Resilience, Rights and Resources: Two years of recovery In coastal zone Aceh

Brackish-water aquaculture in Aceh: post tsunami rehabilitation and problems[1]

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The December 2004 tsunami brought Aceh and its coastal zone to the forefront of public interest in discussions on environment and development. Conversion of mangrove forest to shrimp/fish ponds in the 1980s almost certainly increased the death toll from the tsunami. The devastation was unprecedented in recorded human history. After the emergency relief phase, when clean water, food and shelter were available and the wounded had received care, the discussion started on sustainable livelihood options along the coast – but also on the 'causes' of the human damage and the role of the fish/ shrimp ponds.

1. Socio-economic assessment

The objective of the study is to clarify the social, economic and legal issues that relate to the development of *tambak*s in the mangrove zone, as a contribution to the debate on rehabilitation strategies. The study used rapid assessment methods involved all tsunami affected parts of the North and East coast of Aceh – with a gradient in impact by the tsunami from Banda Aceh Eastwards. Twelve villages in nine *kecamatan* (sub-district) were selected for detailed survey. Figure 1 presents the study site.

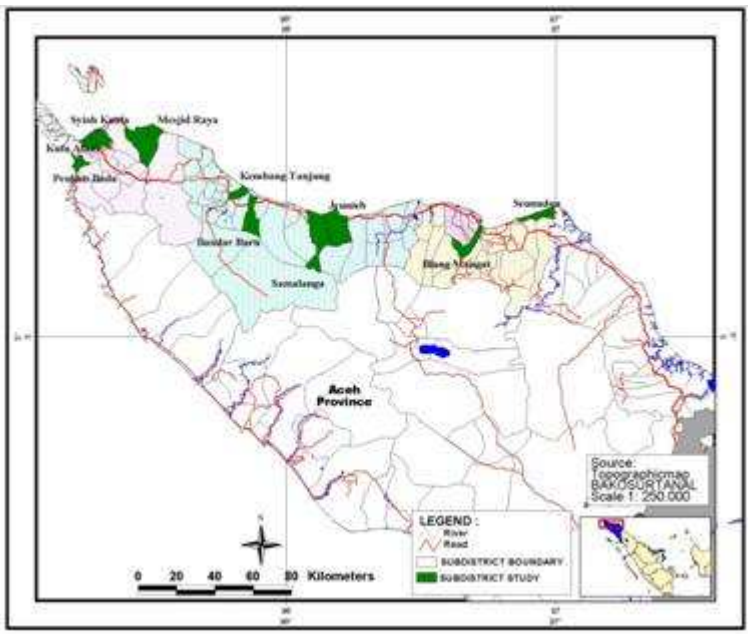

Figure 1. The study site

[1] This is a summary of the study of "Socio-Economic Aspects of *Tambak* Production in the Province of Nanggroe Aceh Darussalam" carried out by World Agroforestry Centre – Southeast Regional Office and partners as part of the Ford Foundation funded project namely Integrated Natural Resource Management & Livelihood Paradigms in Recovery from the Tsunami in Aceh.

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The study observed a gradient where all *tambak* areas were destroyed by the tsunami close to Banda Aceh while damage was about 50% in Aceh Utara and Lhokseumawe where our survey ended. Five aspects to be assessed under this study were : (1) ownership patterns (2) employment (3) production systems (4) legal issues of *tambak* ownership and (5) financing issues of *tambak* production.

2. Prior-tsunami setting

a. Tracing back to brackish-water pond development

Brackish water aquaculture in Aceh started in early 1940's by *ulee balang* in the form of traditional earthen ponds systems that depended on tidal water exchange for wild seed supply and maintenance of water quality. Brackish-water pond establishment along the north-east coast grew rapidly in the late 1970s inline with the development of semi-intensive shrimp farming, evolving to the deliberate stocking of wild or hatchery fry in ever increasing densities supported by feed and water management inputs to increase yields.

