

Lessons from the Chilika lake, India

Institutional Coordination and Policy Development in Lake Basin Management

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Background

Wetlands are among the most productive ecosystems in the world. A source of substantial biodiversity and provide habitat to a host of species ranging from the tiniest microbes to largest mammals. Most importantly, wetlands maintain the livelihood of millions local communities living in and around the wetland and its drainage basin. The Chilika lake is the largest brackish water lake in India and a Ramsar site (Fig-1). The lake is a unique assemblage of marine, brackish and fresh water eco-systems with estuarine characters. It is a hotspot of biodiversity and a wintering ground for more than one million migratory birds. The drainage and coastal process are integral factors determining the ecological integrity of this coastal wetland. The freshwater inflows from the drainage basin drive the temporal and spatial salinity dynamics of the lake, which contributes to the mosaic of aquatic habitats for different plant and animal species, and the varying life cycle requirements of these species. It is primarily this dynamic hydrological regime that enables the lake to support high biodiversity and a productive fishery. The highly productive ecosystem of Chilika lake sustain the livelihood of 0.2 million fishermen and 0.8 million watershed community. The lake encountered a combination of increased siltation due to changes in the land use pattern and degradation of the drainage basin, alteration of fresh water flow due to construction of barrages upstream as well as partial closure of the outlet channel connecting the sea. The decrease in salinity and siltation caused proliferation of invasive species, increased turbidity, shrinkage of water-spread area, loss of biodiversity, and depletion of fishery resources. The retarded flow through the old mouth caused a low variation of water levels and lower drainage time that resulted in water logging in the agricultural lands of the peripheral villages around the lake, which subsequently led to complete crop loss, affecting more than 50,000 hectares, and to the miseries of the agricultural communities living in the flood plain region. Small land holding and limited opportunities for occupation diversification in drainage basin had led to poverty and migration. Lack of an institutional mechanism to regulate the sustainable use of the common property resources both in the wetland and the drainage basin had been the root cause of unsustainable resource use. Resource depletion was also observed to be a result

of social arrangements that forced the users into unsustainable use of the resources they depend on, to meet their immediate needs. Practices also involve access to resources and to institutional support, which are differentially available to various social groups. Understanding the nature of these social patterns and arrangements is therefore crucial and technical interventions alone cannot succeed without changed practices, and practices are not merely a matter of knowledge. Due to changes in its ecological character, it was included in the Montreux Record maintained by Ramsar Secretariat, in 1993.

Constitution of Chilika Development Authority

Generally the area of institutional development in case of restoration projects by government is concentrated on legislative reform and policy development at higher levels. This macro level initiative is necessary to establish appropriate and supportive policy environments, but interventions directed towards achieving sustainable levels and methods of resource use must also be carried out at the grassroot level where resources are being used.

As a macro level initiative for restoration and sustainable management of the Chilika lake as a first step the Government of Orissa created the Chilika Development Authority (CDA) in 1992. Prior to constitution of the CDA, the lake's affairs were looked after by a number of Departments, e.g. Revenue (for lease of the fishery resources), Fishery (for regulation of the fishery leases), Science & Technology (for lake monitoring), Commerce and Transport (for licensing of boats), Forest & Environment (for management of bird sanctuary), Tourism (for tourism), and so on, without any coordination or dialogue between these departments and organisations. To overcome this deficiency, it was felt necessary to create an umbrella organisation like CDA with the following objectives, (i) to protect the lake ecosystem with all its genetic diversity, (ii) to formulate the integrated resource management plan for the lake and its drainage basin in active consultation with the local community, (iii) to execute and promote various multidimensional and multidisciplinary developmental activities, (iv) management of the drainage basin in a participatory manner to reduce the silt load in to the lake, (v) hydrological interventions to facilitate exchange of water between

the lake and the sea and to maintain salinity regime of the lake, (vi) to promote long term multidisciplinary research, prepare environmental status report, (vii) to collaborate with other institutions of the state, national or international institutions for all around development of the lake, and (viii) to establish management information system for the lake.

