POLLUTION CONTROL & OTHER MEASURES TO PROTECT BIODIVERSITY IN LAKE TANGANYIKA

INCEPTION REPORT

Natural Resources Institute, Chatham, January 1997

Contents i

List of Annexes:

1. Executive Summary

This executive summary contains a digest only of sections 1,2,3,11 and 12 of the Inception Report. The remaining sections contain the special studies reports and each of these is summarised in the respective opening paragraphs. For convenient reference, the special study sections are indexed at the end of this executive summary

Section 1: **Introduction and background**

1) This UNDP/GEF project "Pollution Control and Other Measures to Protect the Biodiversity of Lake Tanganyika" is the responsibility of the Natural Resources Institute (NRI) in consortium with the Marine Resources Assessment Group (MRAG) and the Institute of Freshwater Ecology (IFE), all UK based.

2) This Inception Report reviews the progress of Phase 1 of the project, culminating in the outcome of the workshop held in Dar Es Salaam in March 1996 and ratified by the Steering Committee in Lusaka in September, 1996. It describes the management structure produced in consultation with the national authorities which is detailed and sketched in Fig. 2. Outlines of the aims of the project's indicative workplans for the special studies, prepared in collaboration with the regional stakeholders are given and expressed diagrammatically in Fig.3.

3) The collaborative intent of this project is stressed as is its seeding function in establishing a sustainable lake-wide management programme for this regional lacustrine resource. The aims will not be realised unless there is a long term sense of ownership by the national institutions of the riparian countries at one level and by the communities whose livelihoods are bound to the lake at the other level.

4) The national institutions will have the responsibility of carrying out the mutually agreed strategy for the management of the lake environment into the foreseeable future and their capacity to fulfil this task is to be increased. As they will need to become self-sufficient and self-sustaining , the most appropriate mechanisms to achieve this critical level, be they in terms of manpower, expertise or equipment have been discussed in outline.

5) The involvement of the communities around the lake is equally essential as they are, in effect, a part of the lake ecosystem. Here, their major role as stakeholders will be strengthened by programmes of environmental education and participatory exercises so that they can make decisions about their own future.

6) The Final Strategic Plan will be the result of the accumulation of local threat evaluation, local solutions and participation going forward to national institutions where its synthesis for regional application will take place so that it can finally be implemented by an agreed regional management body.

7) The foreseen constraints and difficulties for the successful execution of the project are discussed so that ways to minimise their effects can be found in advance. Likely difficulties identified include: the geopolitical problems caused by the sheer size of the region and its poor communications; the correct placement and availability of specialists; the speed with which trained support staff can be put in place; the speed with which the four lake-side centres can be made operational and the complexities of harmonising the legal systems. However, it was realised that identifying such hindrances was an important step to overcoming them.

Section 2 : **Main Features of Phase 1**

8) Phase 1 of the project was largely concerned with establishing firm foundations for the future. The baseline reviews provided a working theoretical background and identified topics well covered as well as, more importantly, lacunae in the information available that must be filled by later work by the project. On practical and logistical matters, a management structure was formulated into which all the field teams and local institutions, when their composition and placement was determined, would slot coherently.

9) The UK based management is provided by NRI through an internal Project Management Committee formed from senior members of the consortium and other experts as required. This committee will be supported by NRI staff in administrative matters. Its functions include financial control, invoicing, general administration (e.g. travel arrangements) to the PCU; technical direction and back-up on overall project strategy; co-ordination of all other inputs from sources outside the region and advice on technical inputs needed by any of the special study topics.

10) As many sites and institutions as time and logistics allowed in all four countries were visited by the members of the PCU either separately or jointly. In some cases these were follow-up visits from those made by other NRI staff. Finally, a lake-side base was established in Kigoma in mid-November 1995 and the PCU headquarters became operative in offices in the British Council in Dar Es Salaam in mid-December 1995.

11) Relevant data on the region were compiled into five baseline reviews, corresponding to the special studies, and circulated to interested parties as resource documents for the workshop. These documents are titled “Biodiversity”, “Pollution and its effects on biodiversity”, “ Sediment discharge and its consequences”, “Social,Economic and Sectoral Features” and “Legal and Institutional Baseline Study”.

12) The workshop (hosted by the Dept. of the Environment, Tanzania) had the objectives of : a) ensuring that the background and current status of the project were understood by all, b) ensuring that the expectations of the riparian countries, the

funding agency (UNDP/GEF) and the implementing agency (NRI Consortium) were mutually taken into account, c) identifying the strategies and institutional mechanisms for project co-ordination, especially for the special studies and d) developing a preliminary management plan catering for stakeholder involvement and utilisation of scientific data in pragmatic management for the final phase of the project.

