following points are emphasised:

- Importance of farmer record keeping, so there can monitoring technical impacts, outcomes)

- Close technical supervision and monitoring of the cash for work schemes.

- Use of simple environmental monitoring tools to assess environmental changes

- Assessment of benefits to the livelihoods of people involved.

- Monitoring and evaluation as feedback for villagers to inform future decisions

- Monitoring and evaluation for rapid sharing to more widely shared to improve the overall aquaculture rehabilitation activities in village/sub-district/district levels.

- *Widening of impact*

Based on experience, the number of villages should be gradually expanded, sharing experiences and capacity to increase the beneficiaries involved.

Medium to long-term village planning

In some villages, or parts of villages, the damage is too severe for short-term rehabilitation, including use of cash for work programs. In such situations, longer-term planning will be needed, as well as in some cases substantial mechanical excavation.

Restarting shrimp and fish seed production

As tambak farms and water supplies start to be rehabilitated, and farmers prepare for stocking, there will be a need for milkfish and shrimp seed to stock ponds. Over 80% of the hatcheries have been damaged by the tsunami, therefore support is necessary to rebuild capacity of hatcheries to supply shrimp and milkfish for farmers. This will require infrastructure building and technical assistance to ensure hatcheries produce good quality fry for stocking in farmers ponds.

Shrimp seed production

The pre-tsunami demand for shrimp seed appears to have been almost solely met hatcheries in Aceh, most of which were located in Pidie and Bireuen. The Ujung Batee centre also played an active role in encouraging shrimp seed production. The mission supports very much the use of local seed, rather than purchase and import from outside the province[44]. Aceh *P.monodon* broodstock are well for quality known throughout Indonesia and provide the basis for good quality local seed.

Support to rebuilding infrastructure of selected hatcheries should be provided. As hatcheries are owned by private entrepreneurs it will be important to ensure investment of any public funds into hatchery rehabilitation results in a public/community good. Some cost estimates for hatchery rehabilitation, including items of infrastructure, equipment, consumables and fixed and operational costs, are provided in Annex J.

Shrimp farmers in Aceh reported faced problems in obtaining shrimp seed of sufficient quality, contributing to outbreaks of shrimp disease, therefore, technical assistance should be provided to support improvements in the quality of seed stocked in rehabilitated ponds. The use of quality (and relatively disease free) shrimp and fish seed will also help reduce risks to farmers of failed crops. Technical assistance should be provided during hatchery rehabilitation to ensure hatcheries are producing quality seed. The following issues should be considered:

- A careful disease testing procedure, including shrimp broodstock, nauplii and post-larvae, to ensure seed released to farmers have a low risk of transmitting serious shrimp viral diseases.
- A program to introduce “better management practices”(BMPs) to the hatcheries to improve overall quality of shrimp seed produced, and hence reduce the risks of crop losses for tambak farmers. Hatcheries operators should receive training in BMPs and manuals to support adoption of BMPs.
- A simple shrimp seed certification scheme whereby only seed produced from hatcheries with a BMP program could supply seed to village aquaculture rehabilitation programs. Seed should only come from hatcheries that have

[44] Which may encourage local farmers to import the exotic species *Penaeus vannamei* that to date is apparently not available in Aceh.

received technical support from Ujung Batee, and have agree (in writing) to adopt better management practices[45], including no harmful chemicals.
- Monitoring and evaluation program to ensure compliance with the above.

It is recommended to develop a project to support a number of small-scale hatcheries each in Pidie and Bireuen. Kembang Tanjung and Trieng Gadeng villages have suitable small-scale hatcheries, which still have tanks, and can be rehabilitated at less than US$10,000 per hatchery (Annex J). Bireuen already has 38 hatcheries still operating and that are not affected by the tsunami, where technical assistance should be provided to start hatchery production of quality shrimp seed.

To support the above initiatives, there is a need to build the capacity of Ujung Batee to provide technical support, and broodstock and seed testing for shrimp diseases (white spot syndrome virus, SEMBV, IHHNV). The shrimp and fish disease testing facilities at Ujung Batee are seriously damaged. However, the Director has agreed to develop a temporary facility in one of the remaining buildings at the centre, to be transferred to the new facilities when complete[46].

Small-scale nursing of shrimp post-larvae or milkfish in village nurseries should be considered as an option for generating some short-term income to villagers, and is suitable for labourers or tambak farmers who do not have access to aquaculture ponds. This option should be considered in development of the aquaculture plan. Grouper nursing has also been successfully adopted in Bireuen district.

Milkfish seed production

The milkfish seed used for stocking of traditional ponds have originated from Ujung Batee RBDC, imports to the province and wild collection. Imports of milkfish to the province do not pose the same risks as shrimp seed imports and could be used fairly quickly for restocking of ponds. Some possible options for supplying milkfish demand during the rehabilitation phase are as follows:

- Import from lagoons in Aceh Barat and Nagan Raya. Milkfish could be transported by boat from Meulaboh to Banda Aceh and then by road to Pidie and Bireuen. This options requires further study, including best transport options, and also catching techniques (avoiding any potentially damaging fishing techniques) and fishers.
- Import seed from Bali and/or Situbondo through Medan for nursing and culturing. Nursing of milkfish using a hapa or small pond within a pond to create a small-scale income generating activity. Traders in Bireuen or Pidie could be contracted to supply such seed.

Technical supervision could be provided by RBADC Ujung Batee.

[45] There is a manual on *P.monodon* hatchery practices being prepared by FAO, Rome, that could be used for this training, including translation of relevant parts into bahasa for farmers.

[46] The Director of Ujung Batee is keen to get his staff back to work after the tsunami, and has assigned Mr Hendro Wahyudi to provide the technical support for shrimp seed quality control

Rebuilding essential support services

During the mission support was provided to Ujung Batee to develop a proposal for rehabilitation of the centre, for submission to FAO/Government of Italy (Annex K).

Detailed plans for rehabilitation of other aquaculture institutions are required. These should include not only the rebuilding of facilities, but examine the functions of the institutions and the longer-term needs for skills development and capacity building among staff. In other words, a longer-term staff development program should accompany the rebuilding of institutions.

The District authorities have an important role to support rehabilitation at the district level. On the west coast, District Government has been particularly and severely impacted by the tsunami. On the north-east coast, the district administrations are in functioning order, and can and should be used to support rehabilitation of aquaculture.

The mission suggests in the three districts of Pidie, Bireuen and Aceh Utara to strengthen the administration at District level by organizing an aquaculture team that would work closely with the Dinas Perikanan to assess and support rehabilitation of aquaculture. The development of a team at District level will also help to strengthen the local administration to deliver support services for rehabilitation of aquaculture, and in the longer term strengthen the functions of Dinas Perikanan to deliver services to aquaculture farmers.

Capacity building should be provided to build the capacity of the district teams to support communities assess and implement recovery measures.

Short-term assessments

A visit to Simeulue and Nias islands[47] is suggested to assess aquaculture rehabilitation and recovery requirements in these two islands, to further knowledge of the losses to marine cage culture in these areas, and ways and which mariculture can support recovery. Further assessments are needed to determine the extent of damage and support required in Aceh Timur and Aceh Tamiang (insufficient data were available to the team), and the lower west coast.

Information generated from assessments should be collated in a database and made available for wide sharing.

Medium, long-term responses

The mission estimates approximately 46% of ponds (around 10,000ha) are heavily damaged. These require significant time and resources for planning and rehabilitation, paying special attention to proper environmental planning and social issues. It will also take time to rebuild institutions and services.

Whilst the short-term rehabilitation support starts, further planning to determine medium and long-term requirements for aquaculture rehabilitation should be initiated. The following are emphasised:

[47] Support to the recovery of marine cage culture on Nias islands is already planned within an approved FAO project, that is expected to be implemented soon.

- Replanning in severely damaged tambak areas. This will require development of aquaculture and coastal resource management plans. Such plans should be developed within the context of coastal planning and management, including the zoning of areas suitable for aquaculture and green belts. This would cover rehabilitation of tambak areas in Aceh Besar, the west coast and some parts of the north-east coast where coastal erosion is high.
- Development of aquaculture farming areas with better local co-management systems and suitable infrastructure for water supply and discharge.
- Development of plans for rebuilding of institutions and public services to sustain recovery, including capacity building among public services and private sector organisations. Wherever possible, institutional rebuilding should start with the active involvement of local institutions in the rehabilitation of aquaculture, using these experiences to orient institutions towards the development of farmer-oriented services.
- Continued capacity building of public and private sector organizations.
- Development of policies and regulations to support sustainable recovery, building on experiences arising from rehabilitation. The lesson's learned during the next few months should be used to develop policies and practices for the medium to long-term.

Mechanisms of support – where and how to access support

The support needed to communities can be provided through a mix of technical assistance, cash for work, and other mechanisms. Below are some initial suggestions on mechanisms, arising from discussions with FAO, UNDP and government in Banda Aceh and Jakarta. Training and guidelines should be developed to assist the District teams and communities in drawing on the necessary support as and when required.

- *Restoration of water supplies by cleaning of water supply canals*

Tertiary canal cleaning, community pond clearing and minor rebuilding work can be carried out via "cash for work" schemes or contracts:

  - Cash for work funds are available through UNDP, and NGOs (including OXFAM).
  - FAO suggest that digging of tertiary canals by villagers might also be organised through FAO contracts. FAO would be responsible as foreman to manage the payments. Technical supervision also would be necessary.
  - Digging of secondary and primary canals will require mechanical excavation that may be organised through FAO or UNDP contracts with commercial firms (that can also include 'state" companies). A tender process will be required but this can be organised locally within Banda Aceh.

A simple format for a "cash for work" scheme is provided in Annex E.

Cash for work is most suitable for small tertiary and secondary canals, but not for larger secondary or primary canals. In such cases, mechanical excavation will be required.

- *Inputs (seed, lime, fertiliser, seed) to restart farming*

Further work is required to determine the most efficient means of supporting farmers with inputs needed to re-start farming, and whether and how to use grants or credit.

For inputs such as lime, dolomite, fertiliser (urea, TSP), these might be provided through a grant to the most needy farmers, perhaps under the understanding with communities about re-use of any profit to support future community activity.

FAO commercial contracts may be used for TSP, urea and lime. As far as possible the mission emphasises the importance of procuring inputs locally, with appropriate quality control, using existing traders, helping to stimulate the local economy. Lime, dolomite, urea and TSP are all available through local traders in the northeast Aceh.

For shrimp and fish seed, as emphasised above, local seed should be used wherever possible. It is important that the seed is of good quality. To encourage this, procurement of fish and shrimp seed might be organised through a "coupons" system– to be redeemed by farmers (or farmer groups) from hatcheries following BMPs. A contract could be issued to redeem the coupon with selected hatcheries.

For investments of public funds in hatchery rehabilitation, it is important to make the investment beneficial for the community. It is recommended that an arrangement between the hatchery and the beneficiary group be organised. There should be a commitment from the hatchery operator to the community, and as agreed with the community.

- *Other support requirements for tambak rehabilitation*

The following other items are required to support tambak rehabilitation:

1) Water and soil test kit to be provided to the district teams [specifications need to developed on equipment be allocated to each district, possibly also sub-district] – for assistance in detecting acid sulphate soils and suitable water quality.

2) Simple soil and water quality test kits for each village, to be used for farmer testing of soils and water to assist in rehabilitation, provided to each village where rehabilitation is being supported.

3) Capacity building support for building skills of district teams and villagers in aquaculture rehabilitation. Although technical aquaculture skills are available, further skills in community consultation and organization will be required in the post-tsunami situation.

4) Mangrove planting – where possible restoration of mangroves or coastal resources should be supported. A guidance manual and training of district teams in mangrove planting is recommended, including development and management of nurseries as required to support replanting.

The mission also recommends a series of GIS/satellite maps be prepared to assist in the replanning of aquaculture areas. These should be sufficiently detailed to show pre-

tsunami and post-tsunami aquaculture ponds and water supplies, including mangroves, as the basis for aquaculture planning consultations with villagers. These maps should be prepared by a suitable institution as soon as possible[48].

- *Financial mechanisms*

Further work is required to identify suitable financial mechanisms for supporting rehabilitation. Credit and debt should also be included in the livelihood analysis used to develop the aquaculture rehabilitation plan. It is highly likely that many small-scale farmers will be in debt to traders or feed or seed suppliers, due to the loss of previous crops. This issue should be analysed during assessments and development of aquaculture plans for development of the most effective means of support.

Management of aquaculture rehabilitation

The MMAF has established a coordination unit for supporting recovery. The mission suggests an aquaculture rehabilitation program be established within the MMAF to oversee the implementation of the considerable work required to rehabilitate aquaculture.

The following provides some suggestion on organisation of the rehabilitation program, for further discussion and development with Government and community stakeholders.

The approach outlined works within government structures, facilitating coordination at all levels, whilst emphasising capacity building for recovery, and subsequent future development with an emphasis on District levels and community organisations.

The activities of aquaculture should be coordinated with those of fisheries at all levels, and as far as possible others working at district and village level to support livelihood improvement, encouraging as far as possible coordinated planning to respond to community needs at the district and village levels.

National and provincial levels

National and provincial levels would have a responsibility for overall coordination and management of an aquaculture program. The objective should be to build on existing MMAF/Dinas Perikanan structures to establish a well coordinated aquaculture sub-program within the overall fishery sector rehabilitation program. The Directorate General of Aquaculture in MMAF has been given responsibility for supporting aquaculture rehabilitation, and could have an overall coordinating role in collaboration with the Provincial governments in Aceh and North Sumatra.

District levels

The core of support to aquaculture rehabilitation should be an effective team operating at District level. The team would strengthen and work closely with and in support of the District Dinas Perikanan, to provide the necessary support to villagers to prepare and implement aquaculture rehabilitation plans.

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[48] ACIAR, the World Fish Centre and NACA have shown an interest to work with local institutions in Aceh to assist in preparing such maps.

The intention should be to use the teams to build capacity of the Dinas Perikanan to undertake planning and rehabilitation, rather than building separate project structures. In this way, the work on recovery provides at the same time an opportunity to build capacity of Dinas Perikanan. In the medium- to long-term, members of the team may join the Dinas Perikanan, assisting to rebuild these important local institutions. District aquaculture teams would be responsible for:

- Prioritizing villages for support
- Implementing a livelihood approach to assessing needs and building rehabilitation plans.
- Providing technical supervision to village teams to plan and implement recovery activities
- Capacity building for tambak farmers/village organisations
- Monitoring and evaluation of recovery activities
- Communication and coordination – for exchange of experiences and information on recovery activities within districts and with other areas.
- Facilitating other support to needs as expressed by villagers.

