



Eco-hydrology of Mahanadi Delta

Bishnu P. Das

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Hydrological Issues

River Continuum Concept (RCC)

- **Integrates predictable and observable biological features of lotic system.**
- **Bed & Banks impacted by linear unidirectional flow linking various sections.**
- **Downstream section dependant upon and influenced by upstream section.**
- **Cummins, K.W. etal, 2006, Introduction: An Overview of Stream Ecosystems, River and Stream Ecosystems of the World, Elsevier, Amsterdam, Recognized the need to integrate lateral component of vegetation and tributaries, including flood plain.**

Flood Pulse Concept (FPC)

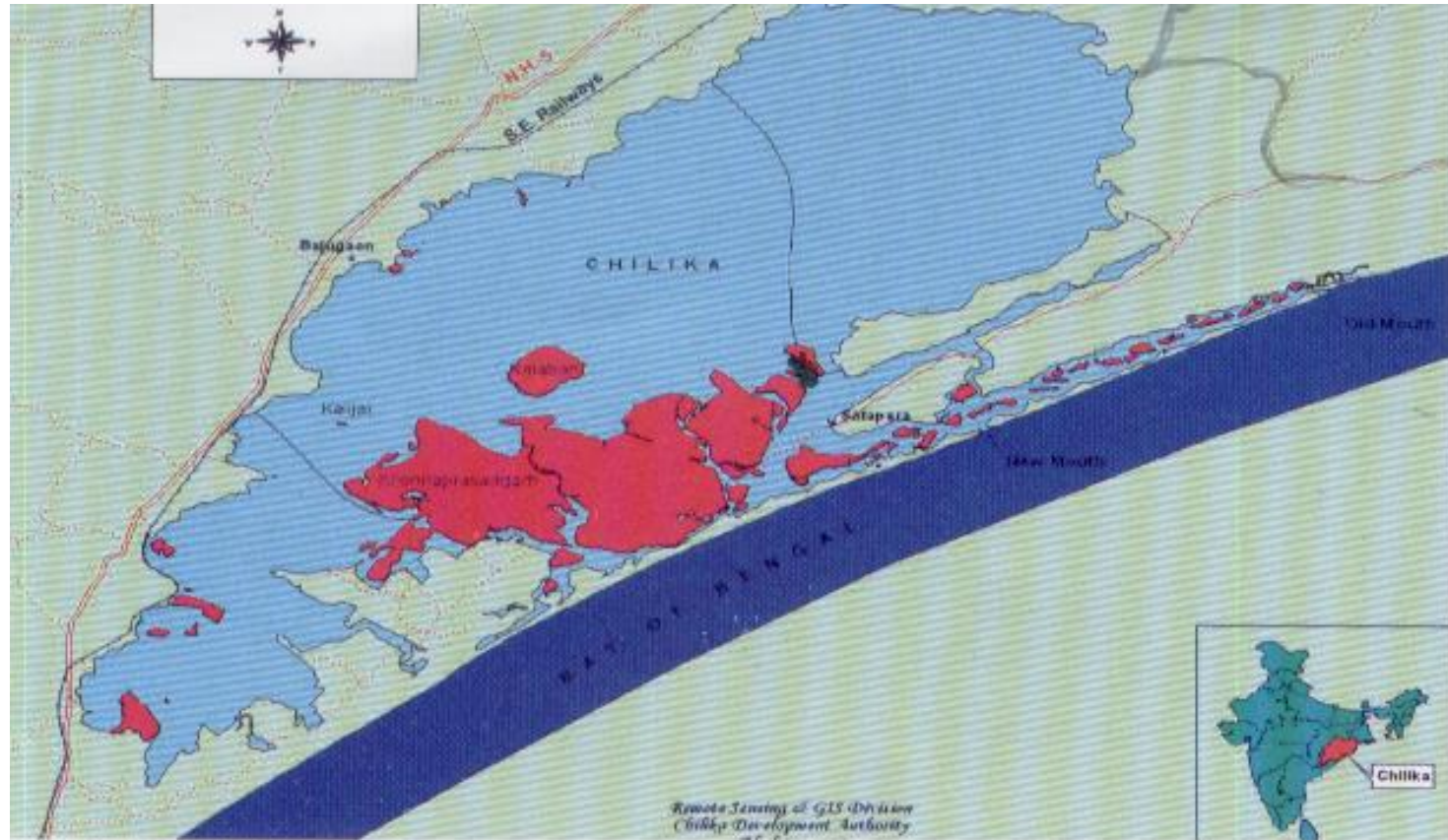
- **Lateral interaction of flood plains through periodic flood events.**
- **FPC emphasise role of flood pulse in mobilising material (organic and inorganic) from flood plain to main channel on to estuary.**
- **Timing important view point for breeding**
- **Breeding season well defined for a particular flood phase**
- **Amplitude and Direction of flood wave.**
- **Continuity, smoothness, rate of change and sharp fluctuation.**
- **Estuaries form the reservoir of nutrients conveyed by flood flow principally and function and terminal habitat in a river from which migration originates.**
- **Absence of flood means a nutrient deficient estuary leading to adverse impact on fish species, population.**
- **The primary productivity rapidly decreases with unfavourable flow alteration.**

