

Gender in Aquaculture and Fisheries: Engendering Security in Fisheries and Aquaculture

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*Technical Paper*

## **Assessing Pre and Post Tsunami Impacts on the Livelihoods of Coastal Women Using Socio-Economic and Gender Analysis (SEAGA)**

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### **Abstract**

The people in coastal villages, particularly the women, face different challenges due to disaster threats such as the 2004 Indian Ocean tsunami, climate and environmental changes. Coastal women in India have in recent years started adopting new livelihood practices apart from their traditional occupations. Detailed gender and livelihood analysis in assessing the impact of disaster threats, climate and environmental changes on the livelihoods of coastal women in India is scanty. 200 women and men including the tribal people from four coastal districts of Tamil Nadu, South India, were selected. A participatory rural appraisal (PRA) tool and socio-economic and gender analysis (SEAGA) were used for data analyses. This study reveals the impact of disaster threats, climate and environmental changes on the livelihoods of women and men, the village environment, the village infrastructure and institution, gender and social issues. This study, as a successful model, can help the concerned development organizations and policy makers to plan and develop programmes for the upliftment of coastal women, actions to be taken towards disaster mitigation and adoption, environmental management and appropriate technologies to be disseminated to develop sustainable livelihoods among the fishers.

### **Introduction**

Climate change impacts are being increasingly observed and coastal communities are especially vulnerable with poor adaptive capabilities

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(Salagrama 2012; Shyam et al. 2014; WHO 2009). It has also been observed that the impacts on women and men are different (UNDP 2013). Most disaster preparedness and management plans do not contain a gender perspective to address the differential vulnerabilities and needs of women and men. Women's roles have been generally underestimated among the coastal communities and they are often excluded from conservation initiatives though their contributions to these can be significant (FAO 2016). As a result of climate change and resultant migration of men in search of livelihood opportunities, women's labour has increased with them assuming responsibilities as heads of families, in addition to carrying out family chores and coping with low family incomes (WHO 2009). Several studies have shown that disaster mortality rates have been also higher in the case of women and children than in men, due to the social status of women and their lack of awareness of the risks (Anderson 2000; Fothergill 1996; Cochrane et al. 2009; Leduc 2008; Elinder and Erixson 2012; WHO 2009 and Government of Tamil Nadu 2017). In the tsunami that hit the Indian coast in December 2004, Nagapatinam was the worst affected district with 6,065 people dead along the Tamil Nadu coast. Fisheries and aquaculture were the sectors most severely hit by the disaster; many boats, fishing gear, ponds and support installations were destroyed or damaged.

In Indian coastal areas, the existing problems need to be identified, and awareness level and adaptive measures taken by the coastal populations towards addressing the short and long-term impacts of climate and environmental changes and to study the challenges faced by coastal women towards these changes. Evidence from participatory rural appraisals of fishing communities suggests that when the tsunami struck, the limited livelihood resources available to people may have been driven down further. Greater impacts on livelihoods are now becoming apparent, with oversupply of boats and gear in some locations, increasing fuel prices and lower fish prices, adding to pre-existing issues concerning illegal fishing methods and fishing by foreign vessels (FAO 2007). In a study, Shyam et al. (2014) found that 75 % of the fishers knew about climate change but only 67 % were actually "aware". The major sources of climate change knowledge were through media, information exchange between family members, friends and village administrative guidelines.

In view of the reduced livelihood options both in fisheries and allied sectors after natural disaster events in the coastal areas, there have been

occupational changes and increased social pressures on women. With the advent of technological advances in the field of aquaculture, new and profitable occupational patterns may be directed towards small-scale aquaculture projects that can be easily taken up by rural folks, especially women (WHO 2009). Brackishwater aquaculture has been identified as a potential means for increasing fish and shellfish production. It can be taken up in ponds, canals, creeks and lakes and can generate employment and improve the socio-economic conditions of the coastal poor (Shanthi et al. 2010; 2012). The gap between technology development and adoption could be bridged more successfully through participatory action plans where all stakeholders form a part of the decision-making process (Chambers 1994; Vivekanandan 2011).