The Chilika Development Authority (CDA) was constituted with the Chief Minister of the state as the Chairperson and the Minister Environment as the working Chairperson. The Secretaries from the key departments like, Revenue, Home, Finance, Tourism, Forest and Environment, Science and Technology and the key functionaries like Engineer in Chief of Water resource department, Director Environment, Director Soil conservation are the members of the Governing Body. In addition to this the representative of the Ministry of Environment & Forest Government of India and the experts from the premier research institutes of the country are also members. Most importantly the representative from the apex fishermen cooperative society is also a member of the Governing Body. CDA acts as the umbrella organisation for integrating various developmental activities carried out by the line departments in the lake and its drainage basin. The most difficult coordination between various agencies and the resource user group is accomplished through the Governing Body of the CDA. The Chairperson of the Governing body the Chief Minister who is the head of the state administration is crucial in ensuring the coordination and integration. The decisions taken in the Governing body under the chairmanship of the chief minister thus become binding on the line departments.

Even though the CDA started functioning from 1992 till 1996 the activities were mainly restricted to the scientific studies to generate much needed data and ancillary information essential for formulation Action Plan. The first Action Plan formulated was mostly focussed on the techniques and engineering interventions. The major shortcoming of the Action Plan was the lack of consultative process and people's participation in the formulation of the plan. It must be noted that at inception, CDA did not have the expertise and experience in dealing with the huge task of management planning for a complex ecosystem like Chilika. There was a pressure on the CDA to come up with a restoration plan. The management plan was formulated by CDA by more of putting together the action plans of different line Department without any linkages. Due to this the sustainability of the restoration intervention suggested in the Action Plan was a big question. In other words the social arrangements and existing institutions which serve as the vehicle for resource use and the cause of present depletion were ignored in the planning process. Due to the inherent deficiencies the Action Plan formulated that was more of a curative in nature did not sell.

Realising the above shortcomings, a wide consultative approach was adopted by CDA starting from 1997. This realization was prompted by the fact that the management plan was not appreciated and could not attract any funding due to the inherent deficiencies. In the meantime CDA with the strategic partnership and equipped with more data and information was better placed to do the management planning with a more holistic approach by this time. One of the key elements of the initiatives by CDA was the successful

Figure 1. A Strategic Process adopted for Restoration



institutional linkages built through networking, consultation and coordination. For example, Chilika Development Authority maintains strategic partnership with 17 state government organizations, 33 NGOs and community based organizations (CBOs), 4 national ministries, 6 other national organizations, 11 international organizations, 13 research institutions, and 5 different categories of community groups.

While developing the strategy for the management planning process, it was further realised that even to reach physical objectives, development planning must be directed through consultative processes, so that the users are involved in right earnest from the very beginning in the process of formulation of the Action plan. For establishing effective mechanisms for such user participation identification of the existing institutional patterns and the organizational structures and processes through which people use the resource were identified. To begin with the local communities, social arrangements, and the existing local institutions were placed at the centre of the project planning process and considered as the means through which resource management can be improved, conservation strategies can be applied and external inputs can be directed to where they are most needed. Understanding and working with existing social arrangements and the institutions allowed the resource users to come up with their suggestions and much needed voice in directing development assistance to their most pressing needs and in ways in which it can be most effectively used. From the preliminary outcome of the consultative process it emerged that the resource depletion had been as a result of the social arrangements that forced the users into an unsustainable use of the resources, to meet their immediate needs. It also became more apparent that addressing these social patterns and arrangements are equally important as the technical improvement. Practices also involve access to resources and to institutional support, which are differentially available to various social groups.

