low, confirming lack of an enhanced calcium absorption.

It is clear that the diabetic rat responds to low-calcium diet by a significant increase in active transport of calcium by the duodenum. Unlike normal rats, diabetic rats do not seem to require intact parathyroid glands for this adaptation. Diabetic rats do show a rise in plasma level of 1,25 DHCC in response to low-calcium diet[4]. However, such levels are still less than those encountered in normal rats on standard lab chow[4] and may still be insufficient to cause an increase in synthesis of calbindin9K, a key protein involved in the active transcellular transport of calcium[7]. In view of these observations, it is likely that some other mechanism is involved in the adaptation of diabetic rats subjected to low-calcium diet.

Recently, the existence of calcium sensor in the intestine with capabilities of modulating the transport in response to plasma calcium level has been proposed[8]. Perhaps such a sensor is upregulated in diabetic rats, which show an increase in the size of intestinal mucosa[9]. This in turn may promote calcium transport in the absence of parathyroids in diabetic animals. Our experiments provide an impetus to look into these possible avenues of research.

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Reclamation and status of tsunami damaged soil in Nagappattinam District, Tamil Nadu

The 26 December 2004 earthquake (9.4 on the Richter scale) in the Indian Ocean led to generation of tsunami which caused devastative damages to human life, natural resources, livelihood assets and infrastructure. In the context of agriculture, the tsunami caused severe damage to standing crops as well as agricultural fields in Kancheepuram, Villupuram, Cuddalore, Nagapattinam, Thirunelveli and Kanyakumari Districts in Tamil Nadu, of which Nagapattinam was the worst affected district. In this district, the basic resources such as soil and water in the farm were severely affected; while common and grazing lands got salinized. Nearly, 4657 ha of cultivated area were affected due to salinization, of which 1367 ha were subjected to sand and silt/clay deposition.

The soil in Nagappattinam District is predominantly sandy in texture and clayey in certain pockets with slight salinity/alkalinity. The soil of the region belongs to the Valudalakudi series and possesses characteristics of dark brown to brown, deep, sandy and mild to moderate alkalinity levels[1]. During the pre-tsunami period the soil pH ranged between 6.1 and 8.55 and electrical conductivity (EC) between 0.2 and 1.1 dsm^{-1}, whereas the post-tsunami analysis (January 2005) showed a steep increase in pH to more than 8.5 and seldom exceeded 9 in selected locations and EC up to 23.7 especially in the clay deposited fields[1].

The type and intensity of damage to soil resources due to intrusion of tsunami varied across the affected areas in the district. Thus it was necessary to understand the area-specific issues as well as the multidimensional nature of the problem. The explorative soil analysis and discussion during July 2005 with the local farmers through a travelling workshop across the affected areas was organized by the M.S. Swaminathan Research Foundation (MSSRF, Chennai) in collaboration with 11 technical and academic institutions. The outcomes revealed three different kinds of major damages to soil such as: (i) Deposition of slushy greyish brown clay deposit; (ii) Sandy soils, and (iii) Sea water intrusion, which receded from the field (within 3 h to one week) leaving behind salts in the field. Among the devastating damages, the clay deposit was a cause for concern among scientists, NGOs and farmers for its mineral constituents and hence heavy metal analysis was carried out. The results showed that heavy metals like, nickel (12 mg/kg), zinc (32.5 mg/kg), chromium (35.5 mg/kg), copper (99.8 mg/kg) and lead (56 mg/kg) were comparatively less than the permissible limits of Indian compost standards with the exception of cadmium (31 mg/kg). (Heavy metal analysis of tsunami clay deposited material collected from Pushphavanam (a village located in Vedaranyam block, south of Nagapattinam) during July 2005 and April 2006 and analysed at the Indian Institute of Technology, Chennai.) At the same time, the clay deposit was rich in organic matter (0.6–1.2%), having good water-holding capacity and cation exchange capacity with an exchangeable sodium percentage of 55. However, more than 90% of the clay deposits were scraped and removed from the field since May 2005 onwards with the support of NGOs working in the field. Similar to soil, water sources too especially farm ponds were severely affected due to deposition of clay material along with seawater inundation. The analysis of water in these farm ponds indicated medium-to-high salinity levels (1.5–26.5 dsm^{-1}) that varied across the affected field ponds in the region. To demonstrate soil rehabilitation, MSSRF identified four villages in Nagapattinam District (Figure 1), which represented different kinds of damage: (1) Neithavasal, Sirkazhi block; (2) Anaikovil, Sembanarkovil block; (3) Vettaikaranirruppu, Kelaiyur block and (4) Vellapallam, Thalainayiru block.