There is a need for gender-oriented methodologies, indicators and policy plans for the upliftment of coastal women in order to assess the impacts of disaster threats, environmental and climatic variations on them. Overall, impacts of the tsunami on fisheries are more related to ongoing and new tsunami-related human factors, rather than the physical or biological effects of the disaster on resources and ecosystems. That is, existing over-exploitation trends had already brought many of the fisheries under severe stress before the tsunami. For the present study, the Socio-economic and Gender Analysis (SEAGA) developed by FAO was used for assessing the pre and post tsunami impacts on the livelihoods of coastal women in fisheries/aquaculture sectors in Tamil Nadu (FAO 1995; FAO 1996; FAO 2004; FAO 2007; Shanthi et al. 2010 and Shanthi et al. 2014). In a comprehensive manner, the livelihoods of coastal women and men, the village environment, the village infrastructure and institutions, and gender and social issues were assessed.

## **Materials and Methods**

200 coastal fisher women and men, comprising 50 people each from Tiruvalur, Kancheepuram, Cuddalore and Nagapatinam coastal districts of Tamil Nadu, South India (Fig.1) were selected for a study conducted by the ICAR-Central Institute of Brackishwater Aquaculture (CIBA), Chennai, Tamil Nadu, India, under the project sponsored by the Indian Council of Social Science Research (ICSSR), New Delhi for assessing the impact of environmental changes on the livelihoods of coastal women in Tamil Nadu. Representatives of the community members, with a mix of socio-economic

groups (men and women (35 %) (middle aged), young (20 %) and old (22.5 %) both male and female, village headmen (5 %) and women self-help groups (17.5 %) participants) from the 4 coastal districts were selected for this study. These districts and villages were selected because of concentration of fisheries/aquaculture activities by coastal fishers and because these districts were affected the most by the tsunami and other environmental changes.

The research questions asked were: What is the impact of disaster threats, climate and environmental changes on the livelihoods of women and men, the village environment, the village infrastructure and institution? The present study was carried out to fulfil the need to test gender-oriented methodologies, indicators and policy plans for the upliftment of coastal women and to assess the impacts of disaster threats, environmental and climatic variations. The Participatory Rural Appraisal (PRA) tool was used for collecting data from the beneficiaries and, using these data, the SEAGA analysis (FAO 2004; Shanthi et al. 2010 and Shanthi et al. 2014) was carried out. This was the first time that the SEAGA toolkit was used in assessing the impact of environmental changes on the livelihoods of coastal women in Tamil Nadu. The SEAGA toolkit addresses: the development context; livelihood analysis; and stakeholders' priorities for development.



**Fig. 1.** Map showing the coastal districts selected for the study in Tamil Nadu, South India

## Results

Each of the elements of the SEAGA toolkit helps in assessing the impact of pre and post-tsunami changes on the livelihoods of coastal women and men, the village environment, the village infrastructure and institutions, and on gender and social issues.

### *Impact of pre and post-tsunami changes on the livelihoods of women and men*

Fish marketing of fresh and dry fish, and wild shrimp collection were the major activity of all coastal women in the above-mentioned villages in both pre and post-tsunami periods. This was followed by other livelihoods such as jellyfish processing, clam collection, goat rearing, crab fattening (in concrete tanks) and as labour on shrimp farms and in agriculture. However, during the post-tsunami period, almost 80 % of coastal women in all the 4 coastal districts participated in the National Rural Employment Guarantee Act (NREGA) Programme, an employment guarantee scheme of the Government of India which assured 100 days of employment. This was followed by crab fattening (in pens and in tide fed ponds), seabass nursery rearing in hapas, polyculture of seabass and crab farming in community ponds, farm-made fish feed development along with fish vending, clam collection, goat rearing, and laborers in shrimp farms and agricultural fields. Men dominated off-shore activities like fishing and also participated in activities such as jellyfish processing and marketing.

Post-tsunami, brackishwater aquaculture technologies were transferred by ICAR-CIBA to the Women's Self Help Groups (WSHGs) at Thonirevu, Light House, Kulathumedu and Kattur villages of Tiruvallur district and New Perungulathur and Allambaraikuppam of Kancheepuram district as an alternative livelihood option. Welfare measures directed by various government agencies and NGOs also brought about positive changes in attitudes among the women and they were able to improve their contributions to family incomes. Aquaculture is an alternative option to cope with climate change. It has considerable adaptation potential via selective breeding, regulating the environment, and resilient species opportunities (Vivekanandan 2011). Coastal aquaculture technologies integrated with agro-based technologies like goat farming, poultry farming, quail farming, mushroom farming, sales of snacks

and running small grocery shops will also be of help during off season or the lean season of aquaculture.