Extensive conversion of mangrove forest for shrimp farming in Aceh, began in early 1960's, when a Medan based investor provided credit scheme for shrimp culture to groups of 40 farmers. By a license (*surat izin menggarap*) issued by village head (*keuchik*), those who did not have land could use any land available in the village, mostly converting mangrove forest. Shrimp culture boom in Southeast Asia that took place between 1970 to 1990s (Primavera, 1997) constitute driving factor of the development of brackish-water pond in Aceh, both area extent and the adoption more intensive technology, with the expense of mangrove forest lost. It is well known that the average operational life of a shrimp pond is two to three years, as chemical feeds and fertilizers coupled with pesticides (used in aquaculture) deteriorate water quality to the point of not being able to raise healthy shrimp. At this point operation shrimp ponds were usually abandoned as investors move on to clear new areas of mangrove forest.

The most recent statistical data on brackish water pond of Aceh prior tsunami shows that shrimp and milkfish farms in Aceh are mainly operated as traditional (74.7%), with low input farming systems in polyculture and/or monoculture situated along the north-east coast. There were 22% (of the total) are semi-intensive farming, mostly found in Bireun and Pidie, and only 3.2% intensive shrimp farms.

b. Brackish water pond : social capital and financial capital

Study in 12 villages noted that there were 2,722 households relied their livelihood on 1,433 ha *tambak*, mostly practicing traditional systems; meaning, per hectare *tambak* serves nearly two households. With regard to property right issue, not all *tambak* were established on privately owned land. It is estimated that 19.8% of the *tambak* area in the 12 villages under study established on non-private land; and only 36.5% of the privately owned land hold land certificate. The land with this kind of secured land title mostly found in the urban area closed to Banda Aceh (Tibang and Lambaro skep, 99.5% and 44.9% respectively) and Pidie (Baroh Lancok, 43.9%). Whilst in rural area, the number of private land equipped with land certificate is very low, less than 15%. It does matter to develop a sustainable strategic livelihood in the future; hence vulnerable to eviction.

Brackish-water aquaculture practices hold complex social interaction. Four main actors involve directly to this production systems: owner, *toke* (traditional money lender and also trader), farm operator and labour. Their interactions describes in Figure 2. *Tambak* owner does not always control *tambak* production systems, but farm operator does. In some cases, *tambak* owner also farm operator. *Toke* provides capital to *tambak* owner or farm operator without a clear interest rate, but the production of *tambak* has to go the *toke*, who also serve as marketing agent. *Toke* provide money not only for *tambak* operation, but also for personal needs and emergency. Social interactions among them were quite close.

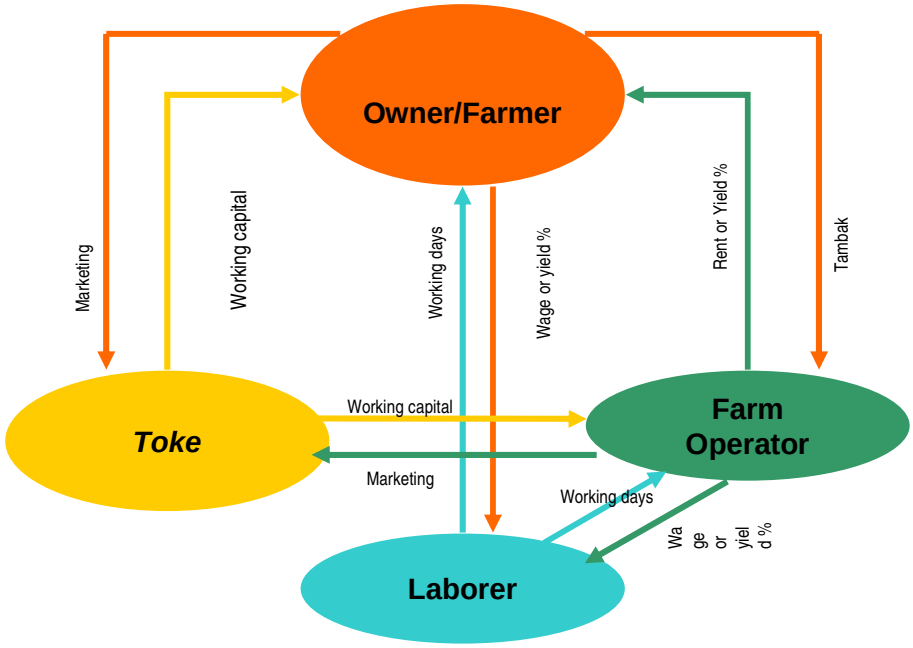

Figure 2. Social interaction among four main actors in *tambak* production systems