The team should be responsible for District coordination among locally-supported projects (particularly livelihood focussed), regular meetings, and facilitating donor support to individual district projects. The team would also be responsible also for identifying gaps in support, and potential overlaps. Strong links should be established with other sectors when adopting a livelihoods oriented approach.

The exact staff requirements will vary with each district, depending on the existing staff capacity within each Dinas Perikanan. However, the district team should be a strong nationally recruited team formed in a way that should include expertise in:

- Tambak aquaculture – with experience in traditional tambak management, soil management, and pond/canal engineering and design.
- Livelihoods – with experience in livelihood approaches in aquaculture and/or coastal fisheries and participatory planning.
- Environment – with experience in planning, environmental management.
- Communications and extension – with experience in computers, extension material (to operate a district "communications hub").

The team should be gender balanced, ensuring that women are properly considered and consulted in the planning process. Each team would be selected with aquaculture technical, environmental, social/livelihoods and economics expertise. Each team should be provided with the following support:

- Basic environmental equipment – including a soil test kit and simple portable water quality test kits
- Village maps, showing canals, ponds, mangroves and other details required for rapid, but effective planning.
- Communications facilities (computer, mobile phone etc)

Each team should also receive training in aquaculture rehabilitation, including use of livelihoods approaches.

Sub-district

Where available (as in Bireuen district), sub-district Dinas Perikanan extension staff should be used to facilitate support to village level recovery. The sub-district extension staff should also be trained in the approach to aquaculture rehabilitation, and would be actively engaged in the rehabilitation team.

Village

At village level, support should be provided through the existing village structures. This would include the local tambak farmer groups (BMPT) where these exist, or other informal groupings of farmers.

In the fishery sector, the Panglima Laut is being proposed by government and donors as a mechanism for support. In aquaculture, the BMPT is less widespread and does not exist in all villages/districts. The process of developing aquaculture rehabilitation plans should identify responsibilities at village level, and as appropriate facilitate development of such local organisations.

As in the case of the Panglima Laut, local organizations will require significant capacity building. This should ideally be provided by the District teams, supplemented as required for Provincial, national or external assistance.

Ujung Batee RBDC

The Ujung Batee research and development centre has the responsibility for supporting aquaculture in Aceh and should be fully engaged to support aquaculture rehabilitation. The centre should be strengthened to support the aquaculture rehabilitation, such as through training of staff, and secondment or hire of new staff, to be given specific tasks in rehabilitation.

Technical and donor support to aquaculture rehabilitation

Technical and financial support should be provided for the establishment and functioning of the management system as follows:

- Support to national and provincial coordination.
- Establishment, capacity building and support to operation of the district teams.
- Technical and financial support for aquaculture rehabilitation

Technical advice is required to develop guidelines, training and identify delivery mechanisms in the following areas:

- Livelihoods approach
- Soils and soil management
- Aquaculture planning/resource management, GIS/mapping
- Seed technology/quality and hatchery management
- Shrimp and milkfish Aquatic animal disease control and risk management
- Development of mariculture and other aquaculture technology options

- Development of delivery mechanisms for provision of support, including financial supporting mechanisms.

This is not an exhaustive list, and it is likely that other technical assistance will be required as the process of rehabilitation proceeds. Several donors, including ACIAR, have expressed an interest to support with capacity building and technical assistance.

Issues in aquaculture rehabilitation

The following highlights some further issues that should be considered in development and implementation of aquaculture rehabilitation plans.

Beneficiaries

The ownership of tambak ponds and aquaculture enterprises appears to be predominantly with small-holders. However, an unknown proportion of ponds are also rented, including from landowners in the local area (village, sub-district, district) and some (it appears to be a small proportion) from outside of each district. Investment in the operational costs of tambak farming has come from the farmers themselves, or through credit arrangements with input suppliers (hatcheries, feed salesmen), or investors. Farmers using feed that have lost crops due to the tsunami are probably indebted to various degrees. Investment from outside the district appears to be mostly semi-intensive or intensive shrimp farming operations. Pond owners, operators and labourers will have been affected to varying degrees by the tsunami.

The physical structures affected are also a mix of public resources (canals and associated water gates) and private resources (ponds).

These complex ownership patterns, and mix of affected public and private resources, likely indebtedness and the different degrees of impact on coastal farmers involved with tambak aquaculture, make it important to have an effective process to identify the most needy and vulnerable during the planning of interventions to support aquaculture rehabilitation.

In the fishery sector, community leaders (keichiek) have been consulted and an agreement reached with the beneficiaries and keichiek over the support required. Further work is needed to develop a system appropriate for aquaculture. The use of a livelihood approach, and training of teams in using this approach, should provide a basis for development of appropriate interventions.

Guidelines should be developed to assist socially-well targeted interventions in the aquaculture sector, and training provided to teams involved in rehabilitation to support their implementation.

Tambak rehabilitation

Soil conditions

The digging of water supply canals and tambak ponds should be planned and implemented carefully, paying particular attention to soil conditions. Within the tambak farming areas, there are a number of risks in digging out canals and ponds that are outlined below, together with simple management options.

- Acid sulphate soils – there are various coastal soils in Aceh province, including actual or potential acid sulphate soils (containing pyrites). The acidity should be assessed before digging, to ensure that the acid conditions are not created.
- Ponds and pond/canal dykes with potential acid sulphate soils should be treated with dolomite during rehabilitation to reduce acidity[49]. In some cases, the rebuilding of dykes offers an opportunity to correct an existing acid problem.
- Sediment deposited by the tsunami varies in type, from sandy to organic material. Each will need proper disposal. All sediment should be carefully disposed of, to avoid washing of material back into the pond/canal during the rainy season.

The problems will be different at different locations, but can be avoided by appropriate use of use of dolomite or lime (at appropriate levels) and careful digging. It implies the need for:

- Careful planning and technical supervision of tambak rehabilitation by district/local teams.
- The need for simple educational tools and decision trees in local language to be developed to assist teams, sub-district Dinas Perikanan and farmers/farmer organization in planning and implementing tambak rehabilitation.
- The need for training of local teams in rehabilitation and acid sulphate soil remediation.

Pond design

It is important to ensure proper pond design, and it is crucial that pond sediment is removed to provide sufficient depth (>1m). If resources (financial, manpower) are not sufficient for digging the whole pond area, then farmers should focus on digging channels along the edge of the pond, providing sufficient depth of over 1 m in a portion of the pond. Without sufficient depth, shrimp (and fish) are likely to suffer from stress, increasing risk of crop losses. Traditional ponds are already constructed with channels along the pond side, although often poorly constructed, so such simple designs are compatible with traditional experiences.

Where possible support to recovery of tambak ponds should seek to improve pond conditions and reduce risks for farmers.

Existing or tsunami damage?

In the assessment of aquaculture damage, it is also important to distinguish damage from what may also have been poorly managed or deteriorated ponds and irrigation infrastructure.

Institutional responsibilities

The institutional responsibilities for rehabilitation of water supply canals should also be clarified before major engineering works. In Bireuen district, for example, the Dinas Kelautan dan Perikanan has responsibility for tambak rehabilitation at tertiary level. The Department of Public Utilities of Directorate General of Swamps and Rivers has responsibilities for and budget for maintenance of primary and secondary

49 See the paper on acid soils by J.Sammut in the Thematic review on coastal wetland habitats and shrimp aquaculture. http://www.enaca.org/modules/mydownloads/viewcat.php?cid=56

canals. As far as is understood, no clear division has been set for post-tsunami rehabilitation responsibilities.

Capacity for rebuilding

The public services in Aceh, including Dinas Perikanan at provincial and district level, have been severely affected by the tsunami. However, it appears that there was already limited staff with specialist skills in aquaculture. Most staff where they have an aquaculture background have a very technical focus, with limited if any skills for extension/participatory approaches. The result is that farmers, where extension has taken place, have been exposed to mainly technology oriented extension approaches, probably adding to risks of failure of some crops (particularly shrimp).

The weak institutional basis for aquaculture means that the capacity for management of rehabilitation of the aquaculture sector is also very limited. This limited capacity may lead to poor design and implementation of projects, leading to risks of farmers losing crops, environmental damage and possibly social exclusion of some of the neediest from aquaculture interventions, as well as limited capacity for extension to sustain projects.

The mission emphasises the importance of training for all staff involved in aquaculture rehabilitation.

- In the short-term, there is a need for rapid training of staff involved in extension and rehabilitation of aquaculture. However, as there are insufficient staff, in addition, we suggest additional staff be recruited to strengthen District aquaculture teams. These could be recruited from Universities, Dinas Perikanan, Ujung Batee, and others. Where possible, these should be recruited on local rates, given training, and responsibilities shared among the various districts. With time, members of the team might eventually be recruited as staff into local government.

- Capacity building, and establishment where required, of local farmers (or fisher groups where involved in aquaculture), who should be given more responsibility for rehabilitation and local management of aquaculture.

- Provision of longer-term educational/training opportunities to build capacity at District and Provincial level.

A more detailed analysis of institutions and short and longer-term capacity building requirements should be undertaken for each institution as part of an institutional rehabilitation plan.

Rebuilding institutions

The budgets contained in the MMAF document for reconstruction of institutions focus mostly on physical rebuilding of facilities, and provision of equipment. The extension services included in the MMAF strategy document have not been identified, but no details or costings are provided. These details are required to develop a comprehensive extension recovery strategy.

For all institutions it suggested the plan for rebuilding should include not just the physical structures, but also the responsibilities and the people and capacity building

required to bring the institution to a functional unit. In the case of the Ujung Batee RBDC, the proposed FAO/Italy project support includes preparation of an institutional development plan that would include functions, facilities required to meet those functions and a medium to long-term staff development plan to allow staff to fulfill those functions. Similar plans should be prepared for all institutions involved with aquaculture (and fisheries?).

Such analysis, and the challenges in the rehabilitation phase, will likely require some re-orientation of the institute functions, more towards capacity building to address development issues within the province.

It is also strongly emphasised to actively engage the local institutions firmly in the aquaculture rehabilitation process, and to support them in this process, providing an opportunity for development of skills and capacity. In this way, the process of rehabilitation should support development of more sustainable public service institutions.

Information and statistics available

The statistical information on aquaculture in Aceh is weak, with significant differences between statistics collected at District and Provincial level. Reliable information is needed for proper planning of the sector, but particularly for effective planning, coordination and monitoring of the rehabilitation of aquaculture and livelihoods of people involved.

Information on the number of people involved in the sector for example has resulted in an under-estimate of the importance of aquaculture to coastal communities. Information on the livelihoods of people involved in aquaculture needs to be substantially improved, as does village-by-village level information.

There is increasing information from assessments, being conducted by FAO, and other organizations. Such information should be made available and shared through an easily accessible communication system, and used to support improvements in data collection and communications in Aceh. A good communication system is also required to monitor and evaluate the impacts of rehabilitation support, to make adjustments as required and improve the effectiveness of the support.

FAO[50] plans to establish a GIS database of villages is a useful initiative that should be considered as a basis for further development of a communications system. Other organizations, including a proposed UNDP livelihoods assessment and impact monitoring system, should be considered in the development of the system.

The use of different channels for communication of extension messages associated with aquaculture rehabilitation should also be considered.

Farmer organizations and community-based institutions

Rehabilitation of aquaculture should be based on the needs of the communities, and developed and implemented with community organizations.

[50] Communication with Dr Shin Imai, Regional Coordinator, Special Program for Food Security (SPFS).

Unlike the fishery sector, where the fisher association (Panglima Laut) appears to be well established, the tambak farmer organization appears to have limited coverage, and capacity. The extent and activities of the organization, including participation and representation by small-holders, need more detailed analysis. In some cases, where such organizations do not exist, there may be a need to support development of informal farmer associations, or possibly use other community organizations.

The approach should be to support as far as possible building of the village institutions. A more detailed analysis of community institutions, past activities, present, future activities, capacity and needs would provide a basis for further decisions to be made on delivery of support for rehabilitation.

Shrimp disease and health management

Aceh has good resources for *P.monodon* farming, but farmers report various problems with disease. Hatchery operators complain of poor demand for post-larvae, yet Aceh broodstock are in demand elsewhere in Indonesia (and other countries in the region) because of their good quality (large size, health). There is therefore a need for introduction of better health management practices to the province at:

- Hatchery level, introducing more effective quality controls for hatchery operators, and building confidence among farmers in the seed quality. This will require improved practices and screening procedures (probably also controlling chemical use).
- Farmer level, introducing better management practices and extension/outreach of better practices.

The Ujung Batee RBDC has some experiences of introducing better health management practices. There are also ample experiences with Asia[51] on better practices in shrimp disease control that could be introduced to the province. These experiences should be used to build in simple risk reduction measures into the support for aquaculture rehabilitation.

Coastal environment and resources management

There is awareness in Aceh, from village to provincial level, of the need for better management of coastal resources, and the government is planning to retain or develop a coastal protective buffer zone of vegetation.

Aceh possesses a significant area of coastal wetlands that are considered by Wetlands International as important based on the criteria of the Ramsar Convention. Wetlands International have made some preliminary recommendations on the rehabilitation of wetlands, and it will be important to identify and as far as possible rehabilitate and protect areas of environmental significance.

The BAPPENAS masterplan for reconstruction of Aceh released on the 26th March 2005, includes some basic spatial planning. It also identifies the need for more detail

51 See www.enaca.org/health for references and relevant experiences in Indonesia, India, Vietnam and Thailand

spatial planning to be made based on communities input and in-depth survey. A working group on "Spatial planning and land use" has been established by BAPPENAS to support this process. In consultations with District government, and coastal villagers, the importance of participation and strong ownership of coastal management among the local community was emphasized. The implementation of better coastal environmental management is likely to be a considerable challenge.

In some areas the coastline has changed, suggesting significant replanning is needed. In some cases, agricultural land may now be more usefully used for aquaculture, particularly on the west coast, suggesting in some areas a need for a major coastal replanning exercise. Such planning will take time, and there will be a need to balance the urgent needs for rehabilitation of people's livelihoods against the need for better planning of coastal resources use and management. Rehabilitation of aquaculture presents a particular challenge in this regard.

Land ownership

Legal status and land use issues need further investigation, as this will have a major influence on the possibilities for coastal planning, including zoning of areas for mangrove replanting and aquaculture.

Mangroves and mangrove planting

Mangroves have also been damaged or destroyed by the tsunami. There is a need to further study the impacts, and potential for replanting, and develop plans, guidelines and strategy, including best plants to use for different ecological conditions. Mangrove planting plans should where possible be included as part of village/sub-district aquaculture planning process. In some situations, simply opening of the area to sufficient water movement may be just as effective as planting. The approach has been used in other parts of the region to promote successful replanting.

