

**Linking drainage
basin to the coast for
restoration and
integrated
management of
Chilika lagoon;
a coastal wetland
of India**



**A.K.PATTNAIK,Ph.D.
Chief Executive ,
Chilika Development Authority.**

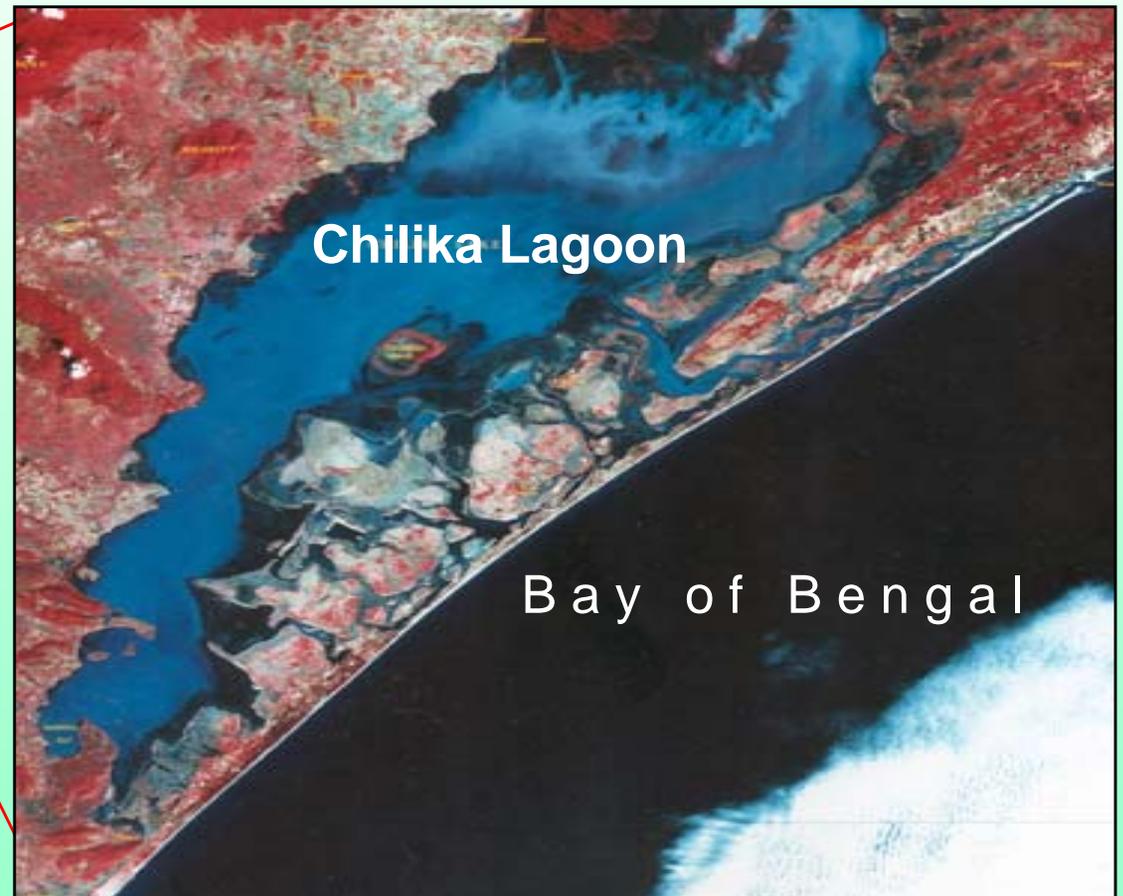
Structure of presentation

- Salient features of the lagoon
- Management issues
- Management strategy
- Phases of implementation
- Lessons learnt



Salient Features

Length	-	64 kms (max)
Breadth	-	20 kms (max)
Avg. water spread area	-	1065 sq. km
Depth	-	0.38 to 4.2 m
Catchment area	-	4406 sq kms
No. of fishermen villages	-	192
Total fisher folk	-	0.2 million



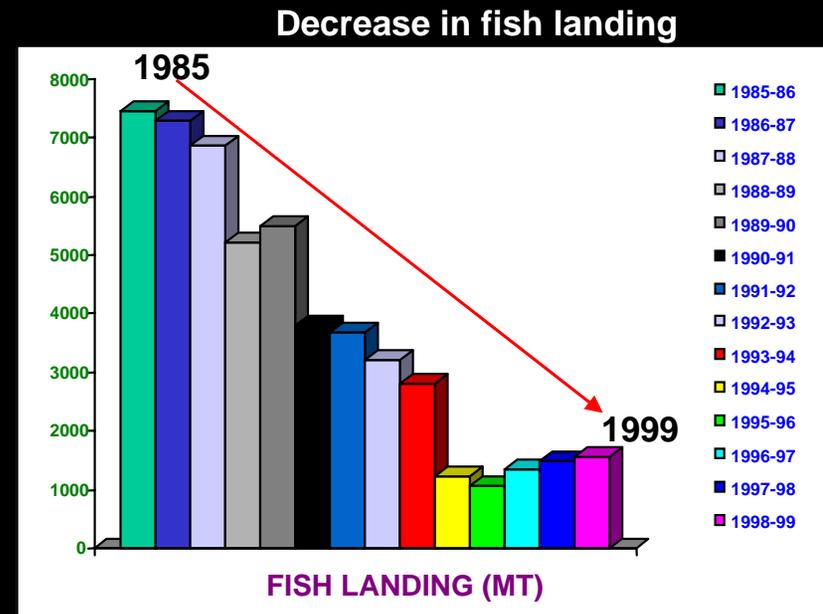
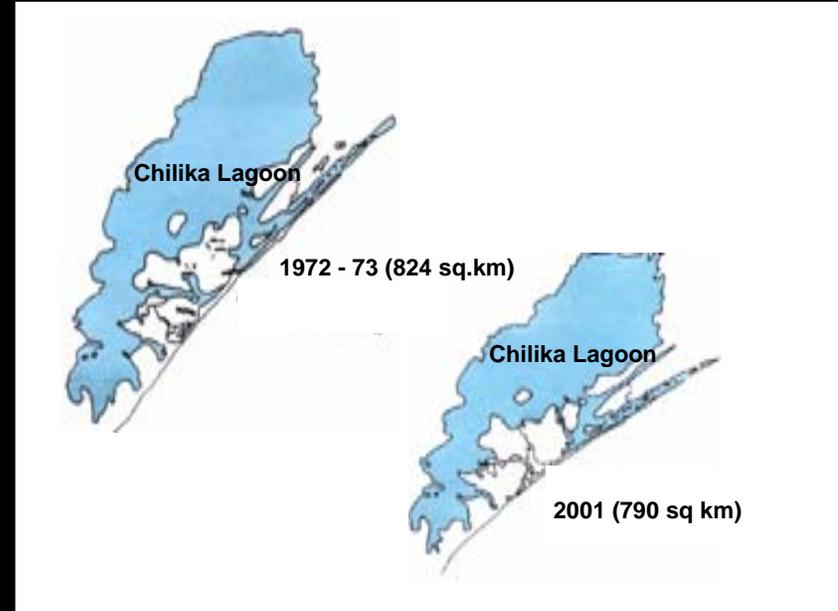
BIODIVERSITY OF CHILIKA LAGOON



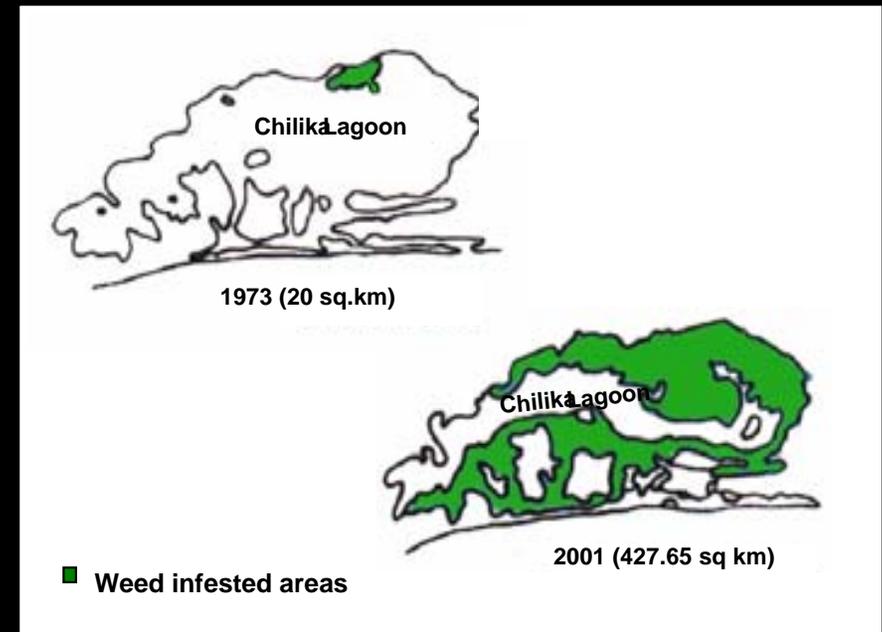
Management issues :

- Complex ecosystem
- Multitude stakeholders(due to very high level biological productivity)
- Shifting and choking of the mouth opening to the sea.
- Shrinkage of water spread area of the Lagoon due to siltation and poor flushing
- Decrease in Salinity
- Decrease in the fish yield/ diversity
- Unauthorized encroachment for shrimp culture

Shrinkage in Lagoon Area (1972 – 2001)



- Proliferation of invasive species
- loss of biodiversity
- Degradation of the life support system, in the lagoon and the drainage basin had an adverse impact on the livelihood of the local communities.
- Included in the Montreux record in the year 1993 due to change in ecological character



GOVERNING BODY OF CDA

CHAIRMAN (CHIEF MINISTER)

WORKING CHAIRMAN (MINISTER, ENV)

MEMBERS

LOCAL REPRESENTATIVES, SECRETARIES FROM STAKE HOLDER DEPARTMENTS, EXPERTS FROM PREMIER INSTITUTES OF THE COUNTRY, REPRESENTATIVE FROM FISHERMEN FEDERATION.