3. Post Tsunami: A lament for the brackish-water pond in Aceh Province

Most of physical capital supporting *tambak* production that was developed in decades was washed away by tsunami. An assessment carried out by FAO (Philip and Budiman, 2005: 34-37) weeks after the natural disaster, noted that 20.429 ha or 42.9% of *tambak* in the province, with varies of damage, lost its production capacity[4]. About 1,000 ha of *tambak* were permanently inundated due to the change of coastal line inward, and 7,300 ha were severely damaged. Those which were only inundated during the time of tsunami, was not clear whether they were not losing their yields. Regarding infrastructure, 810 km (66.8%) of irrigation channels and 193 units (out of 223) hatcheries severely damage.

The damage to the *tambak* from tsunami includes: (1) structural damage such as destruction of dykes, damage to irrigation channels, water gates and loss of associated infrastructure (huts, pumps, machinery), and (2) sedimentation caused by deposition of debris, silt, sand and mud into ponds and irrigation canals. It needs to note that silting up as a result of sand and debris by the tsunami, widespread along the north-east coasts, filling even ponds without structural damage. *Tambak* that were silted up will require more effort to repair. Damage to the embankments is relatively easy to repair. Where as *tambak* that situated between settlements were also filled with debris from the buildings; restoring *tambak* belong to this case is the most difficult to restore. There are four level of physical damage : (1) complete loss of ponds; estimate figures is 5% of the total damage, (2) heavily damage (greater then 50% of embankment and infrastructures loss resulting in loss of the physical structure of the *tambak* and associated infrastructure); estimated 35.6% of the total damage, (3) moderate damage (partial loss of embankment and its associated infrastructures; 25% to-50%); estimate figures is 25.1% of the total, and (4) Minor or light damage to dykes (<20% dykes destroyed, or eroded) and associated infrastructure; 28.7% of the total tambak damage. It probably can be added with the "no damage but lost of its working capital" categories, due to flooding, although no records we made in this regards.

[4]Brackish-water farming contributes highly significant to overall fisheries values in Aceh; 32% of total fishery value. MAFF/World Bank figures give the fishery sector of Aceh a value of Rp 1.59 trillion, or US$176.67 million(Philip and Budiman, 2005: 2)

Thousand of shrimp/fish farmers lost their income as well as their working capital. Sudden lost of working capital, brought about serious impact to the availability financial capital in the community. Quick assessment done in December 2005 in 12 villages in the six regencies with largest brackish-water pond area in the province (Banda Aceh, Aceh Besar, Pidie, Bireun, Lhokseumawe, and Aceh Utara) found out that 92% *tambak* farmers rely on traditional money lender (*toke*) who provide working capital and serve as marketing agent. By the disaster, all toke also lost their capital. Almost nothing left for them to recover quickly from setbacks.

4. *Tambak* Rehabilitation – a year after the tsunami

The efforts to restore this physical capital vary depended on the level of damage. A year after the tsunami hit the province, some patches of damage *tambak* have been restored by international organizations working together with national partner, although still very little. The rehabilitation started from the lighter damage *tambak* like in Bireun and Lhoksemauwe, while the heavier damage *tambak* started quite recently in September 2005, and was implemented relatively small area. No hard data can be referred regarding the progress of this effort. The estimate is less then 15% of the *tambak* have been restored.

Observation in December 2005, found interesting phenomenon on the rehabilitation efforts. Firstly, very few *tambak* that already been restored was optimally used, mostly because of lack of working capital available. Some were returned to do cultivate shrimp, but failed due to water quality. Groups of youngsters in Kuala Meuraksa of Blang Mangat, already running grouper nursing, based on order from Medan- based trader. They nurse grouper from fry to three-inch fingerling for two months, and sell it to the investors. A group of three youngsters could worth Rp 5 million to Rp 7.5 million, or return to labour of grouper nursing approximately Rp 61,250 per person day. The economic of scale of this activity was 10,000 tail of fry per group and assuming 70% survival rate. The return to labour was relatively higher then agricultural labour wage rate.

