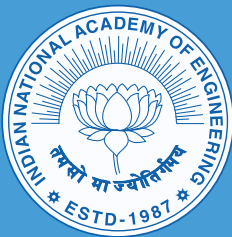


# Engineers Conclave - 2013

Sep 17-19, 2013  
Vigyan Bhawan, New Delhi

## RECOMMENDATIONS



*Organized by:*

Indian National Academy of Engineering (INAE), New Delhi  
Defence Research & Development Organisation (DRDO)

*Coordinated by:*

National Institute of Ocean Technology (NIOT)



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**Indian National Academy of Engineering**

## **ENGINEERS CONCLAVE-2013**

**Organizers: INAE and DRDO**



### **PROGRAM**

**17th September, 2013 – Day 1**

**Venue: Vigyan Bhavan, Maulana Azad Road, New Delhi**

<b>11:00</b>	<b>Opening of Exhibition</b>	
<b>11:00– 12:00 Hrs</b>	<b>Visit to Exhibition, Registration &amp; Tea</b>	
<b>12:00 – 13:00 Hrs</b>	<b>Inaugural Function</b>	
	<ul style="list-style-type: none"><li>• Welcome by President, INAE.</li><li>• Theme of EC 2013 by Chair, SA to RM.</li><li>• Key note address by Dr. R Chidambaram, PSA to Govt. of India.</li><li>• Inaugural Address by Hon'ble President of India.</li><li>• Vote of Thank by Vice President, INAE.</li></ul>	
<b>13:00 – 14:30 Hrs</b>	<b>Lunch / Luncheon meeting with secretaries of S&amp;T departments and invitees*</b>	
<b>14:30 – 15:15 Hrs</b>	<b>Plenary Talk – I by Prof. U.R. Rao</b>	
	<b>Theme I <i>Production and Manufacturing in Aerospace</i></b>	<b>Theme II <i>Engineering Interventions in the Sunderbans</i></b>
<b>15:15 – 17:00 Hrs</b> <b>Technical Session (I )</b>	<b>Parallel Session I  Need of Manufacturing, what is to be done</b>  1. Missiles. Dr. Sekaran, CC (R&D) Missiles.	<b>Parallel Session II  Issues Related to Sundarbans analysis of problems</b>  1. Shri. V.V. Bhat, I.A.S (Retd), Former Sec.to

	2. Launch Vehicles and Spacecraft. Dr. Koteswara Rao, Sc.Sec.ISRO. 3. Defence Aircraft. Dr.P.S Subramayan,Dir, ADA. 4. Industry Perspective. Dr. Pital L&T.	GoI & Member of Finance Atomic Energy, Space and Earth Commissions. 2. Prof. Sugata Hazra, Prof & Dir School of Oceanography Studies, Jadavpur University. 3. Shri. Arun Kumar Saha, Supt. Eng. Sunderban Development Board.
<b>17:00 – 17:30 Hrs</b>	<b>Tea</b>	
<b>17:30 – 18:15 Hrs</b>	<b>Plenary Talk – 2 by Dr. RK Pachauri</b>	

\* Panel Discussion on EC (13:00 – 14:30 Hrs).

Chair – President INAE.

Co-chair- SA to RM.

Discussion Points.

- (i) Concept of EC., how to make it more effective.
- (ii) Listing of important areas where engineering interventions can make difference to country.
- (iii) Listing key issues related to engineering.
- (iv) Next conclave- host and themes.

Participants –themes.

- Secretaries Science Depts.
- VPs INAE.
- Industry leaders.
- INAE council members.
- Etc

Coordinator - Mr. Satheesh Reddy.

**18th September, 2013 - Day – 2**

**Venue: Defence Scientific Information & Documentation Centre (DESIDOC),  
Metcalfe House, New Delhi – 110054**

	<b>Theme – I</b>	<b>Theme - II</b>
<b>9:00 – 11:00 Hrs</b>  <b>Technical Session (II)</b>	<b>Strategy to Achieve the Requirement</b>  1) Dr. Sivatham Pillai – Missiles. 2) Mr. Perumal – LV and Satellite. 3) Industry Perspective – Chairman HAL. 4) Industry Perspective, Mr. Verghese – Lakshmi m/c works.	<b>Scientific studies on various interventions in Sunder ban and various bodies related effect of global warming, migration etc.</b>  1) Dr.A.Jeyaram / Dr. D.Dutta , RRSC-E Kolkata, ISRO. 2) Dr. Uma Panda, MoES-ICMAM. 3) Dr. Subrat Mukherjee, IFS Proj.Dir.Integrated Costal Zone Management Proj. West Bengal.
<b>11:00 – 11:30 Hrs</b>	<b>Tea</b>	
	<b>Theme – I</b>	<b>Theme – II</b>
<b>11:30 – 13:30 Hrs</b>  <b>Technical Session (III)</b>	<b>Policies and Processes</b>  1) Mr. V.K Mishra Ex sec GoI. 2) Mr. Baba Kalyani, Bharat Forge. 3) M/s. Taneja. 4) M/s. Mahendra.	<b>Engineering Interventions that can make a difference</b>  1) Dr. Manik De, Dir. River Research Inst. Kolkata. 2) Dr. Atmanand, Dir.NIOT/ Dr. Ramana Murthy, PD, NIOT. 3) Dr. S.S. Chakraborty, Chairman, CES, New Delhi. 4) Shri.B. Chaudhuri, Chief Hydraulic Eng, Hydraulic Study, Dept. Kolkata Port Trust.
<b>13:30 – 14:30 Hrs</b>	<b>Lunch</b>	

<b>14:30-16:30 Hrs</b>  <b>Technical Session ( IV )</b>	<b>Way Ahead for Industry</b>  1) Organizing Aerospace Quality. Mr. Tamil Mani, DRDO.  2) Industry to Gear-up. Mr. Rahul Chaudhuri, Tata Power.	<b>Enabling the change</b>  (1) Prof. Ravindran, Former Dir. NIOT. Engineering Challenges in Ocean Structures.  (2) Shri. K. Sathiavasani, IAS, Addl.Chief Sec. Sundarban Affairs Dept.
<b>16:30 – 17:00 Hrs</b>	<b>Tea</b>	
<b>17:00 – 17:45 Hrs</b>	<b>Plenary Talk – 3 by Secretary Defence Production</b>	

**19th September, 2013 - Day -3**

**Venue: Defence Scientific Information & Documentation centre (DESIDOC), Metcalfe House, New Delhi – 110054**

	<b>Panel Discussion to arrive at recommendations</b>	
	<b>Theme – I</b>	<b>Theme - II</b>
<b>9:30 – 11-00 Hrs</b>	<b>Chair. Dr. V.K. Saraswat, DAE Bhabha Chair</b>  Panel to be constituted. Panel meet to conclude recommendations.	<b>Chair. Dr. Sam Pitroda, Adviser to PM, Public Information Infrastructure and Innovations</b>  Panel to be constituted. Panel meet to conclude recommendations.
<b>11:00 – 11:30 Hrs</b>	<b>Tea</b>	
<b>11:30-13:30 Hrs</b>	<b>Valedictory Function</b>	
	<b>Chairman – Mr. Montek Singh Ahaluwalia (TBC)</b> <b>EC Chair</b> <b>EC Co-chair</b> <b>Panel Chairs – I &amp; II</b> <b>Few other members from Audience</b>	



## **Engineers Conclave - 2013**

Sep 17-19, 2013 – Vigyan Bhawan, New Delhi

### **Recommendations**

*Organized by:*

**Indian National Academy of Engineering (INAE)  
and  
Defence Research & Development Organisation (DRDO)**

*Coordinated by:*

**National Institute of Ocean Technology (NIOT)**

# **ENGINEERS CONCLAVE EC 2013**

## **RECOMMENDATIONS**

### **INTRODUCTION**

Indian National Academy of Engineering (INAE), the premier engineering professional body in the country, has decided to organize an annual mega event, Engineers Conclave, for engineers to addressing major engineering challenges in the country. It has been decided that event will be organized in partnership with one of the major engineering department in the country (namely DRDO, ISRO, DAE, CSIR etc). Each Engineers Conclave (EC) will have two themes, themes-1, to be decided by the partner department and theme-2 to be decided by INAE, addressing major problem of the society; where engineering intervention is required and can bring perceptible difference to a section of the society.

