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ANALYTICAL STUDY OF LIVING ENVIRONMENT IN THE TSUNAMI-AFFECTED AREAS OF TAMIL NADU, INDIA

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ABSTRACT

More than 4500 km stretch of the Indian coastline was badly affected by the tsunami on 26th December 2004. The worst affected state Tamil Nadu faced the loss of 7993 lives and destruction of about 123,105 houses. In a developing country like India both socio-economic and climatic aspects largely govern the architectural development as a whole and, consequently, the extent of damage, as far as occurrence of natural disasters is concerned. This paper presents an analytical study of damage to living environment and damage pattern of the above-mentioned event. It highlights the character of typical settlement pattern in Tamil Nadu and various socio-economic aspects responsible for architectural development to find out the cause of failure of existing building stock. This paper, based on surveys, examines the suitability of various temporary shelters provided to the tsunami victims in order to find out the appropriate approach for the development of a sustainable architecture for the victims. This is indeed imperative for the people who have suddenly lost their entire social, physical and cultural surroundings.

KEYWORDS: Tamil Nadu, Kuppam, Living Environment, Nagapattinam, Building Stock

INTRODUCTION

On 26th December 2004, out of the 7516 km long coastline of India, more than 4500 km stretch was badly affected by the 9.0 magnitude earthquake-triggered tsunami, resulting in the total destruction of living environment along the coast. The worst affected areas along the Indian coast were in Tamil Nadu, Kerala, and Andhra Pradesh states. Tamil Nadu state suffered maximum loss with the damage concentrated in 4 districts (Figure 1).

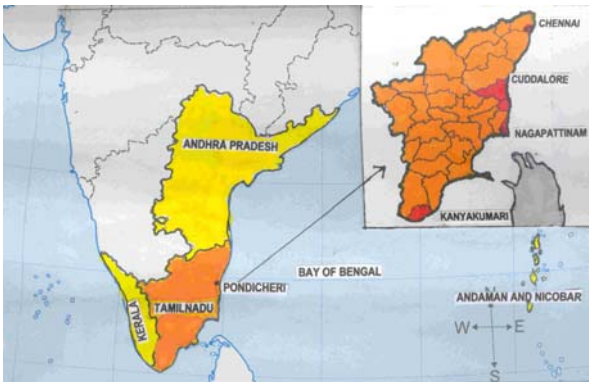

Fig. 1 Tsunami-affected areas of India

Tamil Nadu is located in the northern hemisphere in the Torrid Zone between 8^0 and 13^0N latitude, and between 78^0 and 80^0E longitude. It is the 11th largest state in India, has a population over 60 million, and occupies an area of about 130,058 km^2. The state of Pondichery is a tiny pocket within the boundaries of Tamil Nadu. Nagapattinam, Mylapore, Poompuhar, Mammallapuram and Kayalpattinam are ancient seaports along the coastline. Maritime trade flourished between these ports and the ports of Rome, Greece and the East Indian countries in ancient times. The climate along the coast is warm and humid, and the rainy season is marked by the onset of the northeast monsoon between mid-September and mid-December. Cyclonic storms occur during this period due to depression in the Bay of Bengal (Krishna, 2005).

NATURE OF BUILDING STOCK ALONG THE COAST

Building stock along the coast generally consists of non-engineered and semi-engineered constructions, built with locally available materials like mud, coconut thatch, bricks, wood etc. A typical fishermen hut is a small unit consisting of 1-3 rooms. It has small openings with wide overhanging roof to face the severe climate, and consists of a living space and a semi-covered cooking space, the floor of which is finished with cow dung coating and mud to provide a cool and soothing environment inside. The thatched roof is often tied with coconut ropes (Figure 2).