Secondly, restoring *tambak* with unclear land status. An international aid agency (NGO) faced land status problem in restoring severely damage *tambak* area in LamNga and Gampong Baru of Mesjid Raya Sub-District. The rehabilitation plan that was developed with the community cannot be implemented in some parcels of *tambak*. The land had been part of mangrove area rehabilitation (under NAD-Nias Rehabilitation and Reconstruction Board), and the NGO leave the area untouched. The tension between group of farmers and the NGO staff is occurred afterward. Similar case could happen elsewhere if the land status is unclear.

Thirdly, problem of *tambak* rehabilitation on sandy soil close to shoreline. Rehabilitating *tambak* on sandy soil close to shoreline is problematic. The existence of *tambak* close to shoreline is actually against the old *adat* rule, saying that 200 meters (150 *depa*) from the shore line must free from any cultivation that disturb fishermen activities. It's been no longer practiced, as *tambak* provide more income for coastal communities and unfortunately also vulnerable to tide wave. Case of Meunasah Lancok, Samalanga Sub-District is an example. Only few weeks after been rehabilitated, blocks of sandy *tambak* collapsed its embankment and the pond were flattened by the sand in a single hit of relatively high tide. Waste of resources is the first impression one might have, because reconstructing a sandy *tambak* needs more efforts than it is in more solid grounded *tambak*.

Fourthly, gender related issue in restoring *tambak*. Many Acehnese perceived that *tambak* farming is masculine type of activities. Efforts to provide more opportunity and role for women in *tambak* rehabilitation in a village of Pidie, initiated by an Italian NGO, were failed and the NGO gained protest from the community.

A year after tsunami, *tambak* rehabilitation seems to be very slow. *Tambak* rehabilitation should consider the balance between the use economic potential of coastal resources and environmental problem might occur in the future of exploiting this coastal resources. The conflict between public and private interest should be internalized into rehabilitation process. Multilevel social networks are crucial for developing social capital and for supporting the legal, political, and financial frameworks that enhance sources of social and ecological resilience (Dietz et.al, 2003)

5. Financial assessment of brackish-water pond rehabilitation

Based on the data collected from several *tambak* rehabilitation activities in some villages, cost of *tambak* rehabilitation per hectare is estimated varies between Rp. 5.89 million and Rp 32.41 million depend on the level of damage and the method used; capital intensive (using back hoe) or labour intensive (done manually). Labour intensive will never work to reconstruct severely damage *tambak*, while other level damage can do both. *Tambak* rehabilitation using back hoe is relatively faster than it is done manually. Both methods employ unskilled labour that available locally, and it is actually also employment opportunity for local community. See Table 1.

Table1. Estimate of rehabilitation cost, required working capital and profitability

Financial parameters of tambak rehabilitation	Level of damage due to tsunami				
	Severely damage (capital intensive)	Medium damage		Minor damage	
		capital intensive	labour Intensive	capital intensive	labour Intensive
Estimate of rehabilitation cost (Rp000)	32,414	20,917	12,366	12,373	5,886
Labour requirements					
–professional labour (ps-d)	9	5	0	3	0
–skilled labour (ps-d)	51	41	48	33	42
–unskilled labour (ps-d)	25	21	96	17	22
Cost components (%)					
–Back hoe services	57.4%	48.6%	0.0%	46.1%	0.0%
–Gasoline	12.3%	10.4%	0.0%	9.9%	0.0%
–Tool and Material					
•Water gate	8.6%	12.0%	22.2%	10.8%	22.5%
•Hut	7.7%	12.1%	20.0%	11.6%	24.1%
–Labour cost	14.1%	16.9%	57.7%	21.6%	53.4%

Source: Study on Socio-economic of tambak in Aceh

Ex ante financial assessment on the brackish water pond production after reconstruction, were carried based on the December 2005 prices. The assessment is summarized in Table 2. Traditional systems which is practiced by the largest *tambak* operator in the province, is still profitable under 15% discount rate, and it is assume that survival rate for shrimp fry and milk fish is 48% and 70% respectively. Initial capital is ranging between about Rp 18.5 million and Rp 45 million per hectare (cost of establishment and working capital). In normal condition those amount oh money is affordable. But in situation like in Aceh at present, it is not affordable for smallholder shrimp/fish farmer. Return to labour (which converts the surplus to a wage after accounting for purchased inputs and discounting for the cost of capital and no surplus is attributed to land) is a bit higher than average agricultural wage rate. It is still attractive for farmers to engage.