Restoration strategy



- Key targeted studies to understand the complex ecosystem and to trace the root cause of degradation. **Connect science to restoration plan.**
- **Adaptive restoration plan with ecosystem approach.**
- An **ecosystem approach** to restore the **ecological integrity** and functionality of the lagoon through **wide consultative process.**
- Restoration intervention for improvement of the hydrological regime & watershed to **enhance productivity** thereby increase the livelihood of the local community.
- Integration of the watershed in the management of the lagoon with **micro watershed as a functional ecological unit with community participation.**
- **Extensive out reach programme** to generate awareness about the values and functions of the wetland

Strategic Partnership



Stakeholder consultation

- Legitimate stakeholders, particularly local communities were strongly encouraged to take an active role in planning and in the joint management of the lagoon and drainage basin resources.



Ecological Characters



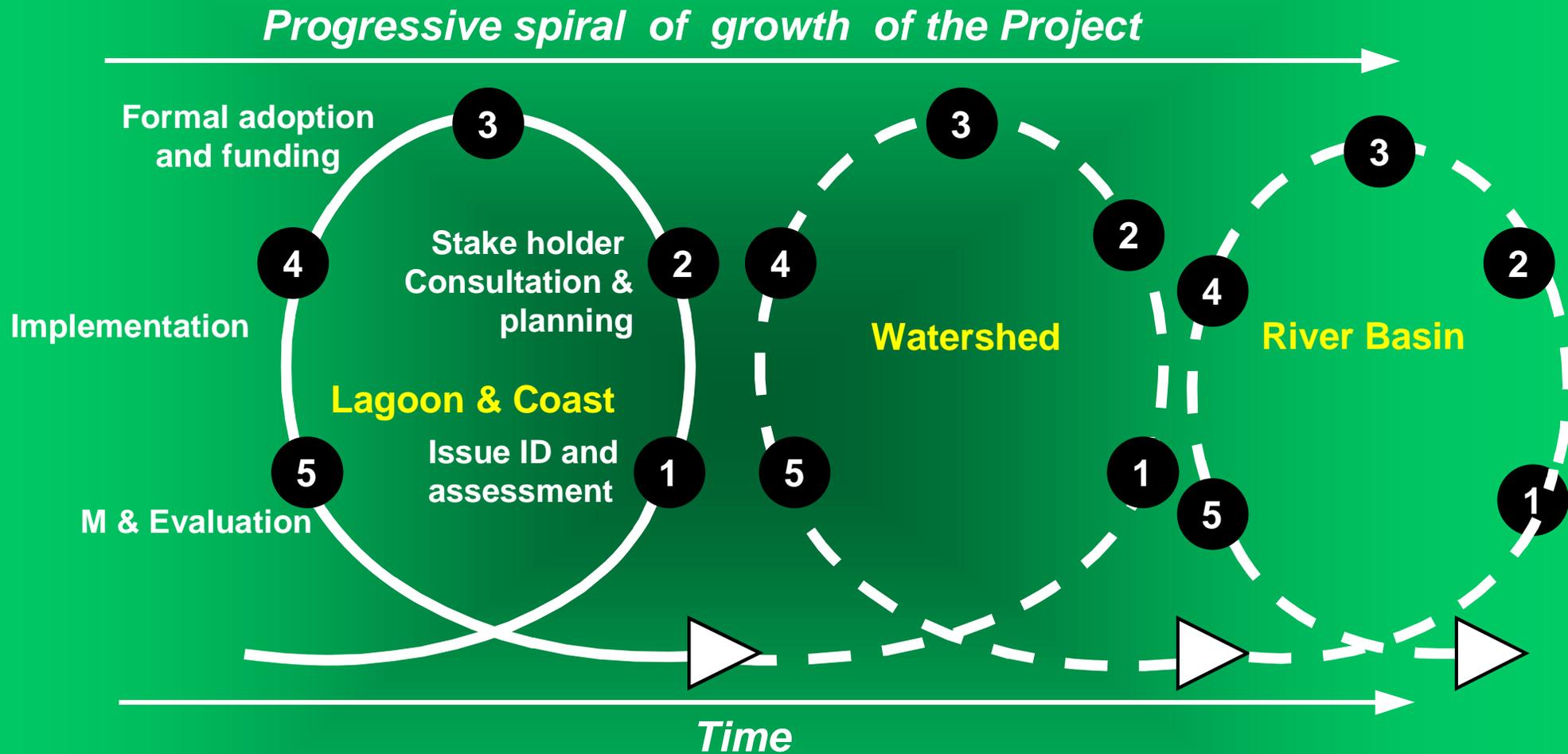
During planning process it was made clear to the stakeholders that the for **uninterrupted flow of benefits and ecosystem services the ecological character** of the lagoon should **not be considered negotiable**.

- However generally legitimate activities should not be curtailed , unless such activities are likely to **threaten ecological integrity of the lagoon**.

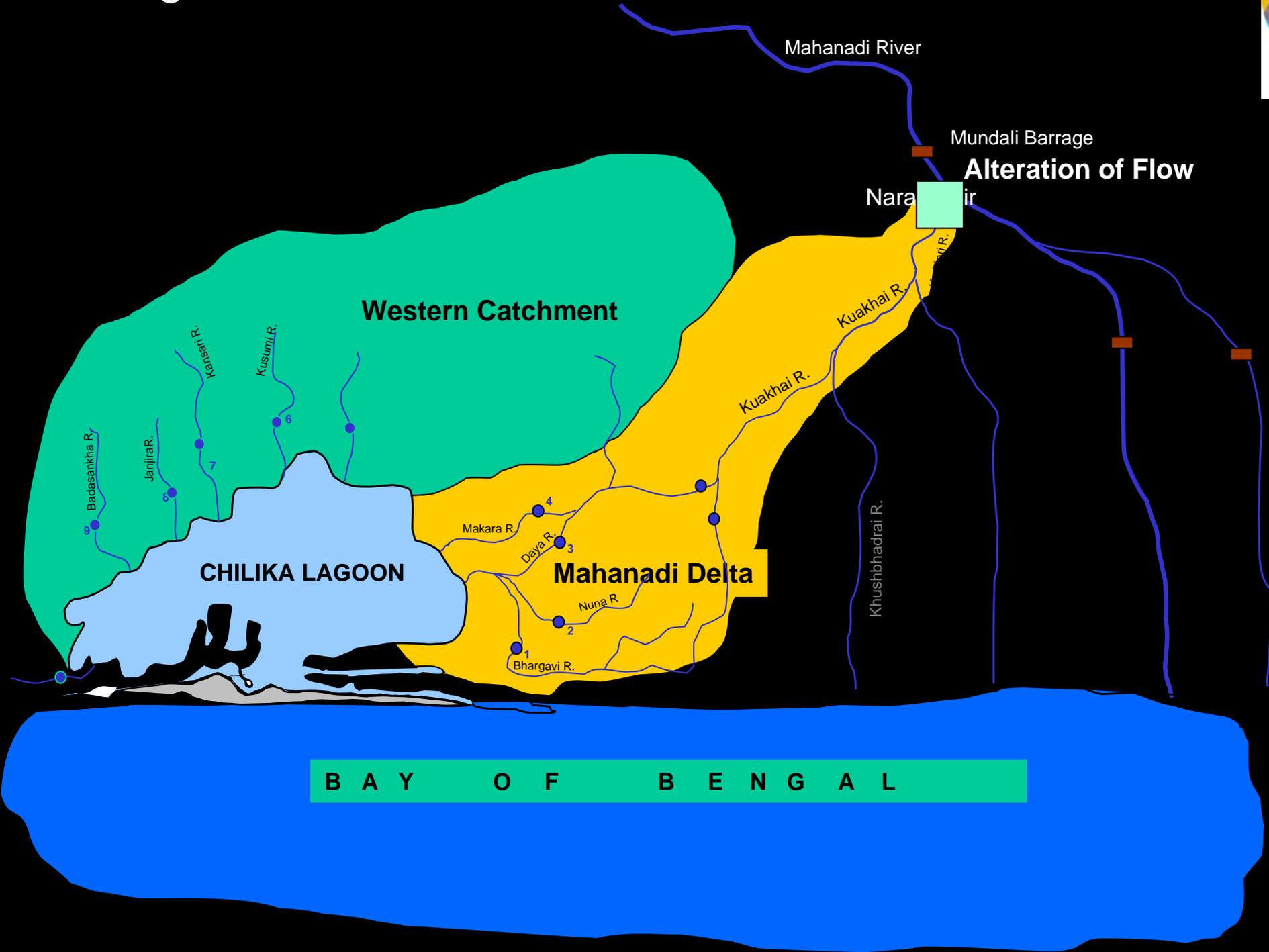
Progressive adaptive approach

- Considering the magnitude and quantum of resources involved for restoration, **all goals were not attempted to be achieved in one run.**
- The Chilika lagoon case demonstrates that the rehabilitation runs through successive cycles, in each cycle a set of goals are being achieved .
- **After completion of one cycle a new one started with better and deeper understanding from the lesson learnt from the previous one.**
- **It is an example of how,using limited financial resources ,the restoration, conservation of biodiversity and management of this critical habitat is possible at the face of the increasing human population and their aspirations.**

