Chapter 5 A preliminary socio-ecological review of post-tsunami ecosystem-derived livelihoods and rehabilitation efforts

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Introduction

There has been a very limited focus on socio-ecological, socio-environmental and environmental aspects of the tsunami and the subsequent reconstruction & rehabilitation. The spatial database developed in this project captures and analyses a range of the various impacts of the tsunami and the subsequent rehabilitation quantitatively. However, some of the process level details and socio-ecological aspects of the tsunami impact and rehabilitation efforts can be reviewed and understood only qualitatively due to absence of either quantitative data or due to the lack of spatial uniformity in information. This chapter aims to review this literature and carry out a preliminary analysis of the same and make recommendations.

The first part of this chapter deals with the impacts of the tsunami and the subsequent rehabilitation of ecosystem-derived livelihoods. One of the major impacts of the tsunami other than loss of lives and infrastructure was the immediate and long-term effects on livelihoods. The major ecosystem derived livelihoods were fisheries and agriculture. The other livelihood source though not directly ecosystem derived, is aquaculture, but is linked to both agriculture and fisheries in the aspects of land use (spatial location next to estuaries, areas of conversion of mangroves and agriculture land), resource use (brackish water, sea water) and production. This sector, in addition to being linked to ecosystem-derived livelihoods, has also been plagued with environmental and social problems in the past (and continues to be so) and hence is reviewed here. The second part deals with all other socio-ecological and environmental aspects of rehabilitation and reconstruction activity in the affected areas.

Under fisheries aspects of the analysis of rehabilitation, over capacity and the resumption of fishing post-tsunami and its different contexts is reviewed. An attempt to understand the underlying causes of rehabilitation and over-capacity through the existing literature and analyses of secondary data is made. It also looks at the data and literature on asset base, catch effort, fish catch and income data, post-tsunami to understand the current situation of fisheries and the current gaps in knowledge/data. Further, two aspects in fisheries are also reviewed namely, the studies on community perceptions of changes post-tsunami and the unique contexts of the cases of group ownership in the pre and post-tsunami scenario.

Under agriculture, an overview of some of the studies of the impacts, especially on soil and water is done. Some of the background trends and coping mechanism of farmers are highlighted. One of the other important and often neglected resources of the coast is the groundwater. It is a scarce and vulnerable resource which in many coastal areas has already been severely impacted/ affected due to a wide variety of factors. The impact of the tsunami and implication of rehabilitation efforts on this vital resource is reviewed and analysed.

The second part of the chapter reviews the environmental and socio-ecological implications of rehabilitation. Here livelihood related issues in re-location and housing layout are examined and the environmental issues and concerns in planning of housing reconstruction such as groundwater, sanitation,

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site selection, wetland drainage etc. are highlighted. The interventions of hard engineering options and bio-shields, both major initiatives of the post-tsunami reconstruction, are examined revealing social, ecological, livelihood implications.

Finally, based on the observations of gaps, opportunities, issues and needs identified above a set of recommendations are made.

PART I- ECOSYSTEM-DERIVED LIVELIHOODS

Fisheries

The stagnation of fish production in the tsunami affected areas especially Tamil Nadu coupled with increase in craft and gear over the last two decades, warrants the need for a combination of management measures, precautionary approaches and livelihood strategies towards restoration and rehabilitation of fisheries in the affected districts post-tsunami. The fishing community, in particular, known for their self-reliance rarely sought assistance from outsiders or the government. Post-tsunami they were not interested in merely being passive recipients of relief and rehabilitation efforts, but instead wanted to get involved and take responsibility for relief and rehabilitation. Many communities were finding creative ways to take their own initiative in the restoration of their livelihoods (Kannam, 2005). This along with their remarkable trademark of independence and self-reliance is a strong indication of their resilience.

Resumption of fishing

One of the key questions that comes up when one enquires or explores the resilience of the fishing community in the light of the tsunami, is how soon communities are able to resume fishing or restore status quo in terms of their livelihood. One would of course, also need to analyse the factors and the context that influenced the resumption of fishing or restoration of the status quo.

As a result of the damage and loss of craft and gear, for at least three months there wasn't any fishing in the traditional sector and up to seven months in the mechanised sector in severely affected areas.[80] In some cases, fishing did not resume till over 6 months (TRINet, 2005c). The delay was mainly due to repair of boats, engines and procurement of new nets (Thaddeus, 2005a). The issue of compensation disbursement also played a role in the resumption of fishing (TRINet, 2005c). For eg., in Nagapattinam District, Arcottuthurai was the first fishing hamlet that resumed fishing after the tsunami. The fisherfolk in this village all belonged to the Padayachi (Vanniyar) community, which had no traditional interactions and links with other fishing hamlets in the district and their feeling of solidarity with the Pattinavar hamlets was weak. They neither waited for other fishing hamlets to take a collective decision nor waited for the District Administration to declare its fishery compensation policy (unlike the case of the Pattinavar hamlets, which waited for the policy and only then resumed fishing). This hamlet wanted to resume fishing as early as possible and was mentally prepared to do so. By 21st March, 2006 they ventured into the sea, while the other fishing hamlets were struggling to prepare themselves. The *Panchayat* in this village showed a special interest in sending the fishermen to sea as early as possible as they felt that earning an income was very important in a crisis. They also felt that going to sea would reduce tension within the village (Thaddeus, 2005a).

In some villages, in the initial stages, when there was a shortage of craft, the NGO intervention in craft donation was limited in scale, and the population of fishermen without craft was large. Studies mention that 6-7 persons were assigned per FRP boat instead of the normal 4-5 in order to share the

[80] It may be noted here that there is also a 45 day fishing ban for this sector between, 1 April and May 15, hence a postponement of repair of boats happened.

income of fishing among more families (Thaddeus, 2005a). This adaptation is perhaps a good indicator of socio-ecological resilience. However, no information exists on the duration of this practice or the prevalence of this among all the tsunami-affected villages.

In many hamlets, especially Pattinavar villages, there was a general rule that fishing would not resume till all members had seaworthy craft (Gomathy, 2006; TRINet 2005). This aspect of the sense of unity, social justice and equity within the community (in terms of assets and resources) is indeed worth exploring in studying its implications for socio-ecological resilience, even though it actually resulted in a delay in the resumption of fishing. In some cases, NGOs had asked communities not to resume fishing. Furthermore, the villages in Karaikal and Nagapattinam followed the 64 village cluster kinship system, with a head village for each clusters of 8, 16, 32 and 64 villages, in which villages resumed fishing only they received a letter issued by the head of the village permitting them to start fishing (Gomathy, 2006 ; Thaddeus, 2005a). It should be noted here that before the official resumption of commercial fishing, subsistence fishing (documented at least in Nagapattinam) on Kattumaram and FRP Boats had resumed in February 2005 itself (TRINet, 2005c). There is no systematic data and information for all the affected villages on this aspect as well. It is believed that in the stretches close to urban centres such as Chennai, i.e. Kanchipuram and Villupuram Districts, fishing resumed much earlier.

Another reason for the delay in resumption of fishing that was mentioned in one study was that when the crafts were repaired /replaced, suitable nets were not available for a long time and in some cases boats were received/replaced but not engines and this resulted in many of the boats lying idle (Salagrama, 2006).

Some micro level studies also cite that there was a fear of the sea in the fishermen's psyche. Fishermen were scared and tried to avoid going to sea, even in conditions similar to what they were used to earlier. This has been reported by many studies, but systematic quantitative data on the same is absent (Thaddeus, 2005a; Thaddeus, 2005b; Salagrama, 2006; Gomathy, 2006; TRINet, 2005c). One study points out that in some cases the fear of the sea had gradually transited into idleness. Many fishermen simply preferred being on land and the extended relief assistance and the compensation they received in cash made them cling on to this idleness (Thaddeus, 2005a).

A summary of the various factors that influenced the resumption of fishing is summarised below:

Box 1: Summary of the factors that influenced resumption of fishing

- Lack of craft
- Lack of suitable nets, engines and gear
- Waiting for Government policy on compensation
- Waiting for restoration of rehabilitation to pre tsunami numbers (till all members had seaworthy craft)
- Waiting for instruction of head village
- Poor quality of boats and frequent repairs
- Non provision of correct nets
- Conflicts –in group ownership
- Unable to adapt to gear /craft
- Fear of the sea
- Fear of the sea transiting into idleness

It is clear from the above that a multitude of factors influenced resumption of fishing; they include internal factors such as culture, caste, equity, community institutions, demography, community cohesiveness, internal conflict, and conflict resolution, as well as external factors such as government policy and NGO rehabilitation interventions. Furthermore, some of these factors in particular contexts actually led to a delay in the resumption of fishing and thus one would need to analyse these factors and contexts. However, there is no systematic data on this available from Kerala, Andhra Pradesh, or Pondicherry and there is only some scattered information in Nagapattinam in a few studies that briefly mention these situations and factors.

Impact of rehabilitation and over-capacity

Immediately about 4 months after the tsunami, it was increasingly becoming evident that in the artisanal fisheries sector the total craft numbers would exceed pre-tsunami levels. This trend would prove counter productive, as fish catches from Tamil Nadu had stagnated for the last few years, and would not result in increased catch or income. This situation would actually lead to over capitalisation, uneconomic operations and even resource depletion (NCRC, 2005e; M. Kasim 2005, pers. comm.). Despite many workshops, recommendations and advocacy efforts regarding the above, this trend was not addressed (SIFFS, 2005; Thaddeus, 2005a). Fortunately this trend did not occur in the mechanised sector.

There have been studies that have analysed the reasons for the above situation and they are again only confined to Nagapattinam. Their conclusions highlight the failure of civil society organisations (CSOs), the government policy environment and traditional *panchayat* institutions. Basically, the initial agreement between CSOs and the Government was to have a 50 -50 contribution of Rs 75, 000 each for replacing FRP boats and that any boats repaired by NGOs would not be eligible for compensation. This agreement was not followed by either of them and neither did the traditional *panchayats* want this. There was a big rush by NGOs to distribute boats and the traditional *panchayat* wanted to get as many as possible from the Government and CSOs (Thaddeus, 2005a; Thaddeus, 2005b; TRINET 2005c). However, the main principle of the traditional *panchayats* was to ensure that all those who had lost craft and gear were compensated adequately and only then were all surpluses to be distributed among other members (Gomathy, 2006).

There were also cases of NGOs donating boats and setting up group ownership with the crews. This was due to the entry of organisations that had no prior experience of working with fishing communities and applying an agrarian understanding/analysis (equating fishing labour to landless labour) to these communities in post-tsunami rehabilitation (Mathew, 2005a). Some studies mention that the NGOs were looking for reasons and ways to distribute boats, even though the government packages would have adequately covered and compensated all damages (Salagrama, 2005).

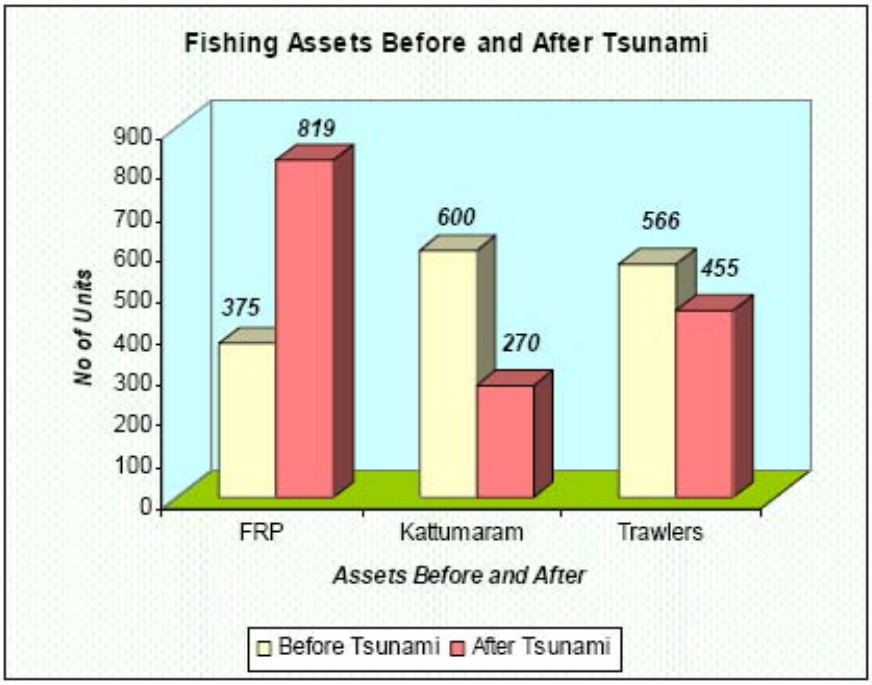
Asset base

When looking at composition of the asset base in the traditional sector there was an initial decrease in the number of catamarans which were replaced by the FRP boats. This was because in Tamil Nadu, catamaran damages and losses were paid in full and proof did not have to be attached. In fact, a study cites the reason for this situation compensation being in excess of the pre-tsunami levels (Salagrama, 2006). However, very few wooden catamarans were replaced and most fishers shifted to FRPs. One of the reasons was due to the immediate non-availability of wood (in terms of scale) and that replacement and provision of FRPs were much easier than catamarans. Secondly, there was also a lack of interest among fishermen in owning a catamaran and most opted for an FRP instead (Thaddeus, 2005a; Thaddeus, 2005b; TRINET 2005c). This was a background trend even pre-tsunami, especially in the nineties with

many catamaran fishers switching over to FRPs popularly attributed the competition from the trawlers (Banerjee, 2005; Thomas, 2005a).