The first conclave, EC 2013 has been organized during Sept 17-19, 2013 at Vigyan Bhawan, New Delhi in partnership with DRDO. The theme I was “Manufacturing and Productionization of Aerospace Systems”, chosen by DRDO and theme II was “Engineering interventions in Sundarbans”. Honorable President of India, Shri. Pranab Mukharjee inaugurated the conclave at Vigyan Bhawan and an exhibition was inaugurated by the EC 2013 Chair, Mr. Avinash Chander, SA to RM.

Mr. Avinash Chander, in his capacity as SA to RM and Secretary Defence R&D was EC-2013 Chair and Mr. Baldevraj President INAE was Co-chair. A program committee and an organization committee were constituted as per the enclosure I. The program details of the EC-2013 are as per the enclosure II. A round table meet has also been organized with Secretaries from Scientific Department of GoI, members from industry, PSUs, DRDO, Services etc to discuss various issues. In addition to deliberations on the theme, three plenary talks were also organized. The highlight of the Conclave was the panel discussions on each theme to arrive at specific recommendations, which were ultimately adopted by the Conclave in the valedictory function, chaired by Dr. R. Chidambaram, PSA.

As the primary objective of the Conclave was to find solutions to the problem with every stake holder onboard, these recommendations from EC-2013 are of utmost important outcome and it is envisaged that these recommendation shall be brought to the attention of each every one, who can help in their implementation, so that the engineering brings the desired change towards faster development of the country. The recommendations of the EC 2013 for theme-I and theme-II are appended to this note.

## **THEME- 1 – “MANUFACTURING AND PRODUCTIONISATION OF AEROSPACE SYSTEMS”.**

### **DELIBERATIONS,**

1. The technical session I was organized to understand the issues as where do we stand w.r.t. manufacturing and Productionization of Aerospace Systems, namely missiles, Defence Aircraft and launch vehicles and Satellites. It is noted that India has a very robust missile systems of various types and the Agni 5 (5000 km range with a 1000 kg warhead) having second successive success just previous day, the country is very well placed in terms of missiles R&D. In the context of present threat perception, India needs in access of 2000 missiles of various types to be produced every year and the requirement would go up to 4000 missiles a year, once some of the current R&D projects mature in about 5 years. The country currently has capacity produce about 200 missiles a year. Hence, the capacity needs to be enhanced by a factor of 10 immediately and another factor of 2 in the subsequently 5 years. It is primarily due to the lack of manufacturing capability that services have envisaged foreign partnerships. However, if the capacity is not increased in manufacturing and production, country will remain in a very disadvantageous position, even though we have the basic capability to develop and test these missiles.

In the area of manned Defence aircrafts, country is producing some of the aircraft like Sukoi-30 and others under license production in which few critical components come from the OEM supplier. We produce certain trainer aircraft or UAVs in small numbers. The LCA is a major indigenous program, but the production capacity is currently a few numbers where as the required number is in hundreds. It is understood that India will need almost 25 years to meet the current requirement of the LCA in various versions. The country needs to augment the aircraft production by one order of magnitude, with major update in production techniques, jigs and fixtures. The production technology upgradation is further needed to address the new fifth generation aircraft, which are in the pipe line.

India has done well with respect to developing capabilities in space. The PSLV with its 22 consecutive success has become a work horse, however, GSLV is struggling to overcome last failure about 3 <sup>1/2</sup> years back. The new GSLV mark III is suffering large delays due to shortage of test facilities, being occupied by the GSLV mark II. Inspite of best communication satellites, particularly the I3K bus, more than half the DTH services are being served by hiring capacity on foreign satellite. It is another example of very good success story of development, but not able to meet the capacity requirement. The global satellite business is approximately 190 billion USD, however, Indian companies are running abroad to

meet India's domestic market demand, rather than competing for being part of this 190 billion US \$ business.

To conclude the scenario of Aerospace Systems, it is noted that though there are few technology gaps, but, by and large it is the lack of manufacturing and production capability that is hampering India's growth, forcing large imports and thus not able to contribute to industrial and employment growth. India is and likely to remain the largest importer of Defence equipment in the world at about 10 billion US \$ per year for the next decade. Can India afford it ?

2. The second technical session addressed the strategy issues to achieved the capability, with views coming from R&D and Industry. One common perception emerged is that the government system is not suited to meet the requirement of quantity. While government system works well for R&D as there are lot of challenge, this system does not deliver for repetitive functions. Even though the government owned Public Sector Units do not accept this, their lack of performance and professionalism is a major factor for delays. The rules and safe approach for the executives is forcing to place order with PSUs. As a result, the private industry is not becoming a part of the Aerospace Process, and where ever it contributing as partner in technology development, it is never sure of getting orders to offset the R&D cost, as the tendering process does not give weightage to expertise developed and investment during the development phase.

It is concluded that the only strategy of the country for manufacturing and production has to be to involve private industry in a big way, by considering it a partner, rather having a cynical view that private industry is only interested in making quick money. The whole world, from whom we are purchasing our equipments is producing in private industry.

However, there are many issues to be addressed in the private industry. Like investment in R&D, tying up with industry in advanced countries, independent QA set-up in the industry, third party quality houses, sustain expertise and maintaining secrecy and confidentiality of projects and technology. While the industry needs hand holding, industry also needs to invest in quality manpower and quality processes.

3. The third technical session was on Policies and Processes and was primarily addressed by the industry representatives. One message industry conveyed that Indian industry is lacking in capability is a myth and that Indian industry in certain areas is as good as best in the world. Another message the industry is giving is that industry is not being treated as partner. Its entry is rather not being encouraged. Third message industry representatives gave is that industry is ready for any type of change bring quality systems into place, provided, it is handheld by the



development partner. It is ready to spend in R&D provided there is certainty of orders.

In short, Indian industry is looking for a paradigm change with which the industry is approached for high tech technology in general and aerospace technology in particular.

4. The forth technical session was for suggesting way ahead for the industry. A special talk was organized on aspects of quality systems that will be needed to be established in the country and industry, to meet the manufacturing requirement of a bigger scale. A few examples of wonderful work done by the industry, like Project Dhruva, the 500 MW Fast Breeder Reactor were presented. It was emphasized that industry is ready to gear-up for a larger role; provided there is a conducive environment for the industry to grow and a spirit of true partnership is nurtured by the premier government R&D establishment. The Defence PSU Chiefs have their own limitations, of not having enough autonomy in investment and decision making. They have to look at Delhi for every major decision for upgradation and investment, which, they have to follow all the GoI policies w.r.to staff benefits.

Plenary talks at the EC-2013 were very analytical, illustrative and focusing on what needs to be done, highlighting success stories in their respective domain, each had a suggestion to make on policy on processes. The panel discussion took note of these strong suggestions and the following recommendations have emerged from the valedictory function of the EC 2013.

## ISSUES

### 5. POLICY

- (1) The country needs major push towards “Manufacturing and Production of Aerospace Systems” capacity, by an order of magnitude in very short terms and further doubling it in another 5 years, with state of the art technology for cost effective, quality and competitive manufacturing.
- (2) While DPSUs need major upgradation and professional management at all levels, the private industry is to be involved as partner, right from the development onwards and policy has to be in place for it to be in the high-tech business, through continuous involvement.
- (3) Whenever numbers are large, say production quantities in money values of 1000 crores or more, more than one production agency be involved from the very beginning, to make the production competitive and efficient.
- (4) It is noted that DPSUs work under serve GoI control and do not have adequate autonomy to respond to fast technology changes / upgradation requirement. There has to be paradigm change in the management structure, a professional

management with autonomy, something on the lines of L&T, which though comes under private industry category, but in practice, it is more like a public limited company.