(a) (b)

Fig. 2 (a) Typical fishermen hut in Tamil Nadu, (b) A typical fisherman hamlet

Very shallow foundations, not more than 900 mm deep, and 150 to 300 mm high plinth are some of the characteristic features. The houses belonging to rich families are made of bricks, finished with mud or cement mortar, and are covered with a tiled roof. Room sizes vary from 10 to 15 square meters. Another type of dwelling is a brick building with mud or cement and sand mortar. Pitched roofs are often covered with locally available mud tiles placed on wooden rafters and purlins. Majority of tsunami-hit areas consisted of rural houses, which were totally ravaged. Many reinforced cement concrete framed buildings faced partial collapse and non-structural damage; here, the extent of damage was attributed to the dashing of floating objects to the structures, faulty architectural configuration, and poor structural strength of the structures because of lack of maintenance and aging. Tables 1 and 2 show the materials generally used for construction in the tsunami-affected areas of Tamil Nadu (BMTPC, 1997).

Table 1: Percentage of Predominant Material for Walls

Affected District	Grass Leaves, Reeds or Bamboo	Mud	Un-burnt Brick	Wood	Burnt Brick	Galvanized Iron/Metal Sheets	Stone
Chennai	3	20	0	0	77	0	0
Cuddalore	1	64	0	0	32	0	3
Nagapattinam	1	75	0	0	21	0	3
Kanyakumari	4	28	44	1	20	0	3
Tamil Nadu State	*3*	*54*	*5*	*1*	*32*	*2*	*3*

Table 2: Percentage of Predominant Material for Roofs

Affected District	Grass Reeds or Bamboo	Tiles/Slate/ Shingles	Metal Sheets	Asbestos Cement Sheets	Brick and Lime	Reinforced Cement Concrete
Chennai	26	36	2	4	6	26
Cuddalore	34	47	1	0	6	4
Nagapattinam	60	27	1	0	11	2
Kanyakumari	41	55	1	0	2	5
Tamil Nadu State	*51*	*35*	*2*	*1*	*6*	*6*

It appears quite plausible that the predominant use of substandard quality material resulted in the catastrophic failure of the housing stock.

LIVING PATTERN

Fishermen of Tamil Nadu live in thatched huts in densely populated hamlets on the shore. They belong to the lowermost section of Tamil society and traditionally have to live outside the villages inhabited by the upper and middle class people. Fishing is the only source of income for these downtrodden and powerless people who constantly live under the threat of big-boat owners, moneylenders and merchants (Sridhar, 2005). Fishermen huts are located one behind the other or in a scattered manner to form a small settlement called "Kuppam". They are very closely spaced in order to provide mutual shade to face the severe heat. Coconut mat walls facilitate airflow through the living areas to create a comfortable living space inside. There are a large number of people living in such huts and they constitute the largest section of the Tamil society (Figure 3) in the affected districts of Tamil Nadu. These people were badly affected due to the tsunami.

The population density in these fishing villages is almost three times higher than the average population density in the rest of the state (Krishna, 2005). The need to live suitably close to the sea to enable fishing has resulted in most of them living in thatched huts, often very close to the shore. It was observed that the poorer fishermen live closer to the sea. The population density is striking in Kanyakumari where it is almost four times larger in the fishing villages than in the district (Figure 4).

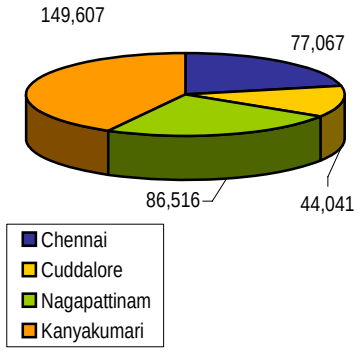

Fig. 3 Fishermen Population in the Affected Districts of Tamil Nadu

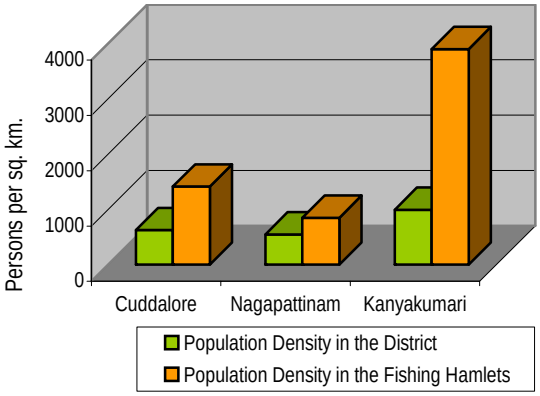

Fig. 4 Population Density in the Worst Affected areas of Tamil Nadu

SOCIO-ECONOMIC ASPECTS

Tamil Nadu state has faced a loss of 7993 lives and destruction of about 123,105 houses. A total of 590 villages were damaged which had about 737,203 people distributed in Chennai, Nagapattinam, Cuddalore and Kanyakumari districts (Figure 5).

