Chilika Lake

2012 Ecosystem Health Report Card

National Centre for
Sustainable Coastal Management

Chilika
Development Authority

Chilika Lake is rich in natural and cultural beauty, and important to local livelihoods

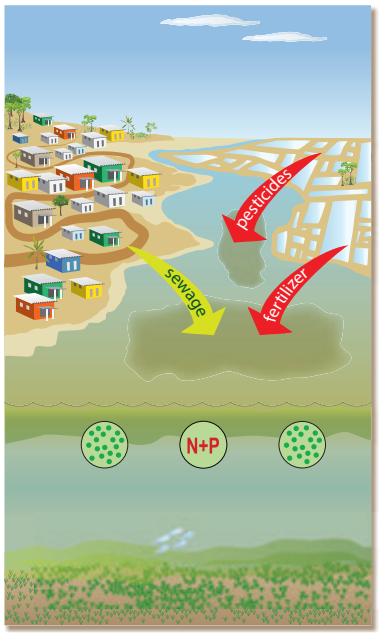
Chilika Lake stores monsoon flood waters and provides a level of salinity needed to sustain its amazing biodiversity of life. Local communities depend on the Lake to provide water for fish and shellfish for food and resale, village transport, and tourism income. It is for all these reasons that Chilika Lake needs our protection.

Pressures affecting the Chilika Lake ecosystem

Chilika Lake is subjected to constant pressures from both natural processes and human activities. The problems highlighted here are overfishing, pollution, tourism, and sedimentation, all of which can result in a degradation of the Lake. By identifying these pressures through efforts like this ecosystem health report card and subsequent management actions, the likelihood of Chilika Lake to sustain itself is improved.

Fishing and Aquaculture

The recent abundance of fish stocks is not sustainable with overfishing and so many fishers. At landings, dead fish thrown back into the water contaminate the Lake. Active shrimp pens and abandoned nets trap sediment and kill juvenile fish.



Pollution

As land use changes from forest to settlements and paddy agriculture sewage, and fertilizer and pesticides runoff increases into the Lake. Algae blooms that float and sit on the bottom are the result of that extra nutrient input N+P.

Tourism

While tourism is providing welcome income to local communities, the activities, if not managed properly, adversely impact the environment. Air pollution, trash, wildlife disturbances, noise, and rapid village growth are increasing around and on the Lake.

Sedimentation

During monsoon season, an excess of sediment is deposited in the Lake, mostly from Mahanadi River tributaries, nearby settlements, and agricultural lands. As the Lake becomes more shallow and its sea outlets fill in with sediment, increased flooding occurs.

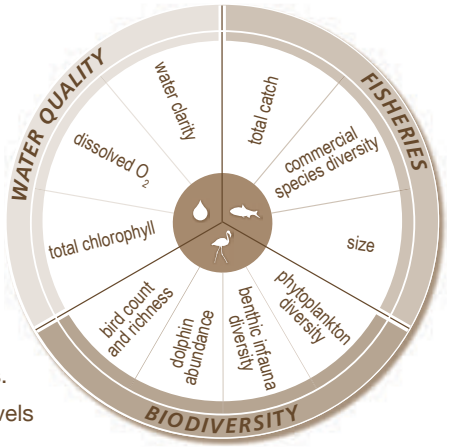
How the report card was prepared

This is the first of a proposed series of annual Ecosystem Health Report Cards for Chilika Lake. The report card was developed in order to enhance understanding and management of the Chilika Lake ecosystem through a collaborative, UNEP/GEF project on "Global foundations for reducing nutrient enrichment and oxygen depletion from land based pollution, in support of Global Nutrient Cycle" by Chilika Development Authority (CDA), National Centre for Sustainable Coastal Management (NCSCM), and UNEP/GPA facilitated Global Partnership on Nutrient Management (GPNM).

The CDA, in partnership with NCSCM and the Integration & Application Network from the University of Maryland Center for Environmental Science, convened a science workshop bringing together local, regional, and international experts and stakeholders, who together identified 10 indicators of ecosystem health currently monitored within the Lake, and developed thresholds for each. Due to data limitation, Nitrogen and Phosphorus were not considered in this report card. However, CDA is currently monitoring Nitrogen and Phosphorus, and this dataset will be included in the next Report Card. Additional indicators may be included in future once measures for data collection are in place. This first Report Card serves as a baseline that will be used as a point of comparison to measure progress towards Chilika Lake management goals and targets.