In fact one study reveals that in Nagapattinam alone, FRP boats saw a 2.18 times increase (in number) along with upgrades in capacity (engine capacity from 6-7 HP to 10 HP) while catamarans had a 55 % decline. The graph below shows changes in assets base before and after the tsunami:

*Figure 1: Fisheries asset before and after tsunami**



*Source: Thaddeus, Koriya P. 2005a

It is interesting to note that the number of trawlers had reduced. This is due to the fact that many trawler owners did not reinvest but diversified into FRP boats, as they considered trawling no longer viable (Thaddeus 2005b; Salagrama, 2005). A hamlet wise asset worth gives a better picture of the situation, two examples from a study are given below to illustrate the situation:

*Table 1&2: Total net worth of fishing assets- before and after tsunami**

Fishing Hamlets	Total Worth of Assets before Tsunami	Total Worth of Assets after Tsunami	Change in Net worth after Tsunami
Arcotturhurai	150636000	165470000	14834000
Akkarapettai	323085000	339330000	16245000
Tharangambadi	72870000	79170000	6300000
Nambiar Nagar	94059000	42510000	-51549000
Total	**640650000**	**626480000**	**-14170000**

*Source: Thaddeus, Koriya P. 2005a

Total Net Worth of Fishing Assets in Tharangambadi- before and after Tsunami

Craft Types	No of Units before Tsunami	Total Worth Before Tsunami	No of Units after Tsunami	No of Units Repaired/ Undamaged	Worth of Repaired/Undamaged Assets	New Units	Worth of New Units	Total Worth of Assets after Tsunami
FRP	168	15120000	295	160	14400000	135	20250000	34650000
Kattumaram	100	2100000	20	20	420000	0	0	420000
Trawlers	53	55650000	42	42	44100000	0	0	44100000
Total	321	72870000	357					79170000

Total Increase in Value of Asset – 6300000

It is felt that actual numbers of craft are definitely more than the official figures. It must be noted here that getting data by any agency on over capacity, gear and fleet strength is difficult and sensitive (even for NGOs working with communities). Comparing with pre-tsunami levels is virtually impossible as many of the boats pre-tsunami were not registered and it is not known if all of the boats have been registered post-tsunami.

In the case of nets another study reveals that there is no significant change in the average number and weight of nets being used post-tsunami (Bhalla, 2006). The same study also mentions that there is a significant increase in the mesh size of nets being used for which the reasons are not known. But this may actually be a shift in the preference to the type of nets being used of which data was not collected or also due to the fact that sampling was restricted to a single season (use of nets vary with season). There are also reports of the increase in the use destructive of fishing gear such as mini seine nets ("surukuvalai") and drag nets post-tsunami. However, the extent of this is not known (Bhalla, 2006; Bhalla, 2007).

In the case of hook and line fishing the average numbers of fishers pre and post –tsunami remains the same, but there is a significant increase in the average length of the line used. The number and capacities of the engines have also both increased significantly with shift of the brands being used (Bhalla, 2006).

In the case of crew size, the earlier theory was that the increase in number of boats would create a shortage of crew. The study by Green Coast shows that this is not the case and that both the average crew size as well as number of active fishers have increased post-tsunami (Bhalla, 2006).

There has been some stock taking of these aspects of asset base only in Nagapattinam, but not in any of the other affected districts. Below is a summary of crafts used pre and post tsunami showing the increase. It is likely that the actual numbers would exceed those shown below.

Table 3: Available boats (Non-mechanised) pre-tsunami & post-tsunami

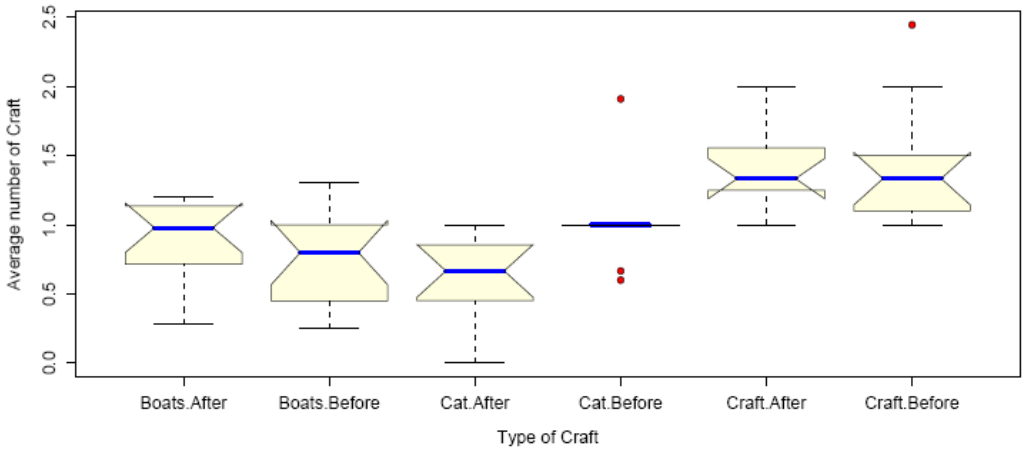
Name of the village	Catamaram Pre-Tsunami	Catamaram Post-Tsunami	Difference Catamaram	Vallam Pre-Tsunami	Vallam Post-Tsunami	Difference Vallam	Total change in no. of craft post tsunami (Vallam +Catamaram)
Kodiyampalayam	107	86	-21	135	156	21	0
Pazhayar	241	236	-5	186	144	-42	-47
Vanavanmadevi	135	120	-15	122	107	-15	-30
Madavamedu	137	110	-27	57	87	30	3
Kottaimedu	52	42	-10	68	94	26	16
Cinnakottaimedu	46	68	22	5	16	11	33
Koolaiyar	227	193	-34	16	75	59	25
Thoduvai	147	140	-7	88	158	70	63
Thirumullaivasal	371	321	-50	53	94	41	-9

Name of the village	Catamaram Pre-Tsunami	Catamaram Post-Tsunami	Difference Catamaram	Vallam Pre-Tsunami	Vallam Post-Tsunami	Difference Vallam	Total change in no. of craft post tsunami (Vallam +Catamaram)
Keelamooverkarai	79	64	-15	5	26	21	6
Keelamooverkarai	256	238	-18	66	113	47	29
Savadikuppam	69	55	-14	3	33	30	16
Nayakarkuppam	145	118	-27	6	58	52	25
Madathukuppam	145	116	-29	9	57	48	19
Pudukkuppam	158	128	-30	22	57	35	5
Poompuhar	750	685	-65	65	92	27	-38
Vanakiri	237	190	-47	97	99	2	-45
Cinnamedu	144	115	-29	22	49	27	-2
Cinnangudi	162	122	-40	41	78	37	-3
Thalampettai	105	95	-10	45	71	26	16
Pudupettai	257	228	-29	59	127	68	39
Perumalpettai	187	150	-37	65	158	93	56
Vellakovil	45	38	-7	41	73	32	25
Kuttiyandiyur	207	187	-20	101	176	75	55
Tharangampadi	347	281	-66	220	230	10	-56
Chandrapadi	227	181	-46	65	63	-2	-48
Cinnurpettai	24	19	-5	18	3	-15	-20
Nagore	245	216	-29	131	197	66	37
Samanthanpettai	133	121	-12	184	269	85	73
Nambiyar Nagar	142	127	-15	100	158	58	43
Nagaiariyanattu Theru	105	100	-5	112	117	5	0
Keechankuppam	60	53	-7	85	215	130	123
Akkaraipettai	179	119	-60	97	196	99	39
Kallar	137	110	-27	15	99	84	57
Velankanni	88	125	37	27	84	57	94
Seruthur	180	155	-25	231	310	79	54
Kameswaram	115	94	-21	51	100	49	28
Vilundamavadi	106	160	54	61	94	33	87
Vellapallam	245	196	-49	75	142	67	18
Naluvethapathy	90	72	-18			0	-18
Pushpavanam	78	74	-4	53	44	-9	-13
Areattuthurai	371	335	-36	66	252	186	150
Maniyantheevu	53	43	-10	5	53	48	38
Kodiyakadu	1	1	0	8	35	27	27
Kodiyakarai	6	4	-2	143	129	-14	-16
Pannal	0		0	26	29	3	3
Seruthalaikadu	45	36	-9	38	67	29	20
Annapettai	0		0	26	26	0	0
Voimedu	0		0	3	3	0	0
Cinthamanikadu	0		0	13	13	0	0
Kovilthavu	0		0			0	0
TOTAL	**7386**	**6467**	**-919**	**3230**	**5126**	**1896**	**+977**

Data based on book released by the District administration on 26/12/05 Basic Raw Data/Table Available at http://www.ncrc.in/fish_compensation.php

Though there has been an increase in the combined total number of craft in the traditional sector, it is not significantly/statistically higher than the pre-tsunami level (Bhalla, 2006). The same is shown in the figure below.

Figure 2: Number of craft pre and post-tsunami*



*Source: Bhalla, 2006

However, when seen in the light of capacity of engine and nature of craft (shift towards FRP boats), the changes in numbers could be significant with implications for catch effort and fisheries.

Catch effort

Thus from the previous table and section, it is clear that the number of craft in the non- mechanised sector (*vallam* and catamaran) has increased, but not alarmingly. Still some feel that the problem now lies with over-capacity and over fishing within the non-mechanised sector (as opposed to the earlier situation of the enemy being trawlers) (Salagrama, 2006). However, when one looks at the number of boats engaged in fishing, one gets a very different picture as not all of them are being used in fishing. This is illustrated by the tables below which show that around 26 % of the *Kattumaram* and 21% of the *Vallams* are not involved in fishing as of February 2006.

*Table 4: Status of resumption of fishing - taluk wise in Nagapattinam, March 1 - 15, 2006**

Status	Taluks	Kattumaram	FRP Boats	Trawlers	Total
Units doing Fishing	Sirkali	870	824	207	1901
	Tharangambadi	370	91	14	475
	Nagapattinam	360	590	427	1377
	Kilvelur	25	235	0	260
	Vedharanyam	114	248	0	362
Units not Fishing	Sirkali	227	43	6	276
	Tharangambadi	119	13	3	135

	Nagapattinam	0	173	2	175
	Kilvelur	17	200	0	217
	Vedharanyam	247	161	7	415

* Source: NGO Co-ordination and Resource Centre (NCRC). 2006c.

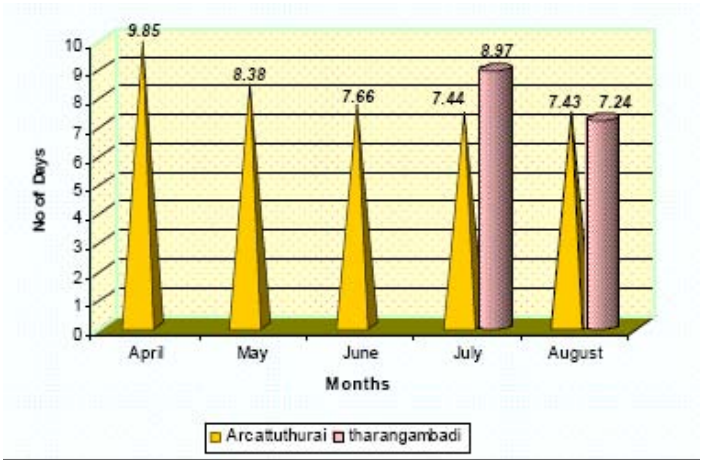
*Table 5: Status of resumption of fishing in Nagapattinam, March 1 – 15, 06 **

Status	Kattumaram	%	FRP Boats	%	Trawlers	%	Total	%
Units doing Fishing	1739	74.03	1948	78.68	648	97.3	4335	78.95
Units not Fishing	610	25.97	528	21.32	18	2.7	1156	21.05
Total	*2349*	*100*	*2476*	*100*	*666*	*100*	*5491*	*100*

*Source: NGO Co-ordination and Resource Centre (NCRC). 2006c.

There have been many reasons attributed to this situation, the main ones being the non-availability of crew for the increased number of craft and the change in owner-crew relations. Thus, in some cases the number of fishing days per boat had reduced (Salagrama, 2006). Many of the boats were also sold and recycling of boats meant that the number of boats were actually less than those reported by NGOs (Salagrama, 2006). The other reasons have been that the quality of boats was poor and they had to be frequently landed for repairs. Some also felt that this could be due to fishing operations becoming unviable (Salagrama, 2006). A FRP boat pre-tsunami that used to do 15-25 trips per month was now doing only 10 trips a month (as of August 2005) (TRINet 2005c) . The figure below illustrates this for some of the months in 2005.

*Figure 3: No. of fishing trips per month in Arcottuthurai &Tharangambadi**



* Source: SIFFS Society records from Thaddues. 2005a

Given below is a summary of the possible reasons for reduction in the catch effort/ utilisation of boats.