There was an assessment of the principal causes of degradation with the objective to implement appropriate and effective methods to restore the lake through targeted scientific study and wide stakeholders' consultation. Intensive studies of the coastal processes and modelling showed that the tidal influx into the lake was adversely affected by the shoal formation along the lead channel and continuous shifting of the mouth due to littoral drift. This also adversely affected the natural recruitment of species through the mouth opening to the sea. To address this problem, a straight cut was made based on numerical model studies, bringing the mouth closer to the lake by 16 kilometres. Interestingly the local communities were

also of the opinion that reestablishment of the connection between the sea and the lake would lead to regeneration of the lake ecosystem. After the intervention there has been a significant improvement of fishery resources due to auto-recruitment, improvement of the tidal and salinity flux into the lake, flushing out of sediment to the sea, decrease of freshwater invasive species and water logging. The effectiveness of this strategy is only one of the factors contributing to the restoration of the lake. CDA initiated an integrated adaptive management planning process to address the complex ecological and socio-economic issues of the Chilika lake with an ecosystem approach. All the goals were not attempted to achieve in one go.

In the successive planning the first phase included the restoration of the lake by re-establishing the flow regime with the Bay of Bengal, pilot project for micro-watershed management with capacity building of the resource users through strengthening of the grass root level institutions. In next phase the pilot project up-scaled to some 13 more micro-watersheds in the drainage basin.

Participatory management of drainage basin

The drainage basin of the lake that spreads over 4000 square kilometres was the logical starting point for planning and management actions for sustainable management of the lake ecosystem. 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 lake (Fig-2).

The large-scale silt flow from catchments (0.365 million cubic meters, assessed through the stream flow measurement) was identified as one of the major management problems. Further assessment revealed that land degradation in

Figure 2. Hydrological set-up of Chilika lake



the drainage basin not only leads to enhanced silt flow into the lake but also causes poverty, due to low productivity in the drainage basin. The chief livelihood strategy adopted by the watershed community is rain-fed paddy cultivation once a year. The average annual rainfall received is 1400 millimetres, but because this average is not consistent, total or partial crop failure is a common phenomenon in the drainage basin. In spite of the endowment of natural ecosystems, which could have constituted a livelihood provider for the watershed communities with sustainable income generation and adequate employment opportunity, due to degradation of the basic life support system, the agricultural productivity was low. Poor crop productivity had been adversely affecting the livelihood of the watershed community, consequently triggering migration in search of employment. The production of paddy was as low as 500-800 kilogram per acre even during the good crop year. The depletion of natural resources and loss of their productive capacity had imparted huge costs on the local communities due to declining agricultural productivity and acute shortage of water. To begin with a series of informal meeting and dialogue and consultation with various groups and resource users was initiated by CDA in association with local NGOs. The goal was to resolve the conflict and empower the community to manage and reverse degradation of life support systems within the watershed, particularly land and water, to enhance the productivity, resulting in alleviation of poverty and promoting improvements in livelihood of the local communities. The importance of social aspects of prevailing resource use in processes of resource degradation and depletion was analysed through the participatory rural appraisal tool. Village level resource utilisation mechanism and the institutions were identified and assessed. Community participation was found to be crucial to sustainable resource management and several models for participatory approaches were outlined.

An innovative participatory micro-watershed management concept was adopted with a "sustainable rural livelihood" approach for holistic management of natural resources. The process was initiated with an analysis of needs, value and perspectives of local communities that are fundamental to ecosystem management. They formed Watershed Association with all adults from the micro-watershed villages as members, which is the key institution to manage, the natural resources and ensure equitable distribution of the benefits. The watershed association is registered under societies of registration act. The watershed association formulate micro-plan, blended with indigenous knowledge and appropriate experts' input, for optimum utilization of the natural resources in a sustainable manner and to increase productivity and provide equal opportunity for livelihood for the landless, marginal farmers and women.

The drainage basin management program was conceived as a long-term participatory process. The objective of this concept was to facilitate the community level institutions to take decisions and build capacity to work collectively.

