

A COMPARATIVE ASSESSMENT OF DAMAGES TO FISHERIES LIVELIHOOD IN VILLAGES AFFECTED BY THE 2004 INDIAN OCEAN TSUNAMI

Rusyan Jill Mamiit

University of Hawaii – Manoa, Joint Institute for Marine and Atmospheric Research, rusyan@hawaii.edu

ABSTRACT

On 26th December 2004, colossal waves known as tsunami engulfed the coastal nations around the Indian Ocean. The disaster brought physical, psychological and emotional suffering beyond measure to many communities. It resulted in immense devastation of many coastal vegetations and marine ecosystems. The fisheries in the coastal villages in Sri Lanka, in particular, were subject to severe damage caused by the tsunami. The impacts of the tsunami on the fishery sector magnified the significance of the resource as important sources of food and livelihood. A comparative assessment of the social and economic dimensions of damages to fisheries following the tsunami was conducted in the villages of Kapuhenwala and Wanduruppa. Functioning and degraded coastal vegetation and marine ecosystems characterize the two villages, respectively. Results indicate that damages to fisheries livelihood in Kapuhenwala, area with intact fishery ecosystems, was approximately SLR 8,676,092 (US\$ 86,761) per fishing household; whereas, Wanduruppa, site with degraded coastal and marine ecosystem generated a loss to fishing livelihood of about SLR 19,952,467 (US\$ 199,525) per household. The economic assessment also demonstrated that a village with intact coastal and marine resource base such as Kapuhenwala can induce an economic benefit of approximately SLR 12,718,448 (US\$ 127,184) per fishing household. The economic estimates suggest that areas with degraded coastal vegetation and marine ecosystem generate lower fishing benefits as shown by SLR 1,256,474 (US\$ 12,565) annual economic value of fisheries per household in Wanduruppa. The findings provide a sound basis for the inclusion of fishery rehabilitation efforts in the post-tsunami rebuilding programs.

Keywords: Sri Lanka, Coastal Livelihood, Fisheries, Tsunami

INTRODUCTION

The Indian Ocean tsunami of December 2004 left massive devastation across South and Southeast Asia. It caused extensive damages to life, property and livelihood. In India, Indonesia, Malaysia, Thailand and Sri Lanka, the tsunami claimed over 300,000 lives and left more than two million people displaced and homeless [1]. In particular, the disaster had the greatest impact on “rural” coastal communities [2], many of which were in extreme economic difficulty prior to the tsunami.

The affected communities depend on fishing and agriculture for their livelihoods. Due to specific socioeconomic difficulties, political instabilities, lack of arable land in certain areas and other factors, the majority of affected villagers rely heavily on fishing as their main source of income [3]. The fisheries are among the most common and important marine ecosystem in the region. They are among the highly productive and taxonomically diverse ecosystems on earth, which has great environmental, commercial, aesthetic and economic value. Similar to other natural ecosystems, fisheries in the Indian Ocean have been exposed to both anthropogenic- and naturally-induced interventions. The increased migration to coastal regions resulted in the degradation of fisheries. The inadequacy and lack of implementation of governing mechanisms to regulate the use of the coastal and marine resources exacerbated the fishery conditions. Of late, fisheries in South Asia, particularly in Sri Lanka, were subject to severe natural damage caused by the tsunami. The impacts of tsunami did not only magnify the significance of the fisheries but also the vulnerability of the communities that are dependent upon the resource.

In recognition of the role of the fishery ecosystems in the economic and social lives of communities hit by the tsunami, the need to include fishery rehabilitation efforts in the tsunami reconstruction and rebuilding plans is paramount. Owing to this exigency, it is important, therefore, to: (1) assess the damages sustained by selected

communities dependent on the resource; (2) present an economic justification for the inclusion of the rehabilitation and restoration of the fishery sector in the current tsunami reconstruction projects in Sri Lanka; and (3) assess the economic value of fisheries to provide a sound basis on future plans of action.

By estimating the damages and placing monetary value to fisheries, this study sets forth the stage to understand and determine the economic viability of a functioning fishery ecosystem *i.e.*, assess the benefits that communities gain from sustaining a healthy fishery ecosystem. The assessment provides a socioeconomic basis for more informed decisions and efficient allocation of limited resources for fishery management.

This study reports the findings of a socioeconomic survey in the coastal villages of Kapuhenwala and Wanduruppa in the southern coastal belt of Sri Lanka. The following section reviews the current status of the fishery sector in Sri Lanka with background information on the two villages. The third section presents the survey methodologies. The subsequent sections present the results of the data analysis and its socioeconomic implications. Finally, the last section draws some conclusions and provides recommendations on post-tsunami fishery management.

