

**CENTRAL WATER COMMISSION
CAUVERY & SOUTHERN RIVERS ORGANISATION,
BEACH EROSION DIRECTORATE, COCHIN – 682020.**

**First meeting of
Coastal Protection and Development Advisory Committee (CPDAC) Sub –
Committee**

on

Performance Evaluation of Coastal Protection Works

Meeting: July 12th 2004 (Forenoon) Venue: CWC Office Complex
Field Visit: July 12th (AN) & 13th 2004.

A. Summary Record of Discussions of the Meeting

The first meeting of the CPDAC Sub – Committee on Performance Evaluation of Coastal Protection Works was held at Cochin on 12th July 2004. The performance evaluation of the works in Ernakulam and Thrissur Districts of Kerala was taken up. The field inspection of the coastal areas of these two districts was carried out on 12th (AN) and 13th July. The following were present in the meeting.

CPDAC Sub – Committee Members:

- i) Dr. T.G. Antony Balan, Chief Engineer, C&SRO, CWC, Coimbatore & **Convenor**, CPDAC Sub – Committee.
- ii) Shri T.K. Sasi, Chief Engineer, (I&A), WRD, Government of Kerala.
- iii) Shri I.Z. Poonawala, Joint Director, CWPRS, Pune
- iv) Shri J. Chandrasekhar Iyer, Director, BED, CWC, Cochin & **Member - Secretary** of the CPDAC Sub – Committee.

Invitees:

- i. Ms. Lathika, SE, Irrigation Central Circle, WRD, Thrissur
- ii. Shri K.S.S. Namboodripad, DD, BED, CWC, Cochin.
- iii. Shri Joppan, EE, Irrigation Division, WRD, Ernakulam.
- iv. Shri Sasankamanidharan, AEE, Irrigation Division, WRD, Thrissur.
- v. Shri A.K. Babujayathilakan, AEE, Irrigation Division WRD, Kodungallur.
- vi. Shri Mathew Raphel, AEE, Addl. Irrigation Sub – Division, WRD, Thrissur.
- vii. Shri M. Shivanandan, AEE, Irrigation Sub – Division, WRD, Ernakulam.
- viii. Shri N.S. Hari Narayan, AEE, Irrigation Sub – Division, WRD, Aluva.
- ix. Shri K.M. Hamza, EAD, BED, CWC, Cochin.

Dr. T.G. Antony Balan, Chief Engineer, Central Water Commission welcomed all the members of the sub – committee and other participants to the meeting. In his introductory remarks, he informed that coastal erosion is a very severe problem experienced by the State of Kerala along a major part of its coastline. Government of India was seized of the problem in early sixties. In order to initiate, guide and implement the programme of anti – sea erosion measures envisaged in Kerala, Ministry of Irrigation and Power, Government of India, in 1966, constituted a “Beach Erosion Board”. Further, the Board was reconstituted in 1971 and again in 1989 enlarging its scope to the entire coastline of the country. In 1995, Ministry of Water Resources, Government of India reconstituted and renamed the Beach Erosion Board as Coastal Protection and Development Advisory Committee (CPDAC).

He informed that Government of India had been providing Central Loan Assistance to States/UTs for protection of seacoast till 1991-92. Kerala has been a major beneficiary in this regard. The main coastal protection measure adopted by Kerala has been by construction of seawalls. No performance evaluation studies were carried out for the coastal protection work done by the State in the recent past. He brought to the notice of the participants that CPDAC vide Ministry of Water Resources resolution dated 17th April 1995 has been given the mandate to review the performance of the works carried out by the States and evolve improved design techniques based on such experience from time to time. Chairman, CPDAC in the 6th meeting held at Pondicherry in April 2004 has constituted a Sub-Committee for performance evaluation of coastal protection works in various States. The sub-committee may visit sites in the maritime States and submit its report to CPDAC. Considering the severity of problem, the States of Kerala has been taken up in this first meeting of the sub-committee being held at Cochin.