- (5) GoI should be ready to invest in private companies for upgradation of production capability, to be recovered over a period of 10 years of production, with necessary safe guards of its investment. While tough laws can be created for violation of interest of the government against executives and industry, the executives need to be given higher powers / authorization in the decision making. Over vigilance in the present circumstances has developed a play safe tendency in the executives by ordering with DPSUs, even at the risk of production schedule. This needs to change and project executive be given more confidence and trust in their decision making.
- (6) Unfortunately, finance is applying common rules for general administration and high tech Aerospace. Special mechanism needs to be created to deal with high tech industry, particularly in the context of empowerment. The L-1 practice has caused much concern as the competent industry with qualified manpower cannot compete with low level industry in L-1 regime, which in turn reflects lack of professionalism, problems in production and schedule, ultimately frustrating experiences.
- (7) There is an urgent need for technology upgradation in many areas, namely
  - Materials – both metal and non metals
  - Sensors and devices
  - Technology for miniaturization
  - 3D printing technology for making components.
- (8) Private Industry does not have adequate quality mechanism for aerospace and there is need for establishing 3<sup>rd</sup> party Quality Houses and Certification labs.
- (9) Exports act as driver for competitive technology, and growth of private industry, hence export policy has to be formulated.
- (10) Policy should allow joint IPR whenever there is collaborative R&D, even though bulk of funding may come from GoI.
- (11) There should be special emphasis on development of raw materials and indigenous materials should be used to the extent possible.
- (12) There should be explicit institutional mechanisms to share expertise and developments among various agencies of the GoI, namely DRDO, ISRO, DAE, CSIR, DST etc.

- (13) The services should adopt spiral development approach to accept mark I indigenous product, even if it is not the best. The approach for best does not leave scope for development. The first product in any technology will not be the best in the world, but use of acceptable gives path to achieve excellence in subsequent effort, mark II etc.

## **6. RECOMMENDATIONS**

- (1) To overcome some of the problems mentioned above, EC-2013 Recommends formation of a high power body, empowered Board for Indigenizing manufacturing (EBIM ) as an Apex body for Aerospace and Defence Systems, to ensure the growth of manufacturing and Productionization and create conducive environment. It will create and continuously review the Aerospace manufacturing and production Policy in the context of issues in Para 5. An outline of suggestions regarding EBIM is as follows.

### **Empowered Board for Indigenizing Manufacturing (EBIM)**

1. An Empowered Board for Indigenizing Manufacturing (EBIM) be created for Productionization and manufacturing of Aerospace and Defence Productionization, Satellites etc.
2. The EBIM shall be responsible for creating all the necessary environment and infrastructure in the country for indigenous production of respective product by way of creating guidelines, making investment in infrastructure and training.
3. The EBIM will implement offset policy by clearly defining the objective of the offsets, in the RFP itself.
4. EBIM may create guidelines for procurement process against each item.  
  
However, only items of bulk quantities, overall cost not less than Rs 500 crore need to come under the purview of EBIM.
5. Private / Public companies may register with EBIM with scrutiny / Assessment by board, for being included in the bidding process. Thus, EBIM will create a virtual Defence Productionization and Manufacturing complex in the country and this complex will be involved in the development process itself, through production orders by services.
6. EBIM may be allotted Rs.500 to 2000 crore for capability development of futuristic infrastructure in the industry.
7. The EBIM will create 3<sup>rd</sup> party quality houses in select areas, as and when needed and give impetus for them to become commercially viable as industry. These should also provide training to the industry to strengthen internal quality processes.

8. Each EBIM be chaired by a senior retired Scientist in the respective area, retired not less than Distinguished Scientist grade. The board may have representative from finance and additional 6 to 8 members from users and respective technology area.
9. The EBIM will report to Defence Technology Commission, Chaired by RM.
10. Performance of EBIM be reviewed by the increase in indigenous value addition and reduction in import of equipment in quantity and percentage of budget through its effort, every 3 years.
11. The board membership be for 3 years, with 1/3 members retiring every year, thus giving continuity of functioning. No member should be allowed to serve more than two terms in the board.
12. The Defence Technology Commission (DTC) (as and when constituted) may provided overall direction to EBIMs and may seek clarifications/ suggestions from the EBIM. EBIMs be seen as facilitators to the DTC in the context of indigenous Productionization. Chairman EBIM may be post facto member of the DTC.
- (2) Creation of independent Aerospace Quality Houses. Aerospace is identified with high quality and the term Aerospace quality remains a mystery to the industry, in a way scaring it. Both ISRO and DRDO have retained the expertise in doors, unlike advanced countries where independent 3<sup>rd</sup> party quality houses ensure the product quality to the user.

As the general quality conscious has penetrated only a few industries through ISRO qualification, a similar drive is need from ISRO and DRDO to create independent 3<sup>rd</sup> party quality houses in selected areas like electronic components, electronic subassemblies, electro mechanical systems, actuators, systems like gun, tanks etc.

- (3) Defence PSUs may be reorganized with lot more autonomy to take their own decisions u professional manner, like L&T, with their own accountability to profitability and professional competence.

**Recommendation  
on  
Development of Sundarbans  
through Engineering Interventions**

**Engineers Conclave 2013**

**17<sup>th</sup>-19<sup>th</sup> September 2013**



*Organised by*

**Indian National Academy of Engineering (INAE)  
&  
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*Coordinated by*

**National Institute of Ocean Technology (NIOT)**

**THEME-II -**

**DEVELOPMENT OF SUNDARBANS THROUGH  
ENGINEERING INTERVENTIONS**

## Foreword

The development in science and technology during the last century has revolutionized our lives. However a large section of our society is untouched from these developments and lives a primitive life style. One of the national goals for 21<sup>st</sup> century is to carry forward the benefits of these developments to society at large and transform their lives.

Engineers have made great contributions in this process of transformation. For Example 30% of Norway's land is below sea level and contributes 70% of its economy. In India we seek such interventions and the contribution from engineers in the decades to come. As a part of this initiative Indian National Academy of Engineers (INAE) has organized an annual event "Engineers Conclave" providing a forum for interaction between Eminent Technocrats, Engineers, policy makers, representatives from Government Institutions, industries, where the engineering applications for the country can be evolved. The first Engineers Conclave EC-2013 was jointly organized by INAE and Defence Research and Development Organisation (DRDO). It mainly focused on two specific themes i) Production and Manufacturing in Aerospace ii) Engineering Interventions in Sundarbans. The theme on Aerospace is coordinated by DRDO and Sundarbans is by National Institute of Ocean Technology (NIOT). The conclave is inaugurated by Shri. Pranab Mukherjee, Honorable President of India. Sundarbans is largest delta and estuarine national park in world but people live with poverty in spite of area having a great potential for development of agriculture, fisheries and allied industries. The major impediments for development of the area are threat from natural disasters and lack of major interventions for economic development. The conclaves mainly focused on the problem areas and brought out various engineering interventions required for economic growth of Sundarbans.

## Executive Summary

Sundarbans is a vast Delta on northern Bay of Bengal formed by the rivers Ganga, Padma and Mehana. The Indian part of Sundarbans with area of about 7900 sq. km covered by National park with mangroves (2585 sq.km), which was set to preserve natural habit and the area outside is available for human habitation. The area by virtue of its geographical location and coastal morphology is vulnerable for natural disasters like cyclone and Tsunami. In recent times, the cyclone AILA caused damage to villages and agriculture lands. Earthen Embankments (3300 km long) built by traditional engineering to protect the life and property are found to be inadequate against surges during cyclones, the intensity of which is increasing due to climate change. On the other hand, increased population density with extreme poverty causing concern on water and food security.

Realizing the importance of social need, Indian National Academy of Engineering (INAE) has taken an initiative and identified a theme “Engineering Interventions for development of Sundarbans” as part of the Engineers Conclave 2013, held during 17th to 19th September, 2013 along with main theme of “Production and Manufacturing in Aero Space”. The conclave was organized by DRDO in VigyanBhavan, New Delhi, which was inaugurated by Honorable President of India. The theme on Sundarbans was coordinated by National Institute of Ocean Technology (NIOT). Eminent speakers from the various institutes and stakeholders working on Sundarbans have attended the conclave deliberated to draw suitable recommendations for evolving major interventions that can enable change in the life of society.

