Experience and Lessons Learned Brief for
Lake Tanganyika

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1. Introduction

Lake Tanganyika has the largest volume of the three African great rift valley lakes. It is also the second deepest and the second largest lake in the world by volume: almost 19 000 km³ – only Lake Baikal is larger. The lake contains almost as much freshwater as the five great American lakes combined. The lake contains a volume of water seven times more than that of Lake Victoria which is the largest lake by area in Africa. It has a length of more than 670 km
and its average width is 48 km. The length of the shoreline is about 1900 km, of which 43% is rocky, 21% is mixed rock and sand, 31% is sand and 10% marshes.

There has been a number of studies into the lake in the last 15 years which have provided a good understanding of its chemistry, hydrology and ecology (Box 1).

- Limnologic and Paleolimnologic Investigations of Lake Tanganyika by University of Arizona
- Global Warming is Choking the Life Out of Lake Tanganyika by Steve Connor
- Lake Tanganyika Biodiversity Project UNDP/RAF/92/G32
- Lake Tanganyika Research (LTR) Project 'Research for the Management of the Fisheries on Lake Tanganyika' - (GCP/RAF/271/FIN)
- Nyanza Project by National Science Foundation (NSF). The project is a Research Experience for Undergraduates (REU) funded by the NSF Paleoclimate Program, University of Arizona
- Pollution Control and Other Measures to Protect Biodiversity in Lake Tanganyika by GEF
- CLIMLAKE ….Climate variability and ecological dynamics in Lake Tanganyika - DWTC-project IGBP/PAGE, IDEAL
- Recent ENSO and paleo-ENSO during the last 1000 years in Lake Tanganyika - DWTC-Duurzame Ontwikkeling
- Pollution Control and Other Measures to Protect Biodiversity in Lake Tanganyika UNDP/GEF
- Developing Detailed Regional and National Project Proposals and Financial Mechanisms to Implement the Lake Tanganyika Strategic Action Programme and the Convention UNDP/GEF/UNOPS

2. Bio-Chemical-Physical Information

Some basic information about the lake is summarized in Table 1 and Figure 1 shows a map of the lake with indication of the most important towns. A bathymetric map is shown in Figure 2. Notice that the maximum depth can be found in the southern part of the lake, while almost the same depth, namely 1250 m, is in the central northern part of the lake. The lake is located between latitude 3°20’ and 8°48’ south and between longitude 29°03’ and 31°12’ east.

The lake has four riparian countries: Burundi (8% of the lake area), Congo(45% of the lake area) Tanzania (41% of the lake area), and Zambia (6% of the lake area). See Figure 1, where the four largest towns in the four riparian countries are shown. These four towns have industries which discharge untreated industrial waste water.

The lake is of tectonic origin and is estimated to be about 12 million years old. It contains around 500 endemic species out of the total of 2156 species. The number of species that inhabit the lake is 325 fish, 759 algae, 81 aquatic plants, 219 crustaceans and 171 birds. That includes about 200 species of cichlids. It has 8 species of crab, 15 species of shrimp and some 60 species of snails. The lake has a unique high biodiversity which however is endangered.
The lake is important for its fishery (commercial, subsistence and ornamental fishing). The annual fish harvest from the lake is 85,000 tons/year, which is a primary protein source.

It is also an important source of drinking and domestic water and as an international transportation route – among other uses. The lake is bordered by three national parks:

- The Rusizi River National Park in Burundi
- The Gombe River National Park and the Mahale Mountains National Park in Tanzania
- The Sumbu National Park in Zambia

Fortunately, the lake has received relatively less human impact than many other African lakes, including Lake Victoria. The population in the drainage area of ten million is, however, growing very rapidly (about 2.5% per annum) indicating that the impact on the lake’s water quality is expected to increase in the coming years. The lake is still – as is Lake Malawi/Nyasa – not polluted. The lake is clearly oligotrophic and has not yet suffered from eutrophication; but some shoreline areas, especially Kigoma Bay, show a less favourable water quality. The chlorophyll concentration is the South lake is on the level of 1 µg l⁻¹, while it is about 2 µg l⁻¹ the North lake and even about 5 µg l⁻¹ in the Central lake. The concentration of reactive inorganic nitrogen (mainly nitrate) is 50-90 µg l⁻¹, and the reactive inorganic phosphorus concentration is 5-10 µg l⁻¹.