Several proposals (eg FAO project submitted to ECHO) include reference to mangrove planting as an income generating activity, including for women and as an alternative where original incomes or livelihood opportunities have been lost. As far as possible, the active involvement of the community in mangrove planting, and subsequent management of mangroves is encouraged. Further guidelines should be developed for mangrove rehabilitation, and training provided in teams involved.

Silvofisheries

Silvofisheries may be a further land use option within coastal areas, retaining some of the mangrove functions of coastal protection whilst allowing farmers and fishers to generate some income from extensive aquaculture of crabs, shrimp and other species. There is some experience in other parts of Indonesia that could be considered as options within the package of support for rehabilitation in coastal areas.

Mapping

Mapping could be used to classify land according to its potential for redevelopment, to identify areas that could be set aside as greenbelts, and to identify areas that may have particular management needs. The mapping would be first approximation otherwise it could take too long to be of benefit. There is a lot of existing data that could be used, and a collaborative effort would be more efficient.

Environmental management of aquaculture

The development of tambaks along the coast of Aceh has generated economic activity in coastal areas, but also contributed to the loss of mangroves. Exact impacts require a more detailed analysis, but certainly rehabilitation will require careful attention to environmental management. The mission recommends developing a set of management practices for Aceh to guide the rehabilitation of tambak farming, and only support tambak rehabilitation that is in conformity to those principles.

The following draft principles are based on work of a Consortium on Shrimp Farming and the Environment[52] and could be further developed as a check list to be used for rehabilitation of aquaculture in Aceh:

1. Tambak ponds should be located in areas that are suitable for shrimp production and in ways that conserve biodiversity, ecologically sensitive habitats and ecosystem functions. There should be clear legal title to the land which should not be located in any existing or proposed green belt.

2. Design and reconstruction should be done in ways that do not cause off-site ecological damage, including risks from acid sulphate or disruption of water supplies. Aquaculture plans should as far as possible incorporate buffer areas and techniques and engineering practices that minimize erosion, leaching of acid sulphate soils and salinization during construction, rehabilitation and operation.

3. Water exchange practices that minimize impacts on water resources should be promoted. Water use is not a major concern for traditional tambak farming, however, care should be exercised to avoid salinisation where ponds are located near agriculture areas. Off-site impacts associated with discharge of effluent and solid wastes should be minimized.

4. Wild broodstock collection and hatchery rearing of shrimp post-larvae should not use destructive fishing techniques, and promote efficiency in hatchery operations.

5. Feed where required and feed management practices should make efficient use of feed resources. Fertilisers should be used efficiently in ways that maintain pond fertility and do not cause degradation of water quality or affect the health or food safety of farmed shrimp and fish.

6. Minimize risks of disease affecting farmed and wild stocks – hatchery operators and farmers should be trained in reducing risks of shrimp and fish diseases through adopting simple risk reduction measures, emphasizing maintaining environmental quality.

7. Ensure food safety and quality of shrimp products and reduce risks to ecosystems and human health from chemical use. Use of chemicals that may lead to residues in product should be strictly controlled. While antibiotics are not used in traditional farming, some chemicals used for pond preparation are a concern, and alternatives should be found and promoted.

52 www.enaca.org/shrimp

8. Develop and operate farms in a socially responsible way that benefits local communities and the province. The rehabilitation of tambak farms, whilst important for the livelihoods of many people in coastal areas, should be done in a way that maximizes employment and social benefits to communities, and does not create social conflicts. A socially-sensitive approach to rehabilitation will be required.

These environmental principles have been further elaborated in Annex F. A further process of multiple stakeholder input is recommended to develop these into a set of practical guidelines that can be widely used.

Extension materials should be developed based on these principles and training provided to supporting teams for their implementation. They could also be used to support land allocation, provision of temporary leases if appropriate, and rehabilitation support decisions, including a "screen" for donors in support to livelihoods through cash for work where it involves tambak aquaculture.

Quality assurance and marketing

The information available on market chains for domestic milkfish, exported shrimp and other aquaculture products is limited, although the trading business has been impacted economically by the tsunami. It is reported that 70% of shrimp product in Medan comes from Aceh (due in part to the Medan shrimp farming areas being significantly affected by disease). Similarly, the government quality control laboratory in Banda Aceh has been lost (although most understand some shrimp product testing was conducted in Medan).

There may be an opportunity to develop market chains and market access for Aceh shrimp in ways benefit small-holders, or ways that support and encourage farmers to adopt BMPs, thus improving the whole process of production and marketing.

Technical assistance and further study is required. Further opportunities to provide technical assistance for farmer organizations to participate in market chains should also be explored.

A major constraint is the availability of capital for rehabilitation. The private aquaculture business as such represents a possible source of capital, supplementing traditional sources of development and rehabilitation assistance. Further assessment is required.

Technical options for coastal aquaculture

Apart from the rehabilitation of tambaks, and cages, there may be other types of small-scale marine aquaculture suitable for supporting livelihoods, on both east and west coasts, including income generating activities for displaced people, or aquaculture labourers without access to land. A preliminary list of coastal aquaculture options, including availability of technologies, markets and any sustainability issues are provided in Annex J. This list should be further developed to provide guidance to agencies involved in aquaculture rehabilitation.

Recommendations

Aquaculture is a socially and economically important activity to coastal communities in Aceh, which has been severely impacted by the tsunami, affecting the livelihoods of many coastal communities. The impact of the tsunami on aquaculture has been previously under-estimated due to poor data on the numbers of people involved.

There is a substantial need to support the rehabilitation of aquaculture for the livelihood of people in tsunami affected communities. Our assessment suggests that action in terms of aquaculture rehabilitation is most urgent along the north-east coast districts of Pidie, Bireuen and Aceh Utara. The assessment identifies some priories for follow up actions that are summarized in the recommendations below.

1) The highest priority for follow up is to put in place the institutional and management arrangements to support aquaculture rehabilitation, including trained district teams as detailed in this report. The program of support to rehabilitation of aquaculture as outlined in this report is in line with government policy, however, it provides an additional level of detail on mechanisms and responsibilities. The approach should be discussed with government and community stakeholders at the earliest opportunity, possibly through a workshop in Banda Aceh to finalise and agree on the arrangements.

2) A process of support to rehabilitation of aquaculture should be organised around trained local teams operating at District level to conduct assessments and implement recover programs in priority districts. The primary responsibility of the District teams would be to support communities to develop locally owned and implement aquaculture recovery plans, and facilitate the delivery mechanisms to support communities in this process. These district teams should be organized, trained and equipped, as soon as possible in the priority three districts of Pidie, Bireuen and Aceh Utara. Donor support should be provided for these teams.

3) To adopt a livelihood approach in rehabilitation of aquaculture, and develop support based on the needs of communities as expressed in a community formulated aquaculture rehabilitation plan. Special attention should be given to identifying most vulnerable and poorest tsunami affected people, and options to support their livelihoods. Although some of the affected aquaculturists did not belong to the “poorest of the poor”, there are substantial numbers of poor people involved with aquaculture, including labourers as well as smaller pond operators. These people need to be properly identified during rehabilitation, and provided with necessary support.

4) To establish clear mechanisms for delivering support to communities for rehabilitation, including cash for work, input provision and technical support. Guidelines on the procedures and mechanisms for delivery of support to aquaculture rehabilitation should be prepared, including contact points to facilitate easy access to the different support mechanisms available in Aceh.

5) No one organization or donor can support the considerable and diverse needs for rehabilitation of aquaculture in Aceh. Several organizations, including FAO and donors, both private and public, have important and complementary skills and resources to offer. It is recommended to adopt a “partnership” approach, with

partnership agreement agreed between government and major supporting donors and technical agencies to promote collaboration and communication in supporting an aquaculture rehabilitation program.

6) Further assessments should be conducted of impacts on aquaculture, and the need for aquaculture rehabilitation in areas not covered in detail by the present assessment (details are provided in the report). The mission is not supportive of stand along assessments, but ideally such work should be undertaken as part of a process of support, to identify village priorities and target groups, rehabilitation/livelihood and follow up support as appropriate required. The following are priorities:

    a) Simeulue island and Nias island to determine the impact of the earthquake and tsunami on mariculture, to identify support for farmers on the islands, and also to analyse the extent to which mariculture could be developed as a livelihood option for tsunami affected coastal communities in these areas. Although mariculture has developed to a limited extent in these islands, both islands are recognized to have significant potential for future mariculture development.

    b) Aceh Timur and Aceh Tamiang to examine the damage to aquaculture in the lower east coast areas and the extent to which rehabilitation is required to support the livelihoods of people living in these districts.

    c) An assessment should be made in the lower west coast (from Nagan Raya south) to prepare an inventory of aquaculture in these districts, and the short to medium term requirements for rehabilitation. The extent to which aquaculture as an alternative livelihood could support medium to long-term rehabilitation should be examined.

7) Capacity building and technical support is essential for district staff, NGOs and farmer and community organizations to plan and implement aquaculture rehabilitation.

8) Guidelines and tools should be developed to support rehabilitation (eg soil identification and acidity management, environmental management, resource planning, livelihoods approaches, and others as noted in this report).

9) A database and communications system should be established to share damage assessments, and rehabilitation experiences, with effective coverage of all affected communities where aquaculture rehabilitation is required. Communication can be improved by working groups, email discussions and promoting more dialogue on aquaculture.

10) Preparation of Provincial/District plans for medium and longer-term rehabilitation of the aquaculture sector, and its integration with coastal resources management should be prepared, building on the concepts provided in this report.

11) Plans should be developed for institutional rehabilitation, covering infrastructure and human skills and capacity building requirements needed to establish effective public institutions.

12) The possibility of creating special market access for aquaculture product from Aceh should be explored, used to encourage adoption of socially and environmentally sound farming practices during rehabilitation and generating private sector support to rehabilitation.

13) Detailed maps of affected villages should be prepared to assist in mapping, design and planning of aquaculture rehabilitation.

14) The social structure of the aquaculture sector is complex, with various degrees of ownership and participation, and different stakeholders and beneficiaries. Further careful assessment should be conducted as part of the process of developing aquaculture rehabilitation plans, to ensure positive social impact from rehabilitation activities.

15) To support socially and environmentally responsible rehabilitation of the aquaculture sector a set of aquaculture rehabilitation guidelines should be prepared, taking into account relevant international and regional agreements (eg FAO Code of Conduct for Responsible Fisheries) and experiences, to guide government, donor and NGO rehabilitation support. These should be prepared through multi-stakeholder inputs, encouraging wide ownership. When complete, training should be provided in their use to government/NGO/projects involved or considering involvement with aquaculture rehabilitation.

16) The need to explore ways to improve access of credit and grant funding for rehabilitation of aquaculture ponds by farmers. The possibility for strengthening of existing PEMP and INBUDKAN programs for rehabilitation among small-scale farmers and farmer groups should be explored.

Annexes

Annex A: Itinerary

11th February	Travel Bangkok-Jakarta (TG)
12th February	Jakarta, FAO office
13th February	Jakarta, FAO office. Security briefing
14th February	Travel Jakarta-Banda Aceh Visit FAO office Meet with Dinas Perikanan (Mr Teuku Said Mustafa) Security briefing Visit Ujang Batee
15th February	Visit hatcheries around Ujung Batee Prepare for field trip in FAO office
16th February	FAO office, Banda Aceh
17th February	Travel to Pidie, meet Dinas Perikanan and visit affected villages in Kota Sigli, and sub-district of Kampeng Tanjung. Travel to Bireuen.
18th February	Visit Dinas Perikana, Bireuen district, and affected sub-districts of Ganda Pura (villages ?) and Samalanga (villages?)
19th February	Visit affected sub-districts in Aceh Besar. Overnight in Ujung Batee station
20th February	Travel from Ujung Batee to Lhoksuemawhe, stopping in Pidie district (for discussions with Dinas Perikanan) and Bireuen (to view affected hatcheries)
21st February	Lhoksuemawhe, visit to affected tambaks
22nd February	Lhoksuemawhe, return to Banda Aceh, flight to Jakarta
23rd February	Jakarta, visit to FAO and meeting at Directorate General of Aquaculture
24th February	Meeting at Directorate General of Aquaculture, and return to Bangkok on TG 414 in evening. End of first mission.
2nd March	Travel Bangkok-Jakarta (TG)
3rd March	Jakarta, FAO office
4th March	Travel Jakarta-Banda Aceh. Visit FAO office. Security briefing.
5th March	Banda Aceh to Pidie, overnight in Pidie
6th March	Pidie to Bireuen, overnight in Bireuen
7th March	Visit Dinas Perikanan in Bireuen, travel to Banda Aceh
8th March	FAO office, Banda Aceh
9th March	Attend fishery and aquaculture workshop, Banda Aceh
10th March	Attend fishery and aquaculture workshop, Banda Aceh
11th March	Work in FAO office in morning, meeting with UNDP, afternoon at Ujung Batee
12th March	Visit Meleuboh, via helicopter, meeting with Dinas Perikanan staff from Nagan Raya and Aceh Barat.
13th March	Return from Banda Aceh to Jakarta
14th March	Meeting with Directorate General of Aquaculture and then work in FAO office, Jakarta
15th March	FAO office, Jakarta, then return to Bangkok (TG)

Annex B – Persons met

Banda Aceh

Mr Teuku Said Mustafa, Head of Fisheries Service of Aceh
Yulham, Dinas Kelautan and Perikanan (0812 6954227)
Adrian Syas, Dinas Kelautan and Perikanan (0816708203)
Yeo Bee Hong, World Fish Centre (b.yeo@cgiar.com)
Ilona C. Stobutzki, World Fish Centre (i.stobutzki@cgiar.org)
Clare Oxby, FAO consultant (choxby@yahoo.co.uk)
Ghassan Husni, Mercy-USA (ghassan_husni@hotmail.com)
Sonny D. Wicaksono, Director, Yayasan Sayang Aceh (NGO – silkroad.batavia@lycos.com)
Mark Van den Berg, Yayasan Sayang Aceh (NGO – silkroad.batavia@lycos.com)
Ainsah Abbas, Program Admin, WWF (isech_03@yahoo.com)
Dede Suhendra, Assistant Program Manager, WWF (suhendra.dede@yahoo.com)
Hanif Sofyan, WWF (tel: 0651 49963)
Adrian Morel, Aceh Task Force, Fishery and Aquaculture, French Embassy (amorel_aceh@yahoo.com).
Rita Shroff, OXFAM (tel: 0816 3181670, email: rshroff@oxfam.org.uk)
Simon Field, UNDP (simon.field@undp.org)
Adrian Morel, Aceh Task Force, Fishery and Aquaculture, Embassy of France (amorel_aceh@yahoo.com)
Shin Imai, Regional SPFS Coordinator, FAO (shin.imai@fao.or.id)
Dr Laurent Pouyaud, Institute de Recherche por le develooement (IRD) (Laurent.pouyand@ird.fr)
Michel Larue, IRD (Michel.Larue@ird.fr)
Yann Moreau, IRD (yann.moreau@ird.fr)
Amber Davidson, Country manager, ACIAR, Indonesia (amber.davidson@dfat.gov.au)
Mirah Nuryati, Assistant Country manager, ACIAR, Indonesia (mirah.mirah@dfat.gov.au)