The conclave has identified that there was no major engineering intervention since 1960's, except a proposal to protect area from natural disasters and for generation of fresh water by building barrage across the Saptamukhi River worked out by River Research Institute in collaboration with Netherlands at cost of Rs 18.75 Crores. The proposal could not be implemented inspite of its advantage in generation of large fresh water reservoir that can bring major change in the economy of the area. After cyclone AILA, which caused extensive damage to life and property of Sundarbans in year 2009, West Bengal Government has taken an initiative to rebuild vulnerable embankments but it could be completed due to various technical and administrative issues. Fresh water in Sundarban is a scarce commodity, both the surface water in tidal creeks as well as the subsurface ground water is saline. The other major issues that are faced by Sundarbans are inadequate power supply (only 25 % of area covered by electricity), lack of communication and transport network across many islands, heavy siltation in estuarine based ports of Haldia and Kolkotta, degradation of rich mangrove ecosystem due to natural and anthropogenic activities and decline in fishery resources.

Conclave has identified a need for major engineering intervention in Sundarbans for its development. The immediate priority is to protect the area from storm surges through rationalization of embankments and a major engineering intervention to build fresh water

reservoir across the Saptamukhiriver ,Calachura- Cruzan creek and Takuran in phased manner. The other major intervention include building tidal power plant with a capacity of 100 MW each at Matla and Saptamukhi, where the tidal range of 5m favorable for generation of tidal power, similar to what has been successfully implemented in France and Korea. This can be supplemented with decentralized power plants using solar and wind as per site conditions. In order to provide opportunities for economic development of region, current proposal of building port at Sagor island with 13 m draft to be taken on priority followed by development of island based deep water port to facilitate operation of larger capacity vessels with draft of 19 m. The improvement in road/rail network, communication and inland water transport with small draft vessel are others aspects, which need to be considered for development of the region. The sundarnbans being rich in bio-diversity, ecotourism found to be viable for maintaining the bio-diversity and also to provide opportunity for economic development of local population. Large scale fish cage farming along with Mud crab culture can be taken up in this area for generation of additional livelihood.

In order to implement the major schemes, a Special Purpose Vehicle (SPV) need to be created for timely implementation of the project. A special monitoring mechanism can be formulated with a committee headed by member Planning Commission similar to that of Island Development Authority (IDA) with members drawn from various central/state departments who are responsible for execution of the projects. Also, National level institutes like National Institute of Ocean Technology, Indian Institute of Technology, ISRO, etc., can be involved in design and implementation of various projects. I urge that Planning Commission should consider the proposal of development of Sundarbans based on the recommendations of the conclave for the benefit of the society.



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## 1.0 INTRODUCTION

Sundarbans is the largest tidal halophytic mangrove forest in the world and UNESCO World Heritage site covering parts of India and the Bangladesh. It lies in the vast delta on the Bay of Bengal formed by the super confluence of the Ganga, Padma and Meghna rivers. It covers area about 20,500 sq km out of which 7900 sq km lies in India and rest in Bangladesh. In India about 2,585 sq km forms the Sundarban National Park, which was set up to preserve the globally dwindling population of the Royal Bengal Tiger in its natural habitat. The area outside the National Park has been subject to human use for centuries and has a population about 4.6 million. The human population that exists on the fringes of the coastal forest, in land that has been slowly adapted to cultivation over the last two centuries, confronts challenges from land, air, and sea that few other local populations have to contend with.

Any adaptation plan for Indian Sundarban for socio-economic development of the region needs to address two major issues. Firstly, protection against natural disasters and secondly, provision of fresh water. Considering the need of the society in Sundarbans, which lacks basic facilities and infrastructure, Indian National Academy of Engineering (INAE) in association with Defence Research and Development (DRDO) has identified the theme “Engineering Interventions for Sundarbans” as part of Engineers Conclave 2013, a first attempt by the Engineering fraternity in the country to make use of the expertise of Engineers for a social cause. The conclave aims at formulating engineering interventions for development of Sundarbans by drawing ideas and experiences of engineers, scientists and stakeholders working in Sundarbans. This particular theme of the conclave is identified by Dr. P. S. Goel, President, INAE and coordinated by Dr. M.A. Atmanand, Director, National Institute of Ocean Technology, Ministry of Earth Sciences. Two workshops were conducted during February and July 2013 in Kolkata at RRCE-E, ISRO, involving concerned scientific, technical and social bodies of the area to identify the major issues. These two workshops were coordinated by NIOT along with RRSE-E, ISRO. The discussion held with various stakeholders in the workshops indicated the need of major intervention for development of the region and requirement of collation available scientific and technical information in relation to need of the society.

After these workshops, four sub themes were identified for the Conclave, namely, 1) Issues related to Sundarbans and analysis of problems 2) Scientific studies on various interventions 3) Engineering Interventions that can make a difference 4) Enabling the change. These four themes were deliberated, following the presentations made by eminent speakers from Central and State Government institutes such as National Institute of Ocean Technology, Indian Institute of Technology, Indian Space Research Organization, National Institute of Oceanography, River research Institute, Sundarbans Development Authority, Kolkata Port Trust, Institute for Wetland Management, Vivekananda Institute of Management and many speakers from various organizations.

## **2. ISSUES IN SUNDARBAN**

Various natural changes and upstream human interventions caused substantial reduction of freshwater flow and sediments to the estuary. Over the last four decades, the 'drowning delta' has lost 210 square kilometer of land area to the sea. This includes few inhabited and uninhabited islands and several villages with sizable population, making thousands of people homeless environmental migrants. The conflict between progressive land loss and competing demand for land use poses a serious problem. Erosion, salinization, along with increasing demand of forest products has caused further degradation in the mangrove forest areas. The natural environment is under serious pressure both from increasing population density and the uncertainty of climate in the future decades.

### **a. Natural Disasters.**

Natural calamities such as cyclones and Tsunamis, have always posed threats on the values of the property and along with saline water intrusion and siltation. The historical records show that 29 ships of a British fleet were totally destroyed in 1737, about 20,000 people died in 1798 and about 60,000 people died due to super cyclone in the year 1864. After detail study of past data and their analysis, the projected assumption is that because of increasing temperature in the Bay of Bengal during the last 35 years the number of cyclones may get reduced but the speed of such climate incidences will increase ultimately leading to more damage in the Sunderban area. The AILA was a semi super cyclone with varying speed of 125 km/hr to 155 km/hr. The direction of AILA was towards the North East in semi lunar fashion and its duration was 4 hrs and 7 minutes on 25<sup>th</sup> June 2009. The super cyclone brought the water level to rise from 13 feet to 18 feet. The water level rose in the entire forest area and breached embankments, with the water entering into agricultural fields and villages. Normally, the Sunderban villages are situated at a lower level than the level of the sea and the villages are situated in reclaimed mangrove forests where long earthen embankments along the shoreline have been built, so that the tidal saline water does not get entry into the agricultural land. Earthen embankments (3300 km long), raised by traditional engineering in order to protect the life and property are found to be inadequate against surges during high intensity severe cyclones which are increasing in intensity.

These existing embankments are subjected to frequent failure which incurs high installation and maintenance cost. The failures of these embankments also affect the drainage pattern in the area which worsens the living standards of people. Present situation of the existing embankments whose renovation and modification would cost around 6000 Crs. Out of which contract for 1000 Crs. has already been awarded and in which 200 Crs has been implemented. The climate change associated factors such as sea level rise, high intensity cyclones with rainfall makes area more vulnerable for flooding, causing threat to population, agriculture and

infrastructure. There is need for integrated strategy to protect the area from Natural Disasters.