The participation of local communities and stakeholders in planning and implementing management of natural resources and in sharing the responsibilities of decision-making is a key feature of the ecosystem approach. The local communities have considerable, relevant knowledge of the ecosystem and ways in which it can be managed in a sustainable manner. The basic approach adopted by CDA was to create an enabling environment, through capacity building of the community, community based organisations and NGOs at the outset, and a series of need-based capacity building training programmes to facilitate an integrated and holistic management of micro-watershed by the community. The goal was to empower the community to manage and reverse degradation of life support systems within the watershed, particularly land and water, to enhance the productivity, resulting in alleviation of poverty and promoting livelihood improvements. The focus was on restoration and conservation of a degraded life support system within the micro-watershed. An analysis of needs, value and perspectives of local communities are fundamental to ecosystem management. To achieve this, an innovative grass root approach was adopted by the CDA, by formulating a micro-plan, blended with indigenous knowledge and appropriate experts' input, for optimum utilization of the natural resources in a sustainable manner and to increase productivity and provide equal opportunity for livelihood for the landless, marginal farmers and women.

To ensure the involvement of the community and sustainability, it was ensured that the watershed agricultural community share a part of the costs 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 quantum of contribution is decided by the watershed association. The amount realised is deposited in the watershed account. The watershed association and the user groups had been able to efficiently implement the micro-plan in consultation with the community. One of the most successful initiatives was a series of rainwater harvesting structures, which they designed and installed. These rain water harvesting structures acted as percolation tank and helped in successfully recharging the aquifers and rejuvenating local ecosystems as well as their surrounding economies. The advantage of the system is that along with arresting soil erosion; it improved the moisture regime in the field, particularly downstream. This acted as an insurance against crop failure that used to be a regular phenomenon. After the rainwater harvesting structures had been constructed, the production of rain-fed paddy improved and there has been no crop failure due to an erratic rainfall. 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 800-1000 kilogram per acre. The small rainwater structures are swift to show regenerative results. 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 two crops can now be easily grown annually. This is believed to be a result of both the water harvesting and regeneration of forests.

Emigration also significantly decreased with the increase in agricultural production and creation of employment opportunities for the landless labourers. Now the intricate link between vegetation water and livelihood is more apparent to the local communities. The holistic management of natural resources at the grass-roots level also facilitated conflict resolution. The longstanding village level conflicts and differences of opinions within the micro-watershed area were resolved by the watershed committee. Additionally, it reduced the ecosystem's vulnerability to drought, improved agricultural income for small farmers, increased wage-labour opportunities for the landless, and provided an equitable distribution of benefits to the most impoverished, and reduced environmental degradation and drudgery. 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 lake. The outside migration in search of employment has reduced by 80%. The long-standing inter-village conflict was plaguing many of these non-descript villages for the past so many years in connection with the use of the forest resources. A number of criminal cases of grievous nature were pending in the court of law. With the launch of the watershed programme seven years ago, inter-village conflict resolution has been achieved in most of the watershed villages. The micro-watershed became the institution by itself in the context of social integration. 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 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."

Watershed Association

With an objective to facilitate the community to manage natural resources within the micro-watershed in a sustainable and equitable manner "watershed association" were constituted. Watershed association emerged as a very effective village-level institution. All adults from the micro-watershed villages are the members of the watershed association. Before constitution of the watershed association the role of watershed level institutions in the management of natural resources of the micro-watershed is deliberated through a series of meeting facilitated by the local NGOs after which the general body of the watershed association is constituted. The general body of the committee constitute a drafting committee. The drafting committee prepares a draft memorandum of understanding and the draft by law, which is circulated among the villagers to obtain their comments and suggestions. Three weeks were given to each village and hamlets. Educated youth from the village help to explain the draft to each individual and viable suggestions received are incorporated in the by-law. The by-law is then discussed in the general body meeting and adopted. The objective of the watershed association is to work as an efficient grass root level institution to manage the resources and facilitate equitable distribution of the usufructs at micro-watershed level. The watershed association then constitutes the watershed committee with fair representation from the landless, socially weaker section and adequate women representatives. The office bearers of the watershed committee i.e. the chairman, vice chairman and secretary are elected in a democratic process. The watershed associations are also registered under Societies of Registration Act.