Measures of ecosystem health

Measuring the ecosystem health of Chilika Lake is conducted using 10 indicators organized into three main indices: Water Quality, Fisheries, and Biodiversity. Together, these indicators represent the ecosystem features of Chilika Lake that are valued (e.g., fishing, tourism, biodiversity); and represent the threats (e.g., overfishing and illegal aquaculture, pollution, and sedimentation) to these values.



WATER QUALITY

Water clarity — a measure of how much light penetrates though the water column which plays an important role in determining Lake grasses and phytoplankton distribution and abundance.

Dissolved oxygen — critical to the survival of Chilika Lake's aquatic life. The amount of dissolved oxygen needed before aquatic organisms are stressed, or even die, varies from species to species.

Total chlorophyll — a measure of phytoplankton (microalgae) biomass. Elevated phytoplankton levels can reduce water clarity and decomposing phytoplankton can reduce dissolved oxygen levels.

FISHERIES

Total catch — total catch of fish, prawns, and crabs recorded monthly at 27 landing stations around the Lake. Allows Lake managers to monitor annual yield in comparison to a calculated maximum sustainable yield.

Commercial species diversity — number of species landed each year that are commercially important for the livelihood of fishermen.

Size — body length of landed bagda or tiger prawns (*Penaeus monodon*), khainga or mullet (*Mugil cephalus*), and Chilika crabs (*Scylla serrata*) should be above (or between) a prescribed length to ensure sustainability of the species.

BIODIVERSITY

Bird count and richness — count of the number of birds and bird species utilizing the Lake. Chilika Lake is the largest wintering ground for migratory waterfowl found anywhere on the Indian sub-continent.

Dolphin abundance — count of the endangered Irrawaddy dolphins surveyed annually in the Lake.

Benthic infauna diversity — Simpson's Index of Diversity (D) is used to assess the condition of this community. Benthic infauna are organisms living in or on the soft bottom areas of the Lake (e.g., clams and worms) and are a key food source for many species.

Phytoplankton diversity (microalgae) — Simpson's Index of Diversity (D) is also used to assess the condition of this microscopic algal community through analysis of the number of species present, and the abundance of each species. Phytoplankton are an important component of the Lake's food web.

Desired conditions guide ecosystem change

Desired conditions are based on available guidelines, current scientific knowledge, and/or historical data and trends, and take into account the influence of a variable climate from year to year. The table below outlines the desired condition developed or identified for each indicator and the source of this information.

Category	Indicator	Desired condition	Source of data
Water Quality	Water clarity	≤ 30 NTU	CDA
	Dissolved oxygen	≥ 5 mg/L or 60% sat.	ICMAM
	Total chlorophyll	≤ 5 µg/L	ICMAM
Fisheries	Total catch	% deviation above or below maximum sustainable yield (11,500 t/yr)	CDA
	Commercial species diversity	Ratio of species landed:desired (45 sp. desired)	CDA
	Size	Proportion of species landed above a sustainable size limit. *M. cephalus*: 219 - 461 mm; *P. monodon*: 116 - 197 mm; *S. serrata*: 87 mm	CDA
Biodiversity	Bird count and richness	Ratio to maximum bird count and diversity recorded since 2003	CDA
	Dolphin abundance	Ratio to maximum dolphin count recorded since 2001	CDA
	Benthic infauna diversity	Simpson's Index of Diversity (1-D)	CDA
	Phytoplankton diversity	Simpson's Index of Diversity (1-D)	CDA

Calculating the ecosystem grade for Chilika Lake

Chilika Lake was divided into four reporting zones, each of which received a report card grade. The grades were calculated from the average of water quality, fisheries, and biodiversity indices, comprised of data collected over the 2011-2012 period. On-going monitoring will allow grades to be updated on a periodic basis, providing a means to track change over time.