Abdul Salam and Fuadi, Dinas Perikanan, Aceh Tamiang (tel: 081360023745)
Cut Yusminar, Kota Langsa (tel: 081361660176)
Mr Zulfahrei, Dinas Perikanan, Aceh Timur (tel: 085261089088)
Surya Darma, Dinas Perikanan, Aceh Barat Daya (tel: 0813 60008693)
Marwan Ismail, Dinas Kelautan and Perikana, Aceh Besar (tel: 0812 6904643)

Muchusin, Z.A., Center for Fisheries and Marine Sciences, Syiah Kuala University (tel: 0813 60205404)

Pidie

Rai Hanna, Head, Dept of Fisheries, Marine and Livestock, Pidie district
Azhari, J.P., staff of Dinas Perikanan
Mr Misla, tambak farmer and fisherman, Lancang village.
H.Salahuddin, Shrimp feed shop, Ulee Glee

Bireuen

Ir Zulkile Ibradin, Balai Penyulunan Perikanan, Semalanga (mobile: 0811689517)
Djalaludin Harun, Vice Mayor, Pidie

Lhokseumawe
Wahyuddin Albra, Economic Faculty, Universitas Malikussaleh
(mobile – 0811676967, email – whachyoe@yahoo.com; wahyu@um.ac.id
Andria Zulfa (mobile – 0811684854)
Edi Suhaimi (mobile – 08126947315; email – e_suhaimi_03@yahoo.com)

Jakarta
Dr Faturi, Director General of Aquaculture, MMAF
Barney Smith, ACIAR
Jes Summut, University of New South Wales (j.sammut@unsw.edu.au)
Jean Gallene, FAO Consultant (gallenejean@hotmail.com)
Rene E. Suter, Emergency Coordinator, FAO (ReneErnst.Suter@fao.org)
Alexander L. Jones, Regional Emergency Coordinator, FAO
(Alexander.jones@fao.org)
Jim Hancock, FAO Investment Centre (jim.hancock@fao.org)

Meleuboh
Mr Tarnigi Nudin - Nagan Raya Dinas Perikanan (tel: 0813 60200840)

Annex C - Matrix of ongoing/planned projects involving aquaculture assessment and rehabilitation

Donor plans

Donor	Ongoing/planned activities and issues
UNDP	Major cash for work program, presently increasing activities in rural coastal areas of the north-east. Good potential for partnership – UNDP (cash for work), and FAO (technical support)
ADB	Has allocated a grant for rehabilitation of aquaculture as part of overall support to the fishery sector. Details under preparation.
ACIAR	Presently developing plans for assistance to the fishery/aquaculture sector
Japan	JICA expressed an interest to support aquaculture rehabilitation in Banda Aceh and surrounding district of Aceh Besar, through the Directorate General of Aquaculture
France	Expressed an interest to support aquaculture rehabilitation
Netherlands	Expressed an interest to support a pilot project on environmentally sound rehabilitation of shrimp aquaculture through WWF
NACA	Requested by Government of Indonesia to assist in aquaculture rehabilitation.
FAO/Italy	Support for rehabilitation of Ujung Batee and pilot farm level project in three districts (details to be prepared)
FAO/Germany	Proposed support for aquaculture rehabilitation as part of a fisheries and aquaculture recovery program in 2-3 districts (not identified, details to be worked out)
FAO/EU	Proposed support for provision of inputs for 1,000ha of small-scale ponds ("ECHO" project, details to be worked out)

NGOs

NGO	Ongoing/planned activities and issues
Terre des Hommes	Cash for work program in Bireuen, including digging of tertiary tambak irrigation canals. Unaware of support beyond this phase.
OXFAM	Supporting cash for work programs in coastal areas that may include (on north/east coast) tambak canals. Plan to conduct a market analysis, including fisheries. Presently developing policy for fisheries/aquaculture sector. Requested the development of guidelines for aquaculture rehabilitation interventions, as concerned to ensure aquaculture interventions are sustainable
Indonesian Red Cross	Expressed an informal interest to support DGA in cash

	for work programs in tambak areas [personal communication of NGO to A. Budhiman]
World Wildlife Fund (WWF)	Presently surveying tsunami impacts on coastal ecosystems and livelihoods. Planning programs on 4) Marine/coastal resource rehabilitation, including mangroves 5) Empowerment of fishers and coastal communities 6) Spatial planning. Interested to collaborate in promoting responsible aquaculture practices in post-tsunami Aceh
World Aquaculture Society	No presence in Aceh, but expressed an interest to support aquaculture rehabilitation

Annex D – Key documents and web sites

FAO 1998. Report of the Bangkok FAO Technical Consultation on Policies for Sustainable Shrimp Culture. Bangkok, Thailand, 8-11 December 1997. FAO Fisheries Report No. 572. Rome. 31p.

World Bank. 1998. Report on Shrimp Farming and the Environment – Can Shrimp Farming be Undertaken Sustainability? A Discussion Paper designed to assist in the development of Sustainable Shrimp Aquaculture. World Bank. Draft.

World Bank, NACA, WWF and FAO. 2002. Shrimp Farming and the Environment. A World Bank, NACA, WWF and FAO Consortium Program "To analyze and share experiences on the better management of shrimp aquaculture in coastal areas". Synthesis report. Work in Progress for Public Discussion. Published by the Consortium. 126 pages (available at www.enaca.org/shrimp).

WWF, Banda Aceh, have compiled a set of all the Provincial regulations ("qanun"), including provincial marine resources regualtions. Conact Dede Suhendra, Assistant Program Manager, WWF (suhendra.dede@yahoo.com)

Rapid environmental impact assessment. Banda Aceh, Sumatra. Ministry of the Environment, Republic of Indonesia
http://www.humanitarianinfo.org/sumatra/assessments/doc/BA_REA_Report.pdf

The effects of the tsunami on women.
http://www.oxfam.org.uk/what_we_do/issues/conflict_disasters/downloads/bn_tsunami_women.pdf

A PRELIMINARY SURVEY OF THE DEVELOPMENT POTENTIAL OF SHELLFISH FARMING IN INDONESIA
http://www.fao.org/docrep/field/003/AB874E/AB874E00.htm#TOC

UNEP report on environmental impacts of the tsunami. After the tsunami. Rapid environmental assessment.
http://mirror.unep.org/tsunami/reports/TSUNAMI_report_complete.pdf

Annex E – Organisation of a cash for work program and check list

The following cash for work scheme was developed for a pilot cash for work program planned to be implemented under contract to Ujung Batee RBDC to support Pasi Lhok village in Pidie district.

Cash for work contract
A cash for work contract will be provided to the Ujung Batee Regional Brackishwater Aquaculture Development Centre of the Ministry of Marine Affairs and Fisheries (MMAF). The contract will cover the following items:

1. Cash for daily work of farmers/villagers. The workers will be selected by the tambak farmers association chief of the sub-district (who is village chief of Pasi Lhok). The village chief will organise work schedules to share the work among villagers who want to work (including tambak farmers, labourers and others who need work in the village).
2. Tools (lham, baskets, bags for putting sand from the canals, strong string)
3. Two water gates (for each village) public canals (to be managed – as before – by the local tambak farmer association)

(1) Cash for work

The following are the estimates of work required prepared in consultation with farmers:

Village	Length of canal to be cleaned (m)	Volume of silt to be removed	Number of person-days required	Estimated time required for completion	Cost (Rp35,000/ day)
Lancang	2500	5000 m3	2222	45 days	77,770,000
Pasi Lhok	3195	6390 m3	2840	45 days	99,400,000
Jeumeurang	1250	2500 m3	1111	45 days	38,885,000
Total			**6173**		**216,055,000**

The estimates are made on the basis of the following assumptions:

- One worker will remove 2.2 m3 of sediment/day.
- 1 m length of canal = 2m3 (2.5 width at top, 1.5m at bottom, x 1.0m depth).
- Maximum of 137 people per day, working over a period of 45 days

(2) Tools and water gates

The estimates of tools and materials (for water gates) required are as follows:

Tools	Number	Unit cost	Cost
Lham	137	30000	4,110,000
Pengki	60	8000	480,000

Bags	6000	1000	6,000,000
Hoe	60	37000	2,220,000
Wheel cart	15	175000	2,625,000
Sub-total			***15,435,000***
Water gate	6	1,500,000	9,000,000
Small bridge	3		6,000,000
Sub-total			***15,000,000***
Total			**30,435,000**

(3) Organisation of the cash for work

The cash for work contract will be organised as agreed with District Fisheries Office, village head and farmer association chair, and Ujung Batee Centre, under the overall management of the Ujung Batee Regional Brackishwater Aquaculture Development Centre of the Ministry of Marine Affairs and Fisheries (MMAF) as follows:

1. Coordinator – one staff from Ujung Batee will be assigned for full time coordination (in the field) of the pilot project. She/he will be paid Rp150,000/day.
2. Supervisor – one district staff from the District Fisheries Office will be assigned for full time coordination (in the field) of the pilot project. She/he will be paid Rp 90,000/day, plus fuel (estimated as Rp 5,000/day).
3. Chairperson – the Chair of the BMPT (tambak farmer organisation) or person nominated by the supervisor and Chair will be responsible for organisation of the cash for work program in each village level, selecting workers with the supervisor, keeping a daily record of the names of people working, and disbursing cash to villagers each Friday. Three Chairpersons will be appointed, one for each village. She/he will be paid Rp 40,000/day.
4. 30-50 persons will work/day under the Chairman, depending on daily availability of labour and other daily commitments of farmers.

Costs estimates

Person	Number of person-days required	Costs/per day	Units	Total cost (Rps)
Coordinator	1	150,000	45	6750000
Supervisors	1	95,000	45	4275000
Chairpersons	3	40,000	45	1800000
Labor	6173	35,000		216055000
Sub-total				***228,880,000***
Water gate			6	15,000,000
Small bridges			3	6,000,000
Tools				15,435,000
Sub-total				***30,435,000***

Total (Rp)				**259,315,000**
Total (US$)				**28,812.7**

The contract for restoration of the water supply in tertiary tambaks will be with Ujung Batee Regional Brackishwater Aquaculture Development Centre. The centre will have the following responsibilities:

1. Technical and organisational supervision of the program
2. Disbursement of the cash through the Chairman of each work group, following UNDP guidelines on cash for work programs.
3. Monitoring and evaluation of the cash for work pilot project according to agreed plan.
4. Organising with the District Fisheries Office a final review workshop involving farmers from the three villages to review outcomes of the cash work lesson's from the pilot, and develop an aquaculture action plan for follow up work to ensure full recovery of the brackishwater ponds, with an emphasis on small-scale farmers and labourers.
5. Reporting on the cash for work pilot, and with FAO backstopping staff, for drawing out lessons and preparing guidelines on tambak rehabilitation cash for work projects for wider application elsewhere.

Attachment 1: Draft format for preparation of a cash for work project [as developed for Pasi LhokVillage]

Location			
District	Aceh Pidie / Sigli		
Sub-district	Kemang Tanjong		
Village	Pasi Lhok		
Beneficiaries			
Number of households in village	323 households		
Number of households dependant on income from tambak farming (%)	60%		
Other occupations	30% Fisherman, 5 % Hatchery, 5 % trader		
Farm sizes	130.6 ha		
- 1ha of less	70.5 ha		
- 1.1-5ha	40 ha		
- >5 ha	20 ha		
%of farmers own tambak	80 %, 20% rent tambaks		
% farmers wanting to rehabilitate water supply/drainage system	100% [number consulted?]		
Rehabilitation design			
Canals	Length (m)	Width (M)	Average depth of sediment to be removed (cm)
Tertiary canal and part of secondary canal	500	1-2 m	100
Workplan			
Number of people to be employed	50 persons		
Number days required	16 day		
Daily salary	35.000/day		
Chairman (local village supervision)	Muslim Raden/ Head of Village/no.Hp 08126930608		
Supervisor	Dinas Perikanan, Pidie		
Coordinator	Ujung Batee aquaculture centre		
Tools required	Lham 50 Bh, Karung goni 500 Bh, Pengki 25 Bh Tali 3 mm 5 Gulung dan cangkul 25 Bh		
Monitoring			
Targets	When expected (days after starting)		
Preparations	10 day		
Secondary canal B +tertiary canal	16 day		
Environmental check list			
Environment friendly disposal of sediment?	Sediment to be removed is mostly sand, and will be put in bags and used to strengthen canal/pond dykes		
Acid sulphate soil problems	None identified		
No damage to mangroves	Some mangrove in the area – none will be damaged		
Not within any green belt area	No damage to green belt		
Any other environmental issues?	None identified		

Annex F – Draft environmental guidelines for rehabilitation of tambaks

The following are principles for "better management " of shrimp aquaculture derived from the World Bank/NACA/WWF/FAO Consortium Program on Shrimp Farming and the Environment[53]. The principles are the outcome of a multi-stakeholder process to develop international consensus on what constitutes better management of shrimp aquaculture, here modified/developed based on our current knowledge of the environmental, and social, interactions of shrimp farming in Aceh. We suggest the further development of these principles, in consultation with government, NGO and farmer partners, into a set of generally agreed guidelines for supporting the rehabilitation of pond aquaculture (tambaks) in Aceh[54].

The draft environmental principles for tambak rehabilitation are as follows.

1. Tambak ponds for rehabilitation should be located in areas that are environmentally suitable for fish and shrimp farming. There rehabilitation should not impact on biodiversity, ecologically sensitive habitats and ecosystem functions. Particular attention should be given to minimizing impacts on mangroves. There should be clear legal title to the land, and the land should not be located in any existing or proposed green belt.

2. Tambak and water supply reconstruction should be done in ways that do not cause ecological damage, including risks from acid sulphate or disruption of water supplies. Aquaculture designs should as far as possible incorporate buffer areas between ponds and natural habitats such as mangroves. Techniques and engineering practices should be used that minimize erosion, leaching of acid sulphate soils and salinization during rehabilitation and subsequent operation.

3. Water supply systems should be rehabilitated in ways that ensure sufficient water supply and drainage. Care should be exercised to avoid salinisation where tambak ponds are located near agriculture areas. Off-site impacts associated with discharge of effluent and solid wastes should be minimized during farming through good water management practices.