Women institutions

In the prevailing social system, women do not participate in the village meetings and thus are kept off from the decision making process. The women fetch the water and the fuel wood for the household. Even though they are the major resource users they are kept off from the decision making

Atmasudhi prayaschita (self purification) diwas (Penance day)

The Dangei Pahad micro watershed was first micro watershed that was taken up by CDA on pilot basis under participatory watershed management programme. The watershed was in a degraded condition. The denuded hillocks and the degraded village common lands were a common sight. After a series of meetings facilitated by the local NGO in collaboration with CDA the watershed communities realised the importance of the soil, water and vegetation. They further they realised that due to the unsustainable use of the resource in the past they are at the receiving end. The watershed communities of Dangei micro watershed took a spontaneous decision to observe the Atmasudhi prayaschita diwas (Penance day) on 3rd June 2001. They had a strong conviction that they were responsible for the degradation of the surrounding vegetation by which they have committed a sin. More than 3,000 villagers including the women, children, and elderly gathered together and marched towards the barren hills within the Dangei micro-watershed and dibbled seeds of indigenous species of their choice. Despite the scorching heat of June, the villagers formed a human chain around the hill. They took an oath that they would not cut a single tree or allow any outsider to do so from the watershed area. This has now become a movement in the watershed of Chilika Lake and is celebrated as "Atmasudhi Prayaschita Week" starting from 3rd June in nearby micro-watersheds. Protection of vegetation on hills is therefore not only part of a larger livelihood strategy in the village, but also an ethical and moral component. They have learned to use the forest judiciously. It is interesting to understand how this knowledge is developed, or how protection can gain unquestioned acceptance. It is possible that people had over the years internalised the idea of forest protection and the use pattern that is associated with it. It has become subconsciously part of their life.

process. To ensure the women participation in the decision making process it was realised by CDA that women need to be empowered and brought to the mainstream. To break this social barrier the help of local NGOs was sought. The ladies volunteers of local NGOs motivated the educated girls from the village to form self help group by involving the women members of the micro-watershed area. It took some time to convince and motivate the women folk to come forward and organize themselves. Ultimately it clicked and self-help groups were formed. A series of need-based capacity building trainings for the self-help groups was imparted by CDA. The self-help groups through micro credit process as well as the loan from the commercial banks started income generation activities and are able to supplement to their family income substantially. 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. The self-help groups became an effective institution at watershed level.

Impact of the hydrological intervention on the lake ecosystem and the agricultural communities

The salinity level of the lake was observed to be decreasing alarmingly due to choking of the inlet channel opening to the sea. The spatial and temporal salinity gradients that exist in the lake gave it the unique characteristics of an estuarine eco-system, exercising a continuous and selective influence on its biota. The root cause of degradation of the lake was identified as due to the alteration of the hydrological regime and over-exploitation of wetland resources. The hydrological alterations leading to the transformation of the lake towards fresh water ecosystem was considered as a potential threat to the flora and fauna of this unique ecosystem. To address this problem, CDA commissioned the services of the premier institutes of the country like National Institute of Oceanography (NIO) to carry out a detail study of the wave climate of the inlet, long shore sediment transport and the bathymetry of the lead channel. The Central Water and Power Research Station (CWPRS),