During the post-tsunami period, the women were supported by men in the villages for activities like construction of crab pens, harvesting of crabs, pond management and farming polyculture of seabass and crab, fish transportation, as watchmen, in purchase of water crabs and sales of the fattened crabs. Women were involved in household chores followed by onshore activities, whereas, men's contribution towards household management was limited. It was noted that women's work load had increased by about 8 hours daily due to migration of many men to the cities during the post-tsunami period and their subsequent employment in on-shore fishing activities and engagement in other government run programs. Recreation included visiting religious centers, shopping and the cinema. Household chores included washing clothes and kitchen utensils, cleaning the house, child care, cooking, serving food to the family members and purchasing groceries and household items. Dry fish sellers engaged in fish drying primarily during the summer season. Assistance was rendered to husbands by their wives when the fish catch arrived at the shore. During leisure time they were found to play dice locally known as "Dhayam" and "Pallanguzhi".

Men engaged in fishing activities during the pre-tsunami period achieved nominally good fish catches and regularly went on fishing trips with few breaks. In the post-tsunami period they reported that the fish catch was poor; and they had to go farther out to sea to fish, taking breaks between their fishing trips. The fishermen were able to spend time with their children, take them to school and spend more time on recreational activities. In these villages, very few men participated in the NREGA scheme for income generation. During recreation, men watched television, smoked or consumed liquor and gambled with dice or cards.

The WSHGs of Kattur, Thonirevu and Kulathumedu of Tirvuluar district facilitated the resettlement of families affected by the tsunami, helped develop new livelihoods, fund raise for new business activities and helped the members in income generation through non-fisheries or aquaculture activities. There was a flow of resources like fish, crab, shrimp, poultry, egg, nets, ice, fresh and dry fish, boats, motor, diesel and vegetables like drumstick, coconut

and plantain between households on a payment basis. There was also a flow of resources and marketing from the village to the town and city. This included fresh and dry fish, salt, processed jellyfish, hardened crabs, seabass fry, value-added fish products, aqua feed and cultured shrimp. From nearby towns and cities, resource materials and purchased inputs flowed to the villages, such as those required for farming activities like diesel, nets, poles, feed, water crabs, and building materials.

### ***Impact of pre and post-tsunami changes on the village environment***

In the selected villages, natural resources as well as aquatic resources like fishes, shrimps and crabs declined. The fish catch was reported to be good during 2002-04. After the tsunami in December 2004, a sudden decline in the fish availability and in certain fish species in the sea were reported (FAO 2007 and Vivekanandan 2011). Day-to-day fluctuations in the fish catch per unit effort were also observed due to the environmental changes. This created the need for an alternate livelihood for these coastal populations.

Post-tsunami, a sea level rise and seawater intrusions were reported in some coastal villages in Cuddalore and Nagapitnam districts. The freshwater ponds in the villages were also observed to be shrinking and the fresh water in the wells was turning saline resulting in a decline in availability of potable water. This added to the burden of the women folk as they had to walk long distances to fetch drinking water.

### ***Impact of pre and post-tsunami changes on village infrastructure and institutions***

During and after the tsunami, the women's groups clearly recognized that institutions like state government departments, research institutions (like ICAR-CIBA), fishermen's associations, non-government organisations (NGOs), community halls, temples and churches (where meetings were held), banks, ration and provision shops and markets served as important institutions which rendered their emergency services in the most affected villages. Other institutions such as primary health centers, hospitals, panchayat offices, youth organizations, schools, police stations and town panchayats served as secondary support institutions. The tertiary support institutions were auctioning centers, colleges, ice factories, post offices and electricity boards.

The perceptions of men's groups were similar. However, in addition, a minor institution like a small tea shop in the village served as an important venue where communication of radio news, TV news and daily news in newspapers was shared among the men fishers and their friends.