4. Wild broodstock collection and hatchery rearing of shrimp post-larvae and milkfish should not use destructive fishing techniques. Hatchery practices that promote quality and healthy shrimp and fish should be encouraged.

5. Feeds and feed management practices should make efficient use of feed resources. Feed and fertilisers should be used efficiently in ways that maintain pond fertility and do not cause degradation of water quality or affect the health or food safety of farmed shrimp and fish.

6. Disease risks for farmed and wild fish and shrimp should be minimised through stocking of ponds with healthy shrimp and fish. Hatchery operators and farmers

[53] www.enaca.org/shrimp

[54] Similar principles could be prepared for marine cage culture, and possibly other forms of aquaculture that may be supported as a livelihood activity.

should be trained in reducing risks of shrimp and fish diseases through adopting simple risk reduction measures, emphasizing maintaining environmental quality.

7. Use of chemicals that may lead to residues or environmental risks should not be used. While antibiotics are not used in traditional farming, some chemicals used for pond preparation are a concern, and alternatives should be found and promoted.

8. Rehabilitation and operation of tambak farms should be done in a way that benefits local communities and the province. The rehabilitation of tambak farms, important for the livelihoods of many people in coastal areas and the priority is to maximize employment and social benefits to communities. Careful consultation and planning is required with communities to maximize benefits and not create social conflicts.

9. Planning for tambak rehabilitation should also consider the cumulative effects of individual ponds, and seek to ensure that developments are within the carrying capacity of the local are to sustain farming.

Once the environmental principles and guidelines have been developed, through multiple stakeholder input, extension materials should be prepared, and training provided for their implementation. Government agencies and NGOs involved in aquaculture rehabilitation should be provided with training and materials as needed.

Agreement to adhere to these principles could be included in agreements to support cahs for work schemes, land allocation and other rehabilitation support. Land allocation and licences might be granted by government against adherence to the basic principles (eg not in designated green belt). Further study is necessary of the future land allocation processes to understand the opportunities to incorporate basic environmental criteria into the process.

Annex G – Detailed information on district and sub-district damage to aquaculture

The following brings together information available from MMAF assessments, and information collected from Provincial and District Dinas Perikanan and Kelauatan, supplement with additional field information collected during the mission,

The assessment is organised by district starting in the north, and then moving to the east and to the south. The assessment initially covers districts in the province of Aceh, and then the province of Sumatera Utara.

Kota Sabang

There was damage to aquaculture on Kota Sabang[55]. There is a small tambak area in sub-district of Sukajaya that was used for culturing small milkfish for tuna bait[56] and shrimp (perhaps 30ha) and some cage culture (2 units, each unit with 40 cages [total of 80 cages], used for grouper and previously keeping milkfish for tuna long line near Pulau Klah in Sukakarya sub-district. We have no information on the tambak, but the cage aquaculture was directly affected by the tsunami, and was totally lost. Using an estimate of Rp 1.5 million/cage (raft and net), plus two huts (total Rp 1 million) the infrastructure loss is Rp 121 million.

The stock losses were grouper in 80 cages (100 grouper/cage, 0.5kg, valued at Rp90,000/kg) estimated at Rp 360 million.

Kota Banda Aceh

Aquaculture in Kota Banda Aceh was, as the rest of the city, severely damaged by the tsunami, with major loss of life.

All irrigation canals were damaged, in some cases lost to the sea. Out of the total of 975.4 ha of ponds, around 687ha were severely damaged or lost. All aquaculture in the sub-districts below have stopped.

Sub-district	**Irrigation canals (km)**		**Ponds (ha)**	
	Pre-tsunami	*Damaged*	*Pre-tsunami*	*Damaged*
Jaya Baro	5	5	13.8	12.8
Meuraxa	80	80	169.4	149.4
Kuta Raja	30	30	98.2	78.1
Kuta Alam	5	5	199.3	199
Syiah Kuala	120	120	268.7	248
Banda Jaya	5	5	226.0	0

55 BBAP have prepared an aquaculture plan for Kota Sabang in 2003, identifying several sites for mariculture development.

56 Although this may have stopped prior to the tsunami due to changes in tuna long line activity on Subang caused by GAM/TNI conflicts [to be verified]

Lueng Bata	0	0		0
Baiturrahman	0	0		0
Ulee Karang	0	0		0
Total	240	240	975.4	687.3

The four hatcheries in Banda Aceh were all severely damaged by the tsunami.

Aceh Besar

Aquaculture in Aceh Besar was heavily damaged during the tsunami. The west coast of the district received the full and direct force of the tsunami which caused massive destruction of life and property, including aquaculture ponds and brackishwater irrigation systems. The north and east coast also received serious damage, with major erosion of shoreline and again loss of ponds and irrigation canals.

Information from District Dinas Perikanan supplemented by staff at Ujung Batee RBDC are summarised in the table below:

Sub-district	**Irrigation canals (km)**		**Ponds (ha)**	
	Pre-tsunami	*Damaged*	*Pre-tsunami*	*Damaged*
Darul Imarah			-	-
Lembah Seulawah			-	-
Seulimum	0.45	0.45	37.60	6.00
Indrapuri				-
Montasik				-
Kuta Baro				-
Krueng Barona Jaya	0.40	0.40	15.30	-
Peukan Bada	10.00	10.00	313.90	195.00
Lhok Nga	2.00	2.00	56.00	56.00
Leupung	2.00	2.00	52.90	16.00
Lhoong	1.80	1.80	92.40	60.00
Mesjid Raya	15.00	15.00	293.1	293.00
Baitussalam	10.00	10.00	163.2	116.00
Darul Amal	2.00	2.00		-
Kota Jantho				-
Pulo Aceh	2.00	2.00	81	81.00
Ingin Raya				-
Total	**48.65**	**20.2**	**1,105.40**	**823.00**

Of the 10 shrimp hatcheries in the district, all were severely damaged by the tsunami, including nine in the sub-district of Mesjid Raya (close to Ujung Batee) and one in Leupung.

Pidie

The district of Pidie on the east coast suffered significant damage also, although pond damage was not as severe as in Aceh Besar. 14 sub-districts were affected by the tsunami, with Kembang Tanjung and Batee the most severely impacted.

Information from District Dinas Perikanan supplemented by staff at Ujung Batee RBDC are summarised in the table below:

Sub-district	Irrigation canals (km)		Ponds (ha)	
	Pre-tsunami	*Damaged*	*Pre-tsunami*	*Damaged*
Muara Tiga	1	1	295.5	173.05
Batee	2	2	594.7	500.1
Pidie	3	2.92	540.3	132.2
Kota Sigli	3	3	119.0	119.0
Simpang Tiga	9.7	9.7	276	276
Kembang Tanjung	20.9	20.9	830.4	830.4
Glumpang Baru	3	3	480.2	203.3
Bandar Baru	29.575	28.495	1023	1023
Pante Raja	3	3	105	105
Trenggadeng	5	5	191.6	191.6
Meureudu	1.5	1.5	129	94.7
Meurah Dua	2	2	122	20.7
Ulim	2	2	185	185
Jangka Buya	2.5	2.5	182	170.4
Total	**88.175**	**87.015**	**5073.8**	**4024.6**

The sub-districts of Batee and Kebang Tanjung, containing the largest areas of ponds in the district, were most severely affected.

All of the 70 hatcheries (of which 69 were shrimp) in Pidie were affected by the tsunami. Impacts ranged from partial damage (mainly loss of roof and infrastructure) to complete loss (tanks and infrastructure, including loss to the sea in extreme cases).

Bireuen

The district of Bireuen adjacent to Pidie on the east coast also suffered significant damage as the tsunami moved along the coast. Information from District Dinas Perikanan supplemented by Ujung Batee RBDC are summarised in the table below:

Sub-district	Irrigation canals (km)		Ponds (ha)	
	Pre-tsunami	*Damaged*	*Pre-tsunami*	*Damaged*
Samalanga	86.2	50.6	1418	1418
Pandrah	14.2	14.2	132.5	42
Jeunib	39.8	21	228	83
Peudada	26.9	26.9	351.75	72
Jeumpa	39.9	19	606.99	364
Jangka	91.2	27	1642	80
Peusangan	0	0	0	0
Gandapura	78.7	59	582.5	230
Total	**376.9**	**217.7**	**4961.74**	**2289**

The sub-districts of Samalanga, Jeumpa and Gandapura were most affected by the tsunami.

Bireuen was an important producer of shrimp post-larvae. Of the 99 hatcheries in the district before the tsunami, 71 were damaged to varying degrees. 28 hatcheries were not damaged, and several have started operating again at the time of this mission.

Aceh Utara

Aceh Utara district is a large tambak farming areas which also suffered significant damage. Information from District Dinas Perikanan supplemented by Ujung Batee RBDC are summarised in the table below:

Sub-district	**Irrigation canals (km)**		**Ponds (ha)**	
	Pre-tsunami	*Damaged*	*Pre-tsunami*	*Damaged*
Sawang				
Muara Batu	2.50	2.50	42.85	42.850
Dewantara	15.0	10.5	295.49	206.85
Nisam			34.20	34.15
Kuta Makmur				
Simpang Kramat				
Syamtalira Bayu	10.0	10.0	209.2	209.2
Meurah Mulia				
Samudera	22.5	9.0	474.1	189.0
Syamtalira Aron			85.0	85.0
Tanah Pasir	47.5	19.0	939.4	375.8
Tanah Luas				
Nibon				
Matang Kuli				
Paya Bakong				
Lhoksukon			142.40	142.35
Cot Girek				
Baktiya Barat	192.2	134.6	3,069.5	2,347.50
Baktiya			781.3	719.3
Seunoddon	161.4	64.5	3,227.15	1,290.0
Tanah Jambo Aye	55.9	39.1	1,118.3	894.6
Langkahan				
Total	**507.0**	**289.3**	**10,418.9**	**6,536.6**

Of the 38 hatcheries before the tsunami, all suffered heavy damage.

Kota Lhokseumawe

Information on Kota Lhokseumawe is provided below. The ponds in this area appear to have been at least partially protected from the tsunami by the shape of the coastline.

Sub-district	**Irrigation canals (km)**		**Ponds (ha)**	
	Pre-tsunami	*Damaged*	*Pre-tsunami*	*Damaged*
Blang Mangat	3.30	3.30	385.8	385.8
Muara Dua	7.00	7.00	576.5	300.0
Banda Sakti	3.00	3.00	65.3	40.3
Total	**13.30**	**13.30**	**1,027.6**	**726.1**

There were no shrimp hatcheries in Kota Lhokseumawe before the tsunami.

Aceh Timur

We were not able to visit Aceh Timur, and the preliminary information below comes from consultations with Dinas Perikanan staff. Further field verification is required (particularly as the length of irrigation canal seems quite short relative to tambak pond area).

Damage is also mostly light.

Sub-district	**Irrigation canals (km)**		**Ponds (ha)**	
	Pre-tsunami	*Damaged*	*Pre-tsunami*	*Damaged*
Madat	5	5	2206	2036.5
Simpang Ulin	0	0	887	459.5
Julok	0	0	1553	1088
Nurussalam	0	0	652	478
Darul Aman	2.9	2.9	718.5	498
Idi Rayeuk	0.35	0.35	298.5	73
Darul Ihsan	0	0	0	0
Banda alam	0	0	0	0
Idi Tunong	0	0	0	0
Peudawa	0	0	431.5	0
Peureulak Barat	0	0	215	0
Peureulak Kota	0.23	0.23	1652	120
Peureulak Timur	0.31	0.31	1077.5	75
RT Panjang Peureulak	0	0	0	0
Sungai Raya	0	0	1186	25
Rantau Selamat	0	0	988	30
Birem Bayeun	0	0	517	15
Serba Jadi	0	0	0	0
Simpang Jernih	0	0	0	0
Total	**8.8**	**8.8**	**12382**	**4898**

There were 6 shrimp hatcheries in Aceh Timur before the tsunami, of which only 2 are operating in March 2005. We have no information on the extent of damage to hatcheries.

Kota Langsa

District Dinas Perikanan report no direct impacts of the tsunami on the physical structures of ponds (4,647ha) and irrigation canals, but some siltation problems in 15km of primary canal. Siltation was reported in the canal to be up to 50cm in places, having some effect on water circulation. Further assessment is required to obtain more detail. According to Dinas Perikanan, the two shrimp hatcheries in the district were not affected by the tsunami.

Aceh Tamiang

District Dinas Perikanan reported no structural damage from the tsunami on the 6655ha of tambak ponds in Aceh Tamiang district although they report that the preceding earthquake caused some silting of irrigation canals from collapse of the canal side walls. Sedimentation is also reported in the mouth of the Kuala Tambiang

with affects on water movement and access by fishers. Further investigations are needed.

Aceh Jaya

All the 317ha of brackishwater ponds in this district are reported to be lost to the sea. Information available is summarized below. No information was available to the mission on canals, but there would have also been severely damaged along with the ponds.

Sub-district	**Irrigation canals (km)**		**Ponds (ha)**	
	Pre-tsunami	*Damaged*	*Pre-tsunami*	*Damaged*
Teunom			2.7	2.7
Kuede Panga			0	-
Krueng Sabee			4.6	4.6
Setia Bakti			15.0	15.0
Sampoinit			20.0	20.0
Jaya			275.0	275.0
Total	**n/a**	**n/a**	317.3	317.3

There were no hatcheries in Aceh Jaya.

Aceh Barat

Aceh Barat district also suffered major damage to ponds and canals, with all 60ha reported as lost to the sea or severely damaged. According to Dinas Perikanan sources in Aceh Barat, a total of 104 farms were affected, with an average size less than 1ha. 60% were traditional ponds, and 40% semi-intensive shrimp ponds. Milkfish, shrimp and red tilapia were farmed, with red tilapia stock coming from Medan.

Information from Dinas Perikana on impacted pond area and canals is given below.

Sub-district	**Irrigation canals (km)**		**Ponds (ha)**	
	Pre-tsunami	*Damaged*	*Pre-tsunami*	*Damaged*
Johan Pahlawan	2	2	10	10
Samatiga	1	1	38.50	38.50
Arongan L.	8	8	5.00	5.00
Meurebo	1	1	7.00	7.00
Total	12	12	**60.50**	**60.50**

Out of the 104 farms, all were reported to operated by local owners. Unlike neigbouring Nagan Raya, Dinas Perikanan report that family labour was not used in Aceh Barat but hired labour. Traditional farms employed 2 people per farm, plus the owner. As elsewhere in Aceh, the number of livelihoods affected therefore goes well beyond the number of "farmers" given in government statistics. Seven traders were also involved in shrimp and fish trade, including farmed and wild fish. Shrimp from aquaculture ponds were sent to Medan by local traders.