The primary production is in the order of 600 mg C m⁻² day⁻¹ in April-May, while it is more than twice as much in October-November, namely about 1400 mg C m⁻² day⁻¹. The annual average is the average of these two values, i.e., 1000 mg C m⁻² day⁻¹.

The lake could, however, serve as an example for other lakes in the developing countries to learn from. As prevention is much more cost moderate than abatement, it is of importance to set up a management plan at this stage to maintain the lake in an oligotrophic state. The residence time is 440 years which implies that, if the water quality becomes deteriorated it will take a very long time for the lake to recover. Many rivers enter the lake, but only one flows out, the Lukuga River. The volume is 18,880 km³ giving the lake an enormous buffer capacity, but also making it extremely difficult to recover if it would be polluted. It is therefore of utmost importance to prevent the pollution and general over-exploitation of the lake. Over-fishing will inevitably lead to reduced fishery in the long term. The catch per haul was still in average 20 kg in the early nineties, but there are some first indication of reduced catch per unit of effort.

The main threats of the lake are:

1) Untreated waste water discharge, including industrial waste water from large cities such as Bujumbura in Burundi, Uvira in Congo, Kigoma in Tanzania and Mpulungu in Zambia. Waste water treatment has not yet been applied in the region.
2) Agricultural run-off, particularly with the rivers Malagarasi and Rusizi. The agricultural expansion in the region has been accompanied by an increase in the sue of agrochemicals, i.e., artificial fertilizers and pesticides.
3) Mining waste water containing mercury.
4) Over-exploitation of the biological resources (over-fishing and fishing with destructive methods), reducing the fishery potential and the unique biodiversity,
5) Siltation due to erosion occurring in the drainage area as a result of increased deforestation. Topsoil is removed to the lake where it joins fertilizers and pesticides washed from the drainage area. An astounding 100% of the northern drainage area and around 50% of the central areas have been cleared of their natural vegetation, leading to increased erosion. See Figure 3. It is the most damaging threat to the lake's biodiversity, especially the siltation from the heavily impacted smaller watersheds of northern Lake Tanganyika, where large-scale deforestation and farming practices have led to a dramatic increase in soil erosion rates.

6) The problems will most likely increase in the coming years due to increased population urbanization and industrialization. The annual population-growth rate of most countries in the region is 2.5-3.1%. This progressive increase in population pressure (this region has among the world's greatest rural population densities) has forced a change in land use from pristine tropical forests (e.g., Gombe National Park) to small agricultural plots located on steep, denuded slopes bordering the lake. As a result, accelerated erosion rates supply streams and rivers with an increased suspended particulate load, which is deposited as fine-grained silts and clays in the rocky deltas. Record sediment accumulation rates in highly impacted river systems can reach up to 100 cm yr$^{-1}$. Unfortunately, traditional attitudes and responses to land and water resource management as well as practices of waste disposal are no longer sustainable because they cannot keep pace with the rapid increase in human population density.

7) Increased tourism that will involve increased impact on the lake, if not properly planned.

The sources of pollution are summarized in the following overview:

I. Industrial wastewater: mainly from the bigger towns, particularly from Bujumbura, Burundi
II. Domestic wastewater: from Bukumbura, Uvira, Kalemie, Kigoma, Rumonge and Mpulungu
III. Pesticides (mainly chlorinated hydrocarbons)
IV. Heavy metals: North basin waters from industrial wastes
V. Mercury: from Malagarasi River (mining)
VI. Ash residues: Cement processing in Kalemie
VII. Nutrients: from Rusizu Plain, Malagarasi Plain and other catchments
VIII. Organic wastes, sulphur dioxide: from sugar cane refining plant close to Uvira
IX. Fuel, oil: ports, harbours, shipping places and boats.

The lake has two main weather seasons. The wet season, usually from September to May, is characterized by higher humidity considerable precipitation and frequent thunderstorms. Heating of the lake takes place mainly during the beginning of this season, that is from September to November. As a result, thermal stratification establishes all over the lake with temperature difference between surface and bottom layers within a 4$^\circ$ C; see Figures 4 and 5. The dry season from May to August has dry weather and strong southern and southeastern winds. The lake loses heat by evaporation caused by strong winds. This cooling is strongest in the southern basin from May to September.