**b. Livelihood:**

The region witnessed sudden influx of population mainly due to migration. The primary occupation of people living in Sundarban is agriculture and aquaculture; other occupations include fishing and crab collecting. Agriculture in the Sundarban is depended on the rainfalls during the rainy season. They are sufficient for growing paddy, but normally allow only one yield. Among the agricultural workers the high percentage of landless agricultural laborers accounting to about 50% substantiates the level of poverty in the region. During agricultural lean season, people resort to fishing and collection of prawn seeds, even risking their lives from man-eating tigers and crocodiles. Next to agriculture, fisheries provide a distinct source of employment and income for the people particularly for small and marginal farmers. Collecting the rare mangrove honey today is allowed only during special times and in selected areas.

The area is cyclone prone, monsoonal and low-lying, with many settlements located alongside the waterways and coastline. The river embankments [3500 km app.] constructed in mid-19<sup>th</sup> century although in a very unscientific manner made inhabitation in the Delta Islands possible. The tidal surges into the estuary system, pushing saline water over the embankments and through the breaches of embankments into agricultural fields causing serious damage to the lives and livelihoods of inhabitants. Frequent breaching of embankments has caused salt water intrusion which declines fisheries and agricultural productivity.

**c. Scarcity of Fresh water**

The saline water intrusion in islands of coastal area due to reduced level of fresh water flow in the dry season and rise in sea level caused spatial and temporal variation of salinity, which eventually would cause damage to agriculture, fisheries and total eco-system of the coastal area. On the other hand, the increase in population is one more factor resulting in scarcity of fresh water both for domestic and agricultural purposes. The scarcity of water is even effecting the life of animals in Sundarban Forest.

**d. Infrastructure**

Transportation and Communication are very poor in Sundarban region due to presence of large number of estuaries and in adequate land inter connectivity. In most of the parts of Sunderban are not accessible by surface transport. The transportation is dependent on boats especially in the villages. Though a program for a vast rural road network having a total length of about 3000 km and construction of about 180 jetties in Sunderban in phases it should be properly

completed to achieve the full benefit. Frequent breaching of bunds spoils the existing transportation facilities. Inadequate power is another major issue for the people living in Sundarban. Only 25% of the total area is electrified. Due to lack of basic infrastructure there is no industrial development and tourism though the area is having huge potential.

**e. Siltation of Estuarine based port**

Several eastern, northern and north eastern states depend heavily on the ports of Kolkata and Haldia experiencing heavy siltation, resulting in operational difficulties. Trade with neighbouring countries like China, Bangladesh and Myanmar will depend on these ports suffer. Port facilities have had to move southward due to morphological changes in the river. Though development schemes were announced, none of them seemed to work and siltation of the navigation channel continued. The flow of water from the Farakka Barrage has also come down, further accentuating the problem. Every year, tonnes of silt are scooped out from the bottom of the river and dumped at locations near the estuary. From there, they get washed back with the tide, affecting the biodiversity and marine life. Siltation of Estuarine based port (Kolkata and Haldia) causing impediment to economic development. The siltation of approach channel is causing huge investments in annual dredging of Kolkata and Haldia ports. The draft for the ships for these ports is also low and cannot handle very heavy vessels. Hence, there is need for development of sustainable deep water port, considering the morphological setup of the Sundarban Delta.

**f. Degradation of Mangroves**

The eco-region that forms the Sundarbans is unique, because it is one of the most extensive mangrove forests in the world, existing in a vast deltaic region where freshwater and seawater mix. The mangrove forests of the Sundarbans are one of the most significant strongholds of the Royal Bengal Tiger, an endangered species, and the national animal of India. The flora of the Sundarbans with the mangrove, presents a natural buffer, a bulwark against Tsunami, coastal erosion and seawater ingress into one of the most densely populated regions of the world.

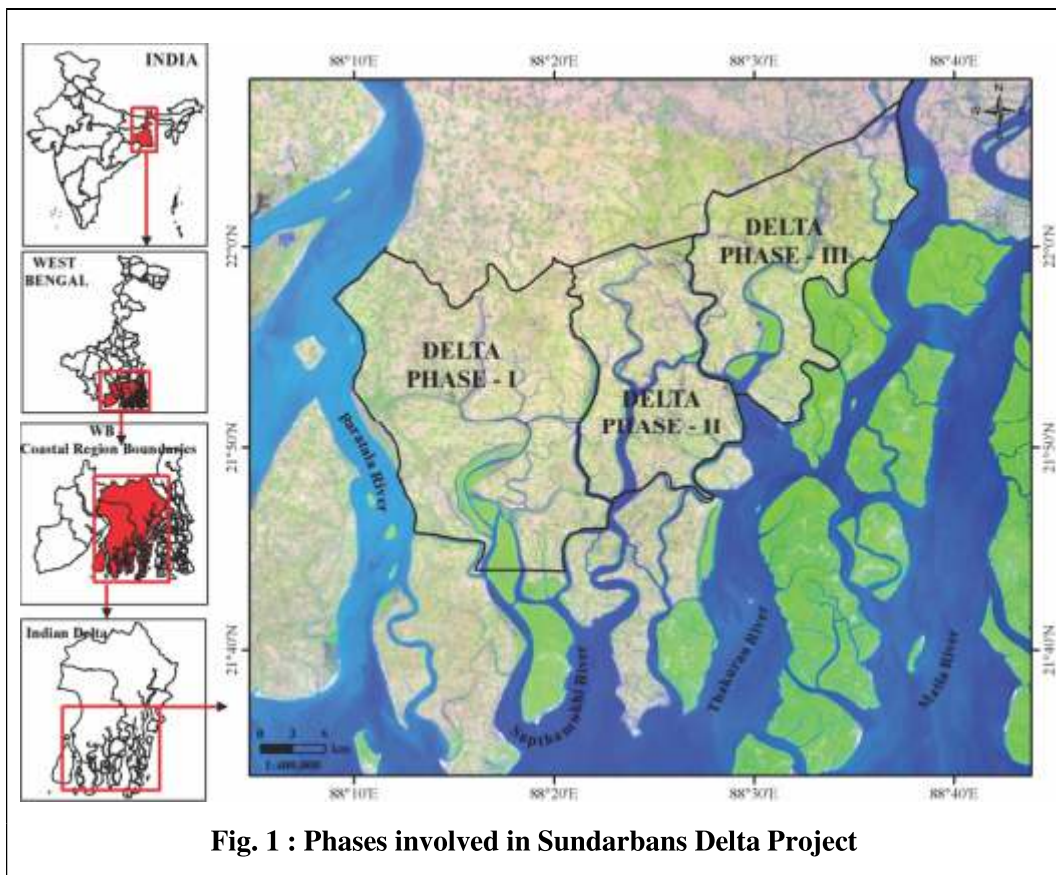
Degradation of mangroves due to natural changes and anthropogenic activities is causing serious concern for livelihood of people. Due to reduction in mangroves, the breeding of aquatic animals is getting disturbed as these areas are breeding spots and further reducing the fisheries. Also, reduction in mangrove cover increases vulnerability of area to natural disasters, directly hitting the populated places causing huge damage.