What do the grades mean? *

A 80–100%. All water quality and biological health indicators meet desired levels. Quality of water in these locations tends to be very good, most often leading to very good habitat conditions for fish and shellfish.

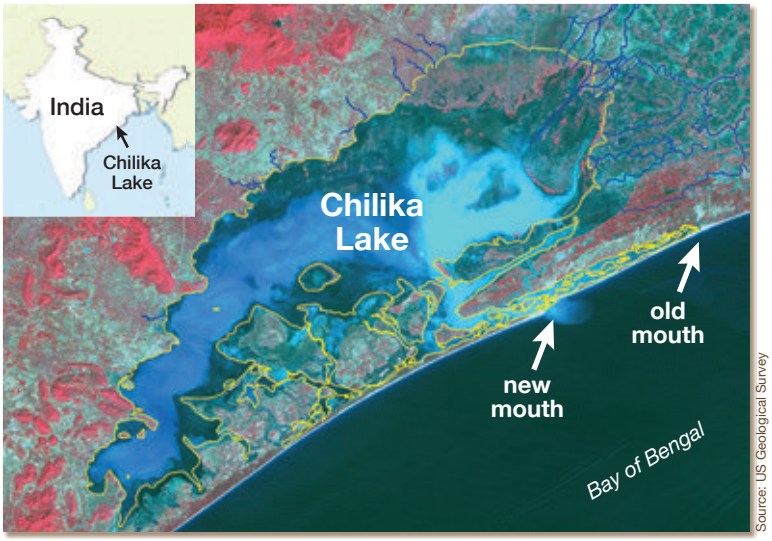
B 60–80%. Most water quality and biological health indicators meet desired levels. Quality of water in these locations tends to be good, often leading to good habitat conditions for fish and shellfish.

C 40–60%. There is a mix of good and poor levels of water quality and biological health indicators. Quality of water in these locations tends to be fair, leading to fair habitat conditions for fish and shellfish.

D 20–40%. Some or few water quality and biological health indicators meet desired levels. Quality of water in these locations tends to be poor, often leading to poor habitat conditions for fish and shellfish.

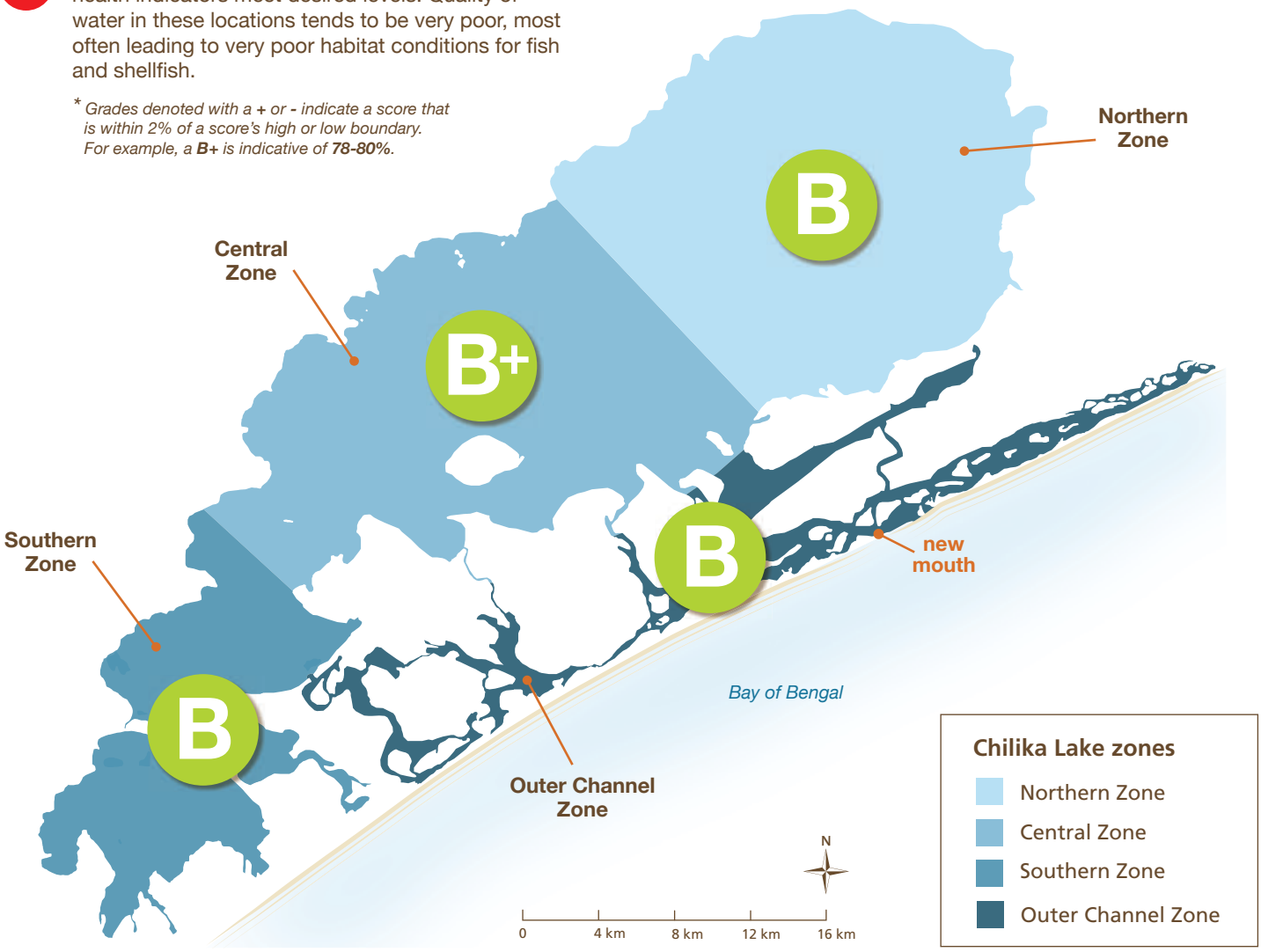
F 0–20%. Very few or no water quality and biological health indicators meet desired levels. Quality of water in these locations tends to be very poor, most often leading to very poor habitat conditions for fish and shellfish.