South eastern winds drive warm epilimnion surface water towards the north of the lake, while water flows south as deep current, causing up-welling along the southern coast. This results in a tilting of the epilimnion. Thermocline depths at Bujumbura and Kigoma was 74-83 m in the
dry season of 1993, while the epilimnion in the south was reduced in May and disappeared in
June during the up-welling. The productivity of the lake is highly dependent on these
hydrodynamic states and on climatic conditions particularly wind and temperature. The
monsoon wind from the South East causes the accumulation of water in the epilimnion as
mentioned above and thereby deepen the thermocline in the north, while in the south deep
rich waters up-well.

After the dry season, when the wind force weakens, oscillations of the metalimnion form
waves. These waves influence the thermocline depth. A regular pulse of production is
consequently induced, when the deep eutrophic water is able to reach the biotic and euphotic
zone, where photosynthesis takes place. Figure 4 shows how the depth of thermocline
changes over the year, and when the thermocline is deep the production is high, i.e. the
production pulses follows the rhythm of the thermocline. The transparency follows the same
pattern. Figure 6 shows the Secchi depth in meters at Bujumbura as function of the time.
Below 100-200 m there is no oxygen in the water.

3. Socio-Economic Aspects

The main activity of the 10 million people living in the drainage area is agriculture. The main
produce include maize, cotton, tobacco, rice, sugar-cane, sisal, coffee, beans, groundnut,
cassava, cattle and goats. The industrial products encompass textile, leather, brewing, various
food products and cement. The area is also important for mining of tin, copper, gold and coal.
The socio-economic statistics for the riparian nations of Lake Tanganyika are given in Table
2. Tanzania, Burundi, Zambia and Democratic Republic of Congo (DRC) all have low levels
of economic development with GNIs per capita of $250, $140, $320 and $110 respectively
(http://www.afrodad.org/debt/burundi.htm). However dependence on the lake vary
significantly.

Fishery is of major importance for the economy of the region. A major increase of the number
of fishermen has been observed throughout large parts of the lakeshore. Many people are now
exploiting the coastal waters which are richest in fish abundance and in biodiversity. In spite
of the need for maintenance of sustainable fisheries which is essential for the livelihoods of
coastal populations, traditional approaches to enforcement have had little success, often
constrained by very limited resources. Particularly, ornamental fishery is a problem because it
is a serious threat to the biodiversity. A reasonable management of this exportable resource
could provide sustainable economic benefits

Fishery products, the "Tanganyika sardine" (Stolothrissa tanganikae, Herring Family) in
particular, is also very important for local economy. Well-developed regular ship lines
connect Kigoma (Tanzania), Kalemie (Zaire) and other coastal towns as essential part of the
inland traffic system of east Africa. In recent years, Lake Tanganyika, like many other
biologically sensitive areas, has begun to feel the effects of increased population pressure.
Fishing practices, for example, have become much more efficient, and consequently, more
destructive. The fisheries of Lake Tanganyika currently yield approximately 200,000 tons of
fish per year, and are far and away the most important source of animal protein for human
consumption in this region of Central Africa. Lake Tanganyika has traditionally supplied
between 25 and 40 per cent of the protein needs of the local people, citizens of the four
countries bordering the lake, Burundi, Tanzania, Zambia and the Democratic Republic of
Congo. 45,000 people directly involved in the fisheries operating from almost 800 sites.
Commercial fishing began in the mid-1950s and has had an extremely heavy impact of the majority of fish species, in 1995 the total catch was around 180,000 tonnes.

Although landlocked, Zambia has water resorts on the shores of Lake Tanganyika in the north of the country. The Shumbu National Park provides a fine world-class game fishing. Goliath Tiger fish, which have been landed at 35kg, Nile perch over 50kg, and giant catfish of over 50kg have been landed at the three lodges: Kasaba Bay, Nkamba Bay Beach and Ndole Bay. The lake also provides boating expeditions. Every year in February or March a national fishing competition is held at Kasaba Bay, which is attended by fishermen from all over the world.

The lake is one of the world’s major biodiversity hotspots and attracts as such international attention and tourism to the lake. This may be in conflict with the fishermen, although the best long-term solution for the lake is one where both the fishery and the tourism co-exist.