Site-specific agronomic rehabilitation strategies were evolved in consultation with local farmers. Soil quality assessments were periodically conducted thrice in ten farmers' fields in each of the four villages during transplanting (October 2005), panicle formation stage (after heavy rainfall during December 2005) and also after harvesting (April 2006).

Site-specific reclamation strategies like deep ploughing, land smoothening, strengthening field bunds and providing adequate drainage, spreading and incorporation of sand/clay deposits heaped, if any, in the field, *in situ* ploughing of green manures like *Sesbania aculeate*, and leaching, wherever required, depending upon soil EC were adopted. To enhance the soil microbial activity, farm yard manure (FYM) at 5 t/ha and salt tolerant strains of biofertilizers such as phosphobacteria, azospirillum and pseudomonas species at 2 kg/ha were applied. Salt-tolerant varieties like TRY 2, CO 43, MDU 5, ADT 43 and traditional landraces like 'kuzhivedichan', 'kallurundai', etc. were planted. In addition to these measures, the high amount of rainfall received during the north east monsoon (nearly 600 mm in 20 rainy days in November and December 2005)[2] flushed the soluble salts and changed the soil towards neutral and slight salinity.

The soil quality testing shows that in three demonstration sites (Vellapallam, Neithavasal and Vettaikaranirruppu) during April 2006 both the pH and EC levels got reduced to normal levels that are observed in coastal soils before the tsunami and most of the lands were found to be suitable for normal crop cultivation. But, in a few fields in Anaikovil village the soluble salt content was higher during the summer season. When looking closely, the texture of the soil, kind of the damage caused and drainage facility of the field were found to play crucial roles in bringing down the salinity. Among the selected villages for field demonstration in Vellapallam, Neithavasal and Vettaikaranirruppu villages, the texture of the soil is sandy and sandy loam with loose friable texture and having considerable drainage facility, whereas Anaikovil fields are in sandy clay texture with poor soil drainage.

In spite of improvement in soil quality parameters, salinity of groundwater increased in small ponds – a common source used for irrigation in the southern part of Nagapattinam District during the second season March–May. The water quality in farm ponds has medium-to-high salinity levels causing crop loss. Results confirm the aquifer study carried out in a similar situation in Sri Lankan tsunami-affected coasts, where the shallow aquifers got salinized and the water is not suitable for irrigation and drinking purpose[3]. During the monsoon season, if the good quality groundwater which floats over saline water in coastal regions (separated by an impervious layer of clay barrier) is adequate, there will always be a water current running towards the sea, which will carry away the leached salts.

It is concluded based on the detailed soil quality analysis and close monitoring of the affected soils in the post-tsunami context, that the soil quality in terms of soil salinity and soil reaction has improved, however the shallow water-table is still saline. As a long-term strategy, a shift in approach from 'reclamation' to 'soil health improvement' is essential to improve soil fertility. Certain agronomic practices like green manuring