Box 2: Summary of the possible factors for reduction in catch effort

- Lack of Labour
- Poor quality of boats
- Non provision of correct nets
- Resale of boats
- Poor economic viability of operation
- Conflicts in group ownership
- Inablity to adapt to gear /craft
- Increased competition for fishing grounds

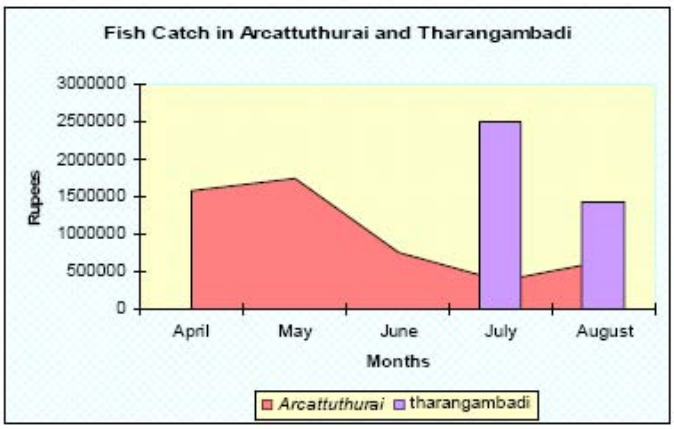
Another important point to note is that despite the average increase in engine capacity, the fishing range and grounds of these boats still remains the same (Bhalla, 2006). The stabilisation of fishing might take place when people adapt to new craft and gear, change in fishing grounds, target species. It is also felt that the number of boats will stabilise after a year with excess boats that remain idle being sold. From personal observations, it does seem that new catamarans have been bought since May 2006. This means there is a likelihood of the nature, composition and quantum of the asset base changing and stabilising with time. It is clear from this that increased fleet size, crew size (no. of active fishers) and engine capacities may not have necessarily increased the catch effort in the same direct proportion but may have increased nonetheless. One needs to study and analyse the reasons for the levels of catch efforts, stabilisation of fleet capacity as well as the adaptations made by the community in fishing operations in various regions.

It must be noted here that this kind of monitoring of craft use and catch is being done only in Nagapattinam and not in all the other affected districts/states. Furthermore, the parameters are dynamic and need to be continuously be monitored for the next few years in order to get a better picture of the trend as well as the underlying reason for them.

Fish catch and income

There is very little information on the monitoring of income and fish catch (pre and post-tsunami) and whatever little is available, is sketchy. Some experts like Dr. Kasim of the Central Marine Fisheries Research Institute (CMFRI) were of the opinion that short-living (in terms of life cycle) invertebrates such as prawns would recover faster and that the gap in fishing for about 4 months post–tsunami coupled with monsoon fishing ban would initially result in an increased catch for the non-mechanised sector when fishing resumed, but would not last very long (in TRINet 2005c). Some records kept by the SIFFS fishermen societies do show this trend as given below showing average catch per unit in income.

*Figure 4: Fish catch data for Arcottuthurai and Tharangambadi**



* Source: SIFFS Society records from Thaddues (2005)

The reason for the initial increase in catch/income could be attributed to the gap in resumption of fishing. The drop in income/catch in the subsequent months after May was reported to be 60-70% of the previous months. Other parameters are being monitored by the NGO Co-ordination and Resource Centre (NCRC) but they do not give details of the catch but show a 28 % decrease of fish catch by weight as seen in table 6 below:

*Table 6: Average fish catch per day and percentage per day **

Pre-Tsunami	7386 x 50 kg	369,000
	3230 x 150 kg	484,500
	948 x 500 kg	474,000
Total		1327,500
After Tsunami	6467 x 35 kg	226,345
	5126 x 110 kg	563,860
	459 x 350 kg	160,650
Total		**950,855**

* Source: NGO Co-ordination and Resource Centre (NCRC), Nagapattinam

Continuous catch data will need to be monitored along with details of species and incomes. This will need to be correlated with the catch effort, running cost etc. to get a clear picture of the status of resources, incomes and fishing patterns post tsunami.

Community perception of changes post-tsunami

There has been very little work on traditional ecological knowledge (TEK) of fishers till date. Post - tsunami some investigation qualitatively investigated the community perceptions of post-tsunami changes in the ecosystem. However, they are quite contradictory as they are actually spatially spread over a large area and hence are not able to capture region/area specific observations.

One study post tsunami, apart from documenting the classification of the winds, currents, and the fishing grounds also indicates the factors influencing the decision to fish and the perception of Nagai fishermen on the impact of the tsunami (Benchila and Prabhu, 2005). The main changes reported are unpredictability of winds, changes in currents, rise in water level at shore, poor catches, appearance of new species such as white fish (after 20 years) (Benchila and Prabhu, 2005). They did not report any changes in the sea bed.

Another study indicated that fishermen, particularly in Kancheepruam, reported changes to the sea bed, its rock formations, areas of sand and slime (contrary to the previously mentioned study) (Gomathy, 2006). As in the previous study this also mentions the erosion of the coastline/shoreline or change in the HTL and refers to the fisher's inability to predict winds, currents resulting in disorientation in fishing as well as gauging safety. The community believes that it will take 4-5 years to understand the fish patterns and chart/map their grounds again to avoid damage to their nets and (Gomathy, 2006).

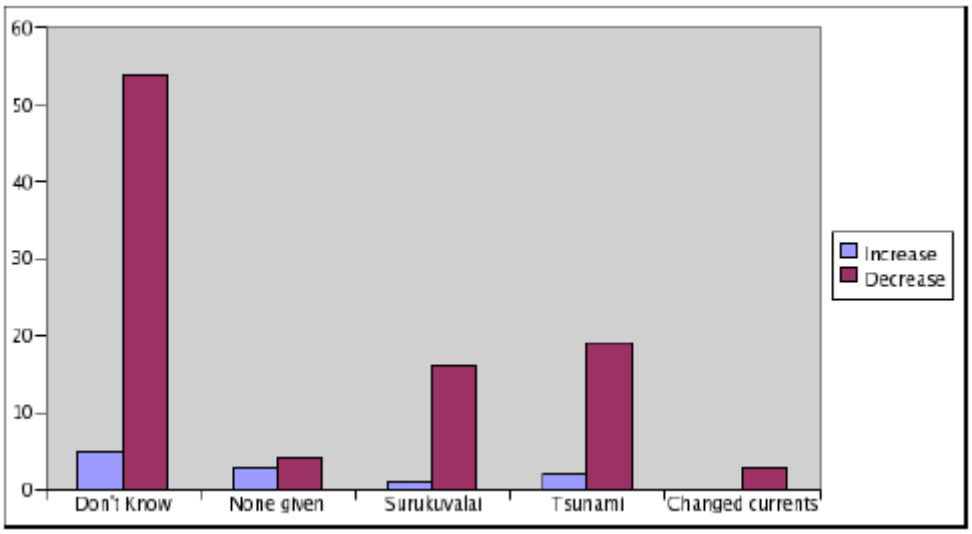
The changes in shoreline in some places such as Anumandai Kuppam in Villupuram are significant and are as high as 40 m. Koonimedu Kuppam in the same district reported changes in the beach quality from clayey to sandy soil (and the other way round in some other locations) (Salagrama, 2006). There were also reports of changes in the depths in some of the fishing grounds by some communities (Salagrama, 2006). As the beaches are very dynamic ecosystems, the stabilisation will take some time. Whether there will be a return to some of the earlier characteristics will be known only with time by monitoring and further studies. A summary of all the different observations and perceptions of the community of post-tsunami changes is summarised in the box below:

Box 3: Summary of perception of fishers on the impact of the tsunami

- Changes in HTL (also observed as increase in sea level)
- Erosion of beaches
- Changes in wind pattern
- Changes in currents
- Changes in sea bed (some villages/regions claim no changes)
- Inability to predict weather patterns
- Inability to predict fish aggregation
- Inability to gauge safety
- Poor catches
- Changes in fishing grounds
- Changes in beach quality and characteristics

A majority of the fishermen in one study reported a decrease in the fish catch and attributed this to the use of *surkuvalai* and the tsunami (Bhalla, 2006). The responses to the questionnaire from the study are shown below:

Figure 5: Reasons for changes in the fish catch *



*Source: Bhalla, 2006.

Most of the above studies on TEK and community perceptions of the tsunami impact are too broad and qualitative. A region specific study in detail would have given a better picture (along with an indication of the fishing grounds that the particular hamlets use for fishing).

Case of group ownership

Group ownership of boats has failed in the past and many fishworker groups and advocacy platforms have discouraged the same. It is well known that in certain areas such as Nagapattinam and Kanyakumari the concept of individual ownership is very strongly rooted in the culture. However, in some districts such as Villupuram, Cuddalore, and Pondicherry, group ownership did exist pre-tsunami (Salagrama, 2006). In all the 4 states many boats were given on group ownership (Salagrama, 2005). The extent of group ownership pre and post-tsunami is not known and quantified. However, there have been reports of cases of conflicts and disputes in the initial stages due to group ownership in rehabilitation (TRINet 2005c).

Various mechanisms to cope with group ownership emerged within the community. In Nagapattinam, one of these was that a written agreement between the traditional *panchayat* and each of the groups that there will be no compensation for any member exiting the group and that the boat could not be sold by the group. The dissolution of the group meant that the custodian of the boat would be the *panchayat*. This was done to discourage possible split up of the group (Thaddeus, 2005a). Another model was the setting of shares within a group and the option of selling or buying out shares for boats (Salagrama, 2006).

It is not fair to write off the concept of group ownership as it was already prevalent in some regions. The areas where it failed post-tsunami were those in which the practice was initiated without any thought or mechanisms in place (or the areas had no history of group ownership). To suggest it will not work implies that the fisherfolk do not have the spirit of cooperation and collectiveness inherent in them, which is unfair and definitely not true (Salagrama, 2006). In fact many fishermen had suggested the role of traditional *panchayat*s in facilitating group ownership with a feeling that this would lessen, ease and facilitate any possible friction. They also believed that eventually a balance could be established and any strife would be worked out (Salagrama, 2006) .

The above does indicate elements of adaptation and resilience. A study to understand the history, origins and reasons of group ownership pre-tsunami as well as the context of how and why they have failed in some areas, while succeeding in other areas would give a better understanding to the socio-ecological resilience in the communities.

Agriculture

Unlike the fisheries sector, the agricultural sector faced immediate and longer term damage of their assets namely soil and water sources. It is felt that this has not drawn any kind of attention that it deserves, perhaps partly because the damage to agriculture was not as visible and dramatic as in the case of fisheries even though about 26,000 hectares of agricultural land was affected by the tsunami with standing crops almost completely destroyed. (Centre for Indian Knowledge Systems, 2006; Das, 2005).

However, the assets like soil and water as mentioned earlier unlike the fisheries sector are different. Their damages are more permanent in nature and have to be either reclaimed or rejuvenated. The time scale of damage and recovery is also much longer than the case of fisheries. Moreover, individual farmers cannot reclaim agricultural fields on their own, as costs involved are prohibitive and activities quite complex (Das, 2005). Thus in reality, the damage to agriculture is indeed actually quite dramatic and drastic.

The impacts of the tsunami can be classified into four major categories:

- Sand/mud casting on the land.
- Salinity in the agricultural land.
- Contamination of water sources (surface and groundwater).
- Damage to the natural resources in the area (standing crop loss, plantations, livestock.

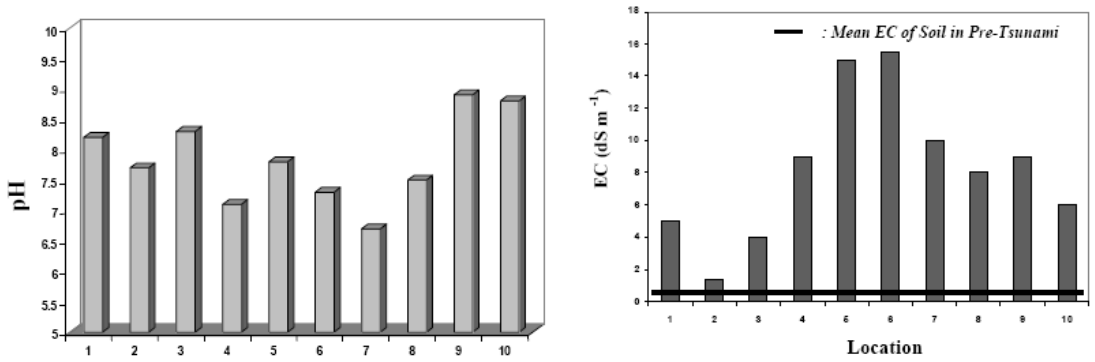
Poor drainage in most areas resulted in water that inundating fields and staying for some time before it drained away thus causing the salts to percolate into the soil as well as groundwater (TRINet 2006a). Initially, the NGOs working on rehabilitation in the agriculture sector couldn't get any useful help or information even in terms of technology when they approached the government departments and had to find ways of desalination and soil reclamation by interacting with farmers. There was also a lack of clarity and coordination between the various departments that were involved in agriculture based livelihood

rehabilitation. Thus there was no comprehensive picture available to specify the programmatic content of rehabilitation in the context of the agricultural land affected by the tsunami (NCRC, 2005b).

Ecological impacts

The full scale effects of the ecological impacts of the tsunami are yet to be understood, but there are definite effects on the land and water resources. The impact on trees and vegetation around was significant. Cashew and mango trees were badly affected by the physical force and the accumulated salts in the soil. Though coconut & palm have withstood the salinity for many months after the tsunami, farmers felt that the effects on them will be known only after more than a year (Green Coast, 2006b). One study of the soil shows the EC levels had increased from 5 to 15 times and the soil pH increased beyond 8 in about 40% of the samples (the pre-tsunami average pH was around 7) (Chandrasekharan et al, 2005). The result are summarised in the table below:

*Figure 6: Variations in EC and pH of soil samples from tsunami-affected areas in coastal Tamil Nadu**

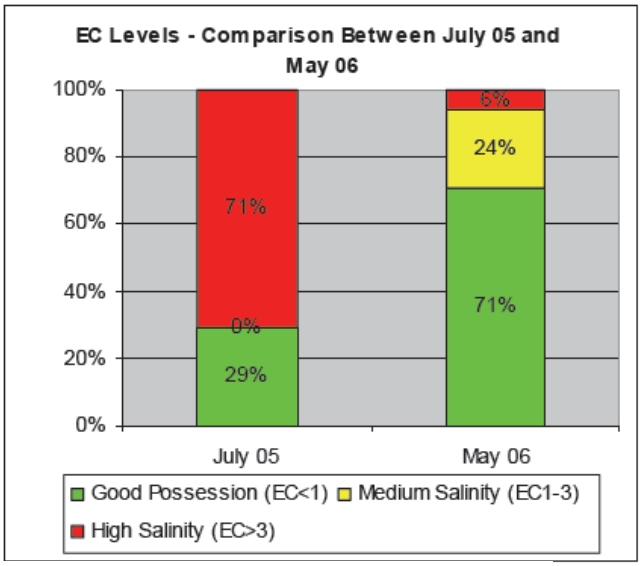


1, Serudhur-I; 2, Serudhur-II; 3, Prathabaramapuram-I; 4, Prathabaramapuram-II; 5, Vellapalam (Vedaranyam); 6, Neithavasal; 7, Manikkapangu; 8, Khozhaiyur-I; 9, Khozhaiyur- II; 10, Erukattancheri.