Pune, carried out the hydrological and two dimensional mathematical model studies. The studies concluded that the tidal influx into the lake was considerably reduced because of the shoal formation along the lead channel and continuous shifting of the mouth that resulted in significant hydraulic head loss. Based on the findings of the numerical modelling, a hydrological intervention by way of opening of the artificial mouth was carried out in September 2000. The intervention not only rejuvenated the ecosystem of the lake but also immensely benefited the community depending on the lake whose average annual income increased by more than US \$ 1,000 per family. There has been significant improvement of the salinity gradient after the opening of the mouth. Before the opening, the salinity level of the northern sector of the lake used to remain zero throughout the year. There used to be an abrupt change in salinity level of the central and outer channel at the onset of monsoons. For an ecosystem with the seasonal and sectoral characteristics as indicated above, an appropriate salinity gradient with a gradual decrease from the lake mouth towards the lake proper is desirable. After the opening of the new mouth, less fluctuation of the salinity gradient was observed. The gradual reduction in the salinity from the lake mouth to the lake interior after the opening of the mouth is providing the desirable sense of direction for the euryhaline forms to enter into the lake from the sea. This facilitates the auto-recruitment of fish, prawn and crab into the lake. The annual average fish (fish and prawns) landing of 1600 metric tons was recorded during the past six years. In 2004, the average increased by eight times that amount, to an all time high of 14,000 metric tons. Based on the average weighted price, the total financial return from fisheries for the financial year 2004 is estimated as US\$18 million. The per family income has increased by US\$1,000 per annum after the hydrological intervention. After the opening of the new mouth, six species of fish and one species of shrimp (of commercial importance) reappeared after apparent disappearance. The increase in the fishery resources facilitated the community to adopt self-initiated good practices, like regulation of the mesh size, refrain from the juvenile poaching etc.

Environmental Flow Assessment

One significant step in the management of the lake has been the environmental flow assessment, for determination of optimum fresh water flow to maintain ecological integrity of the lake. It became a necessity when the construction of upstream barrage was proposed over River Mahanadi by the Department of Water Resources to mitigate the flood downstream and augment the irrigation potential. Flow through the distributaries of Mahanadi accounts for 45% of the total average of annual fresh water inflow into the lake. The fresh water inflow is the driving force for the salinity dynamics of the lake. It is primarily this dynamic salinity regime that enables the lake to support such high biodiversity and a productive fishery resource which supports livelihood of 0.2 million local communities. Any alterations of fresh water flow due to upstream activity need to be critically examined. The construction of Naraj barrage upstream had the potential to affect the hydrology of the lake. So it became imperative to determine the optimum flow allocations and other key ecological functions, through studies to determine the minimum and ideal flow regimes (including seasonal modulation) required to maintain the ecological integrity of the lake. As a part this investigation, considerable stakeholder consultations were initiated and a Stakeholder Executive Committee was established. The Stakeholder Executive Committee is headed by the additional chief secretary of the state and the Secretaries from Water resource, Forest and Environment and Revenue Department with representation from community stakeholder groups and local NGOs. The Committee decides the operating rule for Naraj Barrage and to oversee and ensure its implementation.

There has been a rejuvenation of the ecosystem, which is evident from the significant recovery of the fishery, and the marked increase in biodiversity that followed the re-establishment of this dynamic salinity regime achieved by the opening of the new mouth in September 2000. Strong indicators of improvement in the lake ecosystem are the increase in population of the Irrawady dolphin, a flagship species, to 132, re-sighting of the limbless skink (*Barkudia insularis*), an endemic species, after 72 years of its discovery, reduction in the extent of invasive water hyacinth, and a significant increase in the extent of ecologically valuable sea grass meadows in the lake.

Agriculture provides sustenance to 77% of the working population of the peripheral villages; 55% being engaged in cultivation and 22% as agricultural labourers. The primary crops grown are paddy, green gram, black gram, and groundnut. Paddy is the principal crop of the region. Water logging is highly detrimental to the floodplain agriculture. While paddies can sustain low to medium floods, prolonged water logging severely reduces crop productivity. Floodwaters in situations of water logging used to stay up to three months leading to complete damage to the *kharif* (monsoon) crops. Successive crop failures due to water logging compelled the local communities to undertake shrimp farming. Unfortunately the outbreak of white spot disease in epidemic form resulted in complete crop failure and huge investment loss.