Mahanadi Delta System



Fig.-2: Mahanadi River System

Chilika Lagoon, India



Chilika Lagoon, India

- Chilika, a designated Ramsar site (1981) is the largest lagoon along the east coast of India
- The Water Spread Area of Chilika is 1000 Km², in monsoon varying to 906 Km² in non-monsoon.
- The lagoon is unique combining marine, brackish water and fresh water ecosystems, which are highly productive.
- It is the wintering ground for more than one million migratory birds
- A wetland of International importance due to its unique biodiversity
- Lagoon supports many endangered and endemic species of flora and fauna. Irrawaddy dolphin is characteristic in habitat.

Irrawaddy Dolphin in Chilika Lagoon, India



Chilika Lagoon, India

- **Chilika is primarily fed by Daya & Bhargavi branches of Mahanadi River along with a direct draining catchment of 3000 Km².**
- **Daya and Bhargavi convey 5.65% of Mahanadi flow to Chilika**
- **Chilika receives annually 3700 Mm³ from Daya-Bhargavi and their flood plain.**
- **An additional 1300 Mm³ is received from direct catchment.**
- **A maximum fresh water inflow of 375000 Cusec occurs in a year varying from a minimum of a few hundred Cusec**
- **The vegetation free area of the lagoon is 726 Km² where as the area covered with macrophytes is 179 Km² (varies seasonally)**
- **The lagoon used to receive tidal flow from the sea through a 32 Km long inlet channel of which the tail 7 Km became defunct long back**