Shri J. Chandrasekhar Iyer, Member Secretary of the sub-committee briefed the participants about the sub-committee’s task. He informed that two districts of Ernakulam and Thrissur in Kerala are being considered for this meeting. The sub-committee has to discuss and deliberate on the performance evaluation of the coastal protection works carried out in these two districts. He informed that the meeting will be followed by visit to coastal sites in these two districts.

In Kerala, the responsibility of coastal protection from erosion lies with the Irrigation Department. Chief Engineer (I&A) based at Trivandrum heads this set-up. The Irrigation Divisions of Ernakulam and Thrissur fall under the jurisdiction of Superintending Engineer, Irrigation Central Circle, Thrissur. The coastal district of Kerala is shown in Fig. – 1.

The two Executive Engineers presented a report of their respective Divisions. The members had detailed discussions with the Irrigations officials on the coastal erosion problems and protection measures. The presentation contents are briefly brought out here.

i) Ernakulam Division

The coast length of Ernakulam District is 48.085 km divided into two sections. The coast south of Cochin sea Mouth (port inlet channel) is Chellanam section and the coast north of it is Vypin section. The length of Chellanam and Vypin sections are 20.905 km and 27.18 km respectively. Most of these areas are densely populated and highly prone to action of sea waves even in non-monsoon months. The fishing gaps along the coast are the most vulnerable areas during monsoon months. The coastline of Ernakulam District is shown in Fig. -2.

The main vulnerable areas south of sea – mouth in Chellanam section are Fort Kochi, Beach road, INS Dronacharya, coast Soudi, Cheriya Kadavu, Kannamaly, Puthenthodu, Chalathodu, Gunduparambu, Kandekkattu and South Chellanam. In the Vypin section, north of the sea-mouth, the main vulnerable areas are Elamkunnappuzha, Njarakkal, Nayarambalam, Edavankadu, Kuzhipilly, Cherai, Pallipuram and Munambam.

The coastal protection measures adopted in Ernakulam district in the past are seawalls, groynes or a combination of the two. These have been constructed 20-25 years back. These structures are either partially or fully damaged at many places. The comments and suggestions put forth by the Executive Engineer, Ernakulam Division are as follows:

- a) The main causes of damage to the seawall are due to toe scouring, undermining and subsequent sinking of the seawall. The inundation of the land area behind the seawall, at places, due to the overtopping and underflow has further aggravated the leaching action below the seawall. Presently, the crest level of seawall is being adopted as 3.35m. The suggestion is that overtopping can be limited to a great extent by raising the crest level to 3.90m.
- b) The lowering of bed level in front of the toe of the seawall due to overall changes in bathymetry of the area over the years, has increased the wave action on the seawall, rendering them more vulnerable.
- c) The combination of seawall and groynes (about 30 m long) at about 150 m interval has been working more satisfactorily compared with provision of only seawalls, especially in the northern portion of the seacoast of INS Dronacharya. The combination of seawall-groynes may be considered for the full stretch of the coast as recommended by CWPRS for INS Dronacharya. The groynes trap the sediments in between the groynes and lead to formation of a beach. A combination of seawall and groynes is projected as a reasonably good solution. The sediments dredged by the Cochin Port Trust from the inlet channel can be used for artificial beach nourishment in the area.

- d) Any rubble mound structure such as seawall or groynes is a flexible structure and it is essential to maintain the same as and when damages occur. Periodic survey of the seawall and maintenance thereof should be undertaken. Any damage to the covering armour layer should be repaired immediately to avoid further deteriorations of the structure. A minimum of 10% of the cost of construction of seawall should be set aside for maintenance every year.
- e) As per the typical design of seawall, the land side portion of the seawall is to be filled up to 2.74 m level for a length of 4.50 m from the heel of the seawall. But since most of the areas are thickly populated and fishermen huts are located very near to the seawall, this filling work is not possible. As a result this, underflow is experienced through the core portion of the seawall. To arrest this, replenishing work such as constructing of a retaining wall at a distance of about 6 to 8 m from the heel of the seawall and then filling the inbetween portion using sand bags/gravel up to the core top level of seawall (+2.45 m) with a slope of 1 in 10 towards seawall were done at some stretches in Chellanam area on an experimental basis. This has given good results. The slope given towards the seawall helps escape of overtopping water to the sea. So this type of replenishing work can be undertaken wherever possible where such restriction of area behind the seawall is encountered.