The opening of the new mouth came as a boon for the peasants of the flood plain. The new mouth facilitated a quick and efficient discharge of monsoon flow reducing the problem of water logging. Due to efficient disposal of the floodwater the water-logging problem in the flood plain was redressed significantly. This has immensely benefited the agriculture communities, particularly peripheral villages of the floodplains whose primary occupation is agriculture. Contrary to the watershed, the cropland of floodplain is highly productive. After the improvement of the drainage an average yield of 1.7 tons per acre from *kharif* and 2.5 tons per Acre from the *rabi* (post monsoon season) is achieved from paddy cultivation.

Importance of the case study

This case study demonstrates how integrated water resource management is essential for restoration of a coastal wetland and its watershed. The primary feature of the restoration model is the integration of watershed and the coastal process with active participation of the local communities with a shared decision-making process. The ecosystem approach to restore the Chilika lake resulted in enhanced productivity due to amelioration of the lake ecosystem and it also immensely benefited the agricultural community of the flood plain. At the same time, adoption of a community based ecological regeneration of watershed, with the harvesting of rain water and its equitable distribution lead to substantial enhancement of crop productivity and

reduced silt load into the lake and improved the economic condition of the local community. The enhanced productivity strengthened the livelihood of the local community living both in and around the lake and in the watershed. The appropriate institutional structures, capacity building, monitoring, and enforcement, livelihood and equity issues were properly addressed.

The intensive monitoring and assessment system, linkages between the targeted scientific studies and the management interventions reflect the distinctiveness of the management practices adopted by Chilika Development Authority (CDA) for restoration of this unique wetland with an ecosystem approach. Local communities were considered an integral part of the ecosystem in the process. To ensure the stakeholder's participation an extensive outreach programme was carried out with the help of local NGOs to make the community aware about the ecological goods and services provided by the lake systems, which contribute significantly to their livelihood. The intervention for improvement of the hydrological regime and the participatory management of the watershed resulted in the functional integrity of the ecosystem and enhancement of the productivity thereby increasing the per capita income of the local community. This has also facilitated the self-initiated good practices by the community they being the immediate beneficiaries of successful ecosystem management. Management steps by the CDA are widely debated, researched and implemented. This extensive consultative approach and empowerment and strengthening of the local level institution for sustainable management of resources has contributed significantly to the success of the management actions undertaken.

The extraordinary implementation success of CDA is in part due to the non-bureaucratic organizational setup, which has no formal legal mandate. Supported by a high-level Governing Body and with access to government funding, CDA combines the stability of a government authority with implementation flexibility, avoiding the constraints of the normal bureaucratic system. The management philosophy of CDA is pragmatic and outcome-focused, implemented by innovative leadership and a strong and committed core team.

The successful initiatives by CDA is testified by the fact that based on the assessment of the outcome of the restoration measures taken by CDA, the Ramsar Advisory Mission recommended the removal of the lake from the Montreux record (threatened list of Ramsar sites), and Chilika was removed from the Montreux record with effect from 11th November, 2002. Chilika is the first site from Asia to be removed from the Montreux Record. Chilika Development Authority was conferred with two prestigious awards: the Ramsar Wetland Conservation Award, for the outstanding achievements in restoring the Chilika lake; and the Indira Gandhi Paryavaran Purashkar, the highest national award for outstanding contribution in the field of conservation

of environment. It is a perfect example of how the restoration of a wetland and its watershed with integrated water resource management, can not only restore the ecological integrity of the wetland, but also contribute significantly towards the improvement of the livelihood of the local community due to increased productivity. The core worth of the restoration model is that it is globally relevant. The government of Orissa is now envisaging an ambitious Integrated Water Resource Management plan for Mahanadi basin with Chilika lake at the tail end.

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