# Saga of Sea Erosion at Visakhapatnam: *Lessons yet to be learnt*

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Visakhapatnam - a strategically important and fast developing city on the south east coast of India, in the state of Andhra Pradesh; with a huge potential for becoming an economic and commercial hub of South Asia and also of becoming a strategic pivot in the geo-political strategy of maritime nations – *is also known for its beautiful beaches*.

The beautiful natural beaches jutting the Bay of Bengal off Visakhapatnam - have been experiencing episodic erosion since the last 25 years. The problem however, has aggravated during the last 3 to 4 years due to an increasing number of avoidable factors and decisions (*or rather, a lack of them*) by local, regional as well as central administrators and political leaders of the country.

The sea erosion problem has rightfully attracted the attention and *ire* of the public at large, various levels of administration, academicians, scientists, engineers, politicians and many other stake holders - ably aided by a concerned Media, both Print and TV.

Against the back drop of Prime Minister's praiseworthy exhortation to the World in general, and India in particular; that India's economic progress can and should be linked to Indian innovations and indigenization (*Make in India*) - innumerable discussions, deliberations and meetings of various stakeholders resulted in many novices as well as experts in various fields - airing their views about sea erosion, in private and public, generally creating more confusion and chaos to the common public, as well as decision makers and political leaders.

*As is commonly observed and accepted in India*, the decision makers and political leaders formed various working groups and committees (sitting and standing, *sic!*) to look into the problem. During the course of time, national organizations like CWPRS (Central Water and Power Research Station) in Pune, under the Central Ministry of Water Resources, River Development and Ganga Rejuvenation; NIOT (National Institute of Ocean Technology) in Chennai, under the Ministry of Earth Sciences; NIO (National Institute of Oceanography) headquartered in Goa with a Regional Centre in Visakhapatnam, under the umbrella of CSIR (Council of Scientific and Industrial Research) coming under the Ministry of Science and Technology; NRSC (National Remote Sensing Centre) a premier space research agency under the Department of Space which directly comes under Prime Minister; premier academic institutes of the nation - like IIT Madras; local organizations like Andhra University, Visakhapatnam Port Trust, Central Fisheries Institutes, Dredging Corporation of India, Gangavaram Port, Vizag Sea Port represented by many of their experts, coupled with many

international experts, consultants and *players* of India, The Netherlands, USA, Australia and Europe have had either expressed views and opinions, or, participated in various deliberations with concerned administrators and decision makers.

During an initiative taken by the Honourable Member of Parliament of Visakhapatnam, to discuss with all local experts regarding the sea erosion, Prof. Rao Tatavarti (of Gayatri Vidya Parishad and CASTLE), strongly advocated that the complex problem of sea erosion is site specific, and hence so is the solution. Therefore, it was articulated that one cannot resort to solutions which worked elsewhere, *until a systematic study of all the scientifically known parameters which affect erosion are considered in right earnest, at that specific site*.

Prof. Tatavarti further stated in the meeting that his inter-institutional team comprising of researchers and students from Gayatri Vidya Parishad College of Engineering and GVP – SIRC (Gayatri Vidya Parishad Scientific and Industrial Research Centre); Centre for Earth and Space Sciences, University of Hyderabad; and the Indian Maritime University at Visakhapatnam; would be happy to *voluntarily* take up a study of the various conditions at the specific site using all expertise and sophisticated state of art instrumentation available at his team's disposal; if appropriate logistic support is forthcoming from concerned departments.

The problem of sea erosion was consequently discussed in the legislature of Andhra Pradesh by the Chief Minister, as well as in the Parliament by the Minister of State for Science, Technology and Earth Sciences and discussions were held with many National and International experts.

Based on inputs from local administrators, a standing committee with Chairman VPT as the convener and many representatives from many of the above mentioned organizations was created by the Government of Andhra Pradesh, but somehow the names of GVP and University of Hyderabad representatives who voluntarily and proactively came forward to conduct studies were omitted for unknown reasons.

Later, under apparent instructions from the Chief Minister's office the convener co-opted Prof. Rao Tatavarti (GVP) and Prof AC Narayana (University of Hyderabad) in the standing committee as both of them have vast experience in coastal and ocean engineering projects, having worked together for many decades at different places in and outside India.