A Strategic Process Adopted for Restoration



Lagoon → Watershed



River basin

- Drainage Basin Boundary
- - - State Boundary
- River
- Lake
- Selected City

0 100km



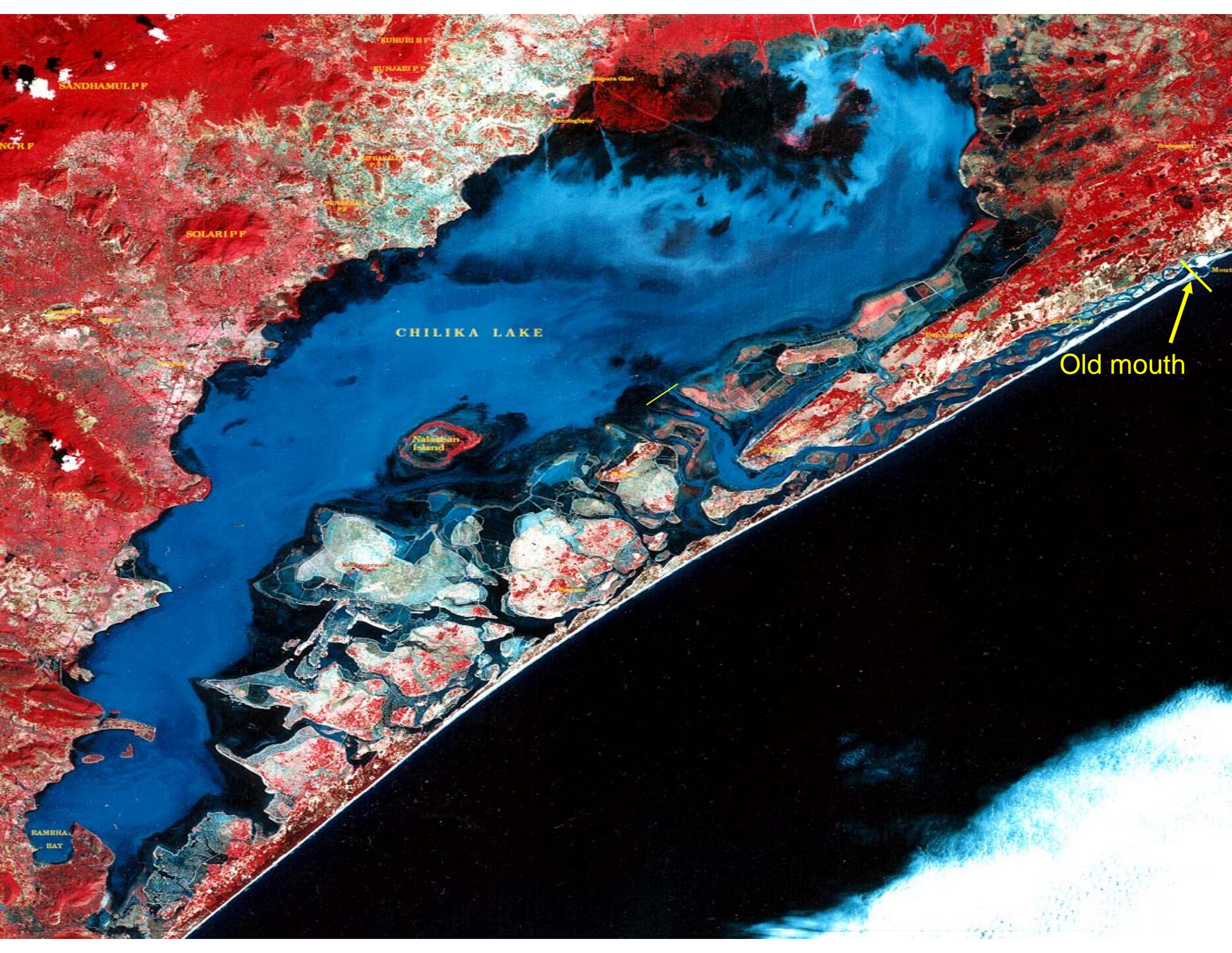
Salinity level of Chilika



1957-58	-	22.31	ppt
1960-61	-	13.20	ppt
1961-6	-	11.83	ppt
1999-2000	-	5.11	ppt

Zoological Survey of India from their extensive study between 1985-87 observed that the lagoon was tending towards a freshwater ecosystem.

Such decrease in salinity would obviously have grave implications for the biodiversity as well as fisheries of Chilika – WWF 1994.



SANDHAMUL P.F.

KUNJARI P.F.

SOLARI P.F.

CHILIKA LAKE

Nalagarh Island

Old mouth

RAMBHA BAY



NEW MOUTH



IRS 1D LISS III IMAGE OF CHILIKA LAGOON

DATE : 23rd OCTOBER 2000



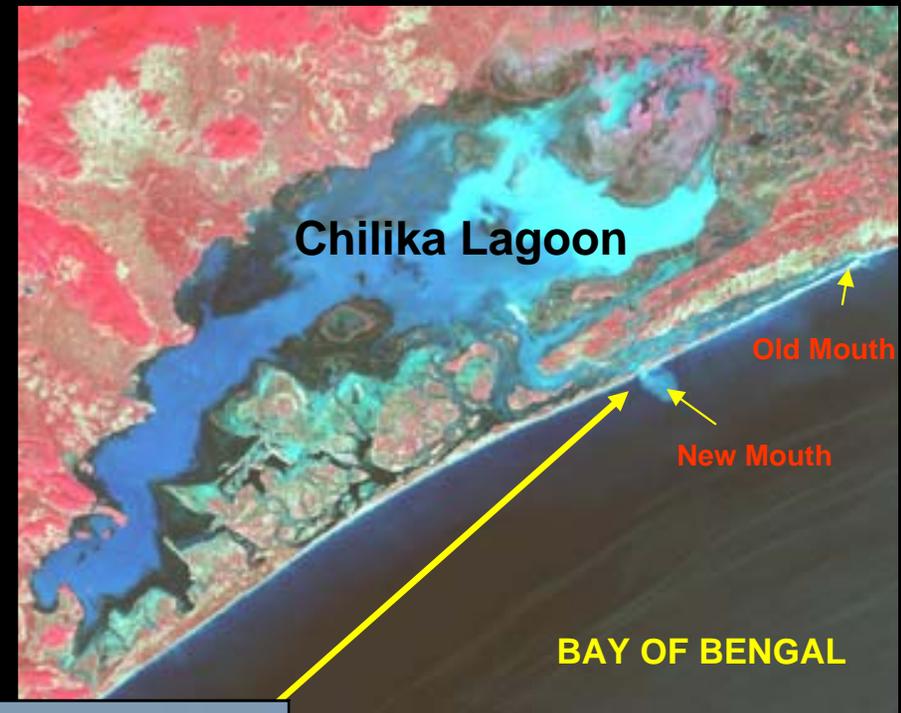
Old Mouth

New Mouth

BAY OF BENGAL

Improvement after hydrological intervention

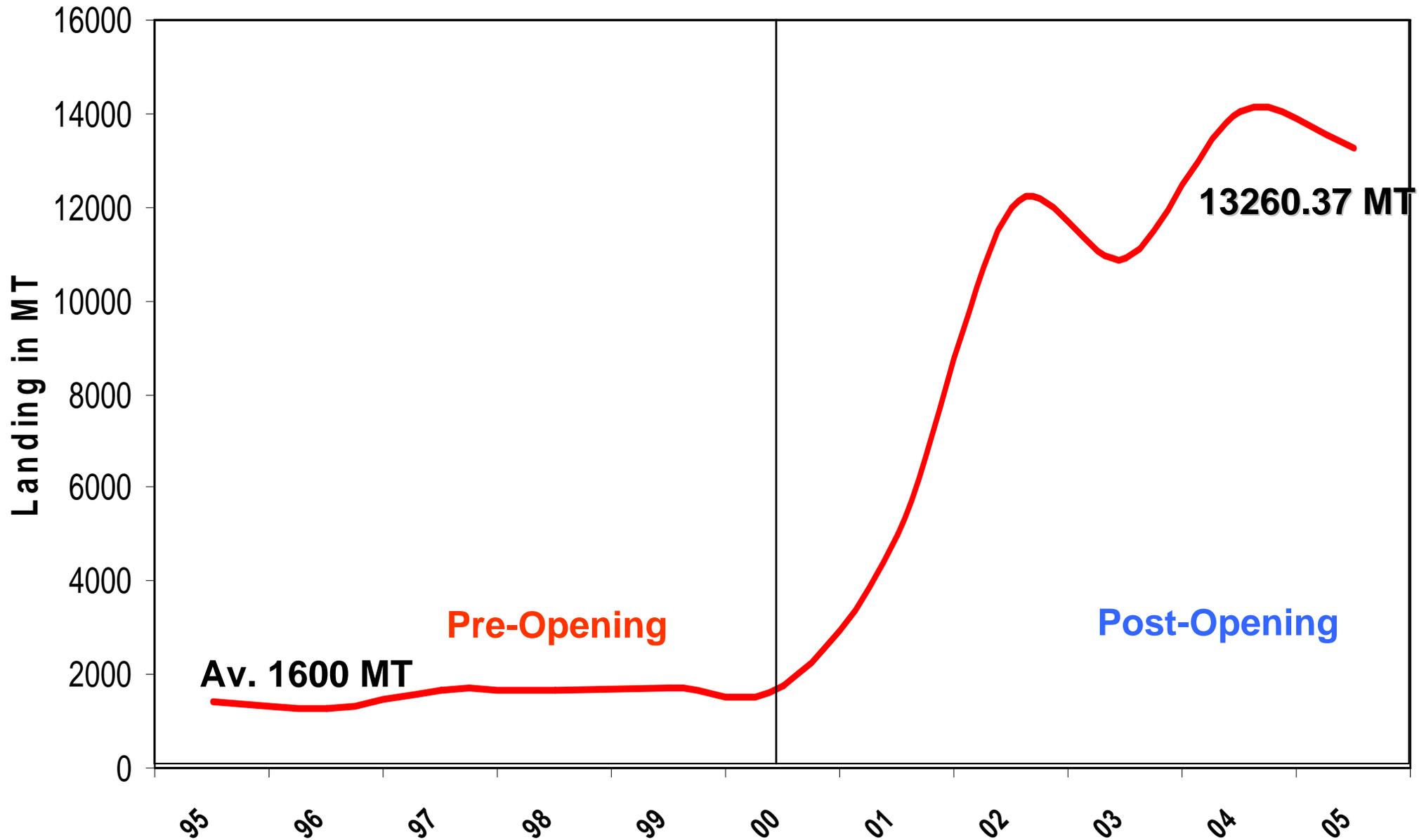
- Eight fold increase in annual fish and prawn landing
- Avg. increase in monthly family income of fishermen by Rs5000 to 10000 during peak season, and Rs 50 000 per annum after opening of the new mouth
- Increase in salinity flux by 40%
- Increase in tidal flux by 45%
- Improvement of sediment flushing
- Quick discharge of flood water
- Decrease of invasive species by 162 sq km