### ***Impact of pre and post-tsunami changes on gender and social issues***

The coastal communities of Nagapatinam district have been prone to loss of life and property due to major environmental threats like cyclones and tsunami. Nagapatinam district alone accounted for 76 % of the deaths of the entire state of Tamil Nadu and was the worst affected district in India. As a result of the tsunami, many fishers lost their possessions, houses and property in Nagapatinam and Cuddalore districts and shifted their dwellings to safer places inland, particularly making use of the post-tsunami houses built and provided by Government institutions and NGOs (Govt. of Tamil Nadu 2017).

### ***Gender and social issues***

The majority of the households in the study areas were found to be led by women who were responsible for supporting the livelihoods and for generating family income. Most of the men had migrated to the cities in search of new jobs; a few women were widows. The family incomes ranged from INR 1,000 to about INR 10,000. The majority of the selected beneficiaries belonged to the Scheduled Caste and Scheduled Tribe communities (80 %), while the rest belonged to most backward classes (20 %). (The Gazette of India. National Commission for Backward Classes).

The fishers in Nagapitanam were highly disturbed by the tsunami. Fishers were very slow to adopt alternative livelihoods. Due to previous taboos and customs in some villages, women were not permitted to participate in village meetings and discussions. But the formation of women's SHGs was encouraged by men because of the benefits available to family members in the WSHGs through government welfare schemes. The women, being members of the WSHGs, have facilitated the adoption of the aquaculture technologies. The previous taboos and customs in the village were overcome due to these interventions and the resulting social mobilization.



**Table 1.** Institutional profiles of Women Self Help Group (WSHG) (Villages of Kattur, Thonirevu and Kulathumedu, Tirvulluvar district, Tamil Nadu, South India)

Goals	<ul style="list-style-type: none"> <li>• To participate in the development and community programmes</li> <li>• To serves as linkages between women and other organizations to receive welfare measures</li> <li>• Helps to initiate income generating programme</li> <li>• Facilitates in adoption of alternate livelihoods among the groups members who are in need of income during male migration to other villages and also facing unemployment problems</li> </ul>
Management	<ul style="list-style-type: none"> <li>• Group leader is elected by group members.</li> <li>• Any woman who is 20 years or older may be a member.</li> <li>• Meeting conducted once a month</li> <li>• Links with women's groups in other villages</li> <li>• Involved in developmental activities</li> <li>• Create institutional linkages</li> <li>• Lending of loan among the groups</li> <li>• Savings helps in re-investment of their savings in their business</li> </ul>
Achievements	<ul style="list-style-type: none"> <li>• Saving the lives of victims</li> <li>• Resettlement of families and victims who are affected by tsunami.</li> <li>• Adoption of new livelihoods</li> <li>• Fund raising for new business activities</li> <li>• Helps in revolving funds within the group</li> <li>• Helps in resource management</li> <li>• Mitigation towards environmental threats</li> <li>• Helps in income generation through non fisheries/aquaculture activities</li> </ul>
Needs	<ul style="list-style-type: none"> <li>• Training and demonstrations in fisheries/aquaculture technologies and adopt alternative livelihoods in aquaculture and allied sectors.</li> <li>• Entrepreneurship development programme</li> <li>• Financial support and other linkages</li> <li>• Infrastructure facilities</li> <li>• Community support</li> <li>• Awareness programmes on environmental changes and its threats</li> </ul>

















































































The goals, management, achievements of WSHGs in 3 coastal villages revealed that they were able to address many issues such as the resettlement of families and victims who were affected by the tsunami and help in income generation through non-fisheries or aquaculture activities (Table 1). Youth organizations of Nagapatinam and Cuddalore districts facilitated many social services like saving the lives of victims affected by the disaster and voluntary services for the victims of tsunami, cyclone and floods (Table 2).

























