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high degree of acidity is in the soil, which may be attributed to heavy rainfall.
Monpa, Miji, Sherdupken and Aka tribes inhabit West Kameng; Tawang district is inhabited by Monpa tribe. The Monpa and Sherdupken are Buddhist by religion. Aka and Miji worship Dongyo–Polo (Moon–Sun god) and Nature. Monpa, Sherdupken, Miji and Aka tribes take holy bath in these hot springs in the belief that their sins will get washed away. They also take a dip in the water for 1–3 h for healing any kind of skin disease.

The ecosystem of the hot springs of Tawang and Dirang districts of Arunachal Pradesh can serve as a source for bioprospecting of novel microorganisms like thermophiles that are stable under high temperature and have the potential for further exploration.


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Anthropogenic input in Asian mega tsunami (2004) disaster along Tamil Nadu Coast, India

As the Tsunami Warning System (TWS) being contemplated by the South Asian territorial nations can only help in evacuating the coastal people on receiving the forewarning, the concept of tsunami vulnerability mapping is gaining equal momentum, since only this can suggest measures for also protecting coastal installations. Though geoscientists have made varied observations attributing the differential and preferential tsunami inundations along Tamil Nadu coast during the 2004 tsunami to coastal geometry1, tectonics2 and geomorphology3,4, the present observations made in certain worst-affected areas of Tamil Nadu coast like Devanampattinam (A), Tirumullivaalasal (B) and Nagappattinam (C) located amidst the fluvio-marine and marine landforms (D, Figure 1 a) show that improper development by humans has significantly contributed to tsunami inundation. Hence anthropogenic input warrants attention while framing strategies for tsunami mitigation.

Devanampattinam village (1) (Figure 1 b, e and f) is located on an elevated palaeo beach ridge (2) with well defined drainage channels of Ponniyai (3), Gadaliam (4), a swale (5) on its three sides and thin beach (6) to its east. The eastern slope of the beach ridge (7) has been flattened to develop a beach resort (Figure 1 c). During the recent tsunami, the waves (8) have directly gushed into the village, rolling over the flattened beach ridge, and inundating the eastern slope as well as the village. Direct gushing of the tsunami waves over the beach ridge and the village is well-manifested in the form of westerly-deflected plants and bushes found to the east of the village (Figure 1 d). While beach ridges of the same elevation range with or without villages on them, were not affected in other parts of Tamil Nadu, the massive disaster at Devanampattinam despite well-defined drainage channels all around indicates that it is mainly due to the destabilization of beach ridges for beach resort development.

The Tirumullivaalasal settlement (9) located on the northern bank of Uppanar River (10), is another area badly affected by the tsunami. The east-northeasterly-oriented sandbars (11) and meander scars (12) seen to the south of the village show that such original east-northeasterly flowing river might have been pushed towards southerly due to the growing settlements in the north. At the same time, nine-month northerly-moving vibrant littoral currents1,2 (13) would not have allowed the river to shift towards southerly and hence, the river might have taken a 90° left-angled turn, enveloping the village and laid its mouth (14) to the east of the village. Littoral currents have subsequently built bay mouth bars (15) at its mouth. Thus, as the village is now positioned right at the mouth of the river, the ferocious waves (16) have gushed through the river mouth and destroyed the village. Had the village not been established abutting the river at its northern bank, neither the river flow would have been modified nor the new river mouth would have been formed facilitating direct entry of waves into the village, causing such a major disaster.

Nagappattinam township (17), the yet another severely affected region during the tsunami, is located on the northern bank of the northeasterly flowing river (18), which is also called the Uppanar River. The original river mouth has been closed by a concrete wall (19) and the river has been diverted towards northerly (20) all along the eastern fringe of the township and west of the coast, and made to open its mouth (21) just east of the town for harbour purposes. Thus the waves (22), unable to enter the original sealed river mouth, took advantage of the river mouth – river bed system and gushed onto the settlements and inundated the entire area, leaving only the central part of the town.

Thus, the observations made in the above three worst-affected areas show that the disaster was of such colossal magnitude only because of the improper developmental practices carried out without understanding coastal morphology and morphological processes. These ob-
Figure 1. a. Devanampattinam (A), Tirumullaivasal (B), Nagapattinam (C), Fluvio-marine and marine landforms (D). b. Devanampattinam village (1), palaeo beach ridge (2), rivers (3, 4), swale (5), beach (6), flattened beach ridge (7), tsunami (8). c. Flattened beach ridge in Devanampattinam. d. Westerly-deflected plants and bushes. e. Tirumullaivasal settlement (9), Uppanar river (10), sandbars (11), meander scars (12), littoral currents (13), river mouth (14), bay mouth bar (15), tsunami (16). f. Unaffected Nagapattinam town (17), Uppanar river (18), concrete-walled river mouth (19), diverted segment of river (20), new river mouth (21), tsunami (22).


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