Notwithstanding the hurdles from different quarters, Prof Rao Tatavarti of Gayatri Vidya Parishad voluntarily steered an inter-institutional team of researchers and students and conducted the *first and perhaps the only known field investigations and detailed scientific study of the nearshore zone (especially the surf zone) of Visakhapatnam* - with various state of art instrumentation coupled with theoretical modelling and simulation studies. Visakhapatnam Port Trust with its dynamic Chairman provided financial support to take care of the logistics for this major field study.

The entire task from the design to development and successful implementation was completed in a record time (even as per international standards and practices) of four weeks; *with locally available human resources* (*undergraduate students and fishermen trained ab initio, and suitably motivated)*, innovative designs and out of the box thinking; with support

from MECON, a local firm which facilitated the logistic support in the form of catamarans for deployment of instrumentation.

The deployment of state of art instrumentation at three spatially separated locations, enabled real time site specific data of cross-shore, alongshore and vertical structures of all the different parameters of waves, currents, tides, sediments, bathymetry, geomorphology, *etc.* pertaining to the nearshore zone (*encompassing the complex surf zone and the location of the specific problem of erosion*). The study demonstrated to the public in general, and the scientific and engineering fraternity in particular, how complex problems can be solved even under challenging conditions and constraints, by locals - *when many national and international stalwarts were suggesting that it is next to impossible to deploy instrumentation in the nearshore surf zone*.

After successful completion of the site specific studies, Prof. Tatavarti and team submitted detailed technical reports (*12 reports running to more than 1300 pages of technical and scientific details*) with a summary of analyses of very large data sets comprising more than 15 million observational data. Based on the site specific studies, the team suggested recommendations for tackling the problem of sea erosion at Visakhapatnam.

The sum and substance of their extensive in-situ studies combined with state of art numerical modelling was that, given the complexity of the nearshore hydrodynamics and sediment dynamics, *construction of any man made structure in the sea would prove to be, not only detrimental to the coast of Visakhapatnam, but also would be prohibitively expensive to the exchequer; and therefore suggested that a shore parallel hybrid rubble mound revetment at the landward edge of the beach can serve as a cost effective protective wall from sea erosion, without jeopardizing the aesthetics of the existing beach.*

The team further suggested that appropriate vegetation on the revetment would also help in enhancing the aesthetics, as well as the beach - over a period of time. The recommended solution was projected to approximately cost, *not exceeding* Rs. 1*crore* per kilometre stretch of coast. The team suggested that the proposed structure can be realized *with locally available human as well as material resources*, at a fraction of the cost compared to the annual sand bypassing costs generally known to be budgeted by VPT, and offered to give a detailed engineering design of the same, if desired by the authorities.

Subsequently, Prof. Tatavarti and Prof. Narayana made a detailed presentation to the Chairman, VPT; District Collector, Visakhapatnam and the Commissioner of Greater Visakhapatnam Municipal Corporation, GVMC. The administrators felt that a decision should be taken after listening to what other National institutes like NIO, NIOT, ISRO and Ministry of Earth Sciences recommend after their studies (*which were not even started by that time, given the peculiar procedures and idiosyncrasies of work culture - associated with governmental organizations)*.

Later, NIO deployed a single wave rider buoy (from *Data Well*, Netherlands) capable of measuring waves at deep water locations at a water depth greater than 10m*, (whose location is kilometres away from the beach of interest, and therefore by no stretch of imagination a site specific study*) to monitor wave heights for a period of time.

Incidentally, the Datawell directional wave rider buoy deployed by NIO is known to be capable of monitoring waves in the frequency range of 0.05Hz and 0.5 Hz only, due to constraints in the fundamental physics of wave sensing mechanisms. This means that far-infragravity waves and motions (wave motions with very low frequency, <0.05Hz) which were generally known and accepted *(by scientific fraternity across the world)* to dominate nearshore dynamics, *and also observed to be at times, dominating the nearshore dynamics off Visakhapatnam by the GVP team* - could not be monitored by the wave buoy.