* Source: Chandrasekharan *et al.*, 2005.

The study points out that remediation of such soil cover is difficult, especially when deterioration has occurred due to sea-water ingress. The study concludes that as the affected areas will receive adequate freshwater to leach out the salts, only during the subsequent monsoon season (July/August 2005) and that the next crop of rice was also likely to be affected in these areas. One study done in 2005 and 2006 shown below shows major improvements in the soil quality in terms of reducing salinity (NCRC 2006c).

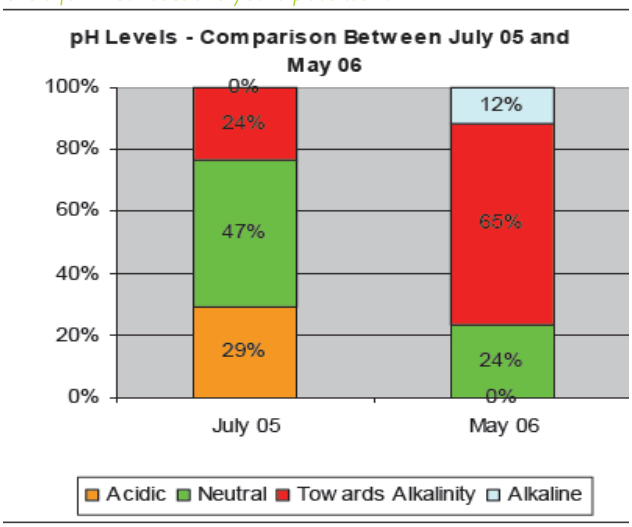
Figure 7: EC levels in soil for two consecutive years post-tsunami



* Source: NGO Co-ordination and Resource Centre (NCRC). 2006d

In the case of pH values, it shows some increase in proportion of samples moving towards the alkalinity range after reclamation. This shown below in the graph below:

*Figure 8: Changes in soil pH levels for 2 consecutive years post-tsunami**



* Source: NGO Co-ordination and Resource Centre (NCRC). 2006d

Water bodies and management

The impact on water bodies was caused by the intrusion of saline water both by inundation and ingress. These were managed by the farmers themselves, with some support for pumping out the accumulated water and desilting the physical slurry (NCRC, 2006d). Many habitations reported that traditional physical structures (bunds, etc.) for drainage and water management had not been maintained over the years due to lack of cooperation, ownership among the communities as well as government support for the same (NCRC, 2006d). During the heavy rains of October-November 2005 in Nagapattinam, in some villages rain water stayed on the fields due to the lack of maintenance of traditional water management and drainage structures (NCRC, 2006a). In some cases the drainage channels, which were reclaimed and desilted all along the coast as a relief work by various agencies and NGOs, were instrumental in the immediate drainage of excess water from the rains (TRINet, 2006a). Thus, there is a need for maintenance of water management and drainage structures, safe disposal of water, harvesting excess water and recharging the ground water in all the affected areas.

The Coramandel coast is known to have traditional water harvesting, soil conservation and watershed management techniques which have now eroded (Sangati CPR Working group). Two known cases are illustrated below:

*Box 4: Traditional techniques to reduce the salinity content in water and soil**

The farmers in Naluvethapathy in Nagapattinam district have traditionally used cake prepared from neem seeds, tamarind leaves, and mowa seeds (also known as 'iluuppai arappu' in Tamil) to remove water salinity. They applied these materials whenever the seawater entered into agricultural land during monsoon. The farmers mix the neem seeds, the tamarind leaves and the mowa seeds in equal proportions (200 kgs of the mixture is required per acre) and then mix them with the soil. However, nowadays they find it difficult to collect sufficient quantities of the materials.

Besides, mixing the materials and applying them to the soil consumes a lot of time. Garlic plants and jute plants are grown in the field, and then they are cut and left to decompose in the field. The land is then tilled 2 to 3 times. This action helps reduce soil salinity. Most of the farmers have knowledge of application of gypsum to reduce the salinity, but they are not confident of it effectiveness. Most of them feel that heavy rain would possibly reduce the impact of salinity in the land. In the month of April 2005 the region received some heavy showers and the farmers feel that these have removed some of the soil salinity. The ponds however remain to be desilted and cleaned.

*Box 5: Stabilization of sand dunes and soil conservation **

South Poigainallur is situated about 10 km south of Nagapattinam along the Tamil Nadu coast. The village has two kinds of lands mainly, that is, lowlands and uplands. The interesting aspect of the lands in South Poigainallur is that almost every piece of land is part lowland and part upland. This is a natural occurrence and the farmers do not try to change it. There is no river or canal irrigation in the village. During the rainy season, the village faces water flooding. The water is therefore channeled through these canals up to the sea. Ponds are dug on each one's own piece of land, and are used for irrigating crops. People use the common ponds known locally as *mandua* when more water is required. There is no discrimination in the usage of these common ponds, and the villagers share in the water equitably. There have also been no conflicts regarding the water of the common ponds.

South Poigainallur is very well known for its sand dunes along the seashore at a height of 30-40 feet. Sand dunes are found on the seashore at a distance of 15 meters from the sea. The height of the sand dunes is about 30-40 feet from the ground level. The dunes start at the northern side of South Poigainallur near Kallar which is ½ km from South Poigainallur and ends near Vailankanni (near Pookara street) and extends to a length of 6.5 kms. In order to protect crops from the waves and institute soil conservation measures (to prevent deposit of sea sand in their fields) the people erected fences using palm leaves along the seashore and planted palm trees along the fence. The people claim that the high tides brought sand to the shore carried on the waves which was then cast along the fencing lines along the seashore. They are of the view that since sand travels easily on the wind, the accumulation has been easy and the height of the dunes has grown over time. Moreover, the community have observed that during the season of the North winds (Winter season—November and December) a lot of sand accumulates on the seashore. The dunes from time to time were then stabilised by various vegetation of cashew, tamarind, and Spinifex. The back dunes with vegetation cover do not show any considerable seasonal variation and the fore dunes with less/no vegetation show a greater degree of seasonal dynamics. The dunes and this vegetative fencing prevented soil erosion and sand casting onto the agriculture fields. This is how they claim they have enhanced the formation of the famous sand dunes in their village. They claim that 500 years ago, the height of the sand dunes was only 5-10 feet, whilst now they are 30-40 feet. The people believe that the sand dunes have protected them from natural disasters such as cyclones and high tides. The dunes have in fact been largely responsible for minimizing the number of deaths in the village during the tsunami. The community have resisted the outsiders and prevented digging of sand from the sand dunes by presenting a united front. After the tsunami, the *panchayat* passed a resolution to protect the sand dunes and banned outsiders digging sand from the sand dunes.

Sources: Praxis. 2005k. South Poigainallur: Village level people's plans: Realities, Aspirations, Challenges. Praxis, Delhi.

Balakrishnan, R. 2006. Presentation at Workshop on Ecological Restoration of Degraded Ecosystems in Tamil Nadu: Planning and Implementation, 19 December 2006, Chennai, organised by Tamil Nadu Forest Department, Nature Conservation Foundation, and UNDP Post-Tsunami Environment Initiative, Nature Conservation Foundation, Mysore.

Background trend in agriculture

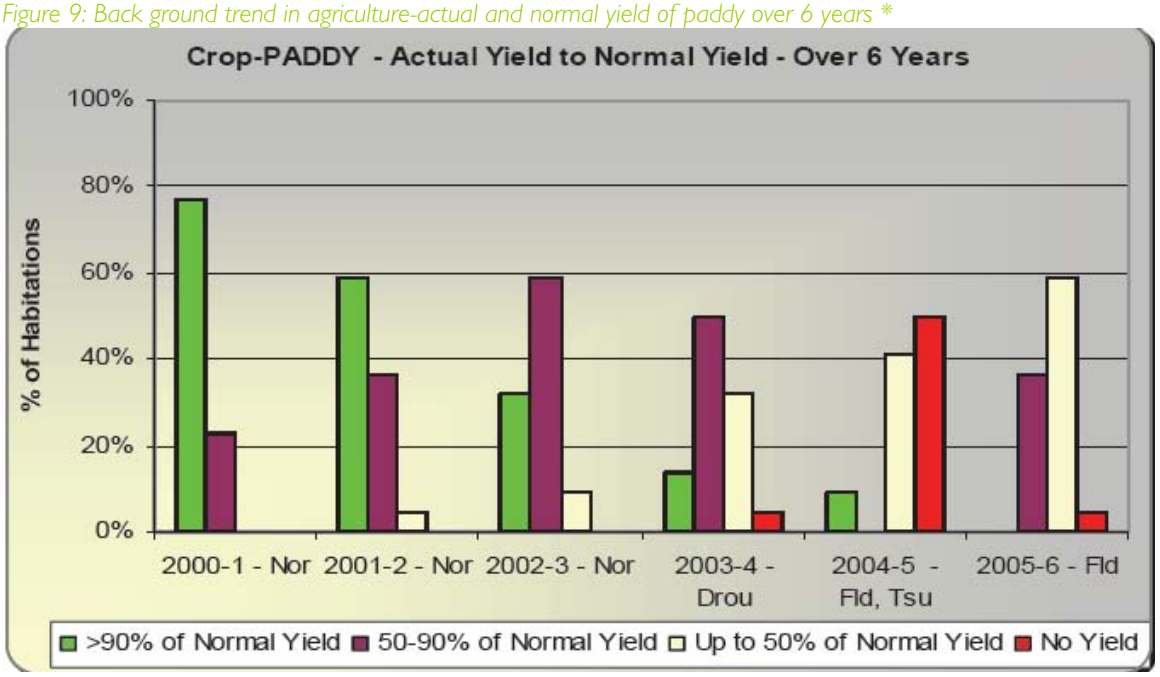
Analysis of past crop data in Nagapattinam district show a background decreasing trend in the yield over the years (even during normal years), which is an area of concern. The studies indicated that the salinity and lower fertility in the soil (indicated through NPK values from soil test) as the main factors contributing towards this trend (NCRC, 2006d). This background trend is similar in both dry and wet lands as well as for the other major crop, groundnut, with the proportion of habitations reporting 90% and above yield coming down to 14.30% (in 2005-06) from 85.70% (in 2000-01) (NCRC, 2006d).

There has also been an increasing occurrence of disasters in the Nagapattinam region in the past few years. Flood and drought have been the main disasters in the region and their impact have been reduced or total loss of production from the particular season, and reduced productivity of land due to salinisation or lack of irrigation (during droughts) (NCRC, 2006d). In some villages in Nagapattinam, agriculture was actually abandoned due to a combination of reasons - lack of irrigation, salinisation of

groundwater, continuous monsoon failure, and the inflow of seawater during the cyclones (Praxis, 2006b; Praxis, 2006e; Praxis, 2006f).

The responses to these disasters from government and other agencies have seemed to be adhoc, temporary and reactive.