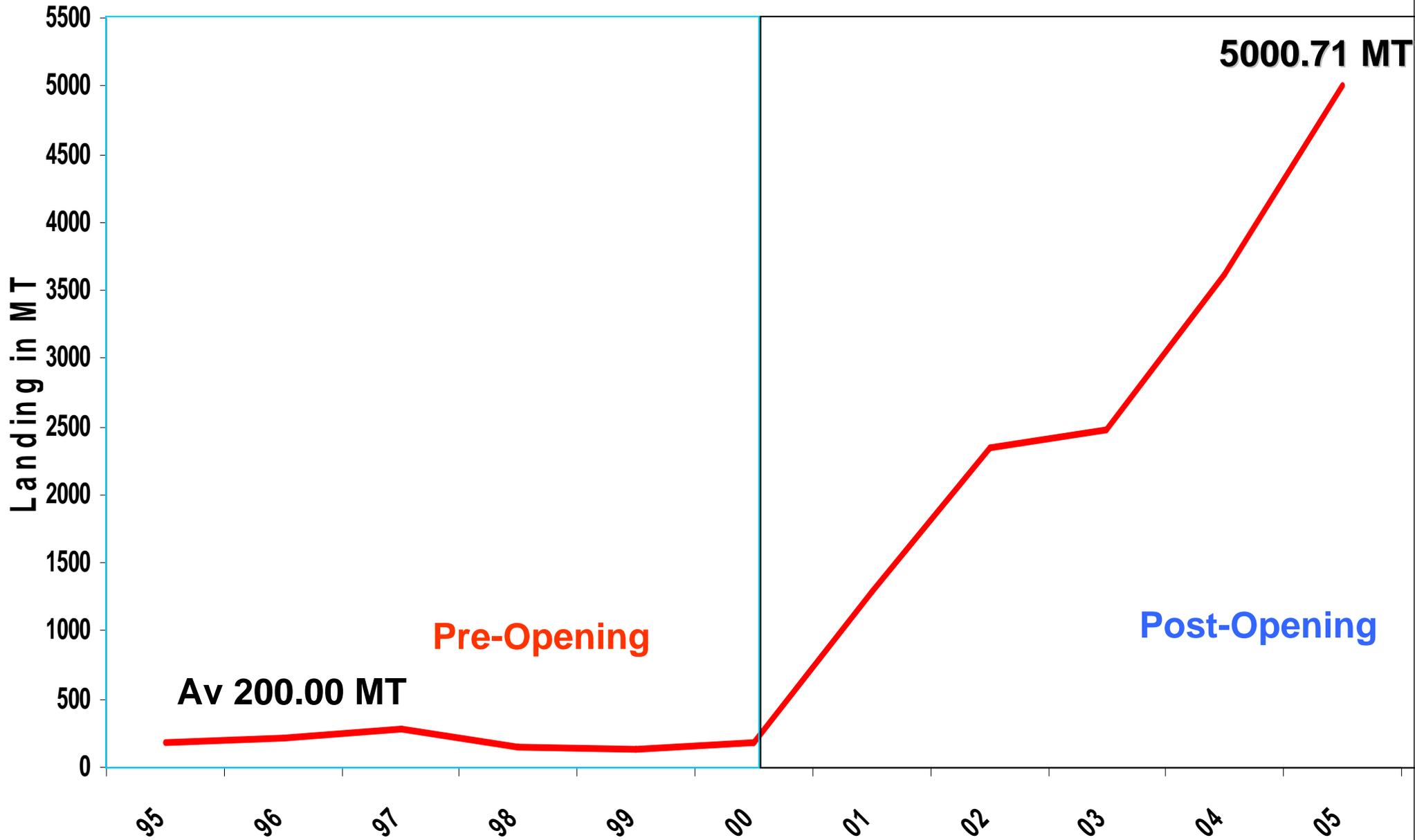
Opening of the New Mouth



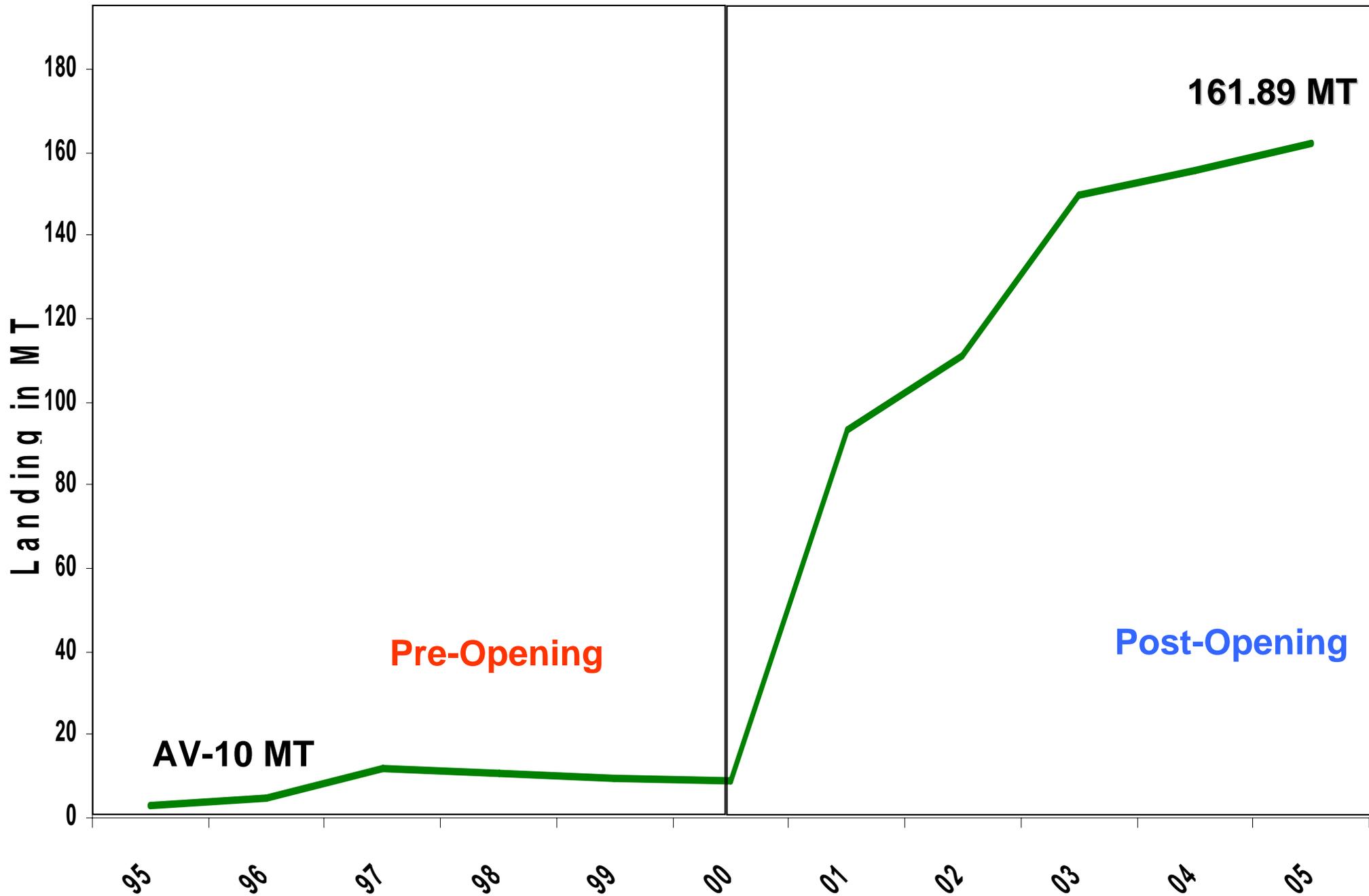
Total Fish, Prawn & Crab Landing in Chilika during 1995 to 2005



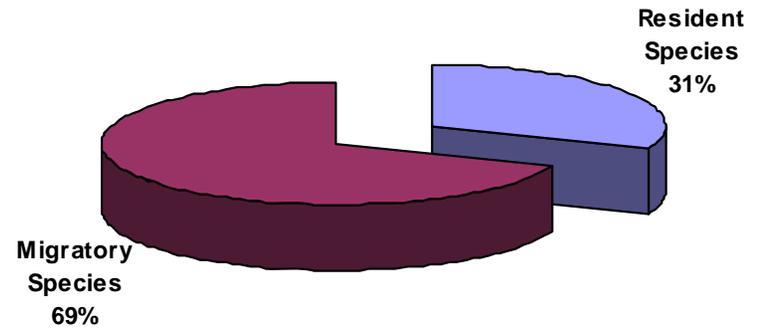
Annual Prawn Landing in Chilika lagoon from 1995 to 2005



Annual Crab Landing in Chilika lagoon from 1995 to 2005

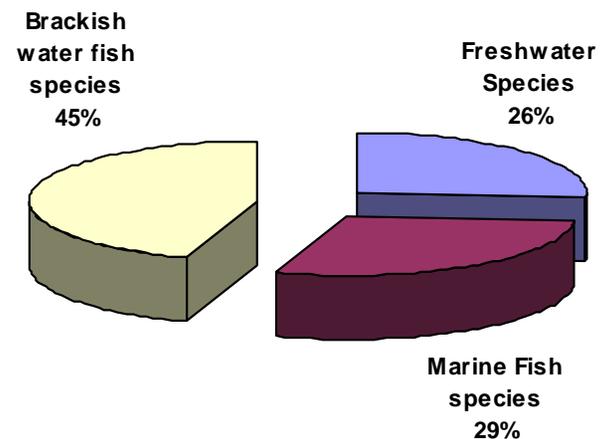


Chilika fisheries dominated by migratory fish species which maintain a phased life cycle
(69% are migratory)



Brackish water fishes most dominant, followed by marine and freshwater fishes

48 species of fish, 4 species of prawn and 6 species of crab were the new record for Chilika after opening of the mouth.



Financial return from capture fishery after the hydrological intervention



Year	US \$(million)
2001-02	11.00
2002-03	10.05
2003-04	17.17
2004-05	18.23

Export earning from shrimp during the year 2004-05 7.5 US \$.

Total Investment for restoration(1998-2005) 13.2 Million US \$

Monitoring and assessment



- The interventions are evaluated, refined, and supported by a strong continuous input, in form of **a multi-agency research, targeted studies to develop performance measures** and a comprehensive in-house close monitoring of key components
- **In addition to this to track the system a set of biological and physical parameters most appropriate to the ecosystem of the lagoon were meticulously identified as performance measures**
- Use of GIS and Remote sensing tool for monitoring.