Section 3 : **Principal issues arising from the workshop**

13) The overall management structure and key linkages of the project are expressed diagrammatically in Fig 4.

14) The particular responsibilities of each member of the consortium were defined as follows: Mobilisation, baseline studies, strategic planning, implementation and sustainability - NRI/Consortium; Training programme and procurement - NRI; Legal framework - MRAG. Responsibilities for the special studies are: Pollution - IFE, Biodiversity and Fishing practices (except Aquarium fish) - MRAG, Sediment discharge, Aquarium fish trade, socio-economic and sectoral matters - NRI.

15) The concern about the change of the intended location of the PCU to Dar Es Salaam was noted, but appreciated as being beyond NRI's control. As discussed at the workshop, the continued location of the PCU in Tanzania was ratified by the Steering Committee. Delegates proposed that the Project HQ be moved from the British Council to private premises and this was done.

16) Field stations are intended to be located on scientific and logistic grounds in all riparian countries, At the moment these are likely to be Mpulungu (Zambia), Kalemie/Uvira (Zaire), Bujumbura (Burundi) and Kigoma (Tanzania), but local circumstances could cause these to be changed.

17) Lead organisations and National Co-ordinators in each riparian country were identified as follows:

Burundi, Institute for the Environment and Conservation of Nature. National Co-ordinator, Dr Gaspard Bikwemu, Director of that Institute.

Tanzania, Division of the Environment, Office of the Vice-President. National Co-ordinator Mr Toziri Lweno (NOTE, later replaced by Mr Rawson Yonazi of the Ministry of Tourism, Natural Resources and Environment, Dar Es Salaam).

Zaire, Department for the Management of Renewable Resources, Ministry of the Environment, Conservation of Nature and Tourism. National Co-ordinator, Mr Mady Amule, Director of that Department.

Zambia, Environmental Council of Zambia. National Co-ordinator, Mr James Phiri, Director of the Environmental Council.

18) The need for "clear and lasting commitment" by the ministries and institutions of the riparian countries to the project was reiterated and good communication between them identified as a vital component to that end.

19) The composition and roles of the National Working Groups, Regional Steering Committee, Project Technical Advisory Committee and Regional Task Forces were discussed and, as determined by the meeting, finalised or referred for later confirmation.

The RV Tanganyika Explorer

20) Details of the use of this research vessel were explained. The unexpectedly high cost of hire meant that other strategies to its extensive use have been investigated. However, charter arrangements for the use of the vessel under an interagency agreement with FAO are being finalised.

The GIS System

21) A geographic information system, mapping various aspects of the lake and its watershed using data from NOAA and Meteostat satellites, will be installed at Kigoma.

Section 11: **Training and Capacity Building**

22) The purpose of this component is to strengthen national institutional capabilities and community involvement to achieve the project's goals.

23) The Environmental Education sub-component aims to improve general awareness of environmental issues by involving local people in the way they use their environment and its resources. Particular focus will be on : sources of Lake pollution; users of Lake resources; development of community groups, especially children through schools and clubs); the responsibilities of officials of relevant government departments.

24) As part of the future sustainability of the conservation effort, the project is developing links with other concordant international organisations whose time scale is known to exceed ours. One such is IDEAL (International Decade of East African Lakes). The project will work closely with IDEAL in providing a series of 6 week long courses, based in Kigoma, where both US and African trainees will be taught the skills of tropical limnology. Most of the funding comes from the National Science Foundation in the US and GEF will be responsible the African Students' participation. The course will be based both in the laboratory and in the field.

25) In order to contribute as much as possible to capacity building, a training management programme is being formulated to cope with the particular needs. Part of this will be done in conjunction with the British Council who have a training framework already established. The need for such training to be in both English and French is noted and plans will be made accordingly. There is provision for both overseas and regional training at undergraduate and post graduate level and a draft plan

for the best use of resources to satisfy the needs of the countries and the project's aims is being devised.

Section 12: **Next Steps**

26) The major study group advisors will visit the region to finalise details of activities and establish clear responsibilities with the local counterpart government institutions and NGOs

27) The National Co-ordinators and the PCU will consolidate the present bases and start developing the other centres in the riparian countries so that the field work can be started.