* *Grades denoted with a **+** or **-** indicate a score that is within 2% of a score's high or low boundary. For example, a **B+** is indicative of **78-80%**.*



Source: US Geological Survey

Until recently, Chilika Lake suffered from increasing sediment loads and reduced connectivity with the sea. In 2000, a new mouth to the Bay of Bengal was opened. This hydrological intervention helped improve salinity levels, enhance fish landings, decrease in the area of invasive species, as well as improve water quality overall.



Chilika Lake 2012 Report Card

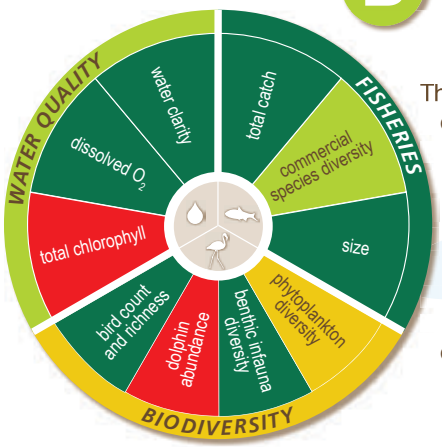
Overall, Chilika Lake scored a B for ecosystem health based on performance of water quality, fisheries, and biodiversity indices.

The Lake as a whole displayed excellent (**A**) dissolved oxygen concentrations, water clarity, total fishery catch and size, and benthic infauna diversity. The Lake failed, however, for total chlorophyll concentrations (**F**), based on desired conditions. Of the ten indicators that were assessed within water quality, fisheries, and biodiversity, 79% (**B+**) in the Central Zone, followed by 76% (**B**) in the Southern Zone, 71% (**B**) in the Outer Channel Zone, and 69% (**B**) in the Northern Zone. A breakdown of these indicators by zone is provided below.