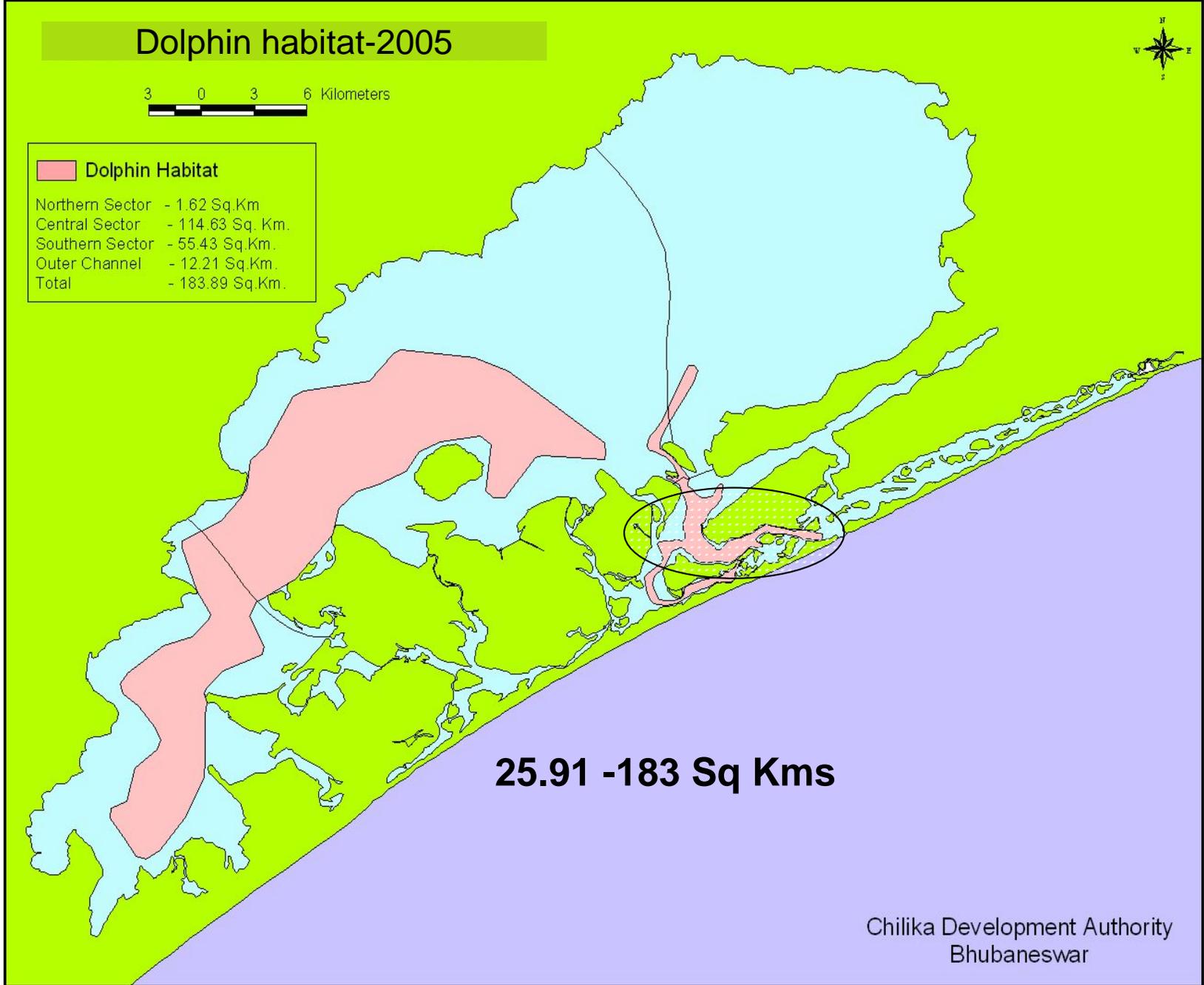
Irrawaddy dolphin

Dolphin habitat-2005

3 0 3 6 Kilometers



Dolphin Habitat	
Northern Sector	- 1.62 Sq.Km
Central Sector	- 114.63 Sq. Km.
Southern Sector	- 55.43 Sq.Km.
Outer Channel	- 12.21 Sq.Km.
Total	- 183.89 Sq.Km.



25.91 -183 Sq Kms

Chilika Development Authority
Bhubaneswar

Threatened species of Avifauna



Common Name

Scientific Name

- 1 Dalmatian Pelican *Pelecanus crispus*
- 2 Spot-billed Pelican *Pelecanus phillippensis*
- 3 Pallas's Fish-eagle *Haliaeetus leucoryphus*
- 4 Indian Skimmer *Rynchops albicollis*
- 5 Spoon-billed Sandpiper *Eurynorhynchus pygmeus*
- 6 Lesser Adjutant *Leptoptilos javanicus*
- 7 Greater Adjutant *Leptoptilos dubius*
- 8 Paer's Pochard *Aythya baeri*
- 9 Wood Snipe *Gallinago nemoricola*

Reduction of coverage of invasive species



Pre - opening
(weed free area - 333 sqkm)

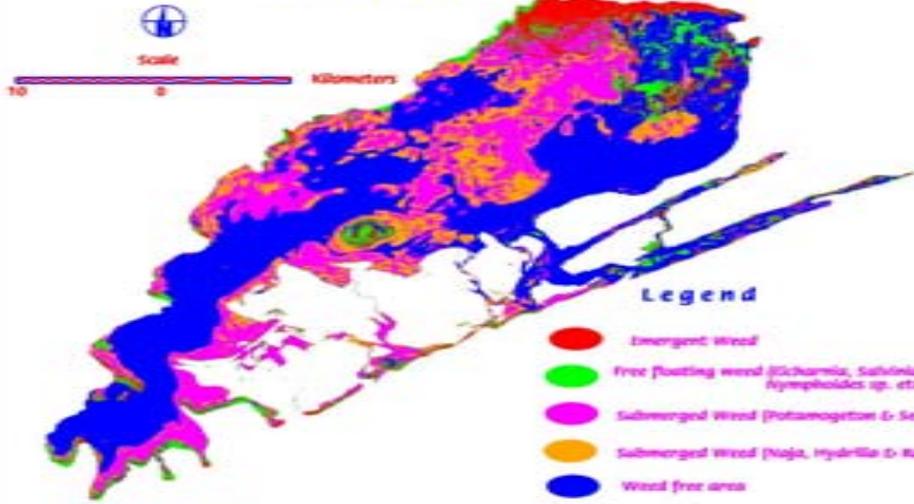


Post - opening
(weed free area - 505 sqkm)



CLASSIFIED WEED AREA MAP OF CHILIKA LAGOON

Data Source : IRS 1D, LISS III
Date of Pass :1st May 2000



Legend

- Emergent Weed
- Free floating weed (Eichornia, Salvinia, Nymphaea, Nymphaoides sp. etc.)
- Submerged Weed (Potamogeton & Sea Grass)
- Submerged Weed (Najas, Hydrilla & Ruppia Sp.)
- Weed free area

Map Information

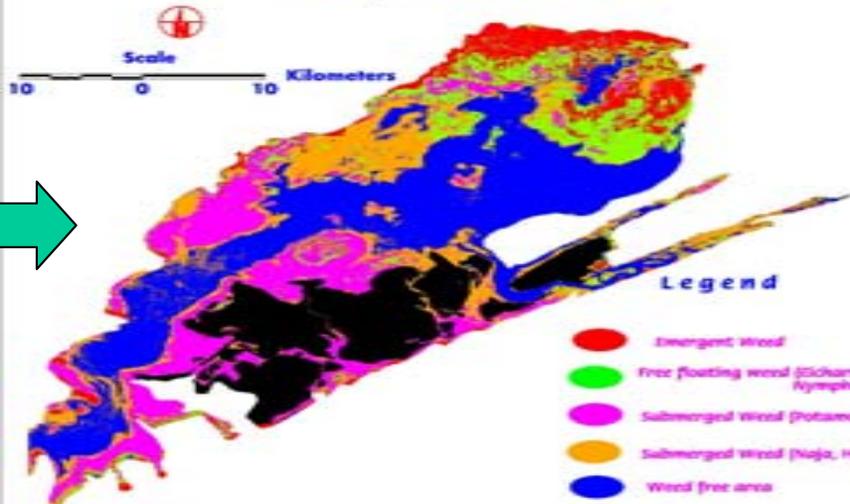
Projection : Polyconic
Units : Meter
Datum : Everest
Spheroid : Everest
GPS Points : Garmin E-MAP

SUMMER 2000

Chilika Development Authority
Bhubaneswar

CLASSIFIED WEED AREA MAP OF CHILIKA LAGOON

Data Source : IRS 1D, LISS III
Date of Pass :23rd October 2000



Legend

- Emergent Weed
- Free floating weed (Eichornia, Salvinia, Nymphaea, Nymphaoides sp. etc.)
- Submerged Weed (Potamogeton & Sea Grass)
- Submerged Weed (Najas, Hydrilla & Ruppia Sp.)
- Weed free area

Map Information

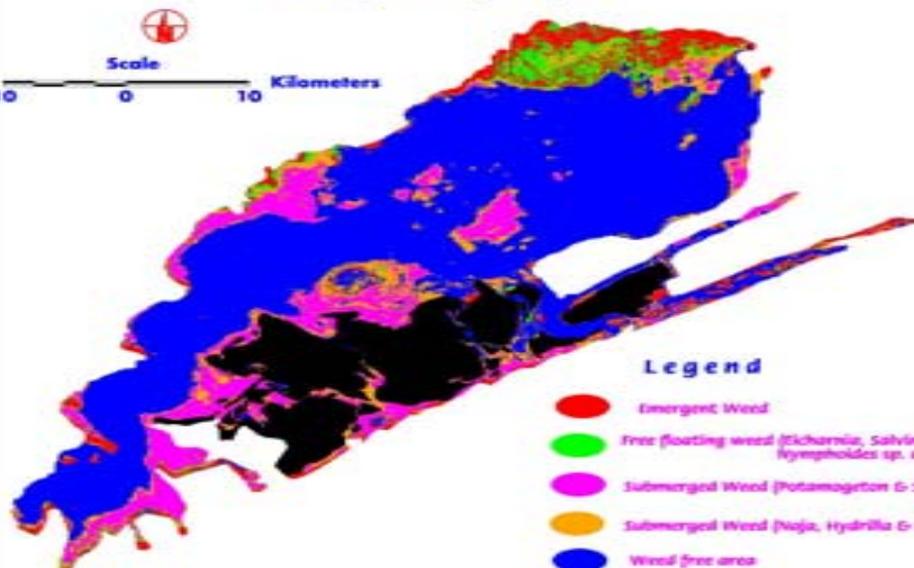
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Units : Meter
Datum : Everest
Spheroid : Everest
GPS Points : Garmin E-MAP