### 3. RECOMMENDATIONS

The major recommendations for the development of Sundarbans regions came out of deliberations of the conclave are:

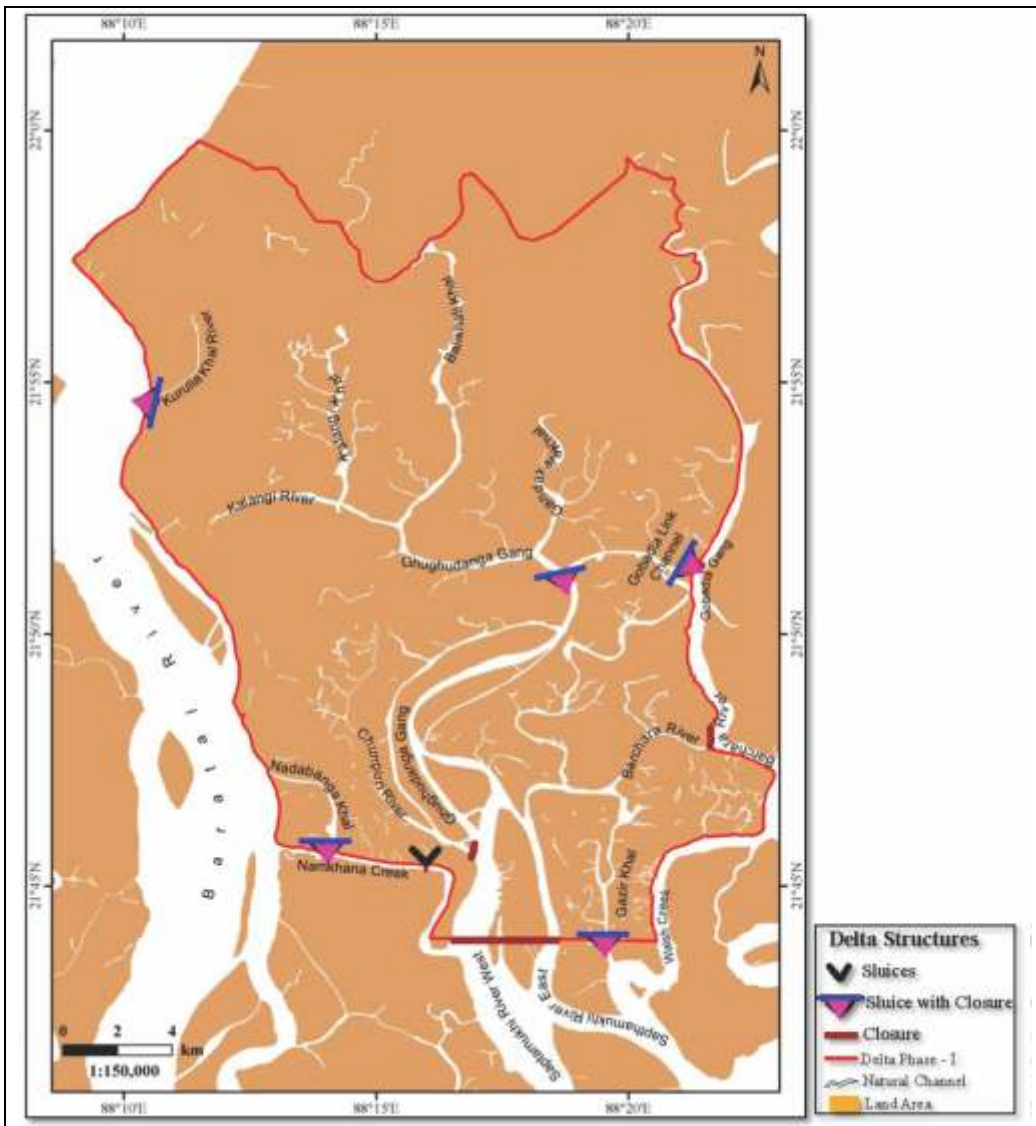
a) **Delta management plan for protection area from natural disasters and creation of fresh water reservoir through barrages/sluice gates.**

One of the major finding of the conclave is that there was no major engineering intervention since 60's, where River Research Institute of West Bengal with the support of Netherlands worked out scheme for protection of Sundarban from natural disasters and generation of fresh water by building barrage. The concept of delta management plan has evolved out of the experience of Netherlands in managing the problems of storm surges in the estuary. The delta plan brought out by River Research Institute of West Bengal (1968) in consultation with experts (Mr. Dronkers) from Netherlands suggested a phase wise plan to protect the area from storm surges through rationalization of embankments and creation of major engineering intervention to build fresh water reservoir across the Supathamukhi River (Phase-I), Calachura- Cruzan creek (Phase-II) and Takuran (Phase-III). The areas covered under each phase are shown in Figure 1. Their report details the methodology to be adopted in Phase – I, which includes dams connected with marginal dykes along the rivers Hooghly, Baratala, Namkhana Creek, Saptamukhi, Walsh Creek, Thakuran and Matla, so as to form a continuous protective belt, along with provision of necessary sluices for drainage. The proposed location of dams and sluice gates are shown in Figure 2. This methodology includes rationalization of the length of embankments and development of barrage in Saptamukhi River, to protect many hectares of land, to store fresh water and to improve drainage pattern.



Partial closure through barrages and sluice gates will be environment friendly. Given the fact that no intervention itself has certain changes and impacts, some reasonable extent of impacts caused by any such engineering can be accepted and managed. In view of the changed circumstances and availability of experience, this plan can be reviewed/revised through a fresh feasibility study. The challenges in implementation of the project were brought out during the discussion, which include complex site conditions in terms of access, availability of construction material and poor soil conditions. Some more recommendation such as plantation of a strip of mangroves of about 40 m width in front of embankments to reduce the impact due to cyclones was suggested.





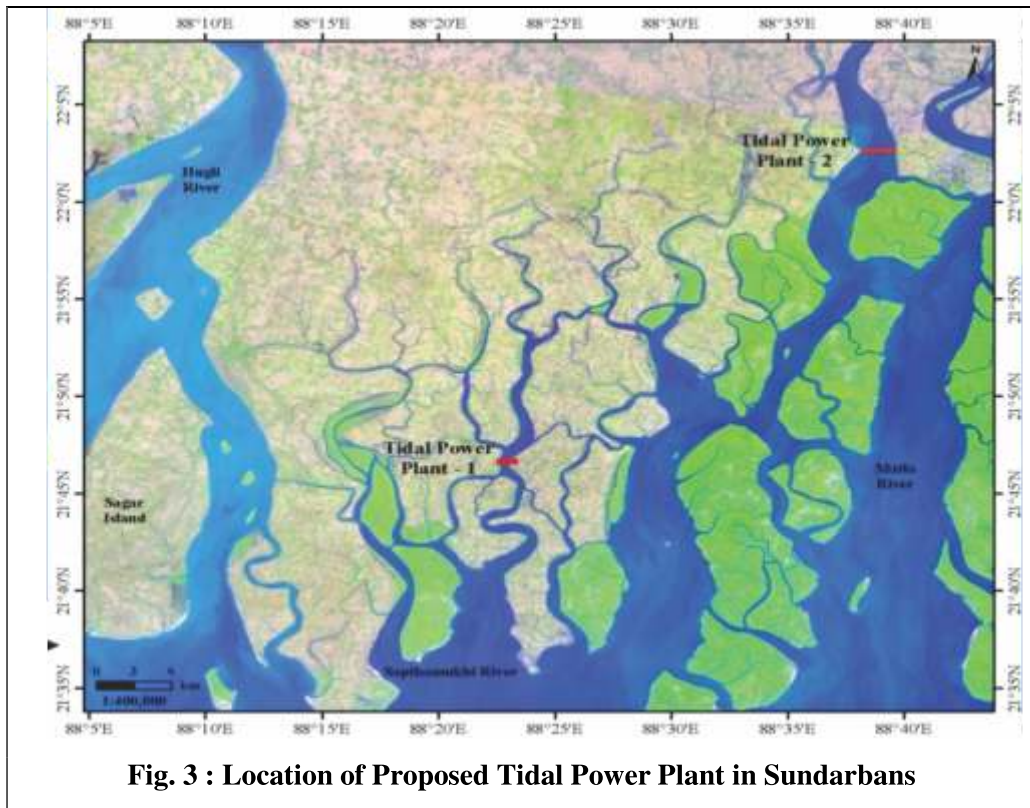
**Fig. 2 : Location of Delta Structures in Phase -I**

**b) Power generation using Renewable Energy such as tides, solar etc.,**

Electrification of an area is very essential for socioeconomic development of people. Sundarban has a good potential of nonconventional energy such as tidal, solar and wind energy. Tidal range at few locations is about 5 m and are