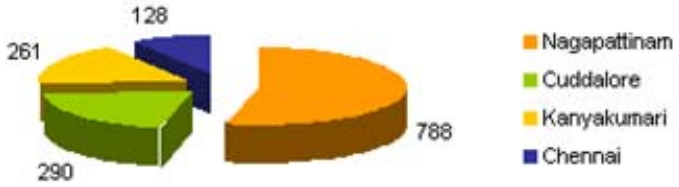

Fig. 5 Death toll in the worst affected districts of Tamil Nadu

Fishing was stopped, because essential fishing gear, including nets had also been destroyed. In addition to this, the fishermen working as daily wageworkers on trawlers were unable to get employment. Hundreds were injured and rendered homeless. More than 31,000 catamarans made of wood and fiber reinforced plastic (FRP), 8140 small boats and about 1000 mechanized boats in total suffered the damage (Chhabra, 2005).

DAMAGE PATTERN

The tsunami exposed the vulnerability of the fishing community on the Tamil Nadu coast. Almost all non-engineered huts were washed away, while semi-engineered houses faced heavy damage in many villages along the coast (Figure 6).

(a) (b)

Fig. 6 (a) A totally ravaged hamlet in Cuddalore, Tamil Nadu, (b) Total collapse of a semi-engineered house in Muzhukuthurai, Tamil Nadu

It was observed that in addition to the total absence of a disaster warning system and the unawareness of the inhabitants, there are many factors concerning architectural development (Christopher and Elsseser, 1982), which resulted in the catastrophic failure of building stock and the subsequent loss of life and property (Dowrick, 1972). Waves rose up to 6 meters and reached the second floor of houses in many places. A large number of fishing villages were totally ravaged (Table 3).

Table 3: Damages in the Worst Affected Villages of Tamil Nadu

Akkalpettai	Keechankuppam	Poompuhar	Sonankuppam
Akkaraigor	Muzhukuthurai	Pudepettai,	Tarangambadi
Chinnagudi	Nagapattinam	Pudukuppam	Tiruvankudu
Devanampattinam	Neithavasal	Roypuram	Tranquebar
Karaikal	Pattanacheri	Singarathope	Vedaranyam
Kasimeda	Pazhayar	Srinivaspuram	Vailankanni

> 75% damaged houses | 60-75% damaged houses | < 60% damaged houses

Many semi-engineered structures, which were located near the coast, were seriously damaged. Brick walls with substandard mortar failed and collapsed (Figure 7). Living areas located within a distance of 2.5 km from the coastline remained flooded for a considerably long period of time, and rescue operations were difficult in the worst affected areas like Nagapattinam, Cuddalore and Kanyakumari. The debris carried away by the waves caused a number of problems in areas not directly hit by the tsunami (Figure 8).

In areas about 1 to 2 km away from the coast water entered inside and resulted in moderate damage. In a large number of semi-engineered houses, walls facing the tsunami collapsed and all the furniture was washed away with the inhabitants (Figure 9). Water entered the villages and blocked the accesses, thus trapping many people inside their houses. This phenomenon resulted in panic and increased the extent of damage to the living environment in the affected areas (Figure 10).