Fisheries in Sri Lanka: A Review

Located southeast of India in the Bay of Bengal, Sri Lanka has approximately 1,700 km of continental coastline and a population of about 19 million [4]. Similar to other island nations in the region, Sri Lanka has a growing coastal population heavily dependent on the fishery sector (Table I). Based on recent estimates, the total fishery-associated population in Sri Lanka is around one million [5]. Fisheries also play a crucial role in supplying 65 percent of the animal protein consumed by Sri Lankans, and it also contributes nearly 3 percent to the country's GDP [6]. On average, each Sri Lankan consumes 17.4 kg of fish product per year [4].

Table I. Fishery Population in Sri Lanka.

	Population
Fishing villages (marine sector)	1,337
Fishing villages (inland / brackishwater [mangrove] sector)	1,289
Fishing households (marine sector)	132,600
Fishing households (inland / brackishwater [mangrove] sector)	11,920
Active fishermen	151,800
Fishing household population	613,900
Estimated employment in the primary sector	250,000
Estimated employment in the secondary sector	100,000

Source: FAO (2006) and Amarasinghe (2005)

The fisheries resources in the country consist mainly of: (1) marine resources from coastal (near-shore), off-shore and deep sea fishing; (2) inland resources from inland freshwater and aquaculture and (3) brackishwater (mangrove) resources from mangrove and wetland lagoons. In 2004, fish production from all sources totaled to about 285,000 tonnes, of which 90 percent was consumed locally and 10 percent was exported [4]. The common pelagic and demersal fish species caught include mackerel (*Rastrelliger* spp.), anchovy (*Anchoa commersoni*), skipjack tuna (*Katsuwonus pelamis*), yellow fin tuna (*Thunnus albacares*), mullet (*Liza melinoptera*) and tilapia (*Oreochromis niloticus*).

Small-scale fishing activities comprise majority of coastal (near-shore) and brackishwater (mangrove) fisheries. Off-shore and deep sea fishing as well as aquaculture development are in its threshold stage in Sri Lanka, and its contribution to the fishery sector remains below coastal and brackishwater fisheries [5]. Accordingly, this study focuses on coastal (near-shore) and brackishwater (mangrove) fisheries.

Medium-sized and non-motorized traditional crafts, owned and operated by small-scale fishermen characterize the greater number of Sri Lanka's fishing fleet. Simple canoes and outriggers make up nearly 50 percent of the fleet [4]. A small fraction of fishermen use beach seine craft without motors.

Most of the taxonomically important fishing districts in Sri Lanka are located in the northern and eastern region of the country. However, due to political instabilities and ethnic indifferences in the area, growth in the fishing sector has been limited. In lieu, government agencies, NGOs and private entities channel fishery development, management and conservation efforts in the southwestern part of the country.

Before the tsunami, the fishing economy in the southern coastal belt of Sri Lanka is thriving. The tsunami that hit two-thirds of Sri Lanka's coastline [4], however, changed the confidence of coastal villagers on the fishing industry. The disaster affected 80 percent of active fishermen and destroyed 75 percent of the fishing fleet^a. Sri Lanka's fishing villages, at present, are gradually rebounding from the impacts of the tsunami.

STUDY AREA

With the intention of assessing the social and economic dimension of coastal (near-shore) and brackishwater (mangrove) fisheries characterized with: (1) healthy and functioning fishery ecosystem and (2) disturbed and degraded ecosystem, eight fishing villages were assessed for suitability through a reconnaissance site survey in southern Sri Lanka. The suitability of the sites was investigated through a physical site assessment approach developed by the IUCN-The World Conservation Union, Sri Lanka. Based on comparable accessibility of the villages, political stability, fishery resource quality and data availability, the reconnaissance survey identified the villages of Kapuhenwala and Wanduruppa as appropriate sites. The two villages exhibit the characteristics of sites with both functioning and degraded coastal (near-shore) and brackishwater (mangrove) fishery ecosystems.

Kapuhenwala and Wanduruppa villages are located in the Tangalle and Hambantota fishing districts, 200 km south of Colombo. The districts are two of the most dynamic coastal areas in Sri Lanka. It has 27 km of coastline extending from Rekawa to Ussangoda in the southernmost coast. The sites demonstrate a diversity of marine and coastal resources.

Kapuhenwala

Kapuhenwala is one of the villages in the larger division of Tangalle. Estuarine and deltaic coastlines characterize the village. The major resources in Kapuhenwala upon which its 59 registered households depend for livelihood includes farming and fishing. Tourism has been an important part of the village economy for the last decade. There are three major hotels in the area.

The majority of the households (52 percent) in the village are engaged in fishing activities. Fishing households in the village are engaged in both brackishwater (mangrove) and coastal (near-shore) fishing. Sixty-five percent of the fishing households are brackishwater (mangrove) fishermen, whereas 39 percent are coastal (near-shore) fishing households. It is interesting to note that 32 percent of the fishing households in the village with an average monthly income of SLR 2650 (US\$ 27)^b practice both brackishwater (mangrove) and coastal (near-shore) fishing.