*Figure 9: Back ground trend in agriculture-actual and normal yield of paddy over 6 years **

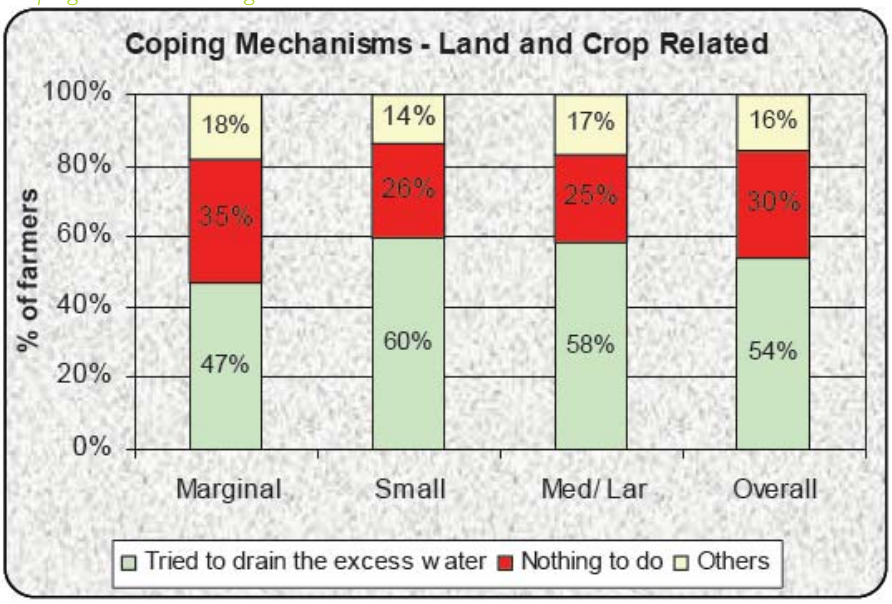


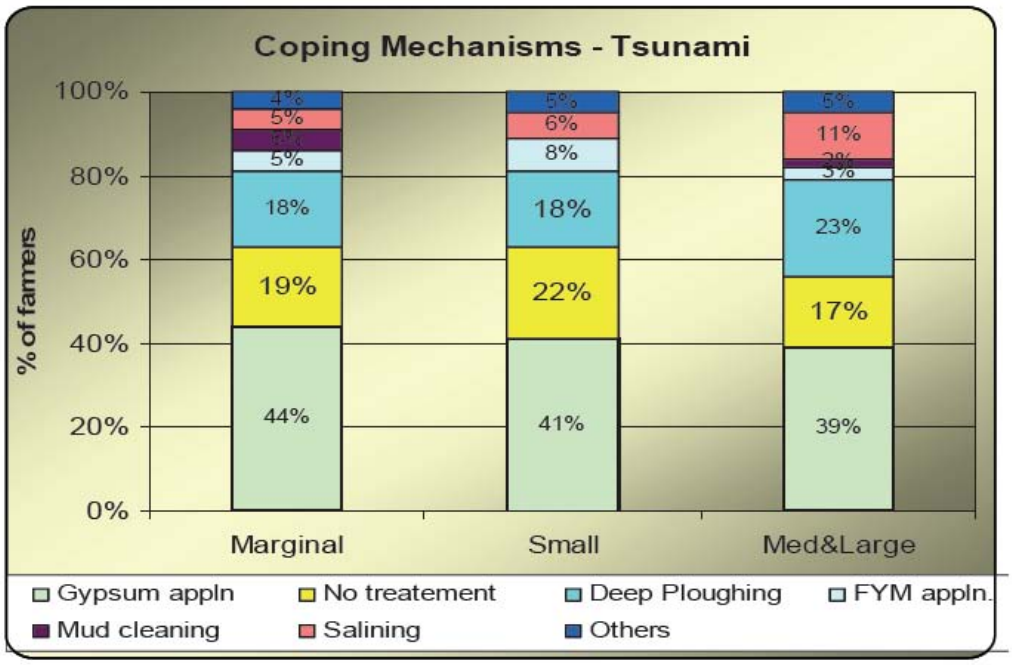
* Source: NGO Co-ordination and Resource Centre (NCRC). 2006d

Coping mechanisms

The coping mechanisms adopted by the farmers were studied in two aspects in Nagapattinam–land and crop. A large proportion of farmers practiced gypsum application, followed by deep ploughing (18 – 23%). In drought years, about 90% of farmers reported that they would not be able to do anything except wait for rain with a few (less than 7%) reporting deepening of farm ponds (NCRC, 2006d). The findings of the study are summarised below:

*Figure 10 & 11: Coping mechanism in agricultural sector **





* Source: NGO Co-ordination and Resource Centre (NCRC). 2006d

Monitoring of crop yield & mapping of water bodies

One of the initiatives taken up by the NGO Co-ordination and Resource Centre (NCRC) is a study to map the water bodies in the coastal areas of Nagapattinam in order to develop safeguard systems against salinity caused by either tsunami or floods by setting a drainage system in place for the water to drain out (NCRC, 2006b). The initiative can be improved upon by use of GIS based mapping along with watershed based management over a larger area. The ground water salinity as well as drinking water sources, both of which have been issues of the past and present can be addressed if taken up. The centre is also involved in the continuous monitoring of crop yield in the Nagapattinam District for the past two monsoons since the tsunami.

Agro-biodiversity

There has been no work on documenting the agro-biodiversity of the affected region. Aspects of wild varieties, land races & cultivars in the entire affected district find no mention the literature post-tsunami.

Impact of the tsunami on groundwater

Groundwater in most coastal areas in India has been facing sea water/salinity intrusion. This has made it very difficult for coastal communities in terms of their daily access and needs of freshwater. So much so, that the prospect of better quality groundwater is one of the reasons given by them for relocating to a new site (Salagrama, 2006). It must be noted that there are a number of factors that are major drivers of changes in water quality and quantity in the coastal zone and there are very few comprehensive studies in this regard.

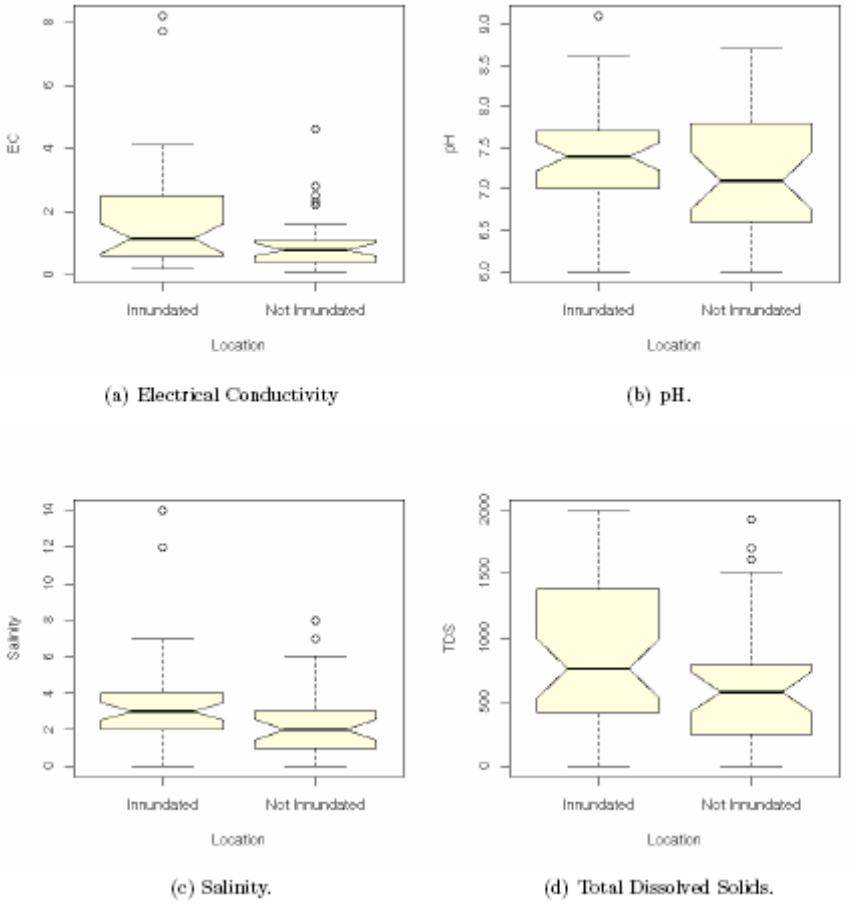
One of the impacts of the tsunami was the increased salinity of groundwater in many areas (Nair 2005). The Central Groundwater Board (CGWB) reports that open wells and tube wells adjoining the sea shore within 300-500 m., turned saline because of inundation and flooding by sea water (in International Groundwater Resources Assessment Centre, 2006b). Many experts d felt that the subsequent rains would improve the groundwater quality. Post-tsunami, in many areas improvement in ground water quality due to natural flushing as well as heavy pumping of these wells to restore water supply was observed (International Groundwater Resources Assessment Centre, 2006b). In some areas, however, contrary to

this, the rainwater dissolved the salt deposited in the soil and thus increased the salinity of groundwater (Srinivasulu, 2006). Studies have also documented and characterised the impacts of the tsunami on geomorphology and water quality (Green Coast, 2006a). Studies have also developed geo-spatial data bases on the damage assessment to ground water village wise showing appreciable damage to aquifer in the form of saltwater mixing and intrusion due to tsunami (Ramasamy *et al*, 2006). The water samples in Andhra Pradesh showed no increase in salinity and in the case of Kerala, the CGWB reported that open wells and tube wells adjoining the sea shore turned saline. Here again there was improvement in ground water quality due to natural flushing and pumping (International Groundwater Resources Assessment Centre, 2006b).

The International Groundwater Resources Assessment Centre (IGRAC) is conducting an overview of the impact of the tsunami on groundwater systems and groundwater based water supply by the collecting, systematising and making available more detailed and/or specialised information. This overview is constantly being updated (International Groundwater Resources Assessment Centre, 2006a).

One study of the impact on water resources shows significant changes in the salinity and Electrical Conductivity (EC) but no major changes in the pH and Total Dissolved Solids (TDS) (Bhalla, 2006). The results of the study are illustrated below:

*Figure 12: Impact of tsunami on water sources**



(a) Electrical Conductivity (b) pH.

(c) Salinity. (d) Total Dissolved Solids.

* Source: Bhalla, 2006

The Central Ground Water Board has developed ground water maps of the coastal areas mapping the groundwater quality including salinity. This is an excellent baseline and shows background trends. It is important to review the background trend of hydrological changes at select sites in the coastal zone and assess the major drivers of changes of these changes in these sites.

Aquaculture

The damages and losses to the brackishwater aquaculture sector, suffered minimal damages and losses due to the tsunami (CIBA, 2005). Being off-season, hatcheries were closed and most farms in the state of Tamil Nadu had not started their stocking operations which normally start around late January or early February (CIBA, 2005). In Kerala, as most of the shrimp farms are creek based rather than sea based and were shut due to the off-season, the damage was minimal (CIBA, 2005).

It should also be noted here that shrimp farms are one of the most common CRZ violations in the more rural stretches of the Coramandel coast (Bhalla, 2006). A study and survey reveals the lack of procedures for selection of sites with a high number of conversions of agricultural land and possible impacts on agricultural areas. It also maps the extent of aquaculture and reveals a huge expanse of this industry along the Coramandel coast (Bhalla, 2006).

Shrimp aquaculture created many social and environmental problems. Some of them include- water pollution, salinisation of ground water & paddy fields, destruction of fry of wild fish & crustacean species and social conflicts related to land conversion. In one case post-tsunami, the housing relocation site is more than 500 m from the HTL, but right next to a prawn farm. The people of this hamlet have asked the Government to ban the prawn farm to prevent further 'salinisation' of groundwater (Praxis, 2005a). Another major impact of this sector has been has been the conversion of mangroves to shrimp farms (Hein, 2000).

The conflicts generated by these problems resulted in public interest litigation in the Supreme Court, the subsequent of this case resulted in the decision banning non-traditional shrimp aquaculture in India's Coastal Regulation Zone in 1996 (All India Reporter, 1997).[81] In this case, the judiciary assumed the pro-active role of a policy-maker (Diwan, 2000). It also used the precautionary approach to curtail commercial shrimp farming in the CRZ (Razzaque, 2002). The Aquaculture Authority was established in order to form a regulatory and institutional framework for the shrimp aquaculture as directed by the Supreme Court. It was established by the introduction of the 1997 Aquaculture Bill.

The Supreme Court ruling and the Authority has had till date very little effect on the sector and the violations continue to exist. The implementation of the current regulatory system is still defective, and in the absence of proper planning and regulation, further expansion of shrimp farms could result in significant additional environmental and social costs (Hein, 2000). The verdict has not been implemented due to the government safe guarding the interest of the industry as well as the lack of willingness by the government administrations towards this. The bill also partly deviated from the Supreme Court decision and allowed existing shrimp farms in the coastal zone to continue operations under certain conditions (Halim, 2004).

There have been very few closures of unlicensed shrimp farms, and hence shrimp farms have very little motivation to apply for a licence resulting in most of them acquiring a licence at all (Halim, 2004). The mandate of the Aquaculture Authority provided a number of directives as per the court order for

[81] The Supreme Court ruling in Jagannath v. Union of India, AIR 1997 SC 811 gave directions prohibiting non- traditional aquaculture along the coast.

shrimp aquaculture in the coastal zone. Some of them included that aquaculture farms were to obtain a licence within six months of the notification of the bill, and no licence was to be granted for aquaculture farming proposed within 200 m from the high tide line or within the CRZ in relation to creeks, rivers and backwaters. However, the restriction on locations did not apply to farms in existence on the day of establishment of the Aquaculture Authority. This provision was a deviation from the initial Supreme Court judgement (Hein, 2002).

Jesu Rethinam of the Coastal Action Network, an NGO which has compiled data on shrimp farms in the CRZ of Tamil Nadu, points out that that successive governments and administrations have not taken any action against the shrimp farms. Just before the tsunami struck, the administration assured various NGOs, that a total of 293 prawn farms in the CRZ would be removed and yet they remained untouched with no action (Raman, 2005).

In Tamil Nadu there are 2086 shrimp farms functioning in all the 12 coastal districts (except Chennai), out of which , only 852 shrimp farms have got approval from the State Aquaculture Authority (Fisheries Dept., 2005). The policy note of the fisheries dept. states "steps are being taken to regulate all shrimp farms functioning without the approval of Aquaculture Authority" (Fisheries Dept., 2005).

It is quite evident from the above that, as of date, there are many farms that are in violation of the CRZ and the Supreme Court directives. The Green Coast study also indicates this, but the exact details/ quantum of these illegal shrimp farms are not known.

Another issue highlighted, specifically in Tamil Nadu was the sector's reliance on mostly tiger prawn indicating a monoculture which has implications in spread of diseases. There is no data, studies and monitoring of the impact these farms are having on economically important fish and wild shrimp species (Bhalla, 2006). Just after the tsunami, documents released by certain multilateral agencies advocated for the conversion of salinised agricultural lands to aquaculture farms (TISS, 2005). Though no formal policy announcement or G.O was issued on this, there are some reports that conversion of salinised agricultural lands to aquaculture farms have occurred, but the exact extent of it is not known (TNTRC, 2006b).