ii) Thrissur Division

The coastal length of Thrissur District is 61.50 km. The sea plays innumerable havoc in the densely populated coastal areas, more so in the monsoon months; the sea attack is most profound to the coasts adjacent to the outfall of two rivers, Chettuvai and Periyar. Out of the district's total coastline of 61.5 km, a length of 30.45 km have been protected. The coastline of Thrissur District is shown in Fig.-3.

The reaches facing severe sea attack in Thrissur District are Eriyad, Pay Bazaar, Azhikkode lighthouse, Thuttukadavu, Anchangadi, Kampanikkadavu, Lorry Kadavu, Kara, Vekkod, Pokklai, West Vemballore, Perinjanam, Arattukadavu, Vatanappilly Ganesamangalam, Ethai, Manakkadavu, and Velichananpady.

The coastal protection measures adopted in Thrissur District mostly consist of seawalls. Damaged and sunk groynes can be seen in certain locations. These structures have been constructed 20-25 years back. At many places, these are partially or fully damaged. The officers mentioned that this is primarily due to lack of maintenance due to insufficient funds for planned maintenance of these structures.

The seawalls in the district have been constructed adopting the design evolved by the State Government (KERI Peechi.) It was reported that the modified section given by CWPRS with a base-width of 21.0 m considerably reduced the quantity of armour stones required in the traditional design. The CWPRS design has a provision of a toe berm. It was also informed that a 300 m long seawall has been constructed recently at one of the erosion sites in Thrissur District as per the modified design suggested by CWPRS, and the seawall is performing well without any damage for the past two years.

Shri I.Z. Poonawala, Joint Director, CWPRS, made a powerpoint presentation highlighting the coastal processes along the country's coast, coastal protection measures being adopted elsewhere and new techniques attempted in other maritime States/UTs. He mentioned that the seawall design was given by CWPRS in 1991-92 for specific sites after wave flume studies. He stated that the same section cannot be applied everywhere and recommended periodic review of the design based on local conditions.

Shri. J. Chandrashekhar Iyer summed up the remarks and suggestions put forth by the two Irrigation Divisions for increasing the efficacy of the coastal protection structures. He requested the State Engineers to submit the details regarding targeted benefits vis-à-vis benefits accrued from the coastal protection works carried out in the last 10 years.

Shri T.K. Sasi, Chief Engineer (I&A) mentioned that the seawall design was evolved in sixties which underwent modifications over the years. The typical section of a seawall being adopted in the State is shown in Fig-4. Based on the recommendations of experts, the crest level of new seawall in certain areas were increased to +3.90 m. This new section with crest level +3.90 m is shown in Fig-5. The typical section being adopted for reformation of damaged seawall is shown in Fig-6. The seawall section as per the modified design by CWPRS based on wave flume studies in 1991-92 is shown in Fig-7. He stated that the modified design of CWPRS has been executed in certain reaches in the State and these are performing well.

Dr. T.G. Antony Balan, in his concluding remarks stated that both the Irrigation Divisions should systematically document all the information about the coastal processes, coastal protection works and submit it to the sub-committee before the next meeting.

The meeting ended with a vote of thanks to the Chair.