POST MONSOON 2000

Chilika Development Authority
Bhubaneswar

CLASSIFIED WEED AREA MAP OF CHILIKA LAGOON

Data Source : IRS 1D, LISS III
Date of Pass : 16th January 2002



Legend

- Emergent Weed
- Free floating weed (Eichornia, Salvinia, Nymphaea, Nymphaoides sp. etc.)
- Submerged Weed (Potamogeton & Sea Grass)
- Submerged Weed (Najas, Hydrilla & Ruppia Sp.)
- Weed free area

Map Information

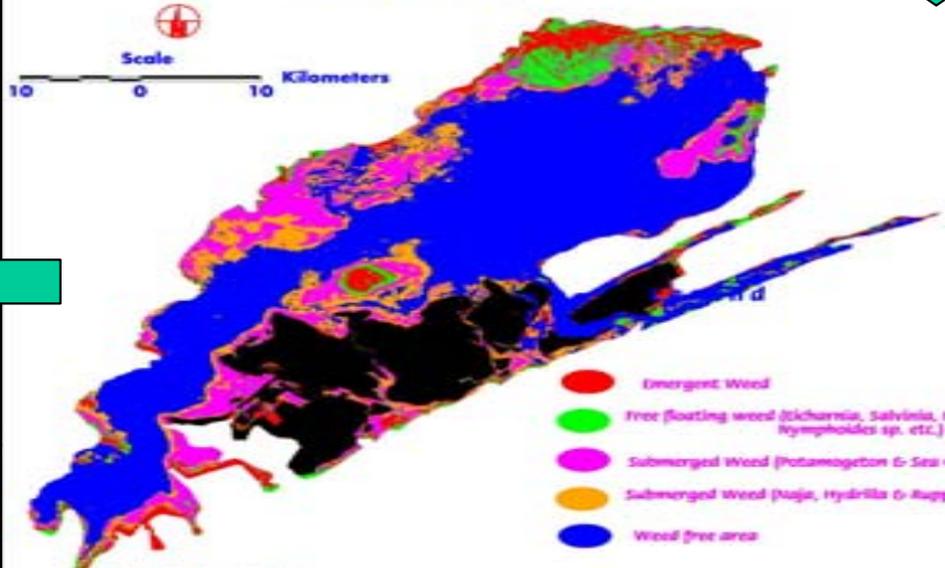
Projection : Polyconic
Units : Meter
Datum : Everest
Spheroid : Everest
GPS Points : Garmin E-MAP

WINTER 2002

Chilika Development Authority
Bhubaneswar

CLASSIFIED WEED AREA MAP OF CHILIKA LAGOON

Data Source : IRS 1D, LISS III
Date of Pass :11th May 2001



Legend

- Emergent Weed
- Free floating weed (Eichornia, Salvinia, Nymphaea, Nymphaoides sp. etc.)
- Submerged Weed (Potamogeton & Sea Grass)
- Submerged Weed (Najas, Hydrilla & Ruppia Sp.)
- Weed free area

Map Information

Projection : Polyconic
Units : Meter
Datum : Everest
Spheroid : Everest
GPS Points : Garmin E-MAP

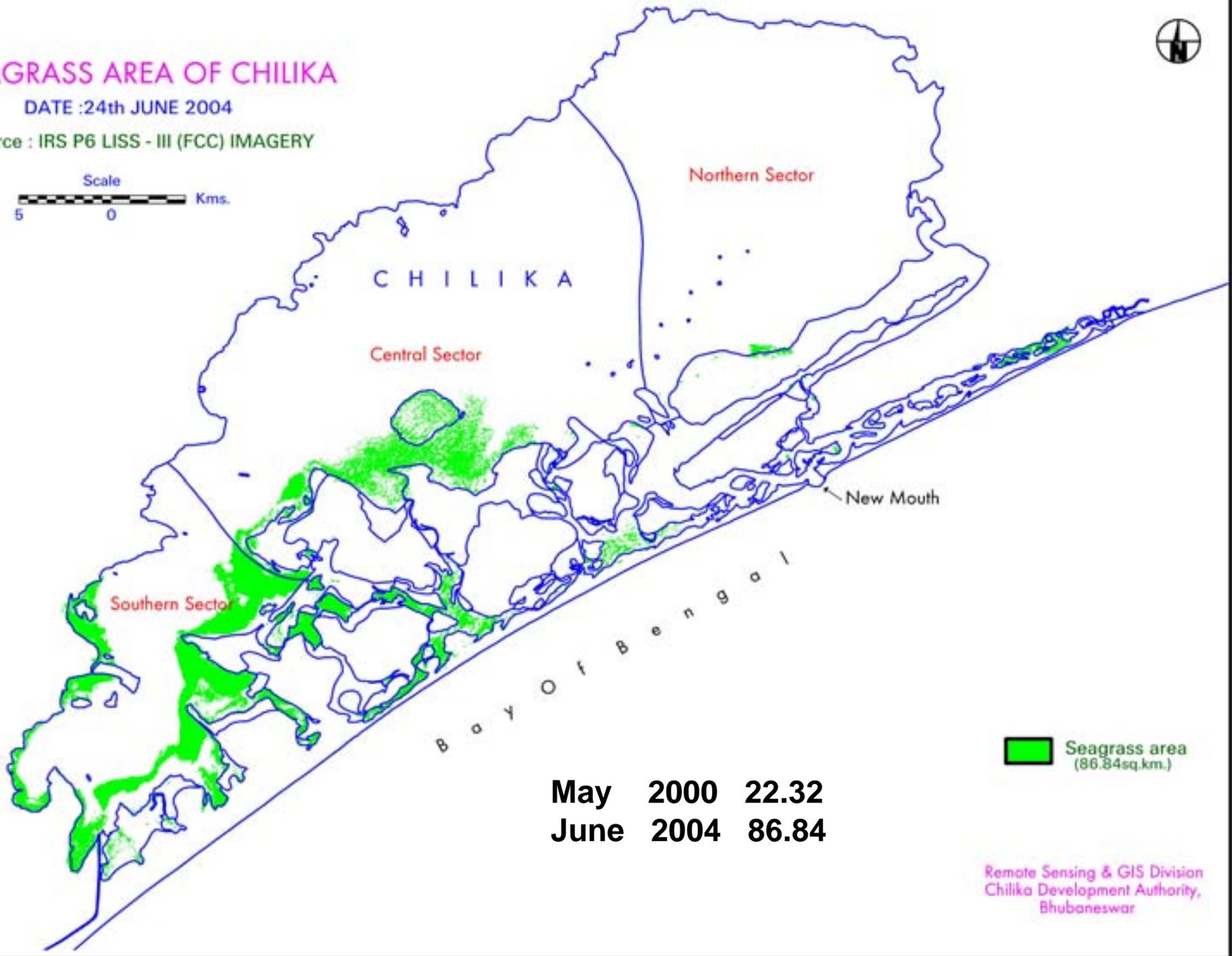
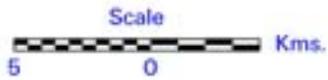
SUMMER-2001

Chilika Development Authority
Bhubaneswar

SEAGRASS AREA OF CHILIKA

DATE :24th JUNE 2004

Source : IRS P6 LISS - III (FCC) IMAGERY



C H I L I K A

Northern Sector

Central Sector

Southern Sector

New Mouth

B a y O f B e n g a l

 Seagrass area
(86.84sq.km.)

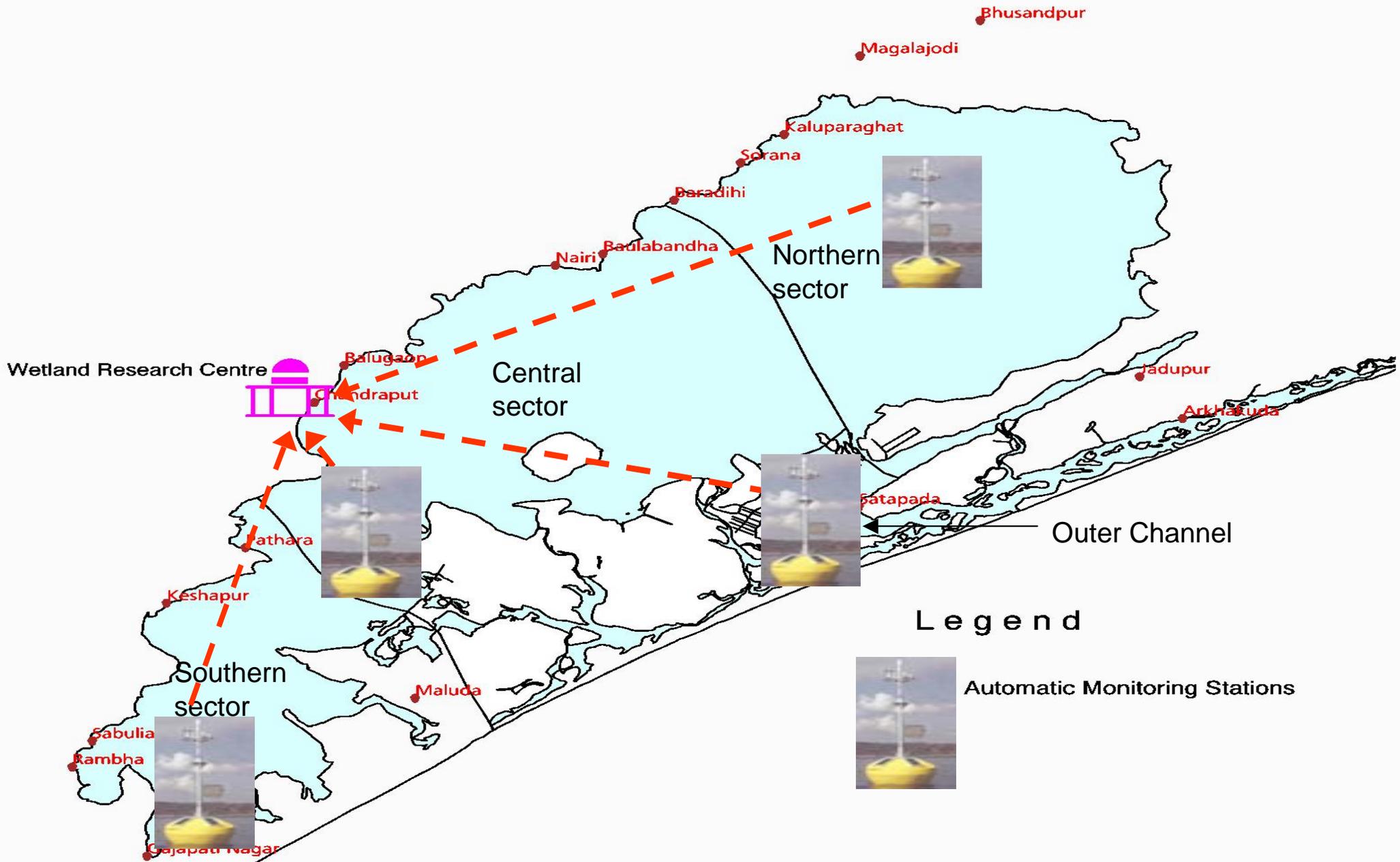
May	2000	22.32
June	2004	86.84

Remote Sensing & GIS Division
Chilika Development Authority,
Bhubaneswar



Halophila -a dominant species of sea grass in Chilika is considered as ideal habitat for Dugong