Grades

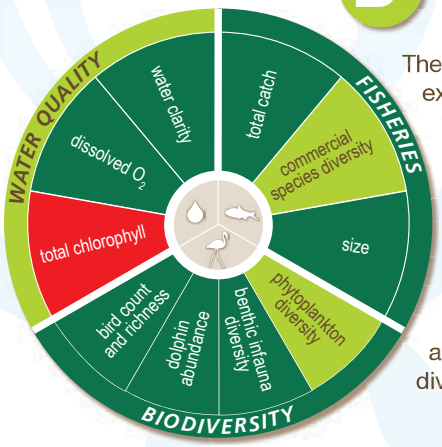
- A 100-80%
- B 80-60%
- C 60-40%
- D 40-20%
- F 20-0%

Northern Zone B



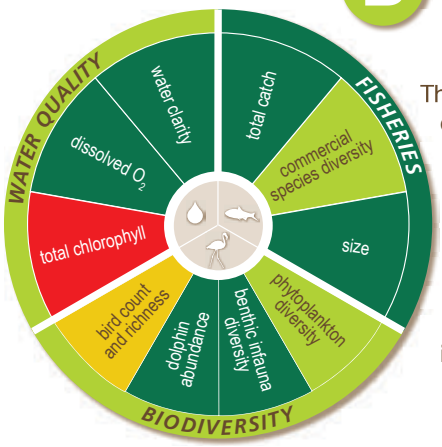
The Northern Zone displayed excellent results for fisheries, good water quality (with the exception of total chlorophyll), and average biodiversity largely due to an absence of dolphin sightings.

Central Zone B+



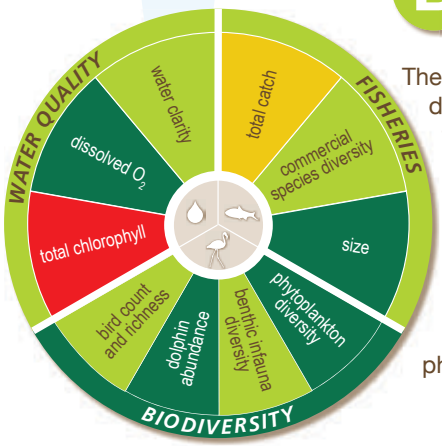
The Central Zone displayed excellent results for fisheries, good water quality (with the exception of total chlorophyll), and excellent biodiversity highlighted by bird count and richness, dolphin abundance, and benthic infauna diversity.

Southern Zone B



The Southern Zone displayed excellent results for fisheries, good water quality (with the exception of total chlorophyll), and good biodiversity highlighted by dolphin abundance and benthic infauna diversity.

Outer Channel Zone B



The Outer Channel Zone displayed good results for fisheries and water quality (with the exception of total chlorophyll), and excellent biodiversity highlighted by excellent dolphin abundance and phytoplankton diversity.

There's more to this story: Salinity

The four zones used in this Chilika Lake Report Card are based mostly on salinity variations that occur within the Lake. Salinity in the Lake is driven by freshwater river flow from the north and west, and tidal seawater from the east and south. This results in a variation of salinity in the Lake, from freshwater in the north, brackish waters in the center and south, and full saline waters to the east around the islands and outer channel. The boundaries between these zones shift throughout the year, driven by monsoonal rains and seasonal winds.

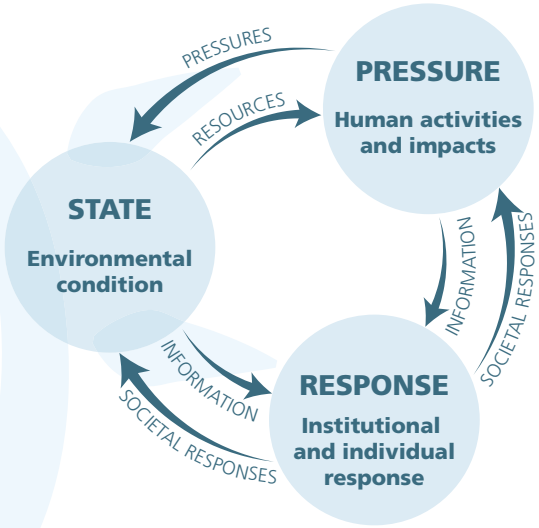
During the 1990s, extensive siltation in the Lake was limiting access to the sea, reducing tidal flushing and decreasing salinity to such an extent that biodiversity declined and invasive aquatic weeds proliferated. This had a highly negative impact on the Lake's habitat for wildlife and fishery resources. In 1992, it was included in the Montreux Record by Ramsar due to change in the ecological character. In 2000, CDA opened a new mouth to restore the lake ecosystem. This new opening increased salinities throughout the Lake, vastly improving water quality, recovering lost habitat for important species, enhancing fish resources, and controlling invasive species. Lake salinity and connectivity to the sea are now closely monitored to ensure that conditions do not return to those experienced prior to 2000. The lake was removed from the Montreux Record due to restoration of the lake ecosystem in 2002.