At the other extreme, *tambak* with intensive systems require more initial capital ranging from Rp. 57.86 million to Rp 84.1 million. It provides the highest profitability, although it assumed that it has only seven years effective out of 11 years production scenario. However, all of those calculation has not internalized the social cost of the mangrove lost, the environmental and social damage where problems of pollution, public health risks and salinity caused by intensive shrimp farming are in stark contrast to the values of communal ownership, coastal protection and domestic food supply intrinsic to intact mangroves (Primavera 1993). These values need to be monetized to provide more comprehensive information to national governments and international funding organizations, which have been working on *tambak* rehabilitation programme in Aceh. Institutions that protect local communities and the environment from short term profit-makers must be developed and supported and their rules must be enforced. (Primavera 1999)

How does the brackish water pond contribute to local community? Using labour requirement we may estimate the employment generation of a hectare of *tambak* may provide. Table 3 presents the estimates of labour requirement. From employment generation point of view, brackish-water aquaculture is a good option for employment generation with reasonable better return to labour than other agricultural wage rate in rural area. As seen in the table, brackish-water aquaculture requires 395 – 813 person-days per hectare per year for its operational, depend on the technology. Intensive systems require more labour than traditional. It seems the intensive system would provide more employment for local community. It is not always happen in reality. Experience in Aceh, as long as *tambak* operators is not from local community, very little local labour would be employed. Some time it creates tension between local communities and the migrant labourer working the intensive shrimp farming. This another issue of an intensive shrimp culture, as also happen elsewhere.

Conclusion and recommendation

The capacity of coastal ecosystems to regenerate after disasters and to continue to produce resources and services for human livelihoods can no longer be taken for granted; rather, socio-ecological resilience must be understood at broader scales and actively managed and nurtured. Incentives for generating ecological knowledge and translating it into information that can be used in governance are essential. (Adger et.al, 2005).

The 'human causation' part of the tsunami impact has received a lot of attention for the city of Banda Aceh that lost its protective mangroves in the 1980's due to conversion to urban use. Attention to the 'human causation' is in line with the general tendency that the judged seriousness of an environmental loss is a matter of what caused it (Brown et al., 2005). The effects on the rest of the coast are more difficult to quantify, but still important in the debate. The social cost of past conversion of the mangroves to *tambak*s had previously been estimated as primarily based on the value of open-sea fisheries (*ref* Turner, 1977?).

Although estimates indicated that the 'social value' of intact mangrove was much higher than the 'private value' of converted mangrove, there was no mechanism to make the relevant benefit transfers to those who had the right to convert to make them reconsider their decisions. Part of the tsunami damage can thus be seen as the result of institutional failure to internalize externalities.

Table 2. Financial assessment of *tambak* production: required working capital and profitability (11 years production scenario)