It seems that the allotment of financial resources for rehabilitation in this sector is unproportionally higher than the damage (TRINet, 2005c). These are also lack of details on the policy and rehabilitation for this sector. For e.g., The allotment of Rs 10 Crore to this sector (for 78 aquafarms covering 271.1.07 Hectares and 22 Hatcheries) in Tamil Nadu has no further details and guidelines on how these were identified, the legality of these farms etc. (Govt. of Tamil Nadu, 2005e).[82] The Aquaculture Authority also did not issue any guidelines, order or directives specific to the post-tsunami rehabilitation. The Authority has no powers to grant solatium to shrimp farmers hit by the tsunami and could only make recommendations to the Centre that could form the basis for providing relief to the affected farmers. It was also publicly admitted by the Member-Secretary, Aquaculture Authority that all their "recommendations can cover only licensed farms," and their main concern was "about small farmers, who own land **over an extent of one-fourth of a hectare or half-a-hectare**" (Ramakrishnan, 2005). In fact most of the violations of the CRZ and Supreme Court guidelines are less than half-a-hectare.

The tsunami provided an opportunity to take stock of this sector and put systems in place for better planning, regulation and management in the sector. This unfortunately did not happen. Coastal

[82] G.O.(Ms).No.603- Dated:25.10.2005 , allotted Rs 10 Crore to this sector for 78 aquafarms covering 271.1.07 Hec and 22 Hatcheries in Tamil Nadu

aquaculture has been a controversial issue in the pre-tsunami phase and given the adverse social, ecological and economic impacts which this industry has had on other coastal communities in the past, it has been suggested that measures for its rehabilitation away from the coastal belt should be given serious thought along with provisions for adequate compensation & alternate rehabilitation options (Kurien et al, 2005). Some advocated that the Government use the tsunami as an opportunity to phase out the presence of aquaculture farms (TISS, 2005).

PART II- RECONSTRUCTION & REHABILITATION

Relocation

The Government of Tamil Nadu introduced G.O 172 on 30th March 2005 declaring the stated objective of providing built houses in safe locations to the tsunami-affected families, and that the Government would pledge assistance only to those who agreed to be relocated beyond 200 metres of the HTL (GoTN, 2005b). Those who intended to construct within 200 metres would not be eligible for government assistance. The government also extended assistance to those whose homes were not damaged but who wanted to relocate nonetheless (Sridhar, 2005).

There was strong resentment and opposition towards G.O 172 from various quarters (TISS, 2005). Several fishworker groups and NGOs termed this a discriminatory order (TRRC, 2005c). Many arguments were put forth against this G.O stating that fisher communities have a right to stay close to the shoreline and that their location and visibility of the coastal waters is important for their livelihood. Furthermore, there were other arguments stating that this G.O in effect tried to remove fishing communities from the coast, making it easy for the tourism industry and other real estate interests to make their entries into the coast. Many groups were weary of the G.O citing the Tamil Nadu "Tourism Policy Note 2005-2006" which provided a clear mandate for developing 'eco tourism' in tsunami hit coastal villages, notified just within a week after G.O. 172. (TRINet, 2005b; TISS, 2005; TRRC, 2005b; TRRC 2005b; TRRC, 2005c). Though G.O 172 does provides for the entry of the vacated sites into the Prohibitory Order Book, its effectiveness in keeping the land from being diverted for other purposes has been seen as questionable (TISS, 2005).

The access and visibility of the seas is very crucial for fishermen as part of their daily decision-making, traditional ecological knowledge, and basic livelihood activities such as launch of boats, shore seine, drying of fish, mending of nets, berthing of boats and many other social functions (Bharathi, 1991; Salagrama, 2006; Praxis, 2005l). Furthermore fishermen have odd hours of fishing and also make unplanned trips based on other's landed catches (Kuriakose, 2006). Fishing communities have historically been autonomous and self governing and their interactions with other communities have been minimal. The relocation does increase the problem or tensions related to caste and problems with the non-fishing communities after relocation and there have been some reported cases of this (Mathew, 2005a). In fact, relocating "west wards" is generally looked down upon by fishing communities and mingling with outsiders is seen as a threat to community's inherent nature and customs (Kannam, 2005).

The table below also illustrates this point showing the results of a study revealing that over 98% of the community households are of the view that their location is important to the livelihood (TRRC, 2005b). The study also revealed the disapproval of G.O.172 by a large majority (95%) of the affected communities. It also shows clearly that these communities are not willing to relinquish their existing properties as required by the G.O. in the case of relocation.

*Table 7: Key observations of the sample study on, "People's Perceptions on G.O.172" **

	No. of houses within HTL				No. of families resisting to move beyond 200 m	No. of families willing to move without relinquishing	No. of families willing to move unconditionally	No. of families who opine that their livelihoods will be affected on moving	No. of families who opine that the moving will create new types of caste / religious/cultural issues
	0-200	200-500	above 500	Total					
TOTAL	38314	11446	2814	52574	28523	21262	2789	51340	20189
% TOTAL	73	22	5		54	41	5	98	38

* Source: TRRC. 2005b.

Soon after the tsunami, the government through the district collectorate carried out a survey of houses (damaged and undamaged) in various zones of the CRZ (i.e. 0-200, 200-500 m from the HTL) and whether the community would like to relocate beyond 200 m and 500 m. Most of these surveys are not public documents. For Kanyakumari District, this survey reveals that only 42% of the households that were not damaged in the 0-200 m were willing to relocate by relinquishing their right of the old site (Kanyakumari District Colleatorate, 2005). However, a TRRC study (only totals and percentage from the whole state shown in the above table) for Kanyakumari District shows only a total 10% of the households were willing to move unconditionally. However, the variation of many factors should be taken into account when considering and comparing these two surveys- time of the survey, difference in resolution of data in both surveys (i.e. category of houses, zonations). It is important to systematically document the community views on this periodically and more importantly, analyse the various incentives and disincentives in the community's view for relocation and their orders of priority/ weightage.

There are many factors and reasons as to the way communities may have responded to various relocation surveys, especially to the willingness to relocate, despite an overwhelming majority being of the view that their current location by the sea is critical to their livelihood. The first being, the timing of the survey as the communities were still recovering from the trauma of the tsunami. As these were not normal circumstances, carrying out these surveys for relocation was not appropriate. Moreover, many NGO and experts have felt that these figures would change if surveys were delayed for a year or done later on. The second factor is that most coastal communities esp. fishing communities did not have *pattas* for the land they occupied and hence a plot of 3 cents (1.5 cents in urban areas) with a clear title deed worth Rs 1.5 lakh was clearly a good deal for the vast majority of the poor fishermen households (NCRC, 2005b).

The third is the "Two House Theory" where the communities believed that they could get a new house while still retaining their existing dwelling thus achieving a "two house" formula despite a clear declaration in G.O.172 that this will not be allowed. Communities still believed that they could hold on to their private property on the beach and build their own houses later on. It is on the basis of this belief that they were ready to move to alternate locations (Salagrama, 2006).

Some studies refer to factors such as ground water having turned saline in the existing site and hope of better water supply in the new site as one of the reasons for communities willing to relocate (Gomathy, 2006).

It must be mentioned here a couple of papers have highlighted the fact that communities had not thought out their response while being questioned on the topic of relocation, which was reflected in their frequent shifts of stance, sometimes between extreme positions (George, 2005; Salagrama, 2006).

Box 6: Summary of perceptions on incentives and disincentives to relocate

Incentives

- House with patta/title deed
- Safety (physical and psychological)
- Two house Theory
- Better groundwater in new location
- Lack of paperwork, documents regarding their land

Disincentives

- Access and visual linkage along shore crucial for livelihood, daily decision-making, traditional ecological knowledge such as *mappu* (sighting of fish from shore, thereby deciding to got to fish or not)
- Landing and storage of craft and gear
- Odd hours of fishing
- Unplanned trips based on others' landed catch
- Safety of equipment
- Weary that land may be given to other interests such as real estate, tourism
- Physiological disconnect from sea
- Tension with non-fishing communities
- Sense of belonging, lived there for generations
- Inalienable right to coastal land
- Site next to shrimp farm

Given the problem of availability of suitable land for housing reconstruction and the design of housing guidelines, in most cases additional land or sites were required for housing. This resulted in some ex-situ sites (completely relocated) for reconstruction as well as villages being split into different locations. This, despite the fact that almost all communities feel that relocation will affect their livelihoods. The table below gives a glimpse of re-location in Tamil Nadu:

*Table 8: A glimpse of settlement re-location in Tamil Nadu **

District	Extent of Land Required in hectares							
	Govt / Porom-boke lands identified	Private Lands required	Temple Lands required	In-situ	Total	Total	% of in-situ land	No. of Locations
Cuddalore	4.5	109.51	--	--	114.01	114	0	31
Tirunelveli	16.68.0	41.92.5	--	--	58.60.5	58.6	0	14
Nagapattinam	8.50.0	158.20.5	50.91.0	85.39.0	303.00.5	303	28.182	79

Kanyakumari	10.12.0	27.31.0	--	--	37.43.0	37.43	0	33
Villupuram	4.14.0	39.27.5	0	11.67.5	55.09.0	55.09	21.184	19
Thoothukudi	13.76.5	2.68.5	--	--	16.45.0	16.45	0	10
Kancheepuram	12.37	12.35	--		24.72	24.72	0	
Total	70.07.5	391.26.0	50.91.0	97.06.5	609.31.0	609.29	15.929	186

* Source: NCRC. 2005d

This table reveals that only 16 % of in situ land is being used for the housing reconstruction in Tamil Nadu. In Nagapattinam, closer analysis of data from housing construction reveals that in-situ construction is in only 23 of the 79 affected habitations with a total of approximately 2,500 odd houses which is only around 15% of the total houses being constructed. Thus, an overwhelming 85 % of the houses are being in new locations or ex-situ (analysed from tables of NCRC, 2005d). In Kanyakumari the number houses ex-situ is 78 % (KRRC, 2005a).

An interesting point to note in the case in Nagapattinam district is that the data shows that 15 % of in-situ houses are being built on 28 % of the in-situ land (from the table above) suggesting that the *built up area of settlements exceed the pre-tsunami level*. This is likely to be the case for all other districts as well.

Spatial information on the habitat reconstruction details to get an idea of the extent of re-location (from HTL, CRZ zone, original location) and area of settlement reconstruction is not available.[83] The pre-tsunami information on this is also virtually absent.

Housing Layout & Allotment

One of the other problems in the housing reconstruction is that participation has been very poor especially with respect to site selection, design and plot allotment prior to reconstruction. This has not been done in most of the village sites in Tamil Nadu (less than 35% of the sampled survey) (UNDP and NCRC, 2006). The extent to which traditional *panchayats* are ensuring plot allotment through consultations is not known.

Communities during some surveys/studies have mentioned that besides the location, the layout of their housing was linked to their livelihoods. Groups of households that live close to each other go fishing together or work on each other's boats. Hence they felt allotment of plots was important in terms of consultation and restoring the same layout (Gomathy and Rodriguez, 2007). Women particularly mention that social support systems among neighbours are important to them and hence restoring *status quo* in plot allotment was important to them (Gomathy and Rodriguez, 2007). However, it is unlikely that women would be consulted by traditional *panchayats* when deciding plot allotment internally, given that there is a sharp and marked exclusion of women in the system (Gomathy, 2006).

It has also been pointed that the lack of community engagement in housing and reconstruction may result in many other impacts, one of them being the two houses concept for many families (UNDP and NCRC, 2006; Salagrama 2006).

[83] Except for Nagapattinam where due to the efforts of the NCRC, there has been some systematic collation of data of location of old sites and new sites of villages but do not have spatial attributes.

Environmental planning

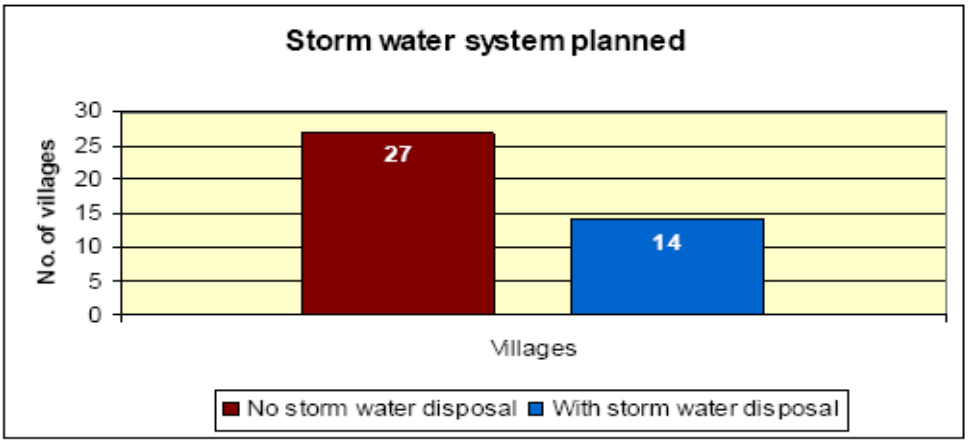
Site selection, elevation and wetland drainage

The housing reconstruction guidelines (applied to both ex-situ and in-situ) have increased the total area of settlements, the built-up area of housing, and in some cases increased the number of hamlets/settlements sites on the coast, when compared to pre-tsunami levels. The actual extent of the above is not known, but it has significant implications for coastal management. The details of settlement reconstruction would need to be collected and mapped for all the sites in different categories & zones of the CRZ (0-200, 200-500 and above 500 m). Preferably the exact location and distance from HTL would need to be spatially mapped and the above incorporated into the CZMP.

Most of the sites of reconstruction are in low lying areas with 42.2% of village sites having a water logging problem (UNDP and NCRC, 2006). The guidelines have not suggested any additional measures for safety in such sites. Thus some of the sites may remain vulnerable, if additional features such as wetland drainage and planning are not incorporated. There have been recommendations that technical guidelines to be evolved further (UNDP and NCRC, 2006). There have also been cases of land filling in many of the reconstruction sites (to meet the elevation requirements in the technical guidelines), which is not permitted as per the CRZ and this will result in a change in the local drainage pattern for surface runoff (Hedao, 2005; Hedao 2006). A lot of these sites will also impact adjoining sites due to spill over effects of their impact on the wetland drainage (Hedao, 2006).