There were no hatcheries in Aceh Barat. Shrimp for stocking came from wild stock (naturally entering traditional ponds) or hatcheries. Ujung Batee had supplied *P.monodon* shrimp post-larvae, with apparently good survival and growth.

Dinas Perikanan also report that the tsunami has created new lagoon areas along the coast of Aceh Barat, presently with an abundance of milkfish fry.

Nagan Raya

The district of Nagan Raya immediately south of Aceh Barat was also impacted by the earthquake and tsunami.

Of the 12.5 ha of pre-tsunami coastal aquaculture ponds, and 2-3 km of canals, all were seriously damaged or lost to the sea as a result of the tsunami. All ponds were small-scale traditional ponds of less than 1ha, farming milkfish and shrimp. Twenty two farm households operated the tambaks with family labour. Dinas Perikanan report that all households lost family members.

Sub-district	**Irrigation canals (km)**		**Ponds (ha)**	
	Pre-tsunami	*Damaged*	*Pre-tsunami*	*Damaged*
Kuala	2	2	11	11
Darul Makmur	1	1	2	2
Total	3	3	12.5	12.5

Nagan Raya also has some earthquake damage to freshwater aquaculture. Dinas Perikanan report that 23.5ha of freshwater ponds growing nile tilapia in Kuala district were damaged by the earthquake, out of 100ha. Two freshwater fish hatcheries (one in Lhok Parom district and the other in Babah Kruen) producing together 500,000 fingerlings/year – common carp and nile tilapia) were reported to be affected by the earthquake.

Dinas Perikanan of Nagan Raya requested priority to supporting rehabilitation of freshwater aquaculture. This appears to be in part related to the market opportunities associated with the present high price of freshwater fish in this area[57].

Aceh Barat Daya

There are major discrepencies in data for Aceh Barat Daya submitted to the MMAF, Provincial statistics and that available from consultations with Dinas Perikanan staff in Banda Aceh.

According to staff of the Dinas Perikana of Aceh Barat Daya, there were approximately 800ha of tambaks in the district, all traditional polyculture of shrimp and milkfish apart form 50ha of intensive shrimp. Of this, 300ha sustained damage from the tsunami. No data were available on canals. The table below provides the information submitted to MMAF, considerably less than 800ha.

Sub-district	**Irrigation canals (km)**		**Ponds (ha)**	
	Pre-tsunami	*Damaged*	*Pre-tsunami*	*Damaged*
Kuala Batee			40.1	40.1
Manggeng			1.2	1.2
Susoh			9	9

57 Prices for freshwater fish in Meleuboh market on 12th March – Rp 20,000/kg nile tilapia (compared to Rp12,000/kg pre-tsunami); Rp 30-35,000/kg for *Clarias batrachus* (catfish) (Rp 15,000/kg pre-tsunami); Rp 22,000/kg for common carp (Rp 12,000/kg pre-tsunami)

Tangan tangan			2.5	2.5
Babah Rot			3.7	3.7
Blang Pidie			0.5	0.5
Total	**n/a**	**n/a**	**57**	**57**

We suggest further assessment of the aquaculture situation in Aceh Barat Daya to clarify the descrpencies in data.

Aceh Selatan

Information from Ujung Batee suggest around 12ha of tambak ponds in Aceh Selatan, of which all were damaged. The ponds were in the sub-districts of Labuhan Haji and Labuhan H. Timur. The short system of irrigation canal in these tambaks were also damaged. No information was available on the extent of the damage.

There were no hatcheries in Selatan district.

Aceh Singkil

According to Ujung Batee, there are only a few hectares of traditional tambak on Aceh Singkil, but these do not appear on Dinas Perikanan statistics. We could find no reports of damage to aquaculture in this district caused by the tsunami. There are fixed cages (3 units, each of 4-6 cages) in Pulau Banyak off the coast of Aceh Singkil District but there are not used for aquaculture, just for holding of live reef fish collected from the wild for export to Hong Kong.

Simeulue

Simeulue island was close to the epicenter of the earthquake and experienced severe shocks and the tsunami wave. In places the shoreline has sunk. There was no tambak in Simeulue, but the island had some marine fish farming and a newly constructed government hatchery, which suffered extensive tsunami damage[58].

The government hatchery (Balai Benih Ikan Pantai – BBIP - operated by Provincial Dinas Perikanan), already with an investment of Rp 1.2 billion [Agus to check], located at Busung village in Simeulue Timor sub district was partly destroyed. The hatchery was not yet operating. The damage is estimated by Dinas Perikanan as Rp 850,000,000 million.

All the floating and fixed marine fish cages on the island, a total of 65 units (each tentatively with 8-10 cages) located in Sinabang bay and Teluk dalam bay, were affected, with loss of nets and some frames. Cages were culturing tiger grouper (*E.fuscoguttus*) and greasy grouper (*E. tauvina*) and lobsters that were also lost during the tsunami.

58 . Information on aquaculture was obtained from a report on a visit to Simeulue distract on 12th-15th January 2005, prepared by the Directorate of Infrastructure of the Directorate General of Aquaculture, and consultations with Ujung Batee staff who conducted a survey during 2003. Supplemented by estimates of Dinas Perikanan, Simeulue, contained in a fax message dated 25th February 2005

Of the floating nets (keramba apung) used for grouper culture on the island, 2 were lost, two seriously damaged, and two with light damage. Estimates are 15 million per unit for lost, 8 million for damaged, and 2.5 million for light damage, giving a total damage estimate of Rp50,000,000.

Fixed nets suffered severe damage. 26 units were lost (8 million/unit), 27 units were seriously damaged (3,000,000 million/unit) and 6 lightly damaged (1,000,000/unit), giving an estimated Rp 305,000,000 damage.

Stock losses include grouper and lobsters; an estimated 237kg of marine fish (grouper) seed lost, with a unit value of Rp50,000/kg and value of Rp 11,850,000; and an estimated 152 kg of lobster, with a unit value of Rp 120,000 and value of Rp 18,240,000.

No information was available on the affects on farmers, but the report referred to above notes that 70% of fishers on the island required assistance. The report estimates 12 farmer groups, each possibly with 5 farmers, and 50 farmers involved in cage culture, suggesting 110 farmers affected. No information was available on labour, family, or other part-time workers.

All the above figures for Simeulue island require further verification.

North Sumatra

No further information was available on the damage to cage culture in Nias island, apart from that reported in the previous section. No damage was reported from any brackishwater tambaks on the west or east coast of the province.

Annex H: Outline of aquaculture rehabilitation program management and coordination

The mission recommends government establish a coordinated program for rehabilitation of aquaculture, to facilitate effective management of support to the recovery of the aquaculture sector.

The following provides an extension of the present MMAF coordination unit, working within government structures, to facilitate coordination at all levels.

The support to rehabilitation of aquaculture would be coordinated with the support to fisheries at all levels, with a particular emphasis on coordinated planning at district, sub-district and village levels.

Administrative level	**Requirement**	**Activities**
National level	Directorate General of Aquaculture, MMAF - position with responsibility for overall management and monitoring of the aquaculture program.	National level coordination of government aquaculture program, monitoring of needs, maintaining database of needs and support, facilitation of donor coordination.
Provincial level	Position within Dinas Perikanan with responsibility for overall provincial level coordination, monitoring and evaluation of the aquaculture program in Aceh.	Provincial level coordination, monitoring, maintainin database of needs and support, dialogue with donors/projects.
District level	Strong District team for management and technical support. This should be a strong nationally-recruited technical team (aquaculture, livelihoods, environment, and engineering) responsible for development, management and local coordination of the district aquaculture "sub-project", based within and supporting Dinas Perikanan, also in close liason with mayor.	District coordination among locally-supported projects (particularly livelihood focussed), regular meetings, possible donor support to individual district projects. Responsible also for identifying gaps in support, and potential overlaps. Strong links established with other sectors for livelihoods oriented approach
Sub-district/village level	Supervisors/extension teams providing technical supervision and support to village aquaculture projects and activities. Depending on the needs, such teams might be located at either sub-district of village level.	Assistance to villages to develop aquaculture plans, training of village teams, technical supervision and support
Village	Village head, or local farmer groups (BMPT, other informal groups) to be given responsibility for management of community aquaculture rehabilitation.	Implementation of aquaculture plans. Strong emphasis should be given to capacity building for "empowerment" of local farmer groups

Ujung Batee	Research and development centre of national government. The centre should be supported to provide services (training, disease testing, quality fish/shrimp seed to jump-start hatcheries/tambaks, technical support) for the program. UB could be strengthened by staff seconded from elsewhere in Aceh, or Indonesia, to supplement existing skills for rehabilitation.	Training and technical support to rehabilitation.

The mission recommends a discussion with Government on the above draft approach.

Annex I: Training requirements and resource materials

There is a need for short-term training for people involved with rehabilation and to create awareness of environmentally sound and socially responsible approaches to aquaculture rehabilitation, among government, NGO and farmer organizations[59].

- **Tambak rehabilitation** – as a priority for teams involved with working with villagers in development of aquaculture rehabilitation plans and implementation of tambak rehabilitation. The training should cover technical topics, such as preparing simple aquaculture plans, pond design and soil and water quality assessment and management (particularly acid soils), environmental issues and livelihood approaches. The principles to be established for tambak rehabilitation (see Annex #) should be a basis for training.

- **Livelihood approaches –** as a priority for all teams involved with working with villagers to develop aquaculture plans, including livelihood analysis, identification of support requirements, including the most vulnerable, and mobilization and organisation of tambak farming communities for rehabilitation.

- **Capacity building among farmers and farming organizations -** training requirements should also be considered during the development of an aquaculture plan and as far as possible technical support provided to assist farmers and farmer organizations in implementation of the plan. This may involve training in various topics, such as aquaculture technologies (eg milkfish nursing), or organizational skills (eg organizing a farmer group, revolving funds, book-keeping etc). There is a need to be flexible depending on needs. There is a large donor and NGO resource base in Aceh, providing excellent opportunities to tap into a substantial skills base for organizing varied training support.

- **Medium to long-term capacity building –** there is a need, generally, to strengthen the capacity and awareness of institutions involved with aquaculture in Aceh. This can be supported by involving and supporting, as far as possible, local institutions to become actively involved in aquaculture rehabilitation. Longer-term training and educational programs for staff from Dinas Perikanan and Universities can also help to build the capacity required for longer-term rebuilding of institutions.

Extension material should also be prepared based on needs. There are a number of resource materials available within Indonesia, and in other countries of the region, that can be made available to support teams involved with rehabilitation. These include:

[59] These notes build on discussions with Dr Jes Sammut and Barney Smith of ACIAR concerning possible items for inclusion in a training program on tambak rehabilitation planned by ACIAR.

- **ACIAR project materials** from tambak rehabilitation projects in Sulawesi, grouper network manuals, and regional shrimp health management programs (with NACA)

- **FAO manuals** – the recent manual on *P.monodon* hatchery practices,

- **NACA manuals** and other materials on "Better management practices" in shrimp aquaculture, including recent work on small-scale shrimp farming in India and Vietnam (see www.enaca.org/shrimp)

Annex J: Rehabilitation options for aquaculture

This section brings together initial information obtained during the mission on existing coastal aquaculture systems in Aceh, and some potential "packages" of support.

Traditional shrimp and milkfish

The following information on costs for restocking of a traditional shrimp-milkfish pond based on interviews in Pidie.

Item	Unit cost (Rp)	Number required	Total cost (Rp)	Total cost (US$[60])
Pond inputs per 1 ha, for one mixed crop of traditional milkfish and shrimp farming				
Milkfish fingerlings (stocked at 1/m2, plus 20% for losses)	300/pc	12,000	3,600,000	400
Shrimp seed (stocked at 2/m2, plus 20% for losses)	20/pc	24,000	480,000	54
Nursing net (hapa)	1 unit	200,000	200,000	23
Cast net	1 unit	200,000	200,000	23
Chemical – pest control	24,000	1 litre	24,000	3
Chemicals – saponin	2,700/kg	100 kg	270,000	30
Fertiliser – urea	1,500/kg	300 kg	450,000	50
Fertiliser – TSP	2,000/kg	150 kg	300,000	34
Lime	600/kg	1,000 kg	600,000	68
Dolomite	1,500/kg	500kg	750,000	83
Fish/shrimp feed	9,000/kg	300kg	2,700,000	300
Total				**2,029**

Grouper nursing

Grouper nursing is already practiced in Bireuen, with favourable response from farmers and good returns to investment within 6 weeks. The technology may be useful to provide short-term economic returns to villagers, including those with limited access to ponds. Community ponds could be used involving several farmers. The following information collected through farmer interviews in a tsunami affected village in Samalanga sub-district, Bireuen.

Technology/farming system:

60 1US$ = Rupiah 9,000

- 6 people, from 6 households involved in nursing, organized through contacts with a trader in Medan, under a cost-sharing arrangement.
- Stocking density – 2,000 fingerlings/hapa
- Hapa – 4x2x1 m, cost is Rp 100,000/hapa (hapa life time of 5yrs). Materials are available locally (in Semalanga sub-district)
- 2 hapas per person, with 12 hapas used in the group. Several hapas are needed, as grouper fingerlings need regular.
- Tiger grouper seed come from Bali or Situbondo (East Java), via Medan.
- Feed – small crustaceans in pond. Large fish – use trash fish bought from fishermen (1 basket, Rp 150,000 – 30kg weight approx.)

Economics:
- Purchase price = 2,600-2,700/pc for 1.2 cm long toger groupers.
- 40 days growth – 3 inches – sell at 4,000/pc.
- 88-90% survival
- Profit – around 1, split with trader if the trader has provided investment.

Markets:
- Trader in Semalanga sells tiger grouper seed to farmers, who then sell back to trader.
- Semalanga trader sells to Medan trader, who sells to Malaysia
- Transport – require plastic bags, and oxygen (trader provides)
- 10 traders involved with grouper nursing in Semalanga – which is the main sub-district for grouper nursing.
- 6 traders in Medan involved with grouper fry trade
- 30,000 grouper seed sold per month(?) to Medan for export.

Environment:
- Salinity should be greater than 18 ppt – if drops to 15 ppt, then groupers will suffer from mortality/disease (mainly a problem of the rainy season).
- Use of hatchery seed avoids having to collect juveniles from the wild, with potential "by-catch" concerns
- Aceh Utara has a similar practice, except seed are collected from the wild.

Seaweed

Seaweed may have potential as a future small-scale economic activity around islands and the west coast, where there is clean seawater. Some seaweed culture trials had been conducted on Pulau Aceh, but apparently stopped because of lack of markets. Further analysis is required, as seaweed markets are available in Indonesia.