B. Site Inspection Report

In continuation to the meeting, the sub-committee undertook field visits of the coastal erosion sites and the protected sites in the two districts in the afternoon of 12th July and full day on 13th July, 2004. The inspection team was led by the Convener, Dr. T.G. Antony Balan. The details of the site inspection are described in the following paragraphs.

i) Ernakulum Division

The location of seawalls constructed by the State Irrigation Department over the last 25 years along the coast of Ernakulum District is shown in Fig-2.

a) South Chellanam

The seawall at South Chellanam was constructed about 25 years back as per the design evolved by the State. No maintenance was carried out for the past several years. As a result, the seawalls have suffered severe damage at different reaches. The seawall was constructed with 175 to 225 dm³ (400 to 500 kg) stones, maximum size. These were dislodged due to monsoon waves over the years and core stones of 20-45 dm³ (50 to 125 kg) were exposed at few places (Photos 1&2).

It was informed by the EE that damage is caused mainly due to action of sea waves overtopping the seawall during monsoon. It is necessary to carry out repairs to the seawall and raise the crest height up to +3.9 m level to avoid overtopping and future damage.

b) INS Dronacharya, Fort Kochi

The coastline at the Naval Establishment, "INS Dronacharya", located at Fort Kochi is suffering extensive damage from sea erosion. About 2.4 km long existing seawall and groynes constructed more than 20 years back have been damaged and settled at different places. CWPRS had recently carried out wave flume studies for strengthening the seawall and the groynes. Based on wave flume studies and desk studies, CWPRS submitted the Technical Report in April 2003. During the visit to INS Dronacharya, the Commanding Officer gave a presentation on the history of the damage to seawall at INS Dronacharya, and described the problem of erosion in the area. It was informed by the Naval officers that due to the high wave action during the current monsoon, in the first week of May 2004, further damage has taken place, and at few strategic locations, settlement of the crest of the seawall was noticed and emergency measures by dumping sand filled bags were carried out by the Navy (Photos 3&4).

It was observed during the inspection that some reformation work by raising of the crest level of the seawall has been taken up by the Irrigation Department. Also repairs to the damaged groynes have been undertaken by the Irrigation Department (Photo-5). The Naval officers informed that the repair works are being carried out manually and no proper machinery such as crane for placing the armour stones on the slope is used. As such, the armour stones dumped manually from steep slope are unstable against action of the monsoon wave and causes further damage (Photo-6).

During the meeting of the Naval officers with the Committee members, it was emphasized that to take up the restoration work of the damaged seawall and the groynes as per the CWPRS report, some good contractors who can mobilize the required equipment/machinery, namely, cranes with sufficient boom length to place the stones in the toe-berm and the slope etc. may be employed instead of the present set of Irrigation Department Contractors whose capabilities in the use and mobilization of heavy machinery are limited.

c) Puthu Vypin

Vypin island is located at the north of the main entrance channel (Cochin gut) of the Cochin Port. (Fig-2). It was observed that large scale accretion has taken place over the last 20 years or so in the area, the approximate area of the accreted land called “Puthu-Vypin” is a about 300m wide and 4 km long (Photo 7 & 8). The seawall, which was constructed about 25 years back, is buried in the accumulated sand. The seawall is presently located about 500 m inside the present coastline (Photo-9).

d) Njarakkal

The rubblemound seawall at Njarakkal, which is located at about 17.0 km south of the Munambam-inlet, was constructed about 25 years back. Adequate maintenance was not carried out for this seawall for the past several years, and the seawall was damaged severely. It was informed by the EE that the high wave action during the present monsoon in the first week of May 2004 caused further damage to the seawall (Photo-10). Due to the overtopping of waves, the houses in the village on the leaside had to be vacated temporarily then. It is essential to restore the damaged seawall and present crest level of +3.35 m needs to be raised to EL + 3.90m.

e) Nayarambalam

Nayarambalam is located at about 15 km south of the Munambam inlet. At the time of inspection, it was high tide with average water level of about +0.8 with respect to Chart Datum (CD) and waves of the order of 2m were seen breaking on the seawall. The restoration work of the old damaged seawall by the Irrigation Department is in progress at this site. It was observed that the crest height of the damaged seawall is being raised to EL +3.9 m and the stones weighing about 500 kg are being manually lifted and placed on the crest (Photo 11 & 12). On enquiry, it was learnt that about 80 stones per day are lifted and placed on the crest by about six laborers. The stones are dumped in a similar way on the armour slope from the crest, and as such, the proper armour slope is not maintained which results in dislodgement of stones due to waves, causing further damage.