Tanzania earns some income generated from tourist activities at Mahale Mountain and Gombe Stream National Parks, which lie at the northern end of Lake Tanganyika. The park's forested mountain slopes, which help define the Great Rift Valley, are home to chimpanzees. Visitors can discover these fascinating creatures for themselves. The chimps are accustomed to humans and therefore somewhat approachable. Having more than 550 plant species, Mahale is rich in plants. Researchers believe that at least 1,000 flower plants are found within the national park boundary. The plant species have been a major influence for the life of chimpanzees, who utilize 328 food items from 198 plant species. Some of these plants are used by chimpanzees as medicine and appetizers.

Burundi's capital Bujumbura is the largest city (pop. 367,000) at the northeastern end of Lake Tanganyika is a site for many tourist hotels. There is a number of German colonial buildings built in the 1800s: The Postmaster's House is the best example. The Musee Vivant includes a reconstructed traditional homestead and a daily drum show. Other sights include the city market and the Parc du Reptiles, which features several of the infamous African snakes. Kalemie and the banks of Lake Tanganyika regarded as reminiscent of the French Riviera provide marvellous tourist attractions to DRC.

The lake plays a crucial travel and trading role with neighbouring countries of Tanzania, Burundi, Democratic Republic of Congo, and Zambia. Bujumbura serves as a shipping centre for Lake Tanganyika trade in coffee, cotton, hides, and tin ore with neighbouring

Pollution will inevitably lead to increased risks to human health associated directly with the declining water quality. In addition, loss of the traditional protein source, the fishery, will increase the vulnerability of the people living in the region. Fish is particularly important to the people during droughts as it combats malnutrition when crops fail. The population of the region is expected to grow by an average of 2-3% the coming twenty years. This will inevitably increase the pressure on the aquatic environment, for instance by increasing fishery and water demands.

All stakeholders including communities, individuals and concerned organisations must in the future be given the opportunity to participate at the appropriate level, in decision-making and management processes that affect the lake. This includes providing appropriate access to information concerning the environment that is held by public authorities and effective access to judicial and administrative proceedings to enable them to exercise their rights effectively.
Co-management is an approach adopted by the Strategic Action Plan (SAP) and considered to be essential for the promotion of many management intervention in the lake area.

4. Institutions

Lake management project implementation arrangements are complex because the lake has four riparian countries. Therefore, any approach to improve the understanding and subsequent management of the lake must have an international and regional perspective. The project addressed in an early phase the following institutional problems: lack of resources for the involved institutions, poor enforcement of existing regulations, lack of appropriate regulations for the lake and lack of institutional coordination.

The threat to the national parks should also be mentioned in this context. Increasing land pressure adjacent to national parks and the lack of alternative livelihood options is resulting in resource conflicts between parks and neighbouring communities. The problem is compounded by a decline in the resources available to parks from central government as part of policies promoting decentralised management. The objective of the proposed intervention is to reduce threats to parks resources by promoting benefits to communities.

- Each government has agencies responsible for fisheries with local offices at or near the lake:
  - The fishery department of The Burundi Ministry of Land Management, Tourism and Environment (IENC)
  - The Government of Congo has a Natural Sciences Research Centre (CRSN) at Uvira
  - Tanzania’s ministry includes the Tanzanian Fisheries Research Institute with a regional office at Kigoma
  - The Zambian Ministry of Agriculture has a department of fishery which maintains a provincial fishery office at Mbala.

Universities, laboratories and research institutes also have an important part to play in the project. The University of Burundi has been primary a teaching university but has in connection with this project developed a research capability. The ministry of health, Burundi and the institute of Agronomy, Burundi have interest in waste water analyses, sanitation problems, waste disposal and studies of erosion and mitigation strategies in the lake. The University of Dar es Salaam has an active biology department with an interest in aquatic biology, and experience on the lake in biology and pollution aspects. It is anticipated that this capability can be utilized and strengthened through the project.