**Table 2.** Institutional Profiles of Youth Organizations (Village of Nagapatnam and Cuddalore district, Tamil Nadu, South India)

Goals	<ul style="list-style-type: none"> <li>• Objectives include maintaining security; solving routine problems; encouraging community cooperation and income generation.</li> <li>• Founded by educated young people in the villages.</li> </ul>
Management	<ul style="list-style-type: none"> <li>• Village developmental activities</li> <li>• Conduct relief and rehabilitation programme, sports, and health camps</li> <li>• Aquaculture activities</li> <li>• Utilization of available water resources in the village</li> <li>• Coordinate in environmental sanitation programme</li> </ul>
Achievements	<ul style="list-style-type: none"> <li>• Maintained security to the village</li> <li>• Helped in school construction work</li> <li>• Volunteered in teaching the village children</li> <li>• Resettlement of displaced people.</li> <li>• Planting and conservation of water resources, afforestation,</li> <li>• Road maintenance</li> <li>• Repairing boreholes</li> <li>• Conducting sports activities</li> <li>• Monitoring mid-day meals and programmes conducted at schools</li> <li>• Voluntary services to the victims of tsunami</li> </ul>
Needs	<ul style="list-style-type: none"> <li>• Training and demonstrations on disaster management</li> <li>• Training and demonstrations on fisheries/aquaculture and allied sector technologies</li> <li>• Meeting room and office</li> <li>• Stationery and operational tools.</li> <li>• Communication and transport</li> <li>• Awareness programmes on environmental changes and its threats</li> </ul>

In the post-tsunami period, the majority of the women were involved (alone or with the men) in taking major decisions on how to use the fish products, how to use the profit from sales and the cash with respect to usage and expenditure of by-products (Table 3).

**Table 3.** Benefit analysis chart of fisheries and aquaculture activities

Fish products	How it is used	Decisions made		
		Pre tsunami	Post tsunami	
Fish sales	1. Home consumption			
	2. Local sales			
	3. Supplied to trader			
	4. Supplied to city market			
	5. Export			
	<b>If sold who decides on cash use</b>			
	1. Invested in business			
	2. Basic needs (Edn., food etc.)			
	3. Savings			
	4. Buying assets			
Shrimps	1. Home consumption			
	2. Sold within the households in the village			
	3. Supplied to traders			
	4. Sold in outlets			
	<b>If sold who decides on cash use</b>			
	1. Invested in business			
	2. Basic needs			
	3. Savings			
	4. Buying assets			
	Dry fish	1. Home consumption		
2. Sold within the households in the village				
3. Supplied to traders				
4. Supplied to feed and fertilizer companies				
<b>If sold who decides on cash use</b>				
1. Invested in business				
2. Basic needs (Edn., food etc.)				
3. Savings				
4. Buying assets				
Value added fish food Products		1. Sold within the village		
	2. Supplied to local shops outside			
	3. Supplied to market agents			
	<b>If sold who decides on cash use</b>			
	1. Invested in business			
	2. Household needs (Edn., food etc.)			
	3. Savings			
	4. Buying assets			
	Crab fattening (in pens)	1. Home consumption		
		2. Sold in local market		
3. Supplied to traders				
4. Supplied to exporters				
<b>If sold who decides on cash use</b>				
1. Invested in business				
2. Basic needs (Edn., food etc.)				
3. Savings				
4. Buying assets				

Polyculture of crab and seabass	1. Home consumption		
	2. Sold in local market		 
	3. Supplied to traders		
	4. Supplied to exporters		
	<b>If sold who decides on cash use</b>		
	1. Invested in business	 	 
	2. Basic needs (Edn., food etc.)	 	 
	3. Savings	 	 
	4. Buying assets		 

Index: Men = ; Women = ; Both = 

The women and men faced the stress and problems like unemployment among the women, irregular employment, interrupted power supplies, non-availability of seasonal fishes, low prices fixed for fishes, land pollution, increasing fishing fleets and associated efforts and use of very small mesh size fishing nets by trawlers, difficulty in drying fish due to lack of space and the migration of men from their coastal villages to cities in search of new jobs due to climate change threats. A study by WHO (2009) showed that when confronted with long-term weather shifts, men showed a greater preference to migrate, while women showed a greater preference for wage labour. In times of crises they mortgaged their assets or had to use the money from their savings for living. The women had no access to the sea for fishing and their involvement was mainly to share the on-shore work after the fish was landed. In the post-tsunami period, the women were found to have access and control of brackishwater areas like creeks, canals, ponds and lakes in the villages for small scale fishing and aqua-farming activities.