PROPOSED TELEMETRIC DATA COLLECTION SETUP

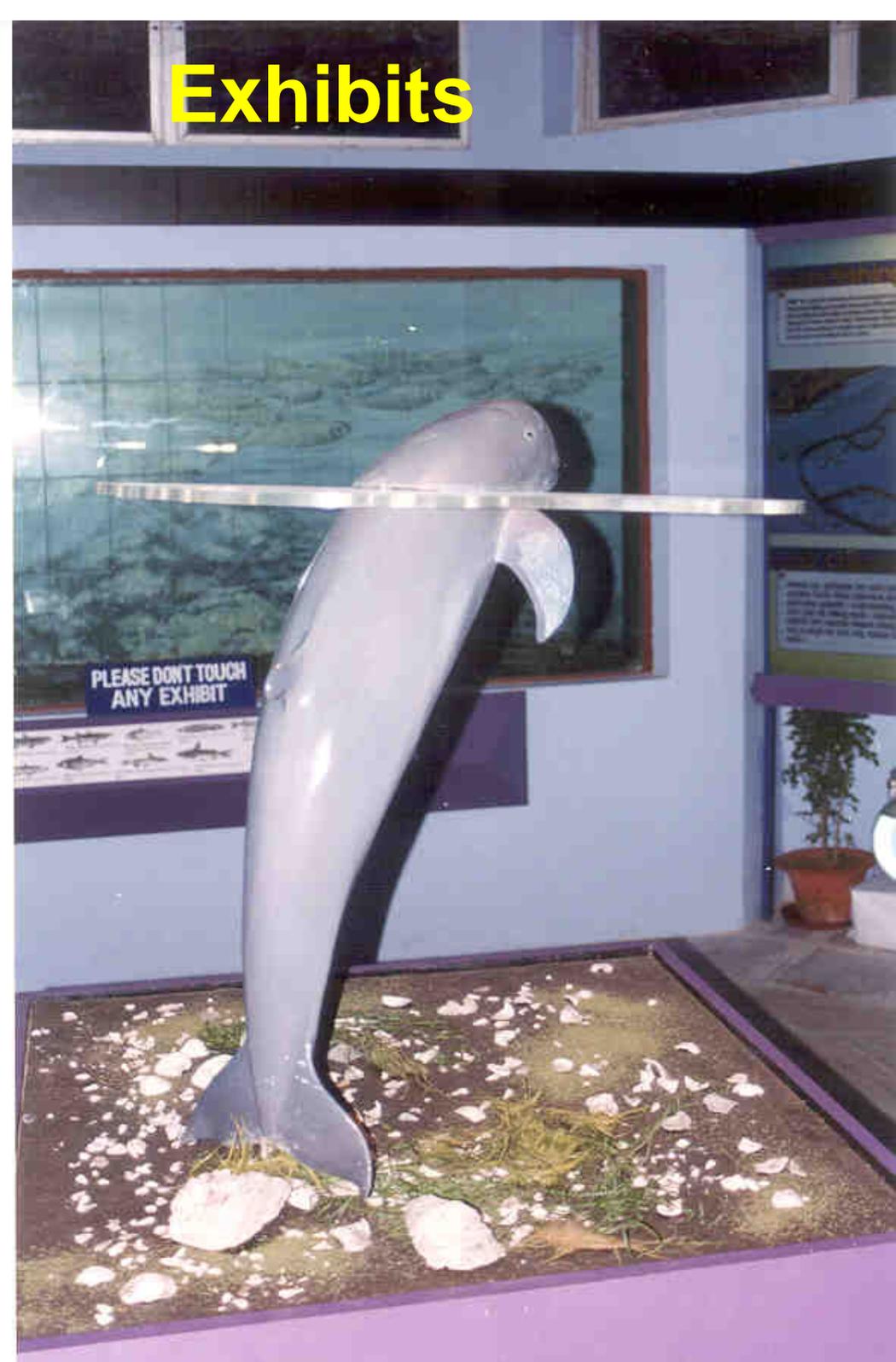




Visitor Centre at Satapada-Chilika



Exhibits

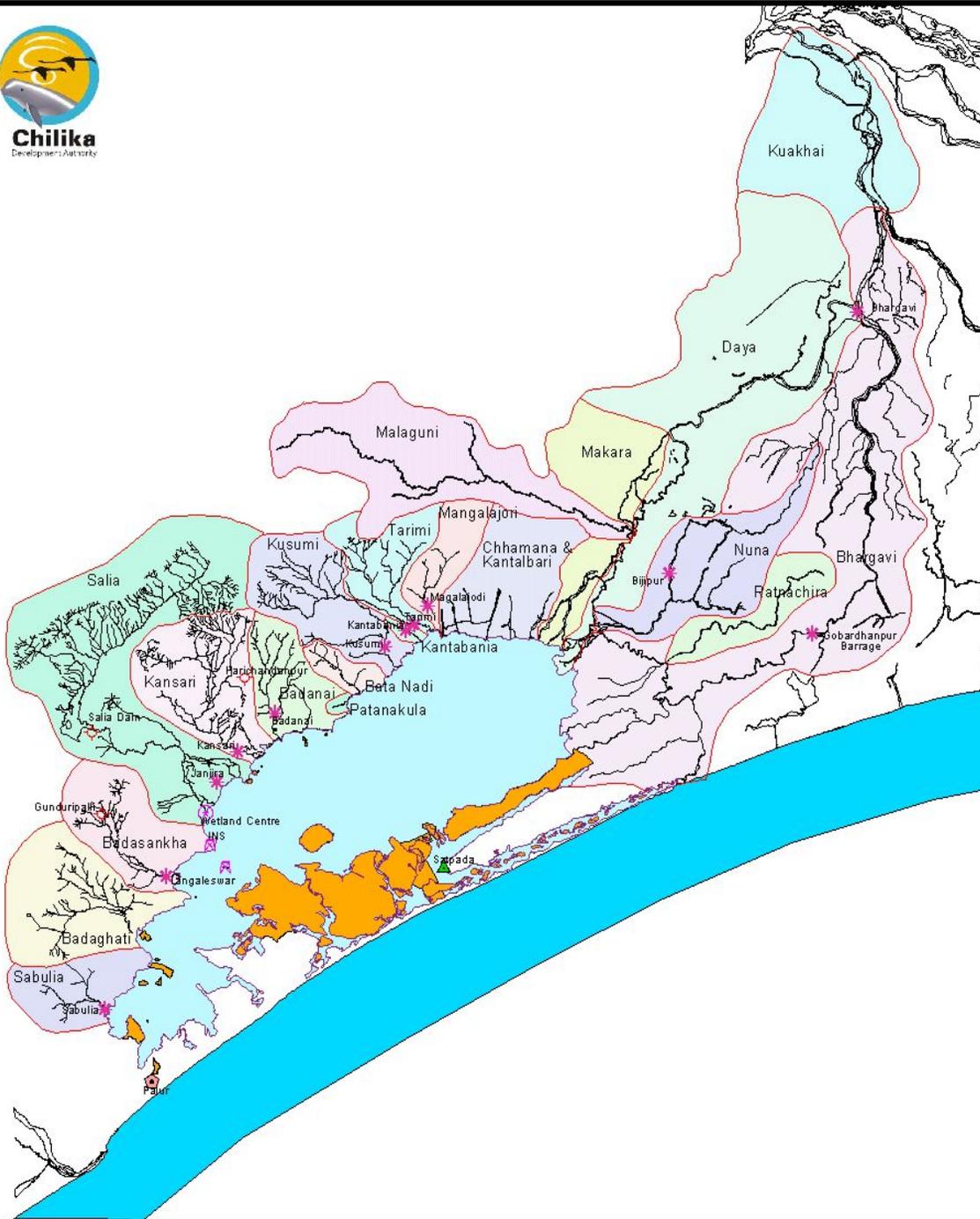




Drainage basin



6 0 6 12 Kilometers



River Catchment	Area (in sq. km.)
Bhargavi	828.359
Daya	540.337
Salia	454.824
Malaguni	289.010
Kuakhai	259.012
Nuna	180.682
Badaghati	179.525
Kansari	160.992
Makara	159.486
Chhamana & Kantalbari	144.188
Kusumi	141.188
Badankha	128.446
Sabulia	88.661
Badanai	86.909
Tarimi	86.558
Ratnachira	83.404
Mangalajodi	62.183
Batanadi	26.194
Kantabania	6.280
Patnakula	4.206

Lake basin Scenario



- Assessment revealed that land degradation in the drainage basin resulted in enhanced silt flow into the lagoon and triggered **poverty, due to low productivity** .
- The depletion of natural resources and **loss of their productive capacity** had imparted huge cost on the local communities.
- The **poor were the first and most directly and adversely impacted** due to land degradation resulting in declining agricultural productivity .

HIGHLY ERODED AREAS

Participatory management of watershed with a “**sustainable rural livelihood**” approach.

- The drainage basin of the lagoon that spreads over 4000 square kilometres was the **logical starting point for management actions** for sustainable management of the lagoon.
- The environmental flow assessment provided necessary clues regarding the **significance of the freshwater flow from the drainage basin to maintain the ecological integrity of the lagoon.**
- The large-scale silt flow from catchments (**0.4 million cubic meters**, assessed through the stream flow measurement) was identified as one of the biggest management problems.