There are a large number of local and international NGOs in the four countries. but not many have been established at the lake shore. NGOs offer, however, an opportunity for reaching out the poorest and most isolated people in the ways that are difficult for the government agencies to achieve from often distant capitals

Increased involvement of local stakeholders in management decision-making and enforcement activities is also indicated as this would improve the overall level of compliance with regulatory measures and thus help to reduce the costs of fisheries administration. With regard to regional institutional modalities, the Terms of Reference of the CIFA Sub-
Committee for Lake Tanganyika should be modified in order to allow the Sub-Committee to function more effectively as a mechanism to facilitate co-ordination of regional fisheries-related matters. The Terms of Reference should explicitly allow the Sub-Committee to:

- facilitate discussions for all related fisheries matters, including coastal zone management, environment and water quality;
- promote the exchange and dissemination of fisheries information;
- develop and recommend conservation and management measures;
- facilitate periodic elaboration and implementation of a regional fisheries management plan and its components;
- harmonize national measures for the sustainable utilization of the living resources of the Lake;
- advise on the direct or indirect effects of introduction of non-indigenous aquatic animals and plants into the waters of Lake Tanganyika and all the waters connected therewith consistent with the FAO Code of Conduct for Responsible Fisheries and the United Nations Convention on Biological Diversity and any other relevant international instruments;
- facilitate periodic elaboration and implementation of a regional monitoring programme and its components;
- facilitate the harmonization of fisheries regulations for Lake Tanganyika;
- establish ad hoc subsidiary committees to perform such of its functions and subject to such conditions, as the CIFA Sub-Committee for Lake Tanganyika may determine;
- continue to explore ways and means of establishing an autonomous intergovernmental organization or arrangement;
- seek international financial assistance to support fisheries development and management programmes;
- facilitate, recommend and co-ordinate training and extension activities in all aspects of fisheries;
- report to CIFA at each session on its activities during the preceding inter-sessional period.

Basic fisheries legislation in all four lacustrine States generally provide sufficient legal basis for the implementation of most of the measures proposed in the FFMP, as they vest broad regulatory powers to competent authorities enabling them to regulate virtually all aspects of inland fisheries. Actions that can be immediately undertaken in all four lacustrine States on the basis of existing legal framework to implement or facilitate the measures proposed in the FFMP include:

- implementation of the FAO Code of Conduct for Responsible Fisheries;
- use of existing traditional institutional arrangements and customary fishing rights, where appropriate, for enhancing local control of fisheries resource access;
- organisation and conduct of an awareness campaign designed to inform local fishers of FFMP objectives and enlist their support for its implementation.
5. Project Objectives

The lake is vulnerable to pollution because of its natural characteristics, and there are presently few efforts to conserve its unique biodiversity. The main threats to biodiversity and sustainable use are the unsustainable fishery – particularly excessive fishery in the pelagic zone increasing pollution, excessive sedimentation and habitat destruction. These issues are therefore the main focus of the GEF project, that has formulated the following objectives:

1) Establish a regional long-term management program for pollution control, conservation and maintenance of the unique biodiversity of the lake. It would require an effective regional approach to identify environmental threats, to control pollution and to prevent the loss of the exceptional biodiversity of the lake.

2) Formulation of regional framework for cooperative management of the lake environment. It implies creation of the capacity in the four participating countries to manage the lake on a regional basis as a sound and sustainable environment.

3) Establishment of a program of environmental education and training for the lake its basin.

4) Establish tested mechanisms for regional coordination in conservation management of the lake basin.

5) To launch research programs aimed at addressing the specifically defined information gaps in the context of the long term management program. These studies should provide a multidisciplinary understanding of the complex scientific, technical and socio-economic issues related to conservation and sustainable use of the lake. The studies covered the following: Fishing practice, identifying the impact of fishing on biodiversity and propose potential remedial action, establish known patterns of biodiversity in the lake, identifying sources of pollution, evaluating the consequences of the pollution and finding preventative measures. Furthermore, monitoring the movement and impact of soil (mainly by erosion due to inappropriate agricultural policy and deforestation) entering the lake, and socio-economics, providing the human context within which the conclusions of the technical studies could be discussed. developed and implemented. In association with these special studies are studies of agricultural practices, merits of sites for underwater national parks, the relevance of the legal systems of land ownership.

6) Implementation and sustainability of the Strategic Action Program (SAP).

Two models were foreseen to be developed under objective (5) above: A lake circulation model project has been carried out of FAO/FINNIDA and an erosion model. The input of sediment to the lake and their fate will specifically be affected by near-shore hydrology, which is a core element in the lake circulation model. An erosion model was developed on this basis. The erosion model used remote sensing data on vegetation cover and rainfall and GIS data on topography and soil erodability. The erosion model was calibrated an validated and applied for setting up prognoses.
6. Evaluation of the Project

The project has indicated ways to achieve self-sustainable management and preservation of the lake biodiversity. Probably the most valuable contribution to the lake biodiversity protection will be the investment in a new generation of environmental projects that will put into practice the present project results within the framework of the SAP and the Convention binding the riparian nations to the sustainable management of the lake’s natural resources.