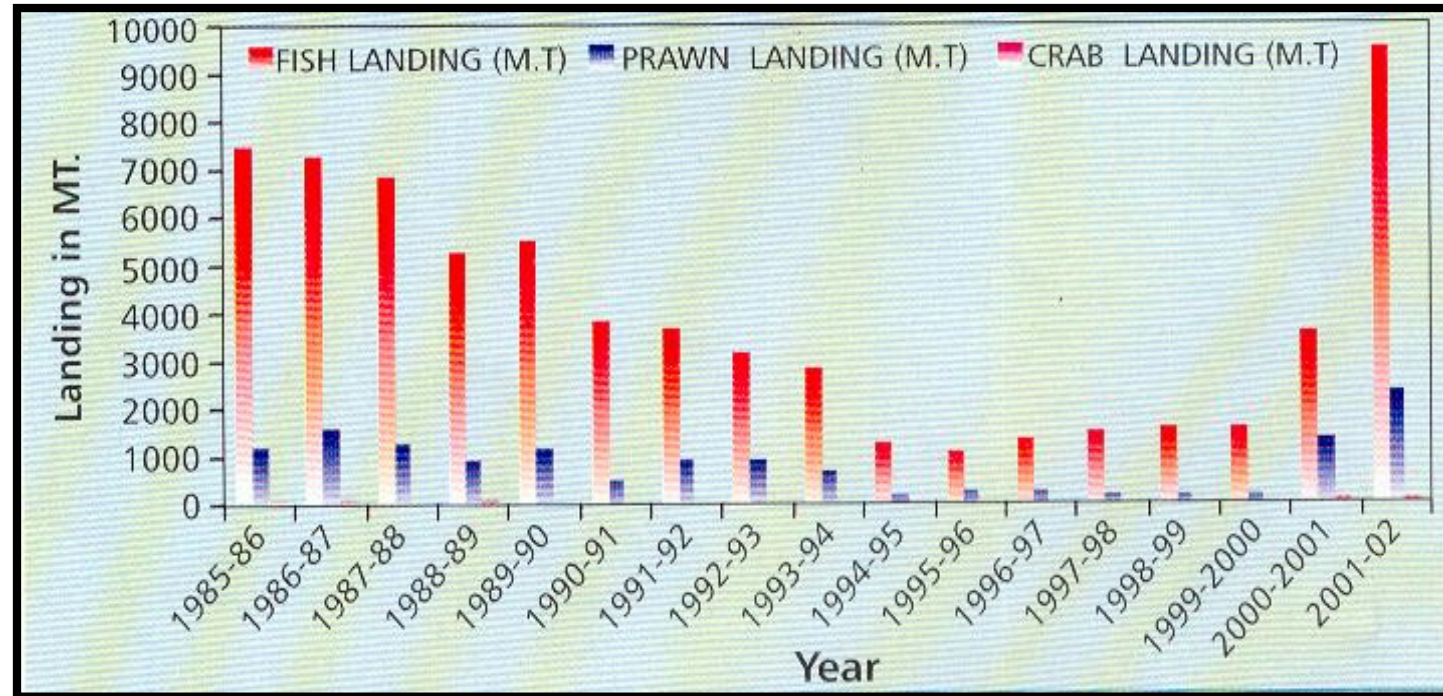
Ecosystem Degradation; Impact of Sediment Flow

- The principal sediment entry is through the two major distributaries of Mahanadi River System; Daya and Bhargavi.
- Excessive sediment inflow into Chilika has become a matter of concern for the health of the lake.
- Hirakud dam (1957) constructed on Mahanadi acted as a major sediment trap for the intercepted catchment area of 83,500 Km².
- The flood moderation by the dam and introduction of irrigation to the northern periphery change the inflow regime to Chilika significantly.
- Experienced increased silting due to altered land use of irrigated agriculture, choking of mouth of 20km long inlet shrinking the lake area by 1.5km²/ year.

Ecosystem Degradation; Impact of Sediment Flow

- Inferred sedimentation rate currently are 1.88, 1.1 and 0.85 cm/year in the northern, southern and central sectors respectively compared to estimated rates of 0.4, 0.25 and 0.66 cm/year in 1900.
- Impact has been progressively adverse after Hirakud.
- Retarded freshwater flow to sea caused drastic reduction of salinity from 23.3 ppt (1950), 13.2 ppt (1961), 0.4-18.6 ppt (1987), 0-10.6 ppt (1992).
- Salinity over 70% decreased to 5ppt against the required 15ppt for optimal fish productivity.
- Decline in fish production from 8000 Mt in 1985 to 1500 Mt 1998.
- Artificial mouth 200 mtr wide opened to sea on 23 Sept, 2000.