- The drainage basin management program is conceived as a long-term participatory process to achieve an **environmentally, economically and socially sustainable management of water resources.**
- The basic approach adopted has been to **facilitate and create an enabling environment, through capacity building of the community, community based organisations and NGOs at the outset, through a series of need-based training and exposure visits.**
- **Community participation central to the Integrated Water Resources Management**



Watershed Association

- Watershed Association at each micro watershed are the **key institutions to manage the natural resources and ensure equitable distribution of the benefits.**
- **All adults from the micro-watershed villages are members of the watershed committee.**
- The general body of the committee constitute a drafting committee to draft the by-laws(TOR).
- The by-law is then deliberated in the general body meeting and adopted.
- The watershed association then constitutes the watershed committee with fair representation from the landless, socially weaker section and adequate women representatives.
- The watershed associations are also registered under Societies of Registration Act.



Micro planning (A bottom up approach)

- The micro-plan blended with local indigenous knowledge and appropriate experts' input, for optimum utilization of the natural resources in a sustainable manner is formulated at community level.
- To ensure the involvement of the community and sustainability, it is ensured that the **watershed community share a part of the cost of the treatment** towards the watershed development fund which would be utilised for maintenance and further improvements of the watershed assets created after the project period is over.
- The watershed association and the user groups has been able to efficiently implement the micro-plan in consultation with the community.







Preventing soil erosion
Replenishment of green water



Rainwater harvesting structures

- One of the most successful initiatives has been a series of **rainwater harvesting structures, designed and installed by local communities.**
- They succeeded in **recharging aquifers and rejuvenating local ecosystems as well as their surrounding economies.**
- The advantage of the system is that along with **arresting rainwater; it improves the moisture regime (Green water productivity) in the field, particularly downstream.**
- This acts as **insurance against crop failure, a frequent occurrence.**
- The farmers have started growing a **second cash crop** like wheat ,sunflower and pulses after the main crop is harvested due to improved moisture regime.
- The **yield per hectare has improved to 0.8-1.0 tonnes) per acre.**



- The most visible change is the presence of water as indicated by the recharged wells and the greenery in the village.
- The villagers say that after **2001** there have been a rise in agricultural productivity and the second less water demanding crops can now easily be grown annually.
- This is believed to be a result of **rain water harvesting and increase of green water in form of soil moisture.**
- Now the intricate link between **ecosystem , water and livelihood** is more apparent to the local communities.





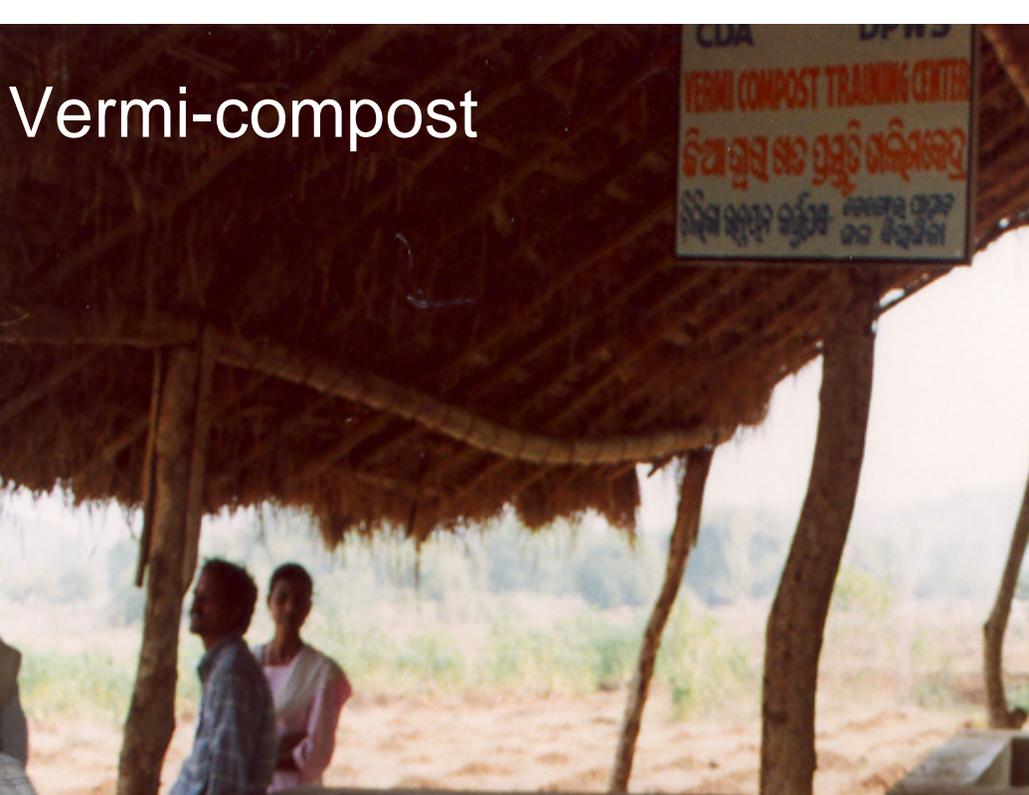
Rooftop rainwater harvesting structure at Watershed office



Pitcher Irrigation

An efficient
example of
micro irrigation

Vermi-compost



The less intensive agriculture with low input is practiced at the moment , so use of organic manure is encouraged with a long term objective.



Women Participation

- It has also taken the lead in integrating women from all communities into the mainstream by way of empowerment through self-help groups and their active participation in the watershed management.
- The women of the community benefited in a special way through the formation of the women self-help groups (SHG) and capacity building training for skill improvement.
- Through a micro-credit mechanism, the members of the SHGs adopted income-generating activities to supplement their family's income.
- By working to earn for themselves, the women empowered themselves against the prevailing social taboo, now they are better placed to take the decision on financial matter



Conflict resolution

- The longstanding village level social conflicts and differences of opinions within the micro-watershed area were resolved as a result of the participatory initiative.
- The long-standing inter-village conflict was plaguing these villages for the **past 17 years, with 16 criminal cases of grievous nature pending in the court of law and the loss of two precious lives.**
- **The micro-watershed became the model in the context of social integration.**



Measurable changes

- Notably, there have been increased earnings from land and non-land activities for the poor, reduced debt, and improved livelihood and food security leading to further poverty alleviation, reduced environmental degradation and reduction in the silt load into the lagoon.
- The outside migration in search of employment has reduced by 80%.
- Additionally, it reduced **the ecosystem's vulnerability to drought, improved agricultural incomes for small farmers, increased wage-labour opportunities for the landless, provided an equitable distribution of benefits to the most impoverished, and reduced environmental degradation and drudgery and by reducing poverty.**
- The project brought a silent revolution and the local community now lives in harmony, as they say, **"We are now an extended watershed family and there is no question of discrimination."**



Pilot project of the Dangei micro-watershed



Positive impact on the coastal zone

- Chilika Lagoon a coastal wetland serves as an important spawning and nursery area for the adjoining coastal zone
- Restoration of the wetland and its drainage basin is playing a major role in the **protection of the marine environment from land-based activities.**
- This is evident from the increase in the **fish production from the adjoining coastal areas and increase in the number nesting *Olive Reedley* on the sand bar located along the estuarine zone.**



Key elements of the case study

- The CDA was established by the government as a semi autonomous body
- Commitment from government; the **restoration programme is entirely funded by government of India**
- A formalised mandate with implementing authority
- Goals that appeal to the **desires and aspiration of the local communities**



Successive adaptive planning

- The first phase included the restoration of the lagoon by re-establishing the flow regime with the Bay of Bengal , pilot project for micro-watershed management (treatment of eroded forest and agricultural land, greening of the area, soil moisture conservation, capacity development etc.)
- In next phase successful pilot project micro-watershed management is up-scaled to some 13 more micro-watersheds in the drainage basin; environmental flow assessment
- It is envisaged to expand the management to the River basin scale.



Important aspects

- **Instilling stakeholders participation from the beginning**, i.e., from the problem identification stage to the restoration and management of the natural resources through capacity development and empowerment .
- **Work within existing sectors, in recognition of the barriers that exist across disciplines**; and recognize that methodological approaches for integration are fluid and dynamic processes.
- **Managing stakeholder expectations**
- The **capacity development of the local community, community level organization and the local NGOs** created an **enabling environment** for sustainable restoration and management of the lagoon and watershed resources.
- **Creating participatory management institutions** (including local people and NGOs) at the site level with a legal status, with a mandate, accountability and authority to make decisions.

Good practices in the watershed

- Participatory management of the watershed with “**sustainable rural livelihood**” approach, adopted by CDA resulted in enhancement of productivity and poverty alleviation.
- Participation of local communities **in planning and implementing management of natural resources and in sharing the responsibilities of decision-making.**
- **Rainwater harvesting – Increasing green water productivity.**
- The project is an ecological success in many respects, notably, there have been increased earnings from land and non-land activities, **reduced debt, facilitated conflict resolution** and social integration and **improved livelihood and food security leading** to further poverty alleviation, reduced environmental degradation and reduction in the silt load into the lagoon.
- The local community now lives in harmony, as is evident from a quote by villagers: “**we are now an extended watershed family and there is no question of discrimination.**”

Lesson learnt



- The rehabilitation of Chilika Lagoon demonstrates that the **interlinked freshwater-marine problems could be solved by an integrated management approach for lagoon and watershed** (regulation of lagoon economic activities, optimisation of land use and watershed management, ensured freshwater flow, etc.)
- The **adaptive successive planning** with ecosystem approach & implementation with **active support of the local community**.

Contd...

- The local action demonstrates the mainstreaming of the notion of “ecosystems as legitimate users of water and the strong link between ecosystem and livelihoods”.
- It is an example of a paradigm shift from traditional sectoral approach of implementation to “an assortment of technology, institutions & social marketing implemented through local stakeholders”.
- The increase in the productivity level both in the wetland as well as the watershed, due to good environmental practices, facilitated the poverty alleviation of both the fishers and watershed community.



Key elements of Restoration



- The extensive **consultative approach** has contributed significantly to the success of the management actions undertaken.
- The **community participation** and stewardship, strategic partnership with various national and international professional institutions
- Intensive **monitoring and assessment** system .
- The **core value** of the restoration model is its **global relevance**.

AWS 2005 was held at BBSR and was attended by 400 participants from 32 countries .

The recommendation of the Symposium was adopted as **“Chilika Statement”**





- Chilika Development Authority was conferred with prestigious **Ramsar Wetland Conservation Award**, and **Indira Gandhi Paryavaran Purashkar** for the outstanding achievements in management of the lagoon and its drainage basin.



- This is further testified by the fact that Chilika was removed from the **Montreux record** in 2002(first from Asia).



Thank you for your kind attention