The project implementation was delayed by shortage of qualified national staff, slow process of national institutions identification and by relatively low priority attached to the lake environmental problems. The project perception by the governments improved, however, considerably after an Inception Workshop in March 1996. The governments’ involvement in the project activities was a steady increase in sharing the project’s goals and contributing to realization of the project’s objectives.

The project completed the special studies. It also prepared the transboundary diagnostic analysis, the strategic action program (SAP) and the draft Convention on the sustainable management of the lake, all nationally driven and good quality documents.

The over-all evaluation can be summarized in the following points covering various aspects of the project (taken from the Terminal Evaluation Report):

I. The over-all conclusion is that the draft Convention is a good quality document.

II. Globally, the management, monitoring and back-stopping were judged by the Project Implementation Group as helpful, supportive and important in the implementation of the project activities.

III. The regional steering committee played an important role in project execution. Unfortunately, the national steering committees were less effective in directing project implementation.

IV. The governments’ involvements in the project activities were increasing with respect to sharing the projects’ goals and contributing to realization of the project’s objectives.

A review of the six objectives of the project concludes that the objectives and the specific studies have not all been completed fully but that the project has established a good basis for further environmental work in the lake drainage area with the aim to reduce the effects of pollution and conserve the biodiversity. The first two objectives (see Section 4) were fulfilled, while objective 3 and 4 were only partly were fulfilled. The project launched five special studies and their results contributed to formulation of a global lake biodiversity protection strategy and helped identify the priority actions what were included in the SAP. The results of the field program are still being elaborated. The available results are incomplete, although very promising. Finally, the environmental management proposals are not implemented by the project. The project implementation group hesitated to launch the implementation of the program before having a clear picture of their scientific and economic values. This decision is justified, since the implementation of management proposals have strong economic consequences on neighbouring fishermen and farmers. The ongoing special studies are proposing managerial programs that successfully link biodiversity benefits to the lake with advantages for the riparian populations, thus giving solid ground for environment management proposal implementation.
The project has particularly provided three outstanding outputs for the region:

A. An augmented and updated knowledge about the lake’s biodiversity  
B. A Program of Action to protect the and conserve the lake and assure it sustainable exploitation  
C. A coherent, well-defined regional management structure

The evaluation report recommend to the regional steering committee and the governments of the riparian countries to identify donors susceptible to support the next phase of the Lake Tanganyika biodiversity protection projects, concentrating on such activities as:

i) Promote the SAP integration in national development programs, and the Convention signature and ratification facilitation  
ii) Assist countries and donors in formulating specific lake protection projects in accordance with SAP  
iii) Test the importance of benefits generated by lake protection activities  
iv) Promote the lake protection approach among donors for the riparian countries  
v) Disseminate the present project results among all stakeholders

6. Lessons Learned

The Lake Tanganyika Biodiversity Project (LTBP) has many achievements, including technical studies in biodiversity, pollution, sedimentation, fishing practices, socio-economic and environmental education programs, a transboundary diagnostic analysis (TDA) of the threats to the lake’s biodiversity, a strategic action plan (SAP) providing prioritised list of these threats and strategies for ameliorating them, a draft legal convention binding the riparian nations to the sustainable management of the lake’s natural resources and finally a commitment from GEF and the governments of Burundi, Congo, Tanzania and Zambia to continue this process through a PDF grant to support a planning and preparation phase to implement the SAP and ratify the convention. These achievements were accomplished within a sometimes tense and unpredictable political climate. The African Great Lakes region has experienced considerable conflicts and turmoil during the last decade. As a result of these wars and insecurities and events, Burundi and Congo both experienced massive refugee movements many displaced people from Rwanda, Burundi and Congo sought refuge in western Tanzania. The results were furthermore accomplished against numerous technical and logistical obstacles.

These conditions are obviously not ideal for conservation initiatives. Lessons learnt review is presented in LTBP: Lake Tanganyika : Results and Experiences of the UNDP / GEF Conservation Initiative (RAF / 92 / G 32) in Burundi, D.R. Congo, Tanzania and Zambia, prepared by Kelly West, dated the 28. of February 2001. A few important points of particular interest from either this report or from the general evaluation of the GEF project are listed below:
1) E-mail links pay back the relatively small investment greatly in terms of increased communication within the region. A web site was an important resource for project affiliates.