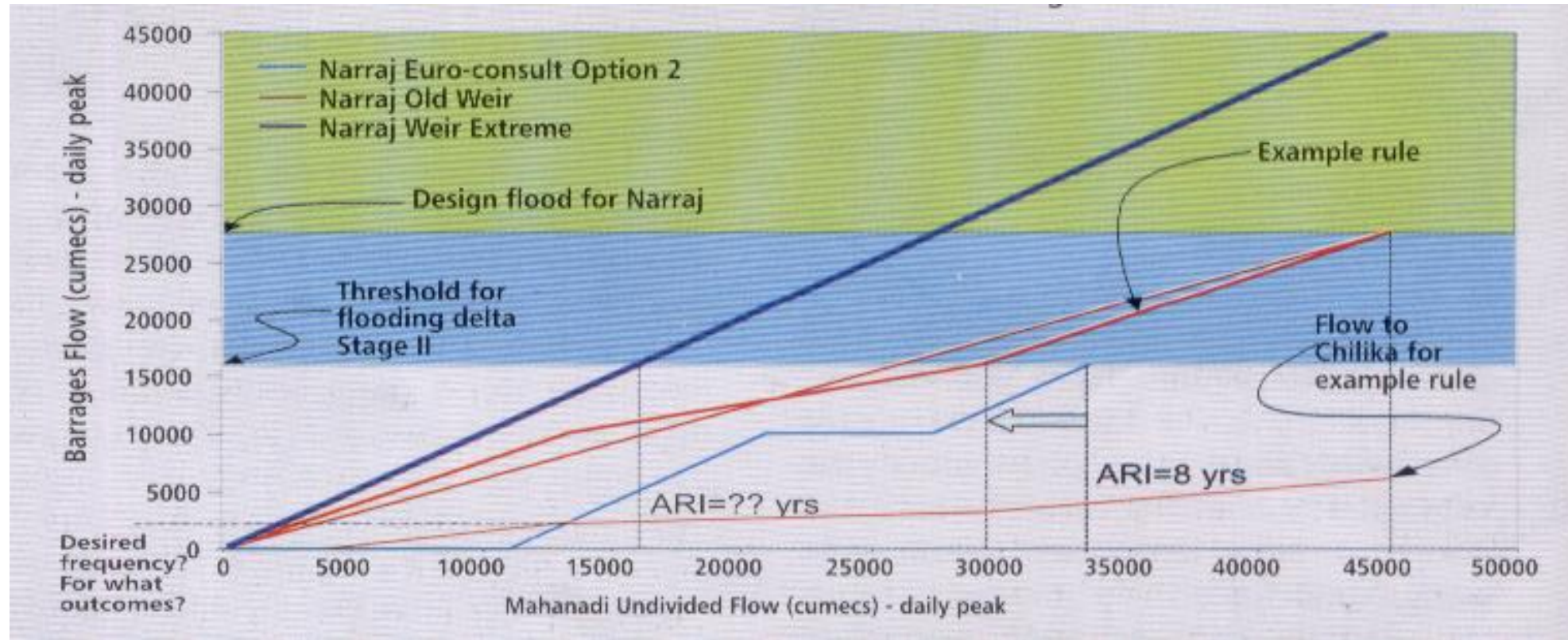
Fish Landing at Chilika



Intervention

- **Naraj barrage constructed on principal deltaic branch of Mahanadi to regulate flood flow to Chilika.**
- **Annual flow to Chilika averages 2163 Mm³, 506 Mm³ in July, 885 Mm³ in August, 586 Mm³ in Sept. and 157 Mm³ in Oct.**
- **Naraj barrage intended reduce entry large July/August flood yet allowing enough fresh water for nourishment and flushing out sediment adequate to maintain / control salinity.**

Relationship between Mahanadi-Naraj Barrage Undivided Flows



Paradeep Estuary

- **As the terminal outlet for Mahanadi which carries 40-50% of undivided Mahanadi flood and store house for Indian major carp as well as Tenousha Ilisha (Hilsa) has a major impact on the fishery potential of the entire Mahanadi river.**
- **The systematic observation of flood and sediment data annually (better month wise) prior to Hirakud dam and decadal changes observed by Dept. of Water Resources are useful input to modelling the eco-hydraulics of the entire river.**

THANK YOU

Dr. B. P. Das

*Former Engineer-in-Chief & Chief Advisor
Department of Water Resources, Odisha
Chairman, Uttarkhand Disaster Committee, MoEF&CC
Chairman, Environmental Monitoring Committee for Command Area of Narmada
Projects, MoEF&CC*