f) Puthenkadapuram

Puthenkadapuram coast is located north of Nayarambalam. The sea waves overtopping the seawall has brought huge quantities of sand along with the waves, and this sand covered the existing seawall and adjoining coastal road with sand piles. The seawall and the road are not visible. The houses behind are facing the wave attack as well as sand deposition. Temporary stone protection has been provided on top of the existing seawall, and sand bags protection surrounding the houses.

g) Cherai Beach

The Cherai Beach is a tourist centre located south of the Munambam inlet. About 7 km long beach has been formed with a beach slope varying between 1:10 to 1:20 (Photo-13). The old seawall was covered with the accreted beach sand (Photo-14).

ii) Thrissur Division

The location of the different seawalls constructed by the Irrigation Department over the past 25 years along the coast of Thrissur District is shown in Fig.-3.

a) Eriyad

On the coastline at Eriyad, 1.68 km gap has remained unprotected over the last several years. During the current monsoon, the coastline at Eriyad suffered heavy erosion such that few huts and two rows of coconut trees were washed away. Emergency protection measures by dumping stones and sand bags were carried out (Photo-15). This area needs to be protected by a permanent seawall.

Ministry of Water Resources has approved construction of a seawall for a length of 1.68 km between Azhikode and Eriyad between KERI CP 4004 and 4012 for an estimated cost of Rupees Three crore under the Centrally Sponsored Scheme "Critical anti erosion works in coastal and other than Ganga Basin States" during the Tenth plan. For this reach, the State Government has proposed the modified design recommended by CWPRS in 1991-92. The State Government has to get the design of the proposed seawall vetted by CWPRS before proceeding ahead with the execution. CWPRS desired that the beach profiles/cross-sections needs to be taken immediately after the current monsoon i.e. by the end of August at suitable intervals along the coastline where the proposed seawall is to be constructed. The bathymetric survey of the area should also be taken; upto -2 m to 3m bed contours and the data may be supplied to CWPRS.

b) Kazhimbram

The beach is located north of the Munambam inlet. It was informed by the EE that there is a formation of *mud bank* in the sea in this area and due to the mud bank, the wave energy on its leeside is significantly reduced, and a beach formation has taken place. About 200-300 m wide beach with beach slope of about 1:20 was observed at the Kazhimbram site (Photo-16). The old seawall was buried under the beach sand (Photo-17).

c) Vatanappilly

A 300 m long seawall was constructed at this site two years back as per the modified design suggested by CWPRS. The filter layer using Geo-textile was laid under the seawall as per the CWPRS design, and the edge of the Geo-textile was visible on the leeside of the seawall (Photo-18). It was reported by the site engineers and was also observed during the inspection that the seawall has withstood well against the monsoon waves. On the termination of the seawall at southern tip, the seawall was partially damaged due to the high wave action during the present monsoon (Photo-19). The site engineers were requested to take immediate action for making proper roundheads at both the tips of the seawall.

It was observed that the unprotected beach length of about 700 m on the south side of the seawall has eroded during the present monsoon leading to uprooting of rows of coconut trees and collapse of a steel-truss tower (Photo 20 & 21) constructed by local administration not long ago. The Irrigation Department has proposed to construct a seawall in this affected reach. It was informed by the Joint Director, CWPRS that bathymetric survey of the area may be carried out and the data supplied to CWPRS for scrutiny and suggesting suitable design of the seawall appropriate to local conditions.