Severe damage was noted in Kapuhenwala following the tsunami. Substantial damage to coastal vegetation, particularly mangroves, was observed around the village lagoon. The impact of the tidal waves was observed to have gone beyond 350 m from the shoreline. Fifty out of the 59 houses were either partially or totally destroyed by the tidal waves [7]. The village, however, was fortunate to have the lowest number of fatalities with only two casualties recorded from the tsunami. Livelihood, specifically, brackishwater (mangrove) and

coastal (near-shore) fisheries were largely affected by the tsunami, as most of the fishing boats and gears were destroyed. Beach areas with tourism infrastructure such as the Hotel Lagoon Paradise and the Lagoon Wadiya Beach Cabanas were reduced into rubble by the tsunami.

Wanduruppa

In Hambantota district, the coastal village of Wanduruppa is one of the largest villages with 512 registered households. Similar to other coastal villages, farming and fishing are the major sources of income in Wanduruppa. Compared to other villages in the district, Wanduruppa has a higher living standard with 41 percent of the families receiving an average monthly income of SLR 7,500 (US\$ 75). This is due to diversity of livelihood opportunities in the area, which include cottage industries.

Despite the economic development in the area, a number of coastal and marine resources remain in the village. Fishery is the most dominant followed by agricultural lands. These resources support the livelihood activities of both residents and non-residents. Thirty-five percent of the households in the village are fishing households. Relatively, Wanduruppa has a lower percentage of households engaged in brackishwater (mangrove) fishing. However, given the size of the community, the village has more fishing households in absolute terms compared to Kapuhenwala (Table II).

Table II. Number of Fishing Households in Kapuhenwala and Wanduruppa.

Types of Fishing	Kapuhenwala	Wanduruppa
Brackishwater (Mangrove)	20 (65%)	107 (60%)
Coastal (Near-shore)	12 (39%)	139 (78%)

Before the tsunami, there were 26 beach seine nets that were in operations in the village. After the disaster only one net suitable for operation remained. The rapid environmental impact assessment in the village indicated seawater has run through a distance of one km from the coast. A total of 348 out of 512 houses were damaged [8]. Road infrastructure was also impaired by the tsunami.

SURVEY METHODOLOGY

At the outset, customary research practices and extensive secondary literature reviews provided background information about the socioeconomic issues surrounding fisheries in Kapuhenwala and Wanduruppa. The socioeconomic assessment of the actual impacts of the tsunami on fisheries resources and coastal livelihood necessitates the collection of primary data from household surveys. A purposive sampling approach was developed to determine the target households. This tactic, although not as statistically representative of the population as other approaches, was deemed the most practical approach for the purposes of the study. The number of samples was determined using the recommended sample size developed by Bunce and Pomeroy [9] for household interviews in coastal areas.

The primary data collection was extensively carried out separately for the two study sites. Household surveys were implemented in the villages over a period of 20 days in April 2005. The surveys were conducted in both English and Sinhala^c with 44 respondents (out of 59 households) in Kapuhenwala and 107 (out of 512 registered households) in Wanduruppa.

One major aspect of the survey was the assessment of the conditions and roles of brackishwater (mangrove) and coastal (near-shore) fishery, before and after the tsunami. A series of questions on resource conditions

were sought from the residents. In the light of better understanding the damages to fisheries after the tsunami, the villagers were asked to give anecdotal experiences on the impacts of the disaster on the resource and their livelihood. Questions on property damages and loss economic activities were solicited.

Despite the many goods and services derived by the villagers from fisheries in Kapuhenwala and Wanduruppa, the resource is under intense pressure from anthropogenic and natural interventions. It was crucial to elicit perceived problems on resource governance, management options and fishery rehabilitation efforts in the post-tsunami reconstruction and rebuilding process to properly evaluate the needs, problems and concerns faced by the communities in their struggle to sustain an intact fishery resource. Relevant socioeconomic and demographic information, both in the community and household levels, were also solicited.

HOUSEHOLD SURVEY

A consensus among coastal communities indicates the significance of intact coastal and marine resources particularly, mangrove and fisheries, before and after the 2004 tsunami. Anecdotal evidence shows that the broad stretch of mangroves in Kapuhenwala served as protective barrier from tidal waves coming inland. As to fisheries, anecdotal accounts demonstrate that fishing areas categorized with disturbed fishery resource exhibited a lower rate of economic recovery after the tsunami. To assess the economic importance of sustaining healthy fishery resource, the villages of Kapuhenwala and Wanduruppa in Sri Lanka, areas characterized by intact and degraded fishery ecosystems, respectively, were investigated.

Personal household surveys were conducted and a total of 151 completed questionnaires were analyzed for the study. The relatively small size and compactness of the Kapuhenwala village allowed the survey completion of 75 percent of the entire village households. Forty-four out of 59 households were interviewed. Correspondingly, the large number of households in Wanduruppa, which totals to 512, did not permit for the same degree of completion. Completing 107 questionnaires in Wanduruppa, in any case, was a close representation of the population.