In fact, one study reveals that of the reconstruction sites sampled the storm water drainage has been studied only in one-third of the prior to construction sites (UNDP and NCRC, 2006).

*Figure 12: Extent of storm water system planning in housing reconstruction **



* Source: UNDP and NCRC. 2006.

In some districts, there have been reports of beach sand mining for use in construction (Lal Mohan 2006, pers. comm.; KRRC 2005b; Bhalla, 2007). The extent to which this is happening in all the districts is not known. In addition, the level of awareness of the ban on beach sand mining (and the CRZ for that matter) among most NGOs is very poor.

In some hamlets in Karaikal, communities have traditionally located their hamlets on sand dunes and elevated places, and many of the village names end with the word "*medu*" which, in Tamil, means 'an elevated place' (Praxis 2005c; Praxis 2005d; Praxis 2005g; Praxis 2005h). It is important to document and research the traditional settlement patterns and locations of coastal hamlets over space and time (since the past 30 years or so) given the current relocations. Also, currently there is no data on how the land and site for housing rehabilitation was chosen in each of the affected hamlets.

Environmental clearance

In August 2006, the Government of Tamil Nadu vide their order G.O 531 made Environment Impact Assessments (EIA) mandatory for reconstruction projects accommodating more than 1000 persons or involving discharge of sewerage of 50,000 litres per day or with an investment of Rs.50.00 Crore and thus requiring an environmental clearance from Ministry of Environment and Forests (GoTN, 2006b). However, work on many such projects had started much before any environmental clearances from the Ministry of Environment and Forest (Bhalla, 2006; Bhalla 2007).

Water and reconstruction

The initial government order on housing, G.O 172 mentions that the housing layouts should have water supply and rainwater harvesting structures. It must be recalled here that the housing referred to here, was for areas 200m beyond the HTL. However, the GO No. 25 on "Rehabilitation construction of permanent houses and infrastructure - affected homeless families through public and private partnership" mentions that the government encourages NGOs and other agencies to take housing projects to provide for among other things water supply (Govt. of Tamil Nadu. 2005b). This G.O has no reference to the location of such housing projects and does not explicitly refer to the fact that mechanical extraction within 200 m from HTL (in CRZ –III areas) is not allowed under the CRZ. None of the other documents, G.Os or guidelines refer to this. This clearly shows that the concern for groundwater issues and the provision within the CRZ has been ignored. This aspect has been pointed out earlier by the UNDP in their document "Statement on the CRZ Notification and Post-Tsunami Rehabilitation in Tamil Nadu" (Sridhar, 2005). This was presented to the government in March 2005 and was also available online. This was officially published and disseminated by the UNDP in May 2006. However, an environmental checklist on the government's website mentions that for housing reconstruction projects, that it should be clarified whether the TN Groundwater Authority regulates the abstraction of groundwater in the proposed housing area and that proper clearances / permissions must be obtained, if required (Anon, 2005b).

The lack of guidelines and awareness material for NGOs on groundwater extraction has resulted in mechanical extraction of groundwater, even in 0-200 m of CRZ-III areas. It is not known if NGOs are actually seeking permission from the Tamil Nadu groundwater Authority. Data on the exact extent of this and levels of extraction spatially are not known. Even in areas beyond 200 m the scale of water supply and reconstruction is considerable and hence, even though allowed (only manually), might have negative impacts on the groundwater levels and quality in the long term. The type of water supply and extraction under the reconstruction in all areas of the CRZ is not known. Thus it is important that rainwater harvesting, ground water recharge and watershed management be encouraged in all areas of the coast. This assumes greater importance within the backdrop of the subsequent inundation affected groundwater by the tsunami and the historical salinity intrusion of the groundwater in most of these coastal areas.

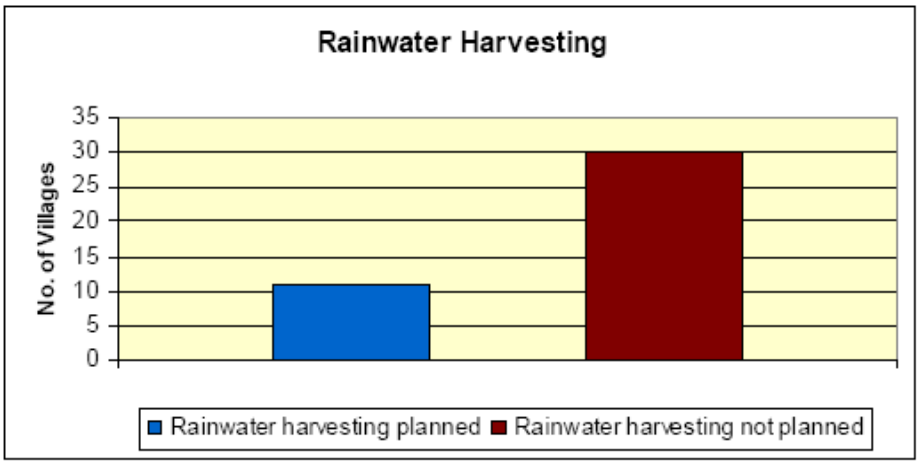
Rainwater harvesting, groundwater recharge & watershed management

The G.O. 172 does mention rainwater harvesting briefly among the other infrastructure facilities in housing reconstruction and the guidelines for reconstruction of house, mentions the provision of rooftop rainwater harvesting under the section on drainage (Disaster Management & Mitigation Department, 2005). The interpretation of this by various agencies is that rainwater harvesting and groundwater recharge are not mandatory and hence has not percolated to the housing programmes (UNDP and NCRC, 2006).

One study reveals that only 25% of the villages sampled for reconstruction had rainwater harvesting (UNDP and NCRC, 2006). It is not clear if this also included groundwater recharge and other

watershed management measure and in most likelihood is probably only roof top rainwater harvesting structures.

*Figure 13: Extent of rainwater harvesting in housing reconstruction**



* Source: UNDP and NCRC. 2006.

Some agencies like Auroville were involved in rainwater harvesting, groundwater recharge and other watershed management measures and had offered their services and assistance on the same (Carel, 2005).

The data and information on measures of rainwater harvesting, groundwater recharge and other watershed management measures in each of the housing sites are not available. There is very little documentation of traditional knowledge and techniques of communities towards rainwater harvesting, groundwater recharge and other watershed management measures. It is most likely that most likelihood many of the coastal agricultural communities would definitely have traditional soil conservation and watershed management techniques. There were in the past, quite a few traditional /indigenous man-made interventions in coastal Tamil Nadu such as *kulams* or *eris* that were appropriate solutions and were well connected with natural drainage pattern of this region. In fact, *kulams* on sand dunes were mainly designed to recharge the groundwater and improve the water quality. Many of these systems of traditional soil conservation and watershed management do not exist today or have declined and the extent of their prevalence in coastal areas is not known/well documented (Sangati CPR Working group).

Sanitation and groundwater

The coastal groundwater table being very shallow in most coastal areas and the inappropriate sanitation facilities provided in the relief phase and intermediate shelters, the ground water table became contaminated. The water contamination from sanitation in the tsunami affected areas of Tamil Nadu (or other states for that matter) has not been well documented (TRRC, 2005a). However, there are few studies to indicate that contamination did occur in almost all temporary and intermediate shelters (Auroville Water Harvest et al, 2005; Bhalla, 2006). A majority of the samples in all three Karaikal, Nagapattinam and Cuddalore had higher than permissible levels of *E. coli.* The average values for *E. coli* were 82.4, 72.3 and 231.5 respectively (Bhalla, 2006). This was due to ground water contamination from the untreated sewage. A large number of the toilets of the relief and intermediates shelters, including those built as part of post-tsunami reconstruction of permanent shelters rely on leach pits, which results in faecal contamination of ground water of most coastal areas, which have sandy soils and shallow water tables. The data suggests that faecal contamination is likely to increase both in terms of higher loads and spatially as more households adopt inappropriate sewage disposal techniques (Bhalla, 2006).

There have been many studies and experts that have called for special designs, guidelines and standards of sanitation and treatment facilities for coastal areas, especially areas with high water tables (TNTRC, 2006a). It has already been identified as a complex issue due to difficult soil and ground water conditions (UNDP and NCRC, 2006). One of the determining factors of design of sanitation and its usage by the community in coastal areas is the quality of water and soil and the availability of water respectively (Green Coast, 2006a; Ahana Lakshmi, 2006, pers. comm.).

Oxfam and RedR-IHE have undertaken a study on 'Ground water - Contamination and Quality Monitoring'. It consists of a coliform study, impact of leach contamination and behaviour in highly permeable soils. The permeability of soil and soil analysis would form as the basis for developing guidelines for toilet systems, disposal strategies (TNTRC, 2005). There are also teams looking at sanitation and treatment facilities for various areas and conditions along the coast. A number of workshops and consultations on the same also have been conducted till date (TRINet, 2006b). Yet, as of date, no special designs, guidelines and standards of sanitation and treatment facilities have been developed by the Government.

The case, as of now is that, the habitation/settlements are being built by one set of actors and another set of actors are dealing with the planning of sanitation after the construction of the settlements. The lack of integration of the aspect sanitation and treatment facilities at the initial stages of design and building of settlements is a problem which poses many limitations on the appropriate options.

Institutional mechanisms in sanitation- maintenance and other issues

The other issue is the lifecycle and financing of maintenance along with the roles, responsibility of community in the sanitation and treatment facilities. Currently there are no institutional structures proposed and one suggestion has been that the *Panchayats* take on some of these responsibilities or evolve mechanisms for the same. Vivekanandan points that the interface and interest of fishing community and fishing community institutions in *Gram Panchayats* is limited which would mean that such measures and ideas might fail in the long run (in TRINet, 2006b). Another issue/question he points out is the situation when the treatment and sanitation facilities have completed their lifespan, how replacement of these systems will be financed (TRINet, 2006b).

Hard options

Immediately after the tsunami, there were reports of sea walls being proposed for a large part of the coast in Tamil Nadu. These were mostly knee-jerk reactions and response to the tsunami, namely, building a 1000 km sea wall along the coastline of Tamil Nadu (Anon, 2005a; Das, 2005) Kerala, already has large part of its coast built up with sea walls. Out of the 560 km coastline of Kerala, the State has so far constructed a 386-km sea wall. The government has sought funding assistance to wall the remaining 92 km and has demanded Rs. 216 Crores from the Centre, pre-tsunami itself (Anon, 2004). The other hard engineering options in the post-tsunami reconstruction were the construction (and reconstruction) of the dykes, groynes, and breakwaters.

Communities have generally not been positive towards building of sea walls in Tamil Nadu, as they feel it is a hindrance to the landing and movement of their boats (Viswanathan, 2005). In Kanyakumari, there are reports that the community was earlier not in favour of Rubble Mount Sea (RMS) walls, but post-tsunami, but are more open to them now (Sunil Paliwal 2006, pers. comm.). In Kerala, due to severe erosion, there has been support for building these sea walls. However, Kerala unlike Tamil Nadu has backwaters where fisherman can dock their boats and hence the impacts and implications on livelihoods are minimal. The landing of craft is not affected drastically by these walls as it would in

Tamil Nadu. In Kerala, the demands for these sea walls have been mainly for the protection of housing. John Kurien feels that sea walls in Tamil Nadu are likely to be the "death knell" of the catamaran, as they need sandy beaches to land in and would otherwise break (Sridhar, 2005).

Agricultural communities are particularly apprehensive about sea walls as they believe it prevents rainwater run off into the sea leading to the flooding of agricultural land and degradation of the soil owing to stagnation of water (Viswanathan, 2005). In Kanyakumari there are many breakwaters that allow beach landing space on the inner side. The local administration has claimed that these are popular and are being demanded by the community. It should be emphasised here that, it is now being widely acknowledged that many of these hard options have serious ecological and environmental impacts (Hedao, 2005). The structures along with their ecological and environmental impacts also affect the livelihoods of fishing communities. There have been almost no studies documenting this, though many fishworker groups have voiced concerns on this aspect. Experts have repeatedly stressed that all hard options should be viewed as a last resort when all other measures are not likely to be effective (Sannasiraj, 2006). They have also pointed that many of the environmental and ecological impacts of these interventions are a result of the lack of or poor scientific and engineering studies in the design and planning of these options (Sannasiraj, 2006).

Sea walls do not prevent erosion they only transfer the problem further north. (Bhalla, 2006; Bhalla 2007). The impacts of these hard options on neighbouring coastlines create a situation where hard options are then required in these new areas creating a vicious spiralling situation. The case of sea walling in Kerala is an illustration of this aspect where the problem has been now shifted to Karnataka coast. In the case of Karnataka, as of 2003, 50% of the coastal zone was subject to moderate erosion and around 6% to severe erosion with varying rates of annual erosion from 5-15 tonnes/hectare in some areas to 15-40 tonnes/hectare in moderate and severe areas (Murthy, 2003; DoEE, 2003). Despite this, Kerala continues to build up the rest of its coastline (Anon, 2005c; Anon, 2006b).

Further, if not designed properly, the engineering structures can cause a negative impact of erosion in adjacent areas. Thus in locations sea walled and areas adjacent to some engineering structures there is a loss of beach space. This lack of beach space makes it unsuitable for basic livelihood activities such as landing boats, drying and repairing nets/motors. In these cases, most of the time the fisher folk are forced to land keep boats and store their gear fairly distant from their houses and sometimes end up anchoring their boats in open water. (Bhalla, 2006).