28) The work on the Preliminary Strategic Plan will proceed in order to concentrate and integrate the activities around the Lake, especially those of the special studies, and to maintain the active involvement of the national institutions in preparation for their self-sufficiency

Sections 5-10: **Special Studies**

Each special study section is summarised in its opening paragraphs. For ease of reference these are paged as follows:

2. Introduction and Background

2.1 Scope of Inception Report

Since August 1995, the implementation of the UNDP/GEF project "Pollution Control and Other Measures to Protect Biodiversity in Lake Tanganyika" has been the responsibility of the **Natural Resources Institute** (NRI) as the leading member of a "Consortium" comprising two other UK institutions - the **Marine Resources Assessment Group** (MRAG) and the **Institute of Freshwater Ecology** (IFE).

This Inception Report serves primarily to present the findings of two key activities of the first Phase of this project: the **"Inception Workshop"** held in Dar es Salaam in late March 1996 and the **"Baseline Review"** of secondary literature information sources which took place in late 1995. Importantly, however, it also takes account of the extensive discussions and liaison held since the project began between the project staff and representatives of government/non-government institutions, other "stakeholder" groups in the region, and UNDP/UNOPS.

The "contents list" for the Inception Report as originally envisaged under Output 1.2 of the Project Document[1] reads:

" Inception Report based on all review data will provide bench-line data for the planning of the management program.

Activity 1.2.1	From all the data assembled all the negative trends amongst processes influencing the lake will be characterised and identified.
Activity 1.2.2	From all the data assembled all the major gaps in information will be identified. This will aid the formulation of special studies which can be directed to filling these gaps. Once these studies have been carried out for a sufficient time, the Lake Tanganyika strategic Plan can be finalised on a firmer planning basis.
Activity 1.2.3	Compile review data in Inception Report into a computerised database which can be shared between project centres and updated as new information becomes available. The Inception report should be available 3 to 5 months after the start of the project.
Activity 1.2.4	The database will be continually updated by results from the special studies and will be made the basis of a GIS system for Lake Tanganyika "

The Consortium Proposal Document[2] adds somewhat to the above by proposing the review covered institutional capacity in the region (see Figure 1 - taken from Table 5 of this document).

[1] United Nations Development Programme, Global Environment Facility, PROJECT DOCUMENT, signed by all four riparian countries of Lake Tanganyika.
[2] "Pollution Control & Other Measures To Protect Biodiversity In Lake Tanganyika" RAF/92/G32- Technical Proposal Volume 1, NRI, February 1995 (which represents the Consortium's response to the original UNDP Project Document).

Insert Fig 1

Apart from the inevitable delays in setting up the project and implementing Phase 1 (see discussion below), the present Inception Report meets the above criteria. In particular, it emphasises the need to develop national ownership and a participatory approach.

It is, however, recognised that changes in circumstances between project preparation (leading to the Project Document) and implementation are inevitable. This is especially the case with this project owing to the considerable time elapsed between these parts of the project cycle and the lack of rigorous pre-project consultation with stakeholders in the region with regard to important overall design considerations. The Inception Report provides, therefore, an important means of taking stock of these changes through reviewing the prevailing requirements for achieving project objectives in comparison with the activities originally proposed. Most significantly, it provides the following:

- **indicative work plans for the Special Studies** which have been prepared in full consultation with institutional and other main stakeholders, making proposals on how these are to be implemented in a way which will ensure a maximum of local participation and development of the regional "ownership" of the project; and
- **proposals for a management structure** which have been prepared in consultation with the national authorities concerned.

Figure 2 [3] provides an indication of how the Inception Report is now seen to take account of the above changes and tie in with the other key activities under Phase 1, ultimately leading to the Preliminary Strategic Plan which will be the next major initiative to take place in the latter half of 1996. Figure 3 takes this one stage further by showing how the Preliminary Plan will "evolve" into the Final Management Plan.

The Report will be essential in guiding the project development process over the second Phase of activities. The information contained in the report and in the contributory Baseline Reviews is contained in "electronic" format and will form an important initial part of the information available to assist in future project execution.

The active participation by regional governments and other interested groups in the Inception Workshop and the positive outputs from this event, are factors which confirm a commitment to, and responsibility for, the continuing development of the project.

2.2 The draft report was scrutinised by the Steering Committee and, subject to certain changes, ratified. This, the final version , incorporates the modifications required by that committee as recorded in the minutes of its meeting in Lusaka in 1996.

[3] Produced for an NRI internal review of project implementation strategies

Insert Fig 2

Insert Fig 3

Format of the Report

The Report is divided into 13 main Sections as follows:

1. **Executive Summary**
2. **Introduction and Background**
3. **Main Features of Phase 1**
4. **Principal Issues Discussed at the Workshop**

SPECIAL STUDIES