Where do we go from here?

This report card is a significant step in progressing our understanding of how human activities (or **Pressures**) affect the environmental condition (or **State**) of Chilika Lake within the **Pressure-State-Response** (PSR) framework for environmental management.

The Chilika Lake Development Authority has a **Response** plan which envisages ecosystem conservation and sustainable resource development and livelihood improvement supported by institutional development; communication, education and public policy; and institutional development as the key management response components.

The addition of this report card that assesses and monitors the **State** of Chilika Lake completes the PSR loop, and strengthens the framework that ultimately aims to reduce uncertainty in resource management decision-making for the sustainability of Chilika Lake and those that depend on it.



Key management **Response** strategies to be adopted include the following:

- **Ensuring hydrological connectivity** of Chilika with freshwater and coastal processes at the basin level.
- **Establishing hierarchical and multiscalar inventory** of hydrological, ecological, socioeconomic, and institutional features and ecosystem services to support management planning and decision-making.
- **Promoting sustainable catchment management practices** to manage inflow of silt and nutrients into the wetland system.
- **Adopting environmental flows** as a basis for water allocation for conservation and development activities.
- **Promoting biodiversity conservation** through habitat improvement of endangered and indigenous species.
- **Supporting ecotourism development** for enhancing awareness, income generation, and livelihood diversification.
- **Promoting sustainable fisheries** for maintaining nutritional security while ensuring maintenance of biodiversity and equitable sharing of benefits.
- **Reducing poverty** through sustainable resource development and utilization and livelihood diversification.
- **Promoting institutional arrangements** enabling integration of wetland management planning and river basin and coastal zone management.
- **Strengthening CDA** with adequate legal and administrative powers to regulate detrimental activities.
- **Building capacity at all levels** for technical and managerial skills for implementation of integrated management planning.

Workshop participants

Up to 45 participants attended the *Workshop on Coastal Ecosystem Heath Report Card of Chilika Lake*, 4-7 February, 2013, Bhubaneswar, Odisha, India, including scientists, managers, and graduate students from: Chilika Development Authority; National Centre for Sustainable Coastal Management; Government of Odisha; State Project Management Units of Gujarat and West Bengal; Indian Nitrogen Group; Gujarat Ecological Education and Research Foundation; International Lake Environment Committee Foundation; United Nations Environmental Programme; Society of Integrated Coastal Management; and FAO Bay of Bengal Large Marine Ecosystem.

The organizers of the workshop (front row, L to R) : Mr. Vivek Wadekar, SICOM, Government of India; Dr. Ramesh Ramachandran, NCSCM; Dr. Anjan Datta, UNEP; Mr. R.K. Sharma, Principal Secretary, Forest and Environment, Government of Odisha; Dr. Heath Kelsey, IAN/UMCES; and Dr. Ajit Pattnaik, CDA — and (back row) local civic leaders and fishing cooperative representatives.
Missing from photo: Dr. Paul Tapas, The World Bank.

Cover and page 2 photos courtesy of Chilika Development Authority; Photographer: K. Ramnath Chandrasekhrar

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Contacts for more information

Dr. Ramesh Ramachandran
NCSCM, Ministry of Environment and Forests, Koodal Building, Anna University
Chennai 600 025, India
rramesh_au@yahoo.com

Dr. Ajit Pattnaik
Chilika Development Authority,
C-11, BJB Nagar, Bhubaneswar
751 014, India
ajitpattnaik13@gmail.com

An electronic copy of this report card and additional information can be found at: *http://www.chilika.com* and *http://www.ncscm.org/*.

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