Tambak Technology	Scale of Operation	Financial parameters	Level of damage due to tsunami				
			Severely damage (Capital intensive)	Medium damage		Minor damage	
				Capital intensive	Labour Intensive	Capital intensive	Labour Intensive
Traditional	- area: 0.5 – 1 ha, continues cultivation - brood stock density: ▪shrimp fry 20,000/ha ▪milk fish 1000/ha	**Rehabilitation cost (Rp000/ha)**	32,414	20,917	12,366	12,373	5,886
		Working capital required (Rp000/ha)	12,624	12,624	12,624	12,624	12,624
		Profitability					
		NPV (discount rate 15%)	3,011	13,009	20,445	20,319	19,133
		IRR	17.7%	32.0%	58.7%	58.5%	103.7%
		Return to labour (Rp/ps-day)	36,449	41,302	44,487	44,948	44,308
Semi intensive	- area: 0.5 – 2ha, continues cultivation - brood stock density: ▪shrimp fry 60,000/ha	**Rehabilitation cost (Rp000/ha)**	32,414	20,917	12,366	12,373	5,886
		Working capital required (Rp000/ha)	26,770	26,770	26,770	26,770	26,770
		Profitability					
		NPV (discount rate 15%)	62,740	72,737	80,173	68,757	85,808
		IRR	58.0%	86.0%	132.2%	116.5%	219.9%
		Return to labour (Rp/ps-day)	60,721	64,994	66,868	63,611	70,512
Intensive	- area: 2 ha < , fallow rotation. - brood stock density: ▪shrimp fry 140,000/ha	**Rehabilitation cost (Rp000/ha)**	32,764	20,967	12,616	12,744	6,436
		Working capital required (Rp000/ha)	51,320	51,320	51,320	51,320	51,320
		Profitability					
		NPV (discount rate 15%)	222,989	233,247	240,509	240,398	245,883
		IRR	274%	403%	585%	582%	858%
		Return to labour (Rp/ps-day)	143,193	149,711	147,964	154,479	156,150

Note:
Net Present Value (NPV) measures return to land; positive NPV means the systems are profitable. Internal rate of return (IRR) is an alternative measure of profitability, which is the discount rate that brings NPV to zero; using it makes the same point with greater clarity. Returns to labour is the wage rate sets NPV equal to zero. This calculation converts the surplus to a wage after accounting for purchased inputs and discounting for the cost of capital; no surplus is attributed to land.

Table 3. Labour requirements of *tambak* production : person-day/ha/year (11 years production scenario)

Tambak Technology	Labour requirement	Level of damage due to tsunami				
		Severely damage	Medium damage		Minor damage	
			Capital intensive	Labour Intensive	Capital intensive	Labour Intensive
Traditional	**Establishment phase**	85	66	144	52	64
	Operational phase					
	–professional labour					
	–skilled labour	9	9	9	9	9
	–unskilled labour	386	386	386	386	386
	Sum	479	461	539	447	459
Semi-intensive	**Establishment phase**	85	66	144	52	64
	Operational phase					
	–professional labour		0	0	0	0
	–skilled labour	201	201	201	201	201
	–unskilled labour	504	504	504	504	504
	Sum	789	771	849	757	769
Intensive	**Establishment phase**	92	73	155	58	75
	Operational phase					
	–professional labour	2	2	2	2	2
	–skilled labour	334	334	334	334	334
	–unskilled labour	477	477	477	477	477
	Sum	903	885	967	870	887

Source: Study on Socio-economic of *tambak* in Aceh

Figure 3. Youngster run grouper nursing in the newly rehabilitated brackish-water pond.of Kuala Meuraksa

Figure 4. Reconstructing *tambak* needs lot of effort and expensive

KEY MESSAGE

1. *Tambak* provide rural employment and generate income for rural economy
2. *Tambak* rehabilitation would accelerate the economy of tsunami affected area
3. Rehabilitation efforts needs to balance between economics potentials of coastal resources with the environments problems might occurred in the future.
4. Trade off between public benefit and private benefit has to be internalize in the *tambak* rehabilitation plan.

World Agroforestry Centre (ICRAF) is one of 15 organizations under the CGIAR (Consultative Group on International Agricultural Research) umbrella. ICRAF aims to stimulate and conduct innovative research, development and capacity building to promote and support agroforestry for both human and environmental benefits. ICRAF has its headquarters in Kenya and six regional offices in the tropics and now cover 21 countries in Africa, Asia and Latin America.
The research bulletins are summary results of collaborative activities of ICRAF and partners in the "Recovery and Resilience of Livelihood and Natural Resources", mainly in West Aceh, after the Tsunami of 26th December 2004. These bulletins were prepared, first in Indonesian language, for a workshop in Meulaboh on 30 November 2006. The primary objective was to share relevant result findings and observations among government and non-government organisations and individuals involved in the post-tsunami recovery in West Aceh. The workshop and preceding research activities were supported by Ford Foundation Indonesia, EU Asia Pro-Eco Program and CGIAR.

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