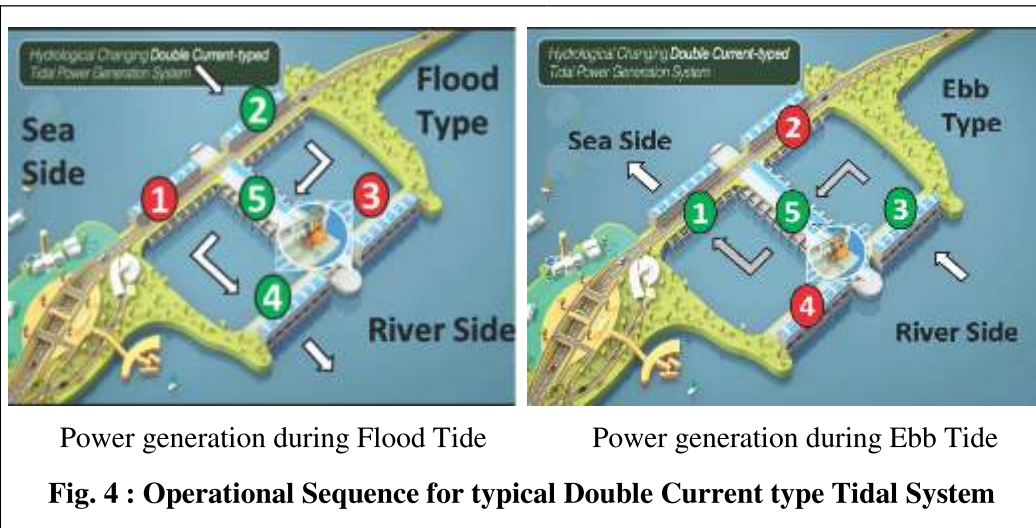


commercially viable for generation of tidal power. A feasibility study is carried out by NIOT and IIT on tidal energy at Sundarban and proposed a demonstration plant of 3 MW at Durgaduani in 1995. Two feasible locations for establishing Tidal power plants are shown in Figure 3. Each proposed tidal plant can accommodate 100MW and available technology similar to France and Korea can be implemented. The operational sequence for the proposed tidal plant has been shown in the Figure 4. In case of Typical Flood type power generation at first all the gates will be closed to increase the water level at sea side. Then Gate No-2, 5 & 4 will be open to produce the power from the turbines which are located only under Gate No-5. During this operation Gate No-1 & 3 will be closed. Now during Typical Ebb type power generation All the gates will be closed to increase the water level at river side. Then Gate No-3, 5 & 1 will be opened to produce the power through the turbines located under Gate No-5. During this operation Gate No-2 & 4 will be closed. After all these operational sequence all the gates will be opened except No-5. to transfer the water from river to sea as to maintain the natural state of water level.



**Fig. 3 : Location of Proposed Tidal Power Plant in Sundarbans**

Along with tide, power can also be supplemented with decentralized power plants using solar and wind as per site conditions. Sunderban is having a fair wind speeds and solar potential for setting up commercial plants. Power can also be utilised to overcome the scarcity of fresh water using various desalination techniques like Solar Multi Effective Desalination and Reverse Osmosis.



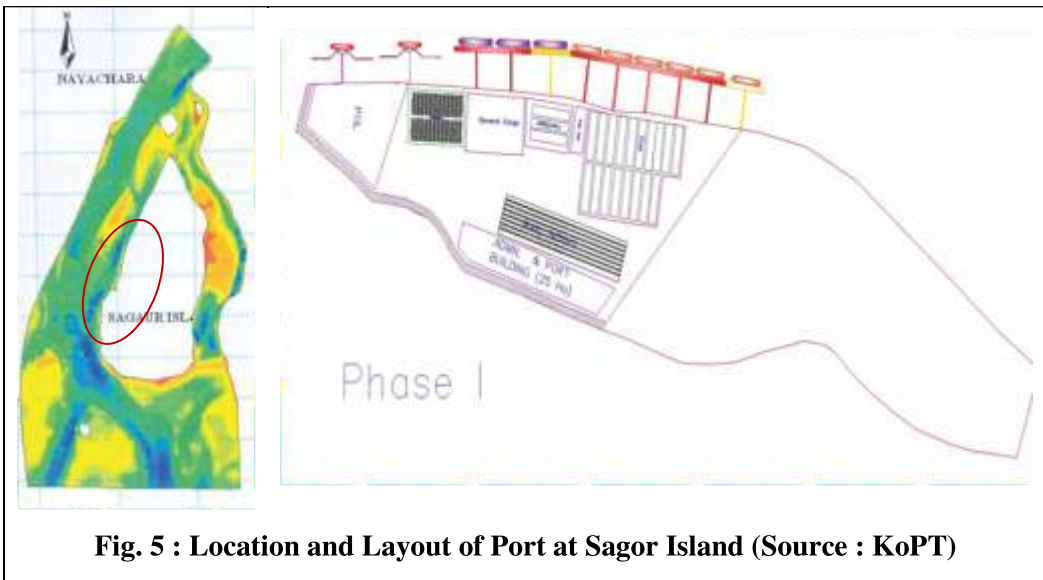
**c) Development of Port in Sagardweep and deep water island based port in future.**

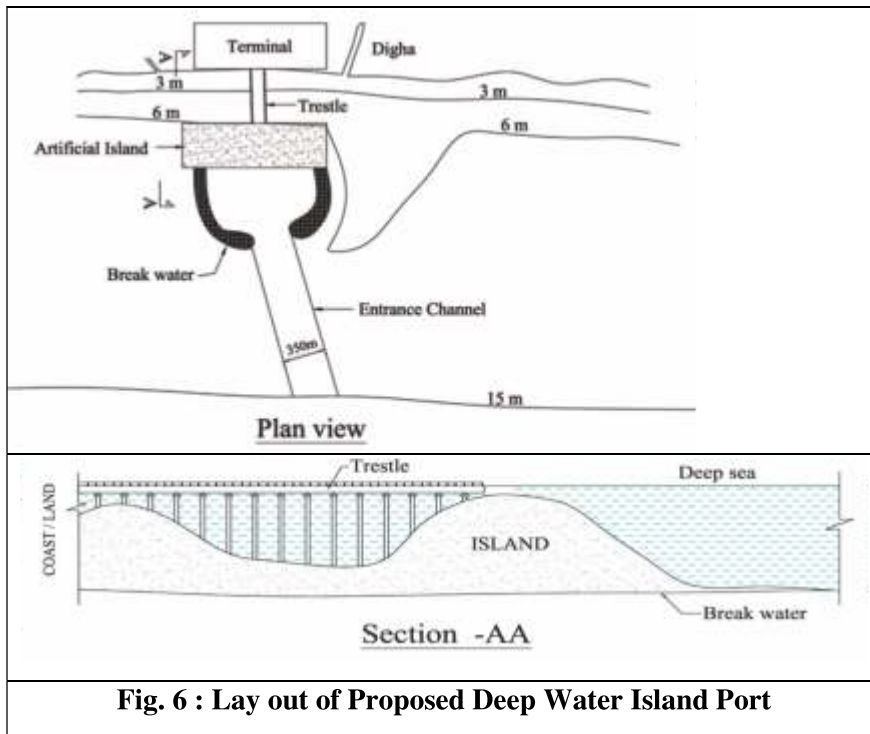
Though the ports of Kolkotta and Haldia are technically outside the geographical definition of Sundarbans, it has significant influence on biosphere of Sundarbans. It is inevitably linked to the problems and prospects of the delta. These existing ports are having draft restrictions and requires high amount of capital and maintenance dredging. Due to draft restrictions and excessive vessel traffic the exports and imports are getting diverted to other ports. In order to overcome draft, dredging issues and vessel traffic issues a new port is proposed at Sagor Island with a draft of 13m. As the port is located at the mouth of Hoogly river the length of dredging channel will be minimum, intern low maintenance dredging requirements. The establishment of new port will provide opportunities for economic development of region. This port also involves development of a Rail cum Road Bridge to connect Sagor Island, in addition to a fleet of barges for transportation of containers. Considering the need for deep water port at this strategic location an island based port to facilitate operation of larger capacity vessels with draft of 19 m is also proposed in longer run. In this proposal, an artificial island will be created in the sea in the area of 100 hectares through sea reclamation from the soil obtained from the capital dredging of the entrance

channel and water spread area of the port as shown in Figure 6. The essential facilities for loading/unloading of cargo will be built in island and cargo is evacuated through trestle connected from island to main land. Shanghai port built with artificial island by increasing Yangshan's area by 60% using billions of cubic meters of soil to form deep water port with draft of 15m. The other examples include port in Hong Kong and Dubai, where artificial island are created by land reclamation.