During the post-tsunami period, the women's income from different sources were: sales of fresh fish (25 %); dry fish (20 %); fattened crabs (10 %); fish-feed sales (6 %); fish vending (6 %); value-added fish products (6 %); wild shrimp collection (5 %); sales of nursery reared sea bass fingerlings (4 %); clam collection (4 %); labour force in agricultural fields (4 %); labour force in shrimp farms (2 %); kitchen garden products (2 %); dairy and poultry products (2 %); jellyfish processing (2 %); and goat rearing (2 %). The income for men was generated from: fishing business (30 %); sale of fresh fish (20 %); trading of fresh and dry fish (10 %); fattened crabs (15 %); fish export (10 %); salary from employment in government, private and other sectors (5 %); net making (4 %); boat repair (3 %); and dairy and poultry products (3 %).

The most important problem that men faced was “low fish catch”. The effect of this problem was that it leads to unemployment, low income, social evils, poor health and early mortality. To overcome this problem, it was suggested that the Government needed to initiate steps to fix fishing schedules and regulations in coastal villages, ban fishing on juvenile fish and the use of very small mesh size fishing nets, adopt fish farming technologies, and create linkages with Government institutions, NGOs and bankers to adopt alternative livelihood opportunities. The perceived outcomes of these solutions were higher incomes, better family status, and better health leading to a good society.

The most important problem as far as women were concerned was “lack of sustainable livelihoods”. The causes of this were male migration, lack of WSHG support, and community support. The effect of these problems was more leisure time, social evils, low family status, low income, poor health and early mortality. To overcome the problems, the main solution suggested was “diversification of livelihoods”. For this there was a need for family support, support from research institutions, government and private institutions, NGOs, banks, WSHGs and community support. The outcomes were perceived to be gainful usage of leisure time, higher incomes, better family status and better health.

Men and women fisher participants identified the strategies to tackle the problem of “how to cope with natural disaster threats”. They identified the affected, losers, gainers and supporters for this problem. The affected were village people, village resources, village infrastructure and the village environment. The losers were the neighboring village who were similarly affected by loss of resources and infrastructure. The supporters were identified as the department of fisheries, research organizations and other institutions and the gainers as the traders, food outlets, medical shop and petty goods shop.

The best bets action plan produced by men’s and women’s groups showed their planning of developmental activities to address the priority problems of handling natural disaster management, irregular employment and lack of income generation activities. For problems such as natural disaster management, men expressed the solution as creating disaster management awareness through training, taking pollution control measures and initiating more community development programmes in their villages.

**Table 4.** Best bets action plan

<b>Problem: Natural disaster threats</b>	
<b>Solution</b>	<ul style="list-style-type: none"> <li>• Disaster management awareness through training</li> <li>• Pollution control measures</li> <li>• Initiate community development programmes</li> </ul>
<b>Activities</b>	<ul style="list-style-type: none"> <li>• Training and demonstration programmes</li> <li>• Awareness camp</li> <li>• Afforestation</li> <li>• Avoid polluting the lake, river, brackishwater area and sea</li> <li>• Housing</li> <li>• Erect walls near sea shore</li> </ul>
<b>Who will do it</b>	<ul style="list-style-type: none"> <li>• Community people (labour)</li> <li>• NGO support</li> <li>• Government institutions (fund)</li> <li>• Pollution control board</li> <li>• Research Organization (technical expertise)</li> </ul>
<b>Cost</b>	<ul style="list-style-type: none"> <li>• Local labour and willingness to work</li> <li>• Building materials</li> <li>• Training programme</li> <li>• Financial support to NGO</li> </ul>
<b>Duration</b>	Six months
<b>Problem: Irregular employment &amp; lack of income generation activities</b>	
<b>Solution</b>	<ul style="list-style-type: none"> <li>• SHG formation</li> <li>• Income generating programme</li> <li>• Vocational training</li> <li>• Work in NREGA</li> <li>• Diversification of alternate livelihoods through brackishwater aquaculture</li> <li>• Entrepreneurship Development programme</li> </ul>
<b>Activities</b>	<ul style="list-style-type: none"> <li>• Training and demonstration programmes</li> <li>• Awareness camp</li> <li>• Seminar/ workshops</li> <li>• Exhibitions</li> <li>• Building</li> </ul>
<b>Who will do it</b>	<ul style="list-style-type: none"> <li>• Community people (labour)</li> <li>• NGO support</li> <li>• Government institutions (fund)</li> <li>• Research Organization (technical expertise)</li> </ul>
<b>Cost</b>	<ul style="list-style-type: none"> <li>• Local labour and willingness to work</li> <li>• Building materials</li> <li>• Training programme</li> <li>• Financial support to NGO</li> </ul>
<b>Duration</b>	6 months