In many of the tsunami-affected areas there have been reports that the sea walls actually magnifying the damage as a result of the stones from these walls being thrown towards the land by the tsunami waves (Gilbert Rodrigo 2006, pers. comm.). Overall, their effectiveness in preventing tsunami inundation seems to be mixed with the only detailed study being done in Kerala which concludes that they do not seem to have any apparent merit considering the high cost and the aesthetic and environmental considerations (Kurian et al, 2006).

Other initiatives

The Asian Development Bank has undertaken technical assistance, with the objective of formulating a comprehensive program of “hard” and “soft” options for coastal protection (Asian Development Bank, 2006). The Technical Assistance “India: Integrated Coastal Management and Related Investment Development” TA-4692 has two study components, one of which is an assessment of coastal protection measures involving a technical analysis of various options. The analysis will consist of a preliminary feasibility study of alternative strategies considering a range of coastal protection measures suitable for

different scenarios (Asian Development Bank, 2005). However, the consultations for this TA has not been inclusive. For e.g., at a recent workshop held on December 8th 2006 for presenting and finalizing the draft report of the project, very few NGOs (both environment and fishworker) were invited (V. Vivekanandan 2006, pers. com.; Ranawana, 2006).

The World Bank assisted the Govt. of Tamil Nadu in the development of a Environmental and Social Management Framework which states "wherever possible, 'soft' options with fewer adverse environmental impacts should be favoured over 'hard' options that may involve changes to coastal hydrology and other natural processes" (Govt. of Tamil Nadu, 2005a).

Need for guidelines, policy and community space

Currently however, there is no framework for community involvement and consultation in pursuing the various hard options. It seems that large funding and demands of various other stakeholders and lobbies are the driving force behind many of these interventions for coastal protection. There is also no study or data revealing the community perspective and options on these hard options.

A combination of science, environmental and engineering based guidelines and criteria on the use of hard options for various contexts should be developed along with adequate space provided for taking into account the community perspectives and livelihood needs. The above two aspects should be mutually inclusive as they might either conflict or the latter may not always be the appropriate choice scientifically.

Data gaps

Pre-tsunami the spatial information of the details of all hard coastal engineering interventions is absent. In the post-tsunami context the same situation continues for repair work of damaged structures as well as new constructions. However, the presence of hard engineering structures pre-tsunami does provide an excellent opportunity for using tools such as satellite imagery, to study the impacts and role of these structures over time either during extreme events or the changes they cause on the surrounding shoreline.

Bio-shields, shelter belts and the community

Post-tsunami, the majority view of stakeholders has been in favour of natural barriers such as mangroves and vegetation in preference to concrete or stone structures. The Government of Tamil Nadu, under the Emergency Tsunami Reconstruction Project with World Bank assistance of Rs.10.17 Crores have undertaken the task of raising 2000 hectares of shelterbelt plantations and 700 hectares of mangrove plantations in the coastal areas of Tamil Nadu for the year 2005-06 (the same target will be executed the following year) (Govt. of Tamil Nadu, 2006a).

The unwritten policy of the Forest Department that in implementing this programme is that the shelterbelt plantations be a mix of 90% *Casuarina* and 10% other species (Narasimhan, 2005). This is carried our despite repeated suggestions and concerns from many environment-based NGOs to reverse this proportion. In fact, some papers mention that communities preferred other species such as *Thespesia populnea*, coconut, and cashew. These species improve the livelihood of the communities (Narasimhan, 2005).

This section will analyse this programme from a socio-ecological point of view. The model is being followed is part of the Joint Forest Management & Social Forestry programmes of the forest department. The Forest Department in each hamlet needs to take up a PRA based on which a village level micro-plan is developed along with formation of Village Forest Committees (VFC) (Rajeshwary, 2006). This does lay down some partial emphasis on process and participation but the ground reality and quality of process and participation is not known. As part of the programme, a number of entry point activities have been planned and envisaged. This is basically to build the trust of the community and get their

cooperation in return (Rajeshwary, 2006). It must be mentioned here that, the experience of the Forest Department in working with coastal communities have been limited. Unlike other areas, here the communities are also unfamiliar with exercises and programmes such as JFM, social forestry and Village Micro Plans.

As mentioned earlier (in the section on housing) access and visibility of the seashore/sea is highly crucial for fishermen as part of their livelihood and daily decision-making. The presence of bio-shields in front of settlements could impede the same. It is also well known that the communities do not want shelterbelts in front of their hamlet. Hence, understandably one finds that in none of the areas, shelter belts are executed directly in front of a settlement. This defeats the purpose of one of the benefits argued by the forest department namely, protection.

There has been very little focus on the social and legal aspects of the shelterbelts in the coastal areas of the country. However, in the past there have been cases of conflicts between the forest department (who promoted and implemented afforestation projects) and local communities on issues of access, passage and rights (Vivekanandan *et al.,* 1997; Ramasubramanian *et al.,* 2003). The communities are aware of these cases (they have narrated instances in other areas/hamlets where conflict have occurred) and hence their perception has not been positive and they are wary of plantations/restoration projects. In some villages, the communities have admitted to removing saplings being planted (Gomathy and Rodriguez, 2007).

The Forest Department have mostly sub-contracted the PRA exercise to local NGOs. A closer look at the PRA format reveals that it is only a survey exercise (a socio-economic analysis form is translated). Most of the fields of the form are socio-economic in nature and only four fields have direct relevance to the shelterbelts. They are fuel & fuel wood requirements, role of plantations during the tsunami, recommendations for plantations, and plant species needed for plantations. Thus, it seems the processes are not true PRA exercises and lack true participation in the exercise.

A review of the reports and plans from five districts namely, Nagapattinam, Tuticorin, Pudukottai, Thiruvallur, and Thirunelvelli reveal the following:

- Elements of equity in process of choosing the entry point activities and its beneficiaries are not clear (some entry point activities involve individual beneficiaries for e.g. distribution of goats).
- PRA format suggests it is only a socio-economic survey (sign on form) with very little community space for participation. Thus the use of the word PRA is misleading.
- In the Village Micro-plans, aspects on tenure of land, access, rights and benefit are not clear and in most cases are absent.
- The response of the community been lukewarm and their understanding of the ETRP project is poor.
- Surveys were done in too short a time to ascertain the needs and aspirations of the community.
- There is very poor participation of women in VFCs and in the PRA exercises.
- There is no focus and emphasis in watershed management and soil conservation measures as part of the programme.
- 90 % of the species planted are *Casuarina* and 10 % of mixed species is found in almost all the cases.

Data gaps

There are no independent or parallel studies reviewing these aspects in the ETRP project. There is also no uniform level and format of information in each district. At the headquarter level there is very little information available and unlike the Department of Environment (DoE) there is no progress monitoring and reporting on the website of the Forest Department.[84] The information does not have spatial attributes and hence cannot be of use for any spatial analysis. The scope and level of participation has been greatly reduced by not conducting PRAs and instead conducting sign up surveys. Finally, the institutional mechanisms followed for the shelter programme of the Forest Department lacks clarity on aspects of tenure, access, rights and benefit-sharing.

Recommendations

From the above review, it is indeed an ironic finding that reconstruction & rehabilitation can prove as damaging (socially and ecologically) to the coastal ecosystem and coastal communities as the tsunami itself. Based on the review the following suggestions have been made below under different topics.

Fisheries

- There is a need to conduct regular long-term monitoring and assessments of craft composition, use, ranges, fishing grounds, engine capacities, trips per month along with net use, targeted species, catch and income in all affected areas. This can then be used to arrive at the Catch per Unit Effort (CPUE) and other analyses in the fisheries. Some innovative aspects such as community-based monitoring of fish catch and income can also be initiated as part of this. For e.g. the SIFFS societies which already keep records can be further trained to keep records and collect data for scientific monitoring of income and catch. This will be able to arrive at the long-term trends and their implications for the fisheries sector.
- A study documenting and mapping the conflicts pre- and post-tsunami on aspects related to fisheries. A further analysis of these conflicts especially their underlying causes will give a better understanding of the present problems linked (categorised into those related to rehabilitation and those which are not related to rehabilitation).
- Document the region specific TEK and community perceptions of changes and trends pre- and post-tsunami, and the community adaptations to these perceived trends.
- Assess the roles, capacities, spaces and mechanisms for community and traditional community institutions for various fisheries management approaches. Based on these pilot studies, fisheries management approaches could be explored.
- Detailed understanding of the factors that influenced resumption of fishing post-tsunami in each village in all the affected districts.
- Survey of the extent of use of destructive fishing gear such as drag nets and mini seine nets "surukuvalai".
- Study of ownership, crew dynamics especially group ownership in each region pre- and post-tsunami.
- Detailed study of land tenure and rights in the coast with special emphasis and focus on fishing communities.

[84] The DoE, GoTN has posted the progress of its component of the World Bank ETRP project online at http://www.environment.tn.nic.in/DOCU/ETRP.pdf

- A study to understand the history, origins and reasons for group ownership pre-tsunami as well as the context of how and why they have failed in some areas, while succeeding in other areas to obtain a better understanding of socio-ecological resilience of these communities.

Agriculture

- Documentation of the agro-biodiversity of all the districts along with seed conservation measures (wild varieties, land races & cultivars). As some of the areas are prone to disasters such as storm surges and floods, seed conservation and storage strategies of the locally used varieties need to be developed.
- There is a need to document the knowledge and support the revitalisation of traditional water, irrigation and watershed management practices along with evolving/reviving mechanisms (such as traditional community institutions &, gram *panchayats*) that can support and sustain them. Government and civil society support is essential for this.
- Steps to address many of the above-mentioned long-term issues and background trends in agriculture such as disasters, management of water bodies, soil quality, poor crop yield etc. using both traditional and modern tools should be taken as part of the rehabilitation.
- The current initiative by NCRC, Nagapattinam of the mapping of coastal water bodies should be done with spatial tools, satellite imagery and data in order to enhance its execution and should be extended to all the affected coastal districts.
- Continuous monitoring of crop yield, soil and water quality in all the affected districts should be taken up for the next few years.

Groundwater

- Analyse the impact of land use and hydrological changes at select sites in the coastal zone of the affected states.
- Document the current status of the quantity and quality of ground and surface water resources in the coastal zone with the predicted trend in the short and long-term and assess the major drivers of changes in water quality and quantity in the coastal zone including emerging land-use/water-use such as aquaculture and reconstruction.

Aquaculture

- A spatially mapping and stock-taking of aquafarms and hatcheries of all categories and sizes should be undertaken in the CRZ.
- The stock-taking should be followed by the enforcement of the Supreme Court's verdict and all guidelines on aquaculture.

Reconstruction & rehabilitation

- Spatial mapping of the new shelters as part of rehabilitation (both in and ex-situ reconstruction) in all affected states. The above will give an idea of changes of built up area in the coastal zone and exact details on the levels of re-location spatially. It is also important to spatially map the pre-tsunami settlement baseline.
- The details of settlement reconstruction would need collected and mapped for all the sites in different categories & zones of the CRZ (0-200, 200-500 and above 500 m). Preferably the exact location and distance from HTL would be needed to be spatially mapped and the above incorporated into the CZMP.
- It is important to study and analyse the trends of settlement patterns and locations traditional of fishing hamlets over space and time (pre-tsunami over 2-3 decades). This will also cover the

linkages of housing layout and its importance in socio-ecological and socio-economic aspects of communities.

- Ensure participation especially of women in housing layout allotment in the reconstruction process.
- It is important to document and analyse the various incentives and disincentives in the community's view for relocation and their orders of priority/ weightage for settlements .
- Study and document through case studies and micro level studies, the socio-economic & socio-ecological implications of relocation on ecosystem-derived livelihoods.
- The technical guidelines for shelter reconstruction need to be further developed incorporating aspects of environmental planning such as sanitation, wetland drainage, water and watershed management.
- In other cases of environmental planning, post-facto measures, surveys and studies in the sites retrospectively should be carried out to at least minimise by the impacts and perhaps reduce vulnerability of the settlement. Specifically, mapping of wetland drainage and watershed in all the reconstruction sites should be undertaken along with retrospective drainage planning and management measures.
- Due process should be followed for environmental clearance procedures for all rehabilitation projects esp. those in G.O 531.
- The type of water supply and extraction under the reconstruction in all areas of the CRZ is should be documented and mapped. All details of groundwater extraction as part of the reconstruction should be furnished to the State Coastal Zone Management Authority with a request for permission along with a No Objection Certificate from the State Ground Water Authority.
- Water harvesting, ground water and watershed management measures should be made mandatory as part of the rehabilitation.
- Develop standards and guidelines for sanitation - toilet systems and disposal strategies in coastal areas.
- Develop mechanisms for roles, responsibility maintenance and replacement of sanitation systems.
- Build stronger environmental advocacy and awareness among NGOs involved in shelter reconstruction.

Hard engineering options

- Develop guidelines and policy on the use of hard engineering options for coastal management and other purposes along with space for community participation and consent.
- A comprehensive assessment of role of hard engineering options in the impact of the tsunami and other natural disasters.
- Detailed quantitative study of the impacts of sea walls and other engineering structures on livelihoods.
- EIA and environmental clearance should be made mandatory for all hard engineering projects are undertaken on the coast.

Shelterbelts & bio-shields

- The Forest Department should develop policy and guidelines for their shelter belt programme through a participatory and consultative process with clarity on aspects of consent, tenure, access, rights and benefit-sharing.
- Awareness & capacity building of communities on various community policies and programmes of the forest department such as JFM, social forestry etc.
- Spatial mapping of all natural and shelter belt vegetation in all the tsunami affected districts.

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