**d) Infrastructure Development through improvement in transport and communication network**

Transportation and Communication are very important for development of any place. As Sundarban are having lot of small channels and estuaries inland water transport with small draft vessel would be a better option. The improvement in road/rail network, communication should also be considered for development of the region. Proper communication facilities are very much required in this area as this will be very helpful to warn the people during cyclones which are very frequent in this place.





**Fig. 6 : Lay out of Proposed Deep Water Island Port**

**e) Improvement in livelihood through fisheries and tourism**

Large scale fish cage farming and Mud Crab culture can be taken up in this area for generation of additional livelihood. The sundarnbans being rich in bio-diversity, ecotourism need to be developed for maintaining the bio-diversity and also to provide opportunity for economic development of local population.



**Fish Cage Culture**



**Mud Crab Culture**



**Eco-Tourism**

**Fig. 7 : Sources for Providing Livelihood at Sundarbans**

**f) Formation of Special District for development of Sundarban**

For better administration sundarban district should be formed from existing North 24 parganas and South 24 Parganas district to adopt implementation strategy through Special Purpose Vehicle (SPV). A special monitoring mechanism should also be formulated with a committee headed by member Planning Commission similar to that of Island Development Authority (IDA) with members drawn from various central/state departments who are responsible for execution of projects. The details of proposed committee are given in Annexure – ii.

**4.0 ACTION PLAN**

<b>Recommendation 1</b> Protection from Natural Hazards	Barrage of 3500m on Supthamukhi River (Delta Project Phase I) connected with marginal dykes for protection against natural disasters and generation of fresh water basin for Domestic and Agricultural use. It will be followed by Delta projects at Calachura-Cruzan creek (Phase-II) and Takuran (Phase-III).
<b>Recommendation 2</b> Power and water	Tidal Power plants (200 MW each) at Matla and Saptamukhi along with Delta project; non-conventional sources like wind, solar (PV and thermal) etc. Location specific, decentralised type of desalination plants using various available technologies like Solar Thermal and Reverse Osmosis
<b>Recommendation 3</b> Development of Port	Development of Sagor port as immediate measure with draft of 13 m, followed by deep water island based port with draft of 19 m for economic development.
<b>Recommendation 4</b> Transport and Communication	Inland water transport between islands using low draft vessels and Improvement in road transport and communication network
<b>Recommendation 5</b> Livelihood and Ecotourism	Additional lively hood by providing large scale fish farming in cages and mud crab culture. Development of ecotourism for economic development of local population.
<b>Recommendation 6</b> Special Purpose Vehicle (SPV)	Adopt implementation strategy through formation of Special Purpose Vehicle and special Sundarbans district from existing North 24 Parganas and South 24 Parganas districts.

## 5.0 BUDGET ESTIMATES

The team has estimated the budget requirement for implementing the above recommendations and the same is given in annexure III. However these are preliminary estimates and detailed budgeting exercise need to be done in project mode.

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### Standing Committee on Development of Sundarbans

S.No	Designation	Role
1	Member (STE), Planning Commission	Chairman
2	Advisor (STE), Planning Commission	Convener
3	Chief Secretary and Additional Chief Secretary I/c, Sundarbans affairs, WB	Member
4	Chairman, Kolkotta Port Trust	Member
5	Chief Executive Officer, Wet Bengal Green Energy Development Corporation.	Member
6	Joint Secretary in the Ministries of Shipping and Transport, MNES, MOEF, MOD, MoES	Member
7	Chief Executive, Ganga River Basin Authority (MOEF)	Member
8	Director, NIOT, Chennai	Member
9	Commissioner, Fisheries, Ministry of Agriculture	Member
10	Nominees of INAE (3)	Invitees
11	Representatives of Stakeholder organisations like NDMA, Sundarbans Development Authority, RRSC/ISRO, Kolkattaetc	Invitees

## Estimated Expenditure for Development of Sundarbans

S.No	Recommendation	Description	Cost (Rs in Crores)
1	Protection from Natural Hazards	<b>Closure Works:</b> Construction of 3500 m long dam across Saptamukhi River South Two subsidiary dams across Saptamukhi River North, Gobadia Link Channel Five minor closures across Barchara, Gazir, Ghiapati, Kurulia, Ghughudanga.	1500
		<b>Drainage and Protection:</b> Drainage sluices connecting various channels like Ghiapati River, Gazir River, KuruliaKhal Construction of marginal dikes for a length of 75 km to form a fresh water reservoir and for protection.	1500
2	Power and water	<b>Power:</b> Construction of two tidal power plants at Matla and Saphthamukhi each of 100 MW. Which include construction of barrage across the river and providing two reservoirs and associated works.	2000
		<b>Water:</b> Construction of decentralized water treatment plants based on Reverse Osmosis or Solar-Thermal plants at various locations	200
3	Development of Port	<b>Sagor Port: (as per estimates of Kolkotta port)</b> Capital dredging of approach channel, entrance channel and port area for a draft of 11.5 m. Facilities for setting up port such as berths, storage yards, Dry/Wet dock,	11000



		cranes and other infrastructures. Rail cum road bridge from Sagor Island to main land for better connectivity	
		<b>Island based Port:</b> Formation of Artificial Island with soil dredged from nearby areas. Facilities for setting up port such as berths, Dry/Wet dock, cranes and other infrastructures. Establishing port infrastructure such as Connectivity between Artificial Island and mainland through Trestle.	8000
4	Transport and Communication	<b>Transportation:</b> Increasing in road connectivity within the islands. Improving use of inland navigation for better connectivity between islands using low draft boats by constructing jetties at suitable locations.	500
		<b>Communication:</b> Improve the existing communications facilities such as telecommunication , satellite communication and provide better cyclone warning systems	100
5	Livelihood and Ecotourism	<b>Fish Cage and Mud Crab Culture:</b> Setting up Fish Cages at thirty locations along with Mud Crab culture. At each location about twenty cages will be installed based on the feasibility.	100
		<b>Ecotourism:</b> Setting up various facilities like Lodging, sanitation, fresh water, Medical, Ferry and watchtowers for watching wildlife.	100
Grand Total			25000





## INDIAN NATIONAL ACADEMY OF ENGINEERING

The Indian National Academy of Engineering (INAE), founded in 1987, comprises India's most distinguished engineers, engineer-scientists and technologists covering the entire spectrum of engineering disciplines. The aims and objects of the Academy are to promote and advance the practice of engineering and technology, related sciences and disciplines and their applications to problems of national importance. INAE also encourages inventions, investigations, and research in pursuit of excellence in the field of "Engineering".

INAE had taken an initiative of organizing an annual mega event of engineers as "Engineers Conclave" starting from year 2013, essentially to provide a platform for all engineers/scientists to deliberate and address major engineering challenges and opportunities of vital concern and relevance to the country and society. The "Engineers Conclave" is organized by INAE jointly with one of the premier engineering organizations/institutions of the country each year. There are two themes for the Conclave, both focusing on the issues relevant to the Country. While the theme-1 will be decided by the host department, the theme-2 specific to some social problem where engineering intervention is desired, will be decided by INAE. The discussions in the two themes will be focused in finding engineering solutions to the challenges with specific recommendations which would be forwarded to the concerned Departments/Industry for consideration.

For more details, please visit INAE website [www.inae.in](http://www.inae.in)



### Indian National Academy of Engineering

Unit No 604-609, SPAZE, I-Tech Park, 6<sup>th</sup> Floor, Tower A, Sector 49,  
Sohna Road, Gurgaon 122002

Phone: 0124-4239480 Fax: 0124-4239481

email: [inaehq@inae.in](mailto:inaehq@inae.in), website : [www.inae.in](http://www.inae.in)