For problems such as irregular employment and lack of income generation activities, the women's solutions were to have an effective, cohesive group of people such as the WSHG, more income generating programmes, and alternate livelihood opportunities to adopt through brackishwater aquaculture technologies and entrepreneurship development programme etc. (Table 4)

Gender differences and emotions both influence risk-taking and decision-making and thus are significant factors in how climate-related risks are managed. This study adds an example, from an aquaculture context and the impact of another form of natural disaster – a tsunami, to the body of knowledge that shows risk decisions are not just analytical considerations but also influenced by emotions (Breakwell 2010; Loewenstein et al. 2001).

Although significant, moderate gender differences in behavior were found in this study. In Thailand, gender differences were greater for cage culture in reservoirs as this activity takes place further away from home (Lebel et al. 2016) than river cage culture which is often undertaken close to home (Lebel et al. 2014). Overall, most farm-level risk management options in Tamil Nadu were equally accessible to both men and women, and in many households, decisions and actions were taken jointly.

At the collective level, participation in risk management, or governance, by women was much less than that of men. In this region men dominate water user groups and play a much more prominent role in conflicts over water shortages and decisions on water allocation (Lebel et al. 2015). Research on the roles of women in community-level water management, and gendered social norms in northern Thailand (Lebel et al. 2017) suggest that it will be difficult for women to reduce risks to their farms at the larger, collective scales than it is for men. Further work is needed on how gender relations influence the management of water uses by aquaculture, as this another area critical to the management of climate-related risks.

## **Conclusions**

From this study multiple coastal changes were evident, including sea level rise resulting in seawater intrusions, shrinking freshwater ponds and salinization of the fresh water in some village wells resulting in drinking water

problems. As a result, women had to walk long distances to fetch drinking water, due to the out-migration of men. When the majority of the men migrated from their villages to cities post the tsunami in search of new alternative livelihoods, women's workloads were increased. Added to their previous responsibilities were decision making for farm and home activities. Fish marketing was the major activity of all coastal women in the villages in pre- and post-tsunami periods, followed by other livelihoods. The decline in the fish catch and natural resources in the selected villages created the need for alternate livelihoods for these coastal populations.

During the post-tsunami period, brackishwater aquaculture technologies transferred by ICAR-CIBA to the Women's Self Help Groups served as alternative livelihoods and served as a significant opportunity for income generation. The welfare measures directed by various non-governmental agencies and government organizations brought in many positive changes in the attitudes of the women who were able to contribute better to their families' incomes. The women's and men's groups clearly recognised the primary, secondary and tertiary institutions which served as important institutions during the tsunami and rendered emergency services during the tsunami and its aftermath in the most affected villages. The death toll among coastal families was high due to many natural calamities and a lack of awareness of the risks. In some villages, women were not permitted to participate in village meetings and discussions. Now, the women, being members of the WSHGs, have facilitated the adoption of new aquaculture technologies, solving many issues and taking up many welfare measures. Youth organizations also facilitated social services in saving the lives of victims affected by disaster.

The women, although having no access to the sea for fishing, found, post the tsunami that they could make better use of brackishwater areas for small scale fishing and aquaculture when helped with the technology. Coastal aquaculture technologies integrated with agro-based technologies help during off season and in lean fishing seasons. These can bring extra income for the coastal women and offer new but familiar options. These options can help women regain their dignity and respectability through increased employment and income.



As a model, the present study could help development organizations and policy makers to plan development programmes and strategies for uplifting the lives of coastal people, particularly women. This will also help in planning the action for disaster and environment management and for disseminating appropriate technologies to develop sustainable livelihoods among the fishers.

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