After some time NIOT apparently conducted a numerical study based on bathymetry surveys conducted off the deeper waters of Visakhapatnam (*as regular boats cannot easily venture into surf zone*) and reached conclusions regarding the preventive measures for Visakhapatnam beach erosion, based on whatever archived data available with Ministry of Earth Sciences.

NIOT with active collaboration from NIO and Andhra University made recommendations to the Government of Andhra Pradesh that *a submerged structure should be built parallel to coast* in water depths of 3 to 5m with special structural units called *tetrapods*.

NIOT and others also recommended that *geo-synthetic tubes should be additionally placed for protection of the beach*, primarily arguing that these measures worked elsewhere in the world and some international experts can vouch for *their* efficacy. The projected cost for the solution was approximately pegged at INR 100 crores.

Even teams representing World Bank came forward to look at sea erosion at Visakhapatnam and offered loans (*of course, to be repaid with premier interest rates*) for resolving the problem by advocating long term engineering solutions to be suggested and implemented by, *you guessed it*, International Agencies *in sync* with World Bank practices and procedures.

Administrators, politicians and even some in the scientific fraternity were thrilled that the local problem had garnered international attention. Many of the decision makers of the state as well as many interested parties outside the country, were visibly excited, apparently at the opportunity of working on a complex problem with significant commercial spin offs.

The Government of Andhra Pradesh, in its wisdom immediately agreed *in principle* to the NIOT recommendations and asked an international agency DELTARES based in The Netherlands to vet the NIOT recommendations and give their views.

Naturally, there was a general amnesia regarding possible irritants and banalities like *Make in India,* and other such related exhortations by well-meaning people.

Presumably, there was a collective yet firm belief, that complex issues and problems created by Indians with either vested interests or appalling levels of inefficiencies and ignorance *(like the sea erosion problem of Visakhapatnam whose roots lie in indiscriminate developmental activities, aided by the complex vagaries of the ocean)* cannot be solved with local expertise and resources.

It seems ridiculous, that we still have to deal with decision makers who strongly believe that Indians are incapable of finding long lasting solutions to complex engineering problems of India. This attitude, *nay conviction*, is clearly an insult to the Indian capabilities and intelligence, in a day and age when India showed the world that it could send a complex technological system *Mangalyaan*, built in India by Indians, at an incredibly low cost that astonished the entire world.

The saga of sea erosion took an interesting turn, when the team from DELTARES refused to appreciate the wisdom in going *for submerged structures and geo-synthetic tubes* in the nearshore zone and indicated that they would like to conduct their own site specific study to arrive at optimal solution, *of course after receiving a request and substantial funds by the concerned authorities*. The DELTARES views have thus pushed the entire saga of sea erosion at Visakhapatnam, back to square one.

Three years after the sea erosion problem caught the attention of decision makers, we are again at a time (January/February) when the sea is expected to taunt the locals by making its now customary annual jaunt shoreward onto the Visakhapatnam coast.

The confounding irony, typical of decision makers in India - *three years on, and the decision makers are nowhere yet to take a decision.* The long winded yet unsolved saga of the sea erosion at Visakhapatnam, should therefore serve as an eye opener to the decision makers of the country, who would *hopefully* be accosted by the following lessons:

- *What's good for goose may not always be good for gander*. Effective solutions in USA, Europe or Australia may not be effective in India.

- *The difference between possible and impossible, lies in the determination*. Nearshore field experiments in the surf zone, hitherto claimed to be very difficult, if not impossible were successfully completed by a small team with local resources, under challenging constraints.

- *Knowledge and ability to solve complex engineering problems are neither proprietary nor the prerogative of National/International institutes*. History and legacies cannot solve present problems; a lot depends on the people who are working on the problems. Ideas propounded by small dedicated and motivated teams can help in Nation building.

- *It pays to not only listen to our own people with good intentions, but also have the wisdom and ability to differentiate good intentions and vested interests.* Cost effective and simple solutions *can also be* the optimal solutions for complex problems.

On a concluding note, it would certainly be an interesting turn of events for decision makers, if the sea decides to show its prowess during the International Fleet Review at Visakhapatnam; when the Indian Navy, Raksha Mantri of India, Prime Minister of India, and of course, the Commander-in-Chief of the Armed Forces of India would like to showcase the nation's capabilities to the many distinguished international visitors.