Seacucumber (*Holothorius scabra*)

Technology - seed is available from Lampung in southern Sumatra. Farming of seacumber involves simple low cost technology, that may be suitable for ranching, perhaps in coastal lagoons (on west coast?). Markets are in China and Hong Kong.

Molluscs

The potential for use of mollusk farming as an alternative livelihood oprtions should be further analysed.

Some prices for aquaculture products

Pidie district – average farm gate prices 3 pieces/kg of milkfish. 20,000/kg. early March price – 11,000 (small size) up to 20-25,000/kg

Bireuen district– the tsunami has lead to price increases, due to lack of milkfish supply. The milkfish from Bireuen are sold in Aceh Tengah – this inland district is presently lacking milkfish from the district. Normal farm gate price is 15,000/kg, (3-4 pcs/kg) and present price is 20,000/kg. There is therefore an influence on trading activity, and transport to other areas.

In Bireuen, soft shelled crab from Jangka sub-district are marketed in Medan for 30,000 Rp/kg. Langkat in North Sumatra also produces soft shelled crabs.

Prices for freshwater fish in Meleuboh market on 12th March – Rp 20,000/kg nile tilapia (compared to Rp12,000/kg pre-tsunami); Rp 30-35,000/kg for *Clarias batrachus* (catfish) (Rp 15,000/kg pre-tsunami); Rp 22,000/kg for common carp (Rp 12,000/kg pre-tsunami)

Annex K: Project concepts prepared

The following draft project concepts/proposals were prepared during the mission, the first two in response to urgent requests from FAO and the last in response to request from tsunami affected farmers in a village in Pidie district.

1) Support to rehabilitation of the Ujung Batee Brackishwater Aquaculture Centre and responsible aquaculture rehabilitation in Aceh Province – US$ 2,179,059 prepared for FAO submission to Government of Italy.

2) Village level small-scale tambak aquaculture rehabilitation project – US$982, 175 prepared for submission to the European Community Humanitarian Office (ECHO). The project supports rehabilitation of tambak water supplies and aquaculture ponds covering around 1,000ha of ponds in the north-eastern coastal area (sites not yet specified).

3) Pilot project for rehabilitation of small-holder tambaks for income and livelihood in three villages in Pidie District, Aceh province, Indonesia. US$28,812 prepared as a pilot project to test approaches to rehabilitation of tambak water supply and drainage systems through a cash for work program.

The detailed documents have been submitted separately to FAO.

Annex L: Draft Terms of Reference for preliminary work on rehabilitation of Ujung Batee

Draft Terms of Reference for International Consultant on "Aquaculture Engineering and Aquaculture Centre Design".

Under supervision of [name, position], and in collaboration with the Director of Ujung Batee aquaculture centre, visit the centre (together with associated ponds and hatcheries) located at Banda Aceh for a period of 30 days for the following tasks:

1. Review in detail the assessments of damage to the centre and requirements for rehabilitation. Consider the impacts of the tsunami on physical structure and operational functions of the centre.
2. Review the pre-tsunami functions of the centre, and identify the planned post-tsunami functions of the centre after rehabilitation, in short (during 2005), medium (1-2 years) and long-term (2-5 years).
3. Review plans and designs for rehabilitation of the centre and prepare a detailed plan and design for rehabilitation of the functions of the centre.
4. Prepare detailed costings for rehabilitation of the centre, including items to be purchased in Indonesia, and from abroad. Identify potential sources for procurement. Follow FAO rules. Give special emphasis, as far as possible to local supplies of products.
5. Identify any gaps that can be considered for further intervention to strengthen the post-tsunami functions of the centre.
6. Identify training requirements of Ujung Batee staff, for short-term and longer-term training as required to fulfil the functions of the centre as required, giving special emphasis on the post-tsunami situation.
7. Conduct with the centre staff, Directorate General of Aquaculture, and other key stakeholders a workshop to review and finalise the plans for rehabilitation of the centre.
8. Prepare a report on the above, and detailed design for the centre, providing the basis for subsequent tendering and construction of the centre, according to Government of Indonesia and FAO rules and procedures.

In preparing the plans and design for reconstruction and rehabilitation of the centre, the consultant will also pay special attention to the following issues.

1. The safety and vulnerability of centre staff and workers in the rehabilitated centre, including location and design of staff housing.
2. Government of Indonesia regulations and plans concerning the coastal "green belt" and maintaining a buffer of coastal vegetation for protection. Recommendations on structures may be developed as required
3. Farmers demand, balance between public and private responsibilities. Assist in restoring functions of private sector.

The consultant would have experience in coastal aquaculture engineering (hatcheries, ponds, and associated buildings) and the design of aquaculture research and development facilities.

There should a national consultant with experience in construction also appointed to work with the international consultant.

Annex M: Terms of Reference

FISHERIES SECTOR EMERGENCY NEEDS ASSESSMENT MISSION – AQUACULTURE

Indonesia

Under the general guidance of the Chief TCEO, the technical guidance of the Chiefs, FIRI and FIPP, under the direct supervision of the FAO Representative in Indonesia, and in close cooperation with the government officials from the relevant line ministries, national and provincial authorities, the consultant will conduct a damage and rehabilitation needs assessment for coastal aquaculture in the Tsunami affected areas in Indonesia. The consultant will assess and compare the status of the aquaculture sector prior to, and after the tsunami(s), as well as the short-, medium- and long-term needs of those whose livelihoods are dependent on aquaculture. In particular, the consultant will undertake following duties:

1) Visit Tsunami affected coastal areas as required,

2) Meet and discuss with the relevant government line ministries and agencies on the impacts of Tsunami on the overall economy (especially fisheries and agriculture) of the country,

3) Consult experts working in the field of fisheries emergency assistance and rehabilitation in the country. Examine the experts reviews and reports on damage assessments, short-term rehabilitation and assistance to fisheries sector, produced by FAO and other international/national agencies,

4) Assess the impact of the tsunami(s) on coastal aquaculture and livelihoods of coastal communities through dialogue with Ministries and their Provincial Offices responsible for Fisheries, Aquaculture, Environment and Natural Resources. The assessment should be supported by field visits and data collection including verification of available data, observation of affected areas and discussion with survivors, local leaders, concerned government officers and other relevant stakeholders,

5) Identify the needs (qualitative and quantitative) at household level of the aquaculturists, focusing specifically on the economic and livelihood needs as income, production and employment. Opportunities for alternative livelihoods should be considered. Specific attention will be given to the poorest households and gender aspects should be taken into full consideration,

6) Discuss with the relevant state authorities and line agencies and understand the Government emergency and rehabilitation strategy and plan, and assess the areas to reinforce national response,

7) Discuss with the relevant state authorities and understand the medium- and long-term vision of the government on rebuilding and rehabilitation of the affected sectors (in some cases governments may have a overall national rebuilding

programme in place with emphasis of overall integrated rural and coastal development). Pay special attention to the vision of the government for developing/rebuilding the fisheries sector and rehabilitation/resettlement of the affected people,

8) Examine and evaluate the medium- and long-term needs for improving aquaculture sector in support of such national development plans, particularly for helping the possible integrated rural/coastal development programmes/plans of the government, taking into consideration the long-term implications for future sustainable development and the impact on natural resources and rehabilitation plans of the government.

9) Examine and evaluate the independent efforts by the NGO sector, if any, on rehabilitation and rebuilding of the aquaculture sectors to see how they fit into the overall development plan of the government,

10) Identify necessary aquaculture inputs and their specifications, and identify potential supply sources with emphasis on local suppliers. See sections B and C.

11) Discuss with the relevant government agencies and develop criteria for selecting beneficiaries for immediate assistance.

12) Develop a strategy for identifying beneficiaries for medium- and long-term assistance for the aquaculture sector.

13) Identify an institutional mechanism for project implementation and inputs distribution at provincial and district level

14) Prepare outline project document(s) for emergency assistance for the affected aquaculture personnel for next 6 to 12 months (to be attached as the Annex of the mission report),

15) Prepare outline project proposal(s) for medium- and long-term rehabilitation in coastal aquaculture sector in the Tsunami affected areas (to be attached as the Annex of the mission report),

16) Prepare mission report and submit to TCEO and FIRI/FIPP within 1 week after the completion of the assignment for technical clearance.

Duration of the mission: 5 weeks (2+2 weeks field work, one week report writing at home). First mission to commence as soon as possible, the second ten days after the first. No briefing/debriefing required.

Qualification: Expert in aquaculture (postgraduate qualifications) with special reference to coastal aquaculture development and planning, including significant experience (over 10 years) in Asia.

Duty Station: As required by the FAO Representative

A) Summary of information to be collected during the assessment: aquaculture

1. Information on the type and nature of disaster, type of water resources and on fisheries production prior to disaster.
2. Information on whether the disaster has resulted in secondary events (such as pollution of water, availability of feed etc) that may inhibit the restoration of production capacity.
3. Information about the impact of the disaster on farmers (with special reference to low income groups and gender issues), aquaculture production system and state of environment and other socio-economic infrastructures.
4. Information on farming methods (species, feeding, material and equipment…).
5. Information on survival/adaptation strategies (savings, land, etc.) and alternative livelihoods.
6. Information on local response capacity (credit facility, organisation of farmers, service providers such as pond preparation contractors, etc.) and Government development plans and strategy.
7. Identify division of labour/skills in relation to aquaculture activities to identify who to target and how.
8. Identify local sources, prices and availability of inputs (fingerlings, feed, fertilizer, etc.) if needed.
9. Identify local market for outputs.

Technical specifications: aquaculture

The following section provides the technical background information necessary to determine what information to collect in the needs assessment in aquaculture. It also provides a basis for assistance

Type of Water Bodies
Freshwater
Brackishwater
Marine

System/Management
Backyard, community, extensive, semi-extensive, intensive, semi-intensive
Tanks, pond, cage, race-ways, paddies, ditches, integrated agriculture-aquaculture (e.g. VAC system – garden/pond/livestock pen; animal-fish, e.g., fish-duck, chicken-fish, fish-pig; rice-fish, rice-prawn, etc.)
All-in, all-out, seasonal
Size and number of units (e.g. size of ponds in ha/or m^3, cage in m^3...)?

Species
Local name/English name (scientific name if possible)
Origin
Monoculture, polyculture, integrated agriculture-aquaculture farming

Phase of operation
Hatchery
Nursery

Grow-out

Nutrition
Feed (alive, manufactured, own farm...)
Feed composition: floating or sinking pallets
Source
Feeding practice
Price
Local availability

Fingerlings
Prices
Local availability
Health conditions
Stocking density of fingerlings/fry prior to shock? (fingerling/m^3)
What is the grow-out season? Length of season? Starting date?
Size of fingerlings generally stocked (grammes or cms) and preferred stocking size?

Broodfish
Number
Male/female ratio
Stocking density
Price
Local availability
Health conditions

Fertilizers and lime
Organic
Local availability
Price

Material and equipment
Equipment: pipes, nets, buckets, pumps, paddle wheels, generators…
Material of tanks: concrete, fibreglass, plastic
Material of cages: nylon/plastic, mesh size, floaters, poles
Availability of medication for fish diseases.

Market
Size preferred by market
Species preferred
Prices of different sizes of fish at market
Sale alive or dead
Farm gate sale
Transport means available
Fluctuation of prices during year

Recommendations in aquaculture

Provision of Inputs

- It is understood that production facilities (ponds, cages, etc) will be ready before distribution of inputs is undertaken.
- Inputs like fingerling/fry and feed are often produced by the more well off entrepreneurs with larger capital outlays. It may make sense to help the fingerling/fry and feed producers and the ice manufactures in parallel to the poor farmers since their inputs are necessary to help the poorer fisherfolk.
- It is recommended to identify local suppliers of fingerlings producers at competitive commercial prices.

Species

- It is generally preferred to opt for species that are traditionally grown locally. Feed requirements and the related input costs are generally lower for traditional fish species. Besides, as these species are normally better able to cope with bad water quality, chemical and drugs requirements are much lower allowing more funds to be spent on fingerlings, feed or on other activities.

Fingerlings

- Distributed fingerlings should preferably be a little bit larger than normally purchased by the farmers as larger fingerlings seem to be less susceptible to fish diseases, adapt more rapidly to the pond environment and have lower mortality rates. Farmers generally prefer less fingerlings of a larger size than more fingerlings of a smaller size.
- It is recommended to use a mix of species to increase overall survival of the fingerlings.
- Verify the costs in relation to the size of the fingerlings that are to be restocked. Prices identified and typically agreed to are almost always well above actual market prices. Explanations given are various (lack of fingerlings in the market, need to transport long distances, mixed sizes of fingerlings produced by hatcheries which make it difficult to specify one size, ..). Yet, there is a 300% difference in price sometimes between a 3 cm fingerling and 5 cm fingerling (typically sizes are referred to as 3-5 cm).
- Ensure that the beneficiaries are totally informed as to the number and size of fish they are to receive.

Broodstock

- If broodstock have been destroyed during a disaster, this has a potential immediate and long term impact on production capacity and needs to be addressed quickly. Brood fish may come as the last option through importation from a neighbouring country. To import brood fish, it is imperative that international standards for live aquatic species movement be used for health certification and quarantine, to avoid potential introductions and transfers of pathogens. It is also important not to introduce/import new species, only brood fish species which are indigenous to the country should be imported.

Transport and Handling

- Distribution of fingerlings should only take place in the early morning and late afternoon when temperatures are lower; this to reduce mortality during transport.

- It is recommended to advise farmers on how to release fingerlings and when in the water.
- It is advised to use light colour/or white plastic bags to transport fingerlings so as to prevent penetration of sun and avoid warming up of water. Moreover, the suppliers should provide sufficient good quality oxygen to the bags before transport from the point of delivery to the farms.

Feed

- A proper feed storage place is recommended.
- Beneficiaries, being poor, may have difficulty in feeding their fish sufficiently to reach marketable size in a certain time period. It is, therefore, advised to use a certain percentage of the total support costs of fingerlings, nets and feed in the form of fingerling feeds to the farmers; this to guarantee a sufficient growth rate of the fingerlings in the first period of stocking in the pond.

Quality

- Quality control before delivery should be ensured by the project in cooperation with local fisheries/aquaculture extension services.

Training

- In some cases where it is possible (time and money) and needed, distribution of inputs and equipment should be combined with training/extension. Training of beneficiaries on the proper use of equipment (to be) provided (e.g. use of net and sticks to make a cover for the fish pond that reduces the chance of fish loss in case of flooding in aquaculture, etc.) constitute an important contribution to the desired project outcomes and impact.
- In aquaculture, it is important that training on transport of fingerlings and pond management be conducted before fingerlings are distributed to the beneficiaries and that extension materials are provided during the training session.
- When providing nets to farmers they should be trained in how to collect fish in a part of their pond or rice-field, as it would not be cost effective to provide enough nets to farmers to circle their complete pond and/or rice field.