2) In implementing multi-country projects, it is tempting to treat all the countries the same. Multi-country projects must recognize early on the differences between the countries and tailor work plans to capitalize on opportunities rooted in specific conditions in each country and to compensate for constraints.

3) The project was delayed due to lack of sufficiently well educated staff. It is therefore recommendable to ensure that a well trained and educated staff is available before the project has been started or incorporate in the project plan that the necessary education is provided – which can also be considered also a capacity building in the area of lake management. It is more concretely proposed to establish a one year diploma in lake management at one of the universities in the region. This education should be tailored for biologist, chemist or environmental engineer with a bachelor degree and should focus on the practical implementation (see also point 4 below) of the environmental management plans and environmental models.

4) The proposed action plan was not implemented. It is important that a reduction in the impact on the lake – it this case mainly on the water quality and the biodiversity – takes place. The biodiversity or water quality is not improved by reports and documents, but only by reduced impact. Steps should have been taken before the project was initiated to ensure that the resulting action plans would have had a higher probability for implementation.

5) All the phases of the project should be discussed at an early stage maybe even before the project is launched. This includes follow up initiatives and how to ensure sustainability of the achieved results. In this context it is also important to discuss what is considered the realistic core results – for instance a workable model or a list of the most important, useful indicators. Project milestones should be formulated and it should be checked to which extent the project follows these milestones. If they are not followed it should be discussed why and what could be done that the project could catch up with the formulated milestones. The minimum objectives of the project is thereby defined as the core results, which under all circumstances will be applicable in the management of the defined problem.

6) The models could have been applied more extensively as management tool. Probably, the understanding of the model development and the extensive possibilities associated with its application on the management level is limited. It would therefore also in this context be beneficial to establish a diploma in lake management as touched on in point 3.

7) A model and / or ecological indicators could have been used to a much wider extent to relate water quality, biodiversity, fishery and waste discharge. It would have made the action plan even more concrete. It would furthermore have been possible to give a close relationship between various goals in the action plan and the achieved results with respect to water quality and biodiversity.

8) It is important to strengthen the local citizen’s participation, as the over-all result of a later action plan is strongly dependent on the entire population.

9) Many collaborators agree that sustainably managing Lake Tanganyika biological resources is a cross-sectoral issue and necessarily demands the diverse viewpoints specialisations of a variety of stakeholders.

10) Be sensitive to language considerations and budget time and money translation. The French speaking countries (Burundi and D.R Congo) perceived the project as having a
bias toward the anglophone countries (Tanzania and Zambia). To avoid this for the
key personnel be bilingual.

11) Projects if this type need a strategic phase when cooperating countries can set
priorities and agree to focus on only the top one or two transboundary issues
Figure 1: Map of Lake Tanganyika.
Figure 2. Bathymetric map of Lake Tanganyika
Figure 3: Map of the contribution to erosion in the drainage area.
Figure 4: Formation of thermocline is shown.
Figure 5: Seasonal changes of the depth of the thermocline

Figure 6: Seasonal fluctuations of the Secchi Transparency
Table 1. Basic information, Lake Tanganyika

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Table 2. Socio-economic statistics for Tanganyika’s riparian nations

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<thead>
<tr>
<th>Item</th>
<th>Burundi</th>
<th>Congo</th>
<th>Tanzania</th>
<th>Zambia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population growth rate %</td>
<td>2.0</td>
<td>3.2</td>
<td>2.4</td>
<td>2.2</td>
</tr>
<tr>
<td>Population density # / km²</td>
<td>250</td>
<td>21</td>
<td>36</td>
<td>13</td>
</tr>
<tr>
<td>Adult literacy %</td>
<td>46</td>
<td>59</td>
<td>74</td>
<td>76</td>
</tr>
<tr>
<td>Per capita GNP ($)</td>
<td>120</td>
<td>110</td>
<td>240</td>
<td>320</td>
</tr>
<tr>
<td>School enrolment (% of school age population)</td>
<td>51</td>
<td>78</td>
<td>67</td>
<td>89</td>
</tr>
<tr>
<td>Life expectancy (yr)</td>
<td>42</td>
<td>51</td>
<td>47</td>
<td>43</td>
</tr>
</tbody>
</table>