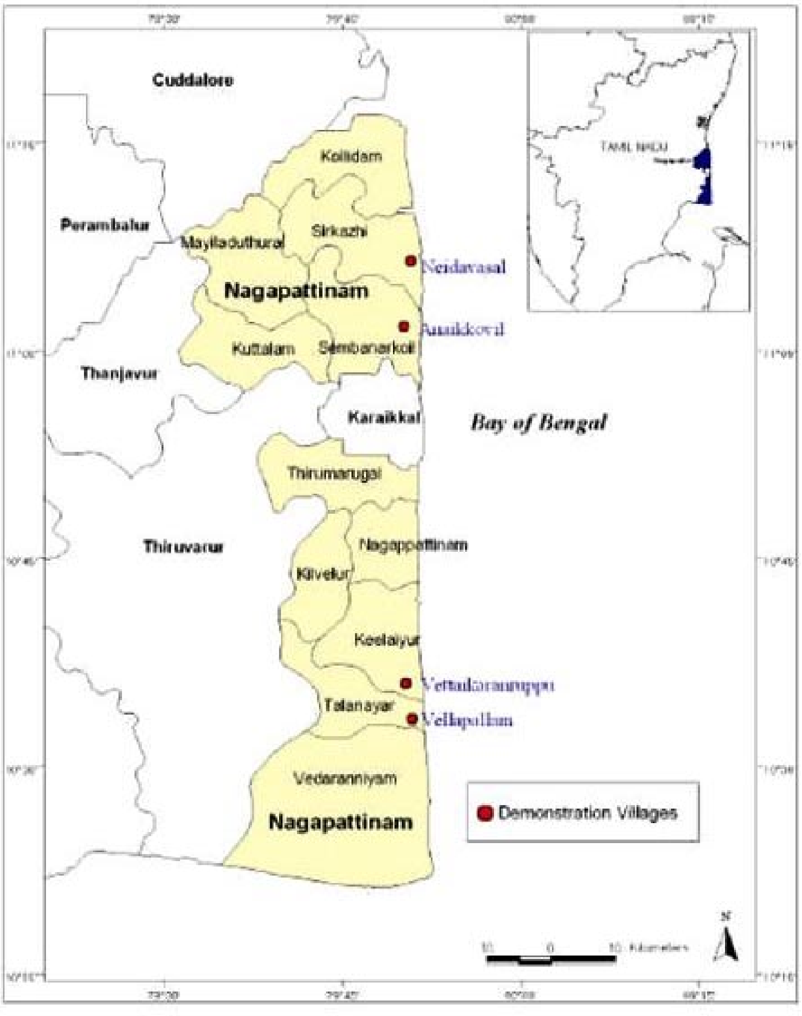

Figure 1. Demonstration villages in Nagapattinam District, Tamil Nadu.

and green-leaf manuring, leaching the excess salts at the time of land preparation or reviving the traditional practice of trenches along the field bunds, FYM or vermicompost application in treatment with biofertilizers, and crop rotation with grain legumes need to be institutionalized at the farm level. Also, it is worth exploring the possibility of reviving the traditional practice that prevailed in the region for reclaiming saline fields through the use of species like *Calotrophis*, *Theprosia purpurea*, etc. as also proper composting. In addition, the integrated farming system approach is a viable option to create backward and forward linkages to use the resources effectively for soil health management. Apart from enhancing soil health, efforts during the current season are needed to study the hydrological situations and there is a need to focus on evolving an integrated reclamation strategy in order to augment and efficiently utilize groundwater resources.

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A holistic study on mercury pollution in the Ganga River system at Varanasi, India

Mercury is one of the heavy-metal pollutants present in the environment. Since the beginning of the industrial era, anthropogenic activities like increased mining, high rate of fossil-fuel burning, widespread use of raw materials containing mercury in the industries are some important contributors of mercury to the environment. Weathering of mercury-bearing rocks releases about 3500 t/yr, while 25,000–150,000 t of mercury is released in gaseous form during volcanic activities. Besides these natural sources, anthropogenic activities add 2000–4500 t of mercury in the global environment every year. Burning of fossil fuels alone contributes 3000 t of the metal every year[1].

The ultimate sink of mercury, probably as cinnabar ore, is believed to be ocean sediments. Part of the released inorganic mercury is oxidized to Hg^{++} and transformed into organomercurials by methylation or other processes. This transformation takes place primarily in aquatic systems. The intestinal bacterial flora of various animals, including fish, though to a much lower degree, are also able to convert ionic mercury to methyl mercuric compounds[2]. Methyl mercury is avidly accumulated by fish and marine mammals and attains its highest concentration in large predatory species at the top of the aquatic food chain. By this means, it enters the human diet leading to serious health problems. The Minamata disaster of early 1950s in Japan was the first recorded case of mercury poisoning in humans. By 1988, 730 human deaths were reported due to the disease, besides 2209 confirmed cases of mercury poisoning in Japan[3].

The Canadian Global Emission Interpretation Center (CGEIC) has studied the spatial distribution of global emissions of mercury into air and has prepared a map of mercury emitted in different parts of the world. It shows that in India 0.1–0.5 t of mercury is released into the atmosphere every year. Emission rate of the metal in coastal areas is even higher (0.5–2 t/yr). According to the study, anthropogenic emission of mercury is estimated to have increased by 27% during 1990–2000 in the country. Thus India is one of the identified hotspots of mercury pollution in the world[4]. Studies show that the aquatic ecosystem in India has significant amount of mercury[5–8], but limited study on mercury in the aquatic ecosystem has been done in a holistic manner.

The present study was aimed to assess mercury pollution in the Ganga River system at Varanasi. Concentration and accumulation of mercury in the river system, including water, sediment, benthic macroinvertebrates, fish, aquatic macrophytes of the Ganga River, and soil and vegetation of the associated floodplains were worked out during the study.

Varanasi is an ancient and religious city situated on the left bank of the Ganga River in its middle stretch in the north-eastern part of India (Figure 1). The city extends from Assi to Varuna, a 7-km long river-face. Over 1.5 million people reside in the city, while the daily floating population is about 0.2 million. Being of religious importance, more than 60,000 pilgrims take a holy dip in the Ganga River at Varanasi every day. The river water is also polluted due to cremation of human dead bodies along its bank. Besides, over 200 MLD effluent is discharged into the river[9]. Up to 1992, there were 2957 small-scale industries, electrical machinery parts and other manufacturing industries in Varanasi, while the number of large and