Beneficiaries

- It is important to identify beneficiaries in an appropriate manner and to involve local administrations in the process.

Credit

- The replacement of aquaculture inputs may be at a level too high to sustain (if the families cash flow has also been affected) and therefore may actually contribute to the families debt (they might borrow informally to buy feed). A slower start-up may be preferable. An area of emergency assistance that is more difficult to implement - but which may actually be of greater value to those affected by disaster, is to improve access to finance to re-invest in affected livelihood activities.

Annex N: Questionnaire used for assessment of tsunami impacts on the aquaculture sector

Rapid assessment of tsunami impacts on the aquaculture sector

Purpose: we are attempting: (1) to make an assessment of the tsunami impacts on the aquaculture sector, building on as far as possible on (diverse) existing assessments, and (2) to identify needs and support actions required for the rehabilitation of the aquaculture subsector, with an attempt to prioritise the needs according to the social and economic benefits from any interventions.

We propose as far as possible to use a simple classification for assessing the damage based on the following main subsets/assets:

- **Farm level production assets and capacity**
- **Physical infrastructure (water supply/irrigation canals)**
- **Household capacity (sufficient human resources, skills, access to finances)**
- **Services and social/institutional support and capacity**
- **Environmental status and capacity**

We propose to organise our assessment using the following approach:

- District profile – this will be used to provide an overview of the tsunami impacts, and needs.
- Sub-district profile – this will be the main unit we will work with. Due to shortage of time, we will focus our work on high priority sub-districts, whilst also including a range of affected sub-districts to better understand needs across the range of affected sub-districts. As far as possible we will also try to create a zoning of each district, indicated areas with different damage/rehabilitation scope
- Village profile – we will conduct profiles of selected villages, involving consultations with local farmers and local institutions in each village. Again, due to time, we will visit selected high priority villages in the affected areas.

Within each area affected (with photo), we will estimate the extent of impacts on the following (% areas affected and degree of damage) [see attached guidelines], and

- Degree of overall damage: (1) almost no damage, (2) moderate to substantial, (3) devastation.
- Degree of damage to coastal/marine environment (preliminary, and if known)

The attached sheets provide a check list of information required:

Sub-District level

Name of Sub-District (Kecamatan)
Name of villages visited Date of visit (Lamanya Kunjungan)

Number of households in village: % engaged full time in tambaks % part-time
% households classified as small-scale (<1 ha of pond area)

Total Nr. of villages in the Sub-District (Jumlah total desa di dalam kecamatan)

Pre-tsunami situation

Farmers involved:	Shrimp	Milkfish	Mixed farming	Others
- number of farmers involved in different farming systems/practices				

Tambak area	<1 ha	1-2ha	2-5ha	5-10ha	>10ha
- total area					
- size profile – number of following sizes by species/farming system if possible					

Private or public land ownership

Species and farming practices	Shrimp	Milkfish	Mixed farming	Others
- species				
- for each species				
o stocking time,				
o density				
o species				
o feeding practices/type				
o harvest time				
o total amount (tonnes)				

    - amount (kg/ha)
    - value (Rupiah)
- seasonal cycle
- major problems faced (disease etc)

Physical infrastructure
- water supply/drainage system
- canals, length and area
- public or private ownership and management

Human resources
- importance of aquaculture for employment
- number of households
    - owners living in village
    - owners not living in village
    - leased ponds
    - direct employment (production)
    - indirect employment (eg labour, describe, post-harvest), including women.

[describe as far as possible by type of farming system – shrimp, milkfish etc]

Input supplies
- Source of inputs – district, province (where) for feed, seed (hatcheries)
- Other input supplies and where from

Post-harvest and markets
- market chains, people involved, where marketed (local, export)

Services and institutions

- Supporting institutions (Dinas perikanan, farmer groups) and responsibilities

Natural assets/environmental conditions

- Land and water quality
- Mangroves and coastal habitat status (type, area, quality)

Post-tsunami situation

Tambak area

- total area affected
    - repairable damage
    - completely lost
    - planned for change to other uses

Type of tsunami effects on tambaks (% and severity of effect[61]:

- trash and debris
- erosion of dykes and/or pond bottoms
- sedimentation

Crop lost – estimate of the species, amount and value of crop lost (IDR, showing calculation)

61 Describe in general terms the degree of intervention required

Physical infrastructure (% and severity of effect):

- water supply/drainage system
    - length and area affected
    - supporting machinery
    - access to ponds

Human resources

- number of households affected, how and their position)
    - owners
    - leased ponds
    - directly employed
    - indirect employed (eg labour, describe, post-harvest), including women.

[describe as far as possible by type of farming system – shrimp, milkfish etc]

Number of of people remaining in/wanting to take up aquaculture again (living in village, full time/part time)

Input supplies ,

- Availability of inputs (quantify effects)
    - district, province (where) for feed, seed (hatcheries)
    - any other input supplies

Post-harvest and markets

- effects, availability

Services and institutions

- supporting local institutions
    - describe effect on services effect
    - local farmer groups and effects
- To what extent can local institutions, and who, can take up restoration of the effected aquaculture farms

Natural assets/environmental conditions

- Impacts on land and water quality
- Impacts on mangroves and coastal habitat status (area, quality)
- How to harmonise tambak rehabilitation with habitat restoration

Costs estimates for rehabilitation

- Tambaks
- Hatcheries
- Infrastructure
- Inputs

[provide estimates and details of how they are calculated, including unit costs]

Village/household level

In each sub-district, we will attempt to visit selected villages and farmers, following the check list above to make an assessment of damage to aquaculture.

The following additional household level questions may be used, as appropriate, for consultations with affected villagers

Household capacity for recovery

- Access to sufficient labour
- Access to aquaculture ponds/infrastructure
- Access to financial assets
- Access to support services

Describe socio-economic situation of these people (rich, poor, education.etc)

Interest to take part in aquaculture again

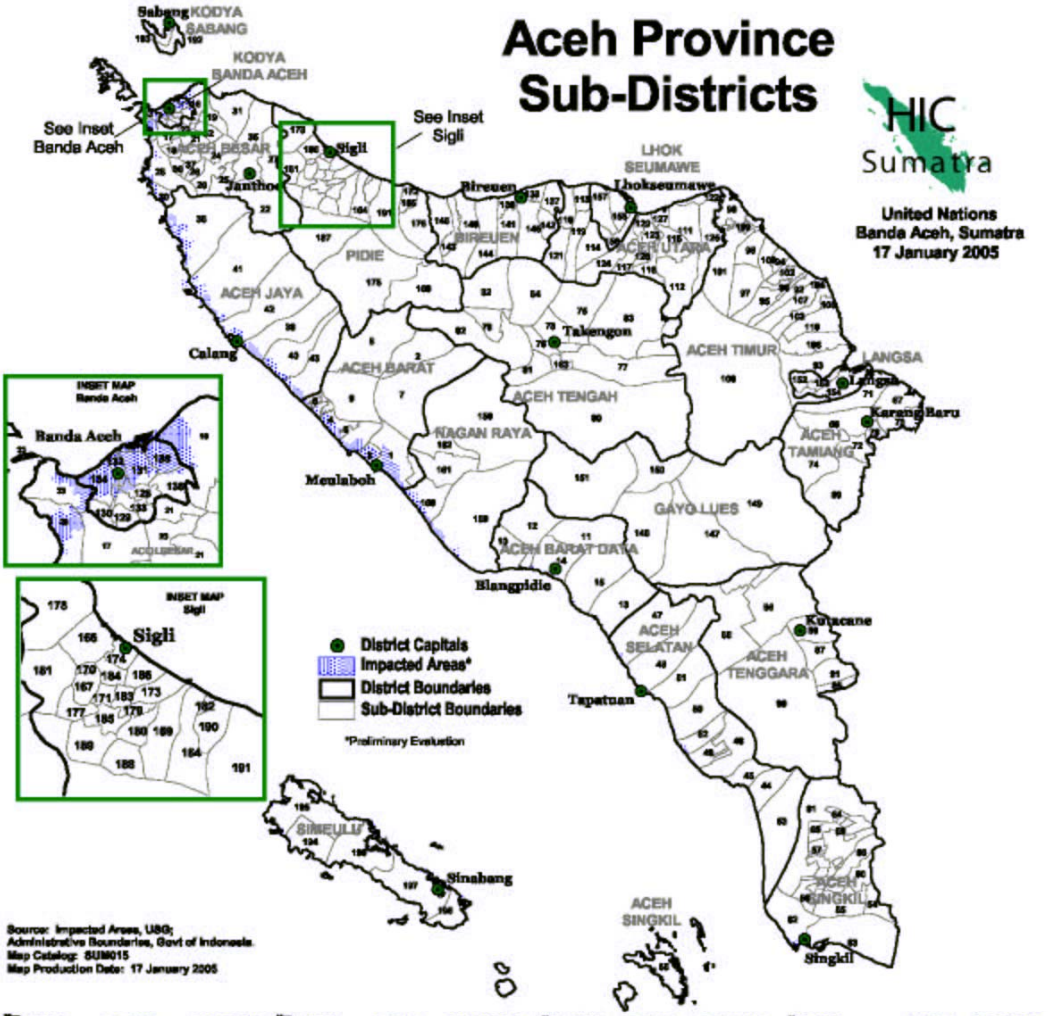
Species intended to culture, intensity of culture (extensive, semi-intensive)

Priority actions

What are the planned and implemented relief and recovery activities.

- priority actions, including based on an analysis of ownership structure and pro-poor ranking
- any pro-poor/gender balanced sub-district (is this the right unit?) rehabilitation plans, including capacity/support/inputs needed
- harmonise plans with habitat restoration needs, in particular needs for restoring mangroves, and the pledge of GOI to restrict settlements and economic activities close to the coast.

Annex O: Aceh sub-district map



Annex P: Some pre and post-tsunami satellite imagery

Plate 1: Before and after tsunami images of the coastline in Kota Banda Aceh, showing severe coastal damage and extensive loss of aquaculture ponds [source: FAO Indonesia tsunami atlas]

Annex Q: Aquaculture related regulations in Indonesia

Ministerial Decree of Agriculture Ministry No. 214/KPTS/UM/V/1973 on Export Prohibition on Some Species of Fish in Indonesia
The decree gives priority to domestic requirements for seed, and prohibition on export of certain species from the country

Presidential Decree No. 23/1982 on Development of Marine Culture in Water Territory of Indonesia and Ministerial Decree of Agriculture Ministry No. 473/KPTS/UM/7/1982 on Operational Guide on Development of Marine Culture in Water Territory of Indonesia
The sea belongs to the public is a source of livelihood to coastal communities. This decree is issued in order to coordinate and accommodate mariculture and their related activities in the coastal area.

Ministerial Decree of Agriculture Ministry No. 700/KPTS/IK.120/11/1989 on Exclusion of Penaidae Shrimp of Republic Indonesia
Penaid shrimp can be exported from the Indonesia region in live condition except for broodstock and pre-broodstock sizes. This decree is designed to protect exploitation of broodstock for export.

Ministerial Decree of Agriculture Ministry No 810/KPTS/IK.210/7/1999 on Examination, Assessment and Release of Fish Type and/ Variety
This decree is issued to guarantee the availability of fish/shrimp seed in quantity and quality and to promote availability of superior varieties.

Ministerial Decree of Marine Affairs and Fisheries Ministry No. 07/2004. Ministerial Decree of Agriculture Ministry No. 1041.1/Kpts/IK.120/1999 on Levying and Distribution of Seed.
Supervision and observation on levying and distribution of seed are needed to guarantee seed in sufficient quantity and quality. Levying is implemented on seeds and/or broodstocks obtained from nature, hatcheries, or imported from abroad and through genetic improvement.

Ministerial Decree of Marine Affairs and Fisheries Ministry No. 09/2002 on Aquaculture Intensification
To increase productivity and production, fish farmer income, job opportunities as well as to accelerate economic growth and strengthen national food security, this decree focuses on an intensification program for priority commodities i.e. shrimp, grouper, seaweed and tilapia.

Government Regulation No. 15/2002 on Fish Quarantine
This regulation is meant to prevent the entry and spread of pests and diseases from abroad, or their exit from the the country. It covers movement of animals, fish and plants.

Ministerial Decree of Marine Affairs and Fisheries Ministry No. 26/2002 on Ready Stock, Distribution, Usage and Observation of Fish Drug.

This decree is made in order to verify the quality of fish drugs as safe for the health of fish, human being and the environment, and to list those chemicals which are efficient and effective to use in aquaculture products.

Ministerial Decree of Marine Affairs and Fisheries Ministry No. 08/2004 on Procedure of Inclusion of New Species or Variety of Fish into Republic of Indonesia
The decree provides instructions on disease prevention and therapeutic actions with introduced species. New species or varieties introduced from other countries present a risk in introducing new fish pests/diseases to Indonesia, and generating negative impact to indigenous species and aquatic ecosystems.

Ministerial Decree of Marine Affairs and Fisheries Ministry No. 02/2004 on Licensing Of Aquaculture Business
This decree categorises aquaculture activities into two groups: those which are obliged to have Fisheries Business Permit (*IUP*) and others that are not.

Ministerial Decree of Agriculture Ministry No. 1042.1/Kpts/IK.210/10/1999 on Certification of Hatchery Unit and Monitoring of Seed.
This decree provides procedures and types of Certificate of Quality for hatcheris. It specifies parameters and eligibilities of facility, human resources and production quality systems, as well as operational matters for certified hatcheries. The intention is to support implementation of technical standards for fish and shrimp breeding in order to guarantee quality seed production.

Ministerial Decree of Agriculture Ministry No. 26/Kpts/OT.210/1/98 on Guidance Of National Seeding Development
This decree covers seed supply and distribution and the fulfilling of seven parameters (type, size, amount, price, quality, time and place) for seed, sustainable development of seed production agribusiness, rural-based culture industry, arrangement of standardization and certification of hatchery unitz, controlling the exploitation and sustainability of fish resources especially of germ-plasm, and arrangement on observation and supervision on the growth of hatchery and seed production activities.

Regulation of Minister Marine Affairs and Fisheries No. PER.55/MEN/2004 on Stipulating of Sumatra Region as Quarantine Area to Common carp and of Koi
This regulation is aimed at controlling the spreading of Koi Herpes Virus disease of common carp and Koi culture to Sumatra, as the island also represents the center of common carp consumers outside of Java. If the disease control is successful, it is expected that this regulation will be withdrawn.