C. Observations of the Sub-Committee

The general observations of the Sub-Committee after discussions held with the Irrigation Department Officers during the meeting and site inspections are summarized as follows:

- i) The seawalls in most of the vulnerable reaches of the Ernakulum and Thrissur district have been constructed 20-25 years back as per the design evolved by the State Government (KERI, Peechi).
- ii) No regular worthwhile maintenance has been carried out after the construction at any of the locations and the seawall have suffered *moderate to severe* damage over the years at different reaches.
- iii) The main causes of damage to the seawall are due to toe scouring, undermining and subsequent sinking of the seawall. The inundation of the land area behind the seawall, at places, due to the overtopping and underflow has further aggravated the leaching action below the seawall.
- iv) It was reported by the site engineers that at many places the damage is due to overtopping of monsoon waves over the crest of the seawall. The present crest level of +3.35 m needs to be raised to at least +3.90 m.

- v) It was also reported by the site engineers that at many locations there is seepage of seawater through the seawall on the leeside causing inundation/water logging in the area behind the seawall. This may be attributed to the dislodgement of the armour stones and exposure of the secondary/core stones leading to passage of water through voids during the up-rush of the wave action. Proper filter on the leeside of the seawall needs to be provided to minimize the flow. Also, drains/gutters may be constructed on the leeside (where area on the leeside is restricted) so that the seepage water is collected and diverted back to the sea.
- vi) The maintenance work carried out manually without utilizing proper crane or other mechanical devices. This has resulted in randomly dumping of armour stones from the crest without formation of proper armour slope, causing instability to the armour stones and further damage. Also, in State like Kerala, where manual labour is extremely costly, this construction method is extremely primitive apart from being cost-ineffective.
- vii) For construction of new seawalls, the alignment and the level are fixed by the Coastal Engineering Field Studies (CEFS) Division under KERI, Peechi. The Irrigation Department executes the work as per the alignment fixed by the CEFS. There needs to be coordination between the two divisions so as to ensure that the design-section of the seawall evolved earlier by KERI/CWPRS is suitable for construction, considering the existing beach profile/cross sections. If the existing seabed levels have deepened, there is a need to recheck the design of the seawall either by KERI or by CWPRS.
- viii) Due to budget and other constraints, the maintenance work for restoration/repairs to the damaged seawalls has not been carried out over the years resulting in further damage /deterioration of the structures. It is essential to carryout periodic surveys of seawalls for damages and attend to the repairs for which adequate funds have to be made available.
- ix) In view of the long history of construction of seawalls by Kerala (Irrigation Department) spanning over four decades and huge public investment done in this sector, the competent authority i.e. the Irrigation Department should immediately undertake a thorough review of their seawall maintenance practices, the annual budget allocations made for maintenance of these infrastructure, and should come up with a full documentation on the inadequacy of maintenance funds provided year after year (after constructions).

It goes without saying the old idiom “A stitch in time saves nine” is particularly applicable to seawall-groyne infrastructure. The armour-stones toppled during the previous monsoon need to be repositioned and section brought up to shape before onset of next monsoon. It should be well understood that seawall-groynes are flexible civil engineering structures, which are designed (and permitted to be so) to be damaged under extreme events. These flexible structures are extremely amenable to timely repairs and periodic reformation, and their prime advantage lies in this feature. However, they can survive only under a strict regimen of maintenance procedures, to be strictly adhered to by the competent authority in a timely fashion.

The field visits and survey of the damage to the seawalls at locations, and the villager’s reactions at all the locations of the visit, all point to this fact that the engineer-in-charge of the seawall was invariably and completely helpless in carrying out timely maintenance with the paltry budget allocations he/she was receiving for maintenance work of this infrastructure. In not one instance, the villagers quoted attending to timely repairs. Both villagers and site engineers narrated mostly instances of emergency measures undertaken by them primarily at the time of extreme sea wave attacks to salvage their life and property from imminent loss, with the meager funds and resources available with them at the time.

It is also important to mention here, that the visiting team comes off with high laurels, for the devotion and dedication of departmental officers and staff for protecting this infrastructure within their Limitations. The blame for ignoring the maintenance of the infrastructure (over long periods – often extending to decades) is squarely to lie elsewhere.