Fishing Household Profile

The residents in Kapuhenwala and Wanduruppa, generally, belong to nuclear family households. The majority of the residents are middle-aged as reflected by 67 percent of the villagers in Kapuhenwala belonging to the 31-40 age bracket and 61 percent of the residents in Wanduruppa belonging to the 41-50 age bracket. Apparently, there is a high proportion of males in both villages – 86 percent in Kapuhenwala and 71 percent in Wanduruppa. It should be noted that the study survey targeted head of households, who in Sri Lanka are typically males. The proximity of Wanduruppa to the Ambalantota town and the accessibility of private and public educational institutions in the area as well as the relatively higher monthly cash income of the households explain the high proportion (71 percent) of residents with an average formal education of 8 years compared to 47 percent in Kapuhenwala. The high level of literacy in Wanduruppa is manifested in a high degree of participation and membership of 62 percent of the households in coastal-based organizations.

Resource Condition

The survey aims to establish the level of awareness of coastal communities on the different functions of the brackishwater (mangrove) and coastal (near-shore) fishery ecosystems. The residents in Kapuhenwala and Wanduruppa have a good understanding of the fishery resources in the area as shown by almost 100 percent familiarity of the residents to mangroves and fish species in both sites. Before the tsunami, 82 percent of the residents in Kapuhenwala agree that coastal and marine resources in the area were intact and in healthy conditions. Remarkably, 79 percent of the villagers in Wanduruppa have the same opinion.

There is a high level of awareness on the different issues surrounding the brackishwater (mangrove) and coastal (near-shore) fishery ecosystems in the study sites. In Kapuhenwala, it is interesting to note that prior to the tsunami disaster, the residents observed that coastal fisheries have been biologically overexploited. The local fishermen in Kapuhenwala noted that there is a lower diversity in fish catch in 2004 compared to previous years. The fishermen expressed concern that the current fishing practices and the absence of craft and gear monitoring system results in fishing operation above the maximum sustainable yield. Findings from recent studies in the southern coastal belt of Sri Lanka corroborate the concern of the residents [10, 11].

The ratio of fishery resource to the population is lower in Wanduruppa. The fishery to population ratio, partly, explains why resources in Wanduruppa are more degraded. Despite the high recognition of the importance of brackishwater (mangrove) and coastal (near-shore) fishery ecosystems, residents remained unresponsive to the incessant overfishing practices in the area.

Damage Assessment

Overall, the damage in Kapuhenwala and Wanduruppa is estimated to be around SLR 155 million (US\$ 1.5 million). Physical infrastructure such as houses, schools, roads and causeways, as well as sources of livelihood such as fishing, agriculture and tourism were severely damaged. Seventy-nine percent of the residents in Kapuhenwala and Wanduruppa had damaged boats and fishing gears. Damaged fishing grounds were noted by 26 percent of the villagers.

The proportion of damages sustained by fishing households in both villages is illustrated in Figure 1. It can be noted that in all categories, the village of Wanduruppa registered greater percentage damages compared to Kapuhenwala. This confirms the initial claims and immediate observations after the tsunami that areas with more intact natural resource base experienced relatively lesser damages than areas with more disturbed ecosystems. Interestingly, damages on boats and fishing gears were greater in Kapuhenwala. Fishermen in Kapuhenwala explained that the reason why the village registered greater damage on boats and fishing gears is that most fishermen in the Kapuhenwala leave their boats and gears along the coast after their daily fishing activities, making it more vulnerable to impacts of the waves coming inland.

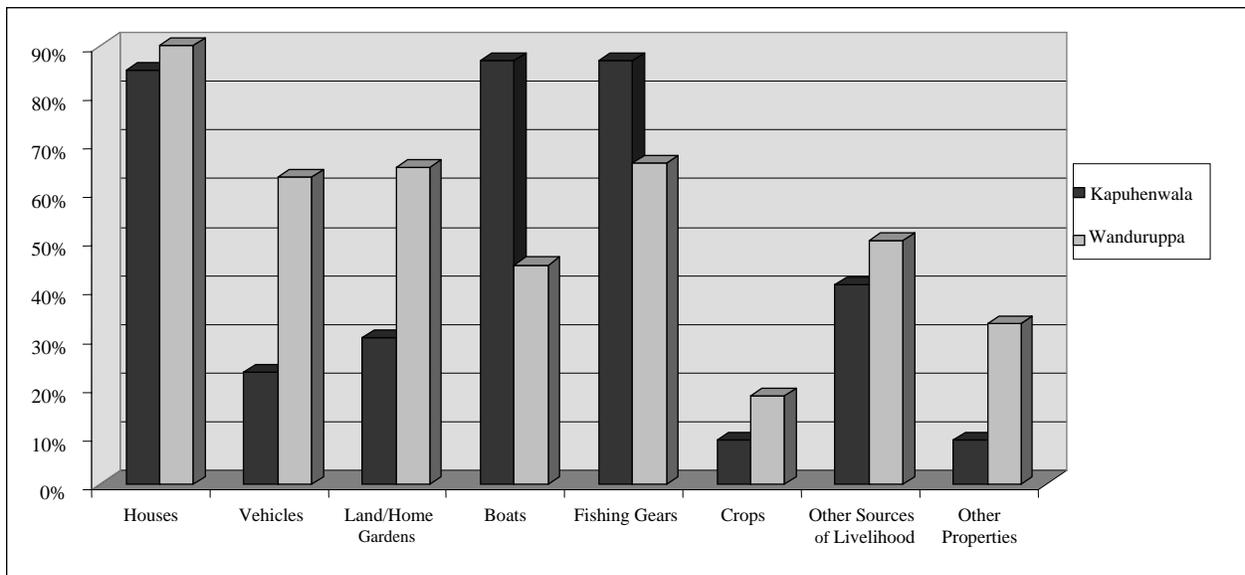


Fig. 1. Proportion of fishing households in Kapuhenwala and Wanduruppa who experienced damages to their properties and livelihood when the 2004 Indian Ocean tsunami hit Sri Lanka.

Previous studies, which investigated the impacts of severe natural disaster to coastal communities, have assessed the damages based on expected property and livelihood losses or expenditures. This study, however, is using **actual** damage estimates on private properties, livelihood (fishing) and public infrastructure from two villages severely affected by the tsunami. Costs of damages from the tsunami were estimated for properties, which include houses, vehicles, hotels and residential lands. The assessment of damage to houses was based on the proportion of houses damaged in both sites. The damage to livelihood includes destruction of fishing gears and boats. The estimates were adjusted based on the number of households involved in fishing. The costs of damage to community infrastructure include damage costs on public roads, schools, causeways and public parks. Table III summarizes the damages incurred in the study sites. The severity of the livelihood damages in Wanduruppa was expected to generate a higher damage cost value since it was postulated that the degree of destruction is greater in areas where coastal and marine ecosystems are relatively disturbed. The damage cost avoided estimates underscore the significant role of intact and healthy ecosystems at the event of disasters such as tsunami.

Table III. Costs of Tsunami Damages to Property and Livelihood.

DAMAGES	Kapuhenwala	Wanduruppa	Damage Costs Avoided (in SLR/household)
	Total Weighted Costs (in SLR)	Total Weighted Costs (in SLR)	
Property	SLR 6,666,750 (US\$ 66,668)	SLR 116,136,395 (US\$ 1,161,364)	SLR 191,716 (US\$ 1,917)
Livelihood	SLR 8,676,092 (US\$ 86,761)	SLR 19,952,467 (US\$ 199,525)	SLR 19,748 (US\$ 197)
Community Infrastructure	SLR 1,980,000 (US\$ 19,800)	SLR 1,700,000 (US\$ 17,000)	(SLR 490) (-US\$ 5)
Others (e.g. Appliances, Clothes, etc.)	SLR 32,625 (US\$ 326)	SLR 8,594 (US\$ 86)	(SLR 42) (-US\$.50)
Total	SLR 17,355,467 (US\$ 173,555)	SLR 137,797,456 (US\$ 1,377,975)	SLR 210,932 (US\$ 2,109)

Note: The damage costs avoided estimates are costs that could have been avoided if the area in Wanduruppa has healthier ecosystems. The estimates per household were determined by calculating the difference between the monetary values of the damages in both sites. The monetary values were adjusted based on the number of households affected in each site.

Socioeconomic Assessment

The assessment of the social and economic significance of brackishwater (mangrove) and coastal (near-shore) fishery ecosystems in Kapuhenwala and Wanduruppa involves an economic valuation of direct uses associated with fisheries. Direct use values are goods or services derived from direct use or interaction with the resource. The most common direct use value derived from fishery ecosystems is marketable fish.

Detailed catch information collected in Kapuhenwala and Wanduruppa revealed that for brackishwater (mangrove) fisheries, fish catch is composed of mullets (CN: Godeya; SN: *Liza melinoptera*), chromides (CN: Koraliya; SN: *Etroplus suratensis*), white prawns (CN: Kirissa; SN: *Penaeus indicus*), threadfish (CN: Panna; SN: *Alectis indicus*), carps (CN: Carp; SN: *Cyprinus carpio*) and tilapia (CN: Niloti; SN: *Oreochromis niloticus*)^d. Skipjack tunas (CN: Balaya; SN: *Katsuwonus pelamis*), yellowfin tunas (CN: Kelawalla; SN: *Thunnus albacares*), trevally (CN: Trevally; SN: *Carangoides spp.*), anchovies (CN: Halmassa; SN: *Stolephorus indicus* and *Thryssa baelama*) and mackerel (CN: Bolla; SN: *Rastrelliger kanagurta*) dominate majority of the catch from coastal (near-shore) fisheries. A fishery expert from the National Aquatic Resources

Research and Development Agency (NARA) validated the association of the fish species with brackish and coastal waters. The validation was conducted in lieu of actual physical sampling.

Income derived from catching brackishwater (mangrove) and coastal (near-shore) fish species is a major component of the household income in Kapuhenwala and Wanduruppa. Income generated from natural ecosystems such as fishery is called nature-based or environmental income. Wild income and agricultural income are the major constituents of environmental income [12]. Brackishwater (mangrove) and coastal (near-shore) fisheries generate wild income for coastal villages. Typically, wild income is estimated as the gross value of fishery resource less the cost of labor and gears and equipment used to sell and market the catch. Gross value of fishery resource includes both the value of the fish consumed by the household and the cash value of fish sold [12].

Assessing wild income as a component of environmental income at the household level provides better economic information that is valuable in judging the impact of nature-based income in the social and economic lives of coastal residents. The dependence of the residents of Kapuhenwala and Wanduruppa on fisheries was quantified through the implementation of a household survey and application of the ‘gross wild income’ equation for fishery resource [12].

$$\text{Gross value of wild income}_{\text{FISHERY}} = \text{Subsistence income}^e + \text{Cash income}^f \quad (\text{Eq.1})$$

Based on the wild income equation, the average gross values of brackishwater (mangrove) fishery per fishing household in Kapuhenwala and Wanduruppa are SLR 641,148 and SLR 243,662, respectively. Income from coastal (near-shore) fishery in Kapuhenwala is approximately SLR 12 million (US\$ 120,000). Appendices A and B show a summary of the wild income generated from both types of fisheries.

Fishing households in Kapuhenwala are engaged with brackishwater (mangrove) fishery for an average of 25 hours per week, whereas those in Wanduruppa spend 43 hours per week. It can be noted that it will take 3.5 times the number of hours or 151 more hours per week for fishing households in Wanduruppa to match the current catch of fishing households per fishing effort in Kapuhenwala (Appendices A and B). The estimates suggest the significant role that healthy and intact fisheries play in supporting the needs of the villagers. Fishing effort in healthy and intact fishery resource is relatively lower in terms of gross value of catch per hour per year.

Brackishwater (mangrove) and coastal (near-shore) fisheries are important sources of cash income for most villagers. Eighty-six percent of fishing households in Kapuhenwala re-sell part of their catch and practically all fishing households in Wanduruppa bring some of their catch to the market. Subsistence fishing comprises a large portion of the catch in Kapuhenwala and Wanduruppa.

Fishing households involved in Kapuhenwala have an average monthly cash income of SLR 2,650 (US\$ 27) from fishing in Kapuhenwala. Residents of Wanduruppa derive SLR 3,735 (US\$ 37) per month from fishing. Based on the fishery values in Appendices A and B, the proportion of the monthly cash income, apparently, does not reflect the livelihood significance of fishery since subsistence fishing, which is practiced by 91 percent of households in Kapuhenwala and 93 percent in Wanduruppa, is not accounted for. The cash value of catch for subsistence use, in general, is not included in the monthly cash income reported. Figures 2 and 3 illustrate the proportion of actual cash and subsistence annual gross value of fish catch in Kapuhenwala and Wanduruppa.

FISHERY RESOURCE REHABILITATION

The recognition of the socioeconomic role(s) of brackishwater (mangrove) and coastal (near-shore) fishery ecosystems before and after the tsunami is highly remarkable among residents in Wanduruppa. The villagers, however, remain unresponsive to fishery resource management efforts in the area as indicated by 80 percent of

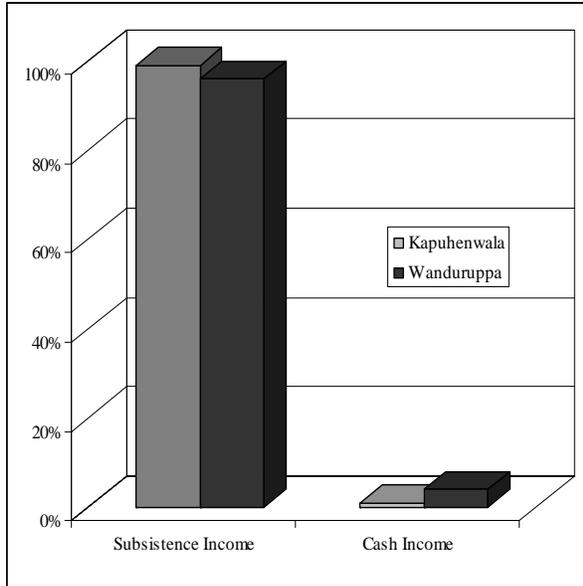


Fig. 2. Distribution of the gross value of wild income (cash + subsistence income) generated from coastal (near-shore) fisheries.

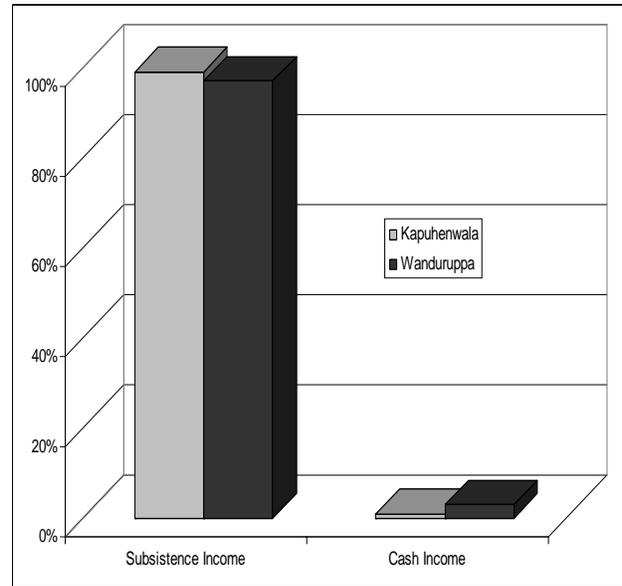


Fig. 3. Distribution of the gross value of wild income (cash + subsistence income) generated from brackishwater (mangrove) fisheries.

the households who are familiar but not involved with any fishery management and conservation programs and projects in the village. This attitude towards fisheries, particularly brackishwater (mangrove) fisheries, is supported by more than 30 percent of the residents in Wanduruppa who do not think that the fishery management options in the area are effectively implemented. The residents of Kapuhenwala, on the other hand, have better understanding of the fishery management activities in the village as suggested by 90 percent of the households with good recognition of the conservation activities taking place. Seventy-seven percent of the residents in Kapuhenwala agree that fishery management options in the area are working efficiently for the protection and enhancement of the resource. Despite the perception that the current management options are working well, 91 percent of the residents in Kapuhenwala believe that there is a need to change current strategies in the area especially after the tsunami. Sixty-seven percent of the households in Wanduruppa, however, expressed indifference in changing the management options. There is a consensus among the residents that fishery rehabilitation efforts should be an integral part of the tsunami reconstruction and rebuilding plans. Ninety-five percent of the households in both sites expressed their willingness to participate in ongoing and future efforts, mostly by volunteering their time and labor.

CONCLUSION

The Indian Ocean tsunami damaged many properties and infrastructure. Exacerbating the destruction was the devastation it brought to brackishwater (mangrove) and coastal (near-shore) fishery ecosystems upon which most coastal residents depend for food and livelihood. The resilience of functioning fishery ecosystems has been substantially and tragically demonstrated by the disaster. Results indicate that damages to fisheries livelihood in Kapuhenwala, area with intact fishery ecosystems, was approximately SLR 8,676,092 (US\$ 86,761) per fishing household; whereas, Wanduruppa, site with degraded coastal and marine ecosystem generated a loss to fishing livelihood per household of about SLR 19,952,467 (US\$ 199,525).

The findings demonstrate that fishery livelihood damage costs for sites with intact fisheries are significantly lower compared to areas with degraded ecosystems. The results of the damage costs avoided assessment provide a sound basis for the inclusion of fishery rehabilitation efforts in the current post-tsunami reconstruction and rebuilding programs. The estimate suggests that fisheries, if managed sustainably, represent

a much higher overall livelihood value.

It is apparent that there is a high degree of dependence on brackishwater (mangrove) and coastal (near-shore) fisheries among coastal households. The resource is important for both subsistence living and cash income sources of the residents. The absence of incentive tools to effectively manage the resource results in an alarming rate of decline. This calls for a strengthened institutional framework for livelihood and environmental management. Effective tools such as economic incentives to promote sustainable use of the fishery resources should be implemented.

ACKNOWLEDGMENT

This study would have not been possible if not for the generous financial and professional support provided by the members of the IUCN Regional Ecosystems and Livelihood Groups and the IUCN Sri Lanka. The author is especially grateful to Lucy Emerton, Mikkel Kallesoe, Usman Iftikhar and Shamen Vidanage for initially developing the topic for the study. Equal gratitude is given to Kaushalya Wijayaweera, Kumi Ekarathne and Diana Alwis for the field assistance. The author is also grateful to Sandun Perera, Gayathri Sriskanthan and Mattias Rust for the assistance in the reconnaissance survey.

REFERENCES

- [1] World Bank. 2005. *Update on the World Bank Response to the Tsunami*. The World Bank: Washington, DC. April 22.
- [2] Stobutzki I and S Hall. 2005. Rebuilding Coastal Fisheries Livelihoods after the Tsunami: Key Lessons from Past Experience. *NAGA WorldFish Center Newsletter*, 28(1 & 2), pp. 6-12.
- [3] Haug R. 2005. Tsunami's Effect on Fishing. <<http://academic.evergreen.edu/g/grossmaz/HAUGRC>>. Accessed: 14 July 2005.
- [4] FAO. 2006. FAO fishery country profile – Sri Lanka. <<http://www.fao.org/fi/fcp/en/LKA/profile.htm>>. Accessed: 14 April 2006.
- [5] Amarasinghe. 2005. *An assessment of the post-tsunami recovery process in the fisheries sector of Sri Lanka* In ICSF Post-tsunami Rehab Workshop Proceedings. Regional Workshop on Post-tsunami Rehabilitation of Fishing Communities and Fisheries-based Livelihoods. ICSF: Chennai, India. 18-19 January 2006.
- [6] ITDG. 2005. Rebuilding fisheries livelihoods in Sri Lanka post tsunami – Concept note by ITDG – South Asia. <[www.itdg.org/docs/region_south_asia/rebuilding-fisheries-livelihoods-\(draft\).pdf](http://www.itdg.org/docs/region_south_asia/rebuilding-fisheries-livelihoods-(draft).pdf)>. Accessed: 14 June 2005.
- [7] Jeewananda R. 2005. Grama Niladari of Medilla. *Personal Communication*. 5 April. Medilla, Tangalle, Sri Lanka.
- [8] De Silva J. 2005. President, Pradeshiya Sabha of Ambalantota and GN of Wanduruppa North. *Personal Communication*. 20 April. Ambalantota, Hambantota, Sri Lanka.
- [9] Bunce L and R Pomeroy. 2003. *Socioeconomic Monitoring Guidelines for Coastal Managers in Southeast Asia: SocMon SEA*. World Commission on Protected Areas and Global Coral Reef Monitoring Network/Australian Institute of Marine Science, Townsville, Australia.
- [10] Kotagama H. 2000. *Mimeo*. Department of Agricultural Economics, University of Peradeniya, Sri Lanka. Mimeo.

- [11] Amarasinghe O. 1999. *The Economics of a Fishery and Optimal Resource Use*. Department of Agricultural Economics, University of Ruhuna, Sri Lanka. Mimeo.
- [12] WRI. 2005. How Important is Environmental Income. *World Resources 2005 Report Online*. <<http://multimedia.wri.org/worldresources2005.cfm>>. Accessed: 7 March 2006.

ENDNOTES

^a See: Amarasinghe (2005), pp.70-75.

^b US\$ 1 = SLR 100.

^c Sinhala is the local dialect spoken in the villages.

^d CN = common name and SN = scientific name.

^e Subsistence income is the value of fish consumed by producer.

^f Cash income is the sales of fish at the market.

Appendix A. Gross Wild Income Value of Brackishwater (Mangrove) Fishery.

Species	Kapuhewala			Wanduruppa		
	Catch (kg/year)	Local Market Prices (SLR/kg)	Total Value (SLR/year)	Catch (kg/year)	Local Market Prices (SLR/kg)	Total Value (SLR/year)
<i>Penaeus indicus</i>	22,632	400	9,052,800	-	-	
<i>Lisa melinoptera</i>	11,868	120	1,424,160	59,280	120	7,113,600
<i>Etroplus suratensis</i>	11,868	100	1,186,800	89,376	100	8,937,600
<i>Alectis indicus</i>	7,728	150	1,159,200	-	-	
<i>Cyprinus carpio</i>	-	-	-	74,328	75	5,574,600
<i>Oreochromis niloticus</i>	-	-	-	59,280	75	4,446,000
Total gross value	54,096		12,822,960	282,264		26,071,800
Average gross value per mangrove fishing household			641,148			243,662
Average annual gross value per mangrove fishing household per fishing effort (SLR/hour/year)			493			109

Notes: (a) An actual market survey in both villages was conducted to generate the average market price for each species.; (b) In terms of fishing effort, fishing households in Kapuhewala are engaged with brackishwater (mangrove) fishery for an average of 25 hours per week.; (c) Fishing households in Wanduruppa are engaged with brackishwater (mangrove) fishery for an average of 43 hours per week.

Appendix B. Gross Wild Income Value of Coastal (Near-Shore) Fishery.

Species	Kapuhewala			Wanduruppa		
	Catch (kg/year)	Local Market Prices (SLR/kg)	Total Value (SLR/year)	Catch (kg/year)	Local Market Prices (SLR/kg)	Total Value (SLR/year)
<i>Homarus gammarus</i>	33,672	4000	134,688,000	-	-	-
<i>Katsuwonus pelamis</i>	14,628	300	4,388,400	-	-	-
<i>Thunnus albacares</i>	14,628	400	5,851,200	-	-	-
<i>Carangoides spp.</i>	-	-	-	311,448	300	93,434,400
<i>Stolephorus indicus and Thryssa baelama</i>	-	-	-	266,304	100	26,630,400
<i>Rastrelliger kanagurta</i>	-	-	-	188,328	110	20,716,080
Total gross value	62,928		144,927,600	766,080		140,780,880
Average gross value per near-shore fishing household			12,077,300			1,012,812
Average annual gross value per near-shore fishing household per fishing effort (SLR/hour/year)			7,742			354

Note: Fishing households in Kapuhewala are engaged with coastal (near-shore) fishery for an average of 30 hours per week; whereas households in Wanduruppa are engaged with coastal (near-shore) fishery for an average of 55 hours per week.