Fig. 7 A collapsed semi-engineered house at Muzukuthurai, near Pichvaram

Fig. 8 Debris collected in front of an undamaged house

Fig. 9 Destruction to house interior

Fig. 10 Blocked access in a well-built residential unit

DAMAGE TO ARCHITECTURAL HERITAGE

Many architecturally and culturally important buildings/structures like the shrine of Mother Mary at Velunkanni, the statue of great leader M.G. Ramchandran at Muzhukuthurai etc. were badly damaged. A number of churches at Kanyakumari suffered moderate damage, while the historic site of Danish fort in Nagapattinam, built in 1620 A.D., remained unscathed. The huge and strong stonewall in front of the fort saved this heritage building, listed as architectural heritage building by the Monuments and Archeological Sites and Remains Act of India 1966.

NEED FOR A SUSTAINABLE ARCHITECTURE

The development of a sustainable architecture for disaster prone areas is a matter of serious concern. In such circumstances the architectural development must respond to the climatic condition and to the life style of the inhabitants. Rehabilitation programmes are often worked out in hurry without giving due importance to these crucial issues. This has resulted in a totally different built environment for the local people as is observed in Nagapattinam and Cuddalore districts of Tamil Nadu.

Many temporary shelters, designed without considering the severe heat and space requirement have failed to serve the purpose (Figure 11). A box-like temporary house made of Ferrocrete walls (walls constructed with steel mesh and cement concrete) and very thin roof have resulted in inside temperatures rising to 30-50^{o}C, which is much higher than the desirable temperature. Absence of adequate openings for light and ventilation have created highly uncomfortable and unhygienic indoor environment.

Tamil fishermen community which is largely conservative and used to living in a joint family system, having 6-8 family members on an average, refused to live in small 2.5×3.0 m size temporary shelters, because the space was not enough to provide shelter for the family. The survival of victims in the absence of space for cooking and washing became difficult. Many open tent-like shelters failed to provide a feeling of security to the victims who were in a state of trauma (Figure 12). It has been observed that many rehabilitation projects consisted of shelters made of locally available materials like coconut mats and thatch roof in addition to modern materials like polythene or galvanized iron sheets. They proved successful in providing the required physical comfort (Gokhale, 2002) because of the insulation provided with the use of coconut-thatched roof.

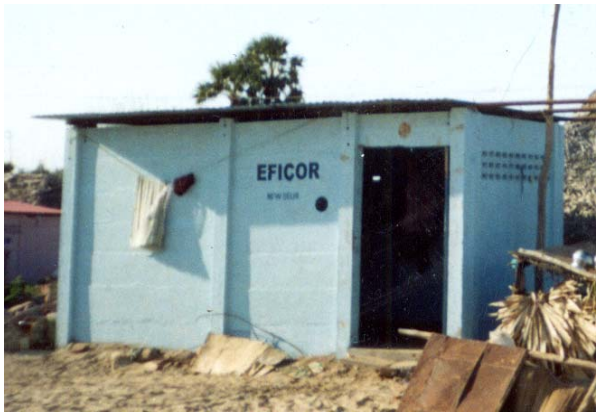

Fig. 11 A small-sized temporary shelter without adequate provision for light and ventilation

Fig. 12 Empty temporary shelters in Pichvaram

CONCLUSIONS

Although the loss of lives was concentrated in three or four districts of Tamil Nadu, the living environment everywhere along the coast has been affected. Fishermen need adequately designed shelters, conforming to architectural forms that respect climate, site, culture and region. Such shelters should be cost-effective, efficient and designed to cater for the spatial requirements of traditional lifestyle of the local inhabitants. Houses should not be located in a high hazard area but also should not be located too far away from the shore in order to facilitate easy conveyance of fishing implements. Houses should be designed with adequate insulation so that they can prove useful and habitable throughout the year. Use of locally available material like coconut thatch and coconut mat should be encouraged which can be used in combination with modern materials like cement concrete, asbestos cement sheets and Ferrocrete. Such houses should be arranged in a way, such that those can retain the character of a typical fishing hamlet where adequate space is allocated for the performing of day-to-day activities. Considering the characteristics of typical rural houses of fishermen, the upgrading of traditional design and constructional practices is the key consideration for rehabilitation projects so that they stand a better chance of survival in the future. The requirement is that the architects should study and learn the skills that will make their contribution truly useful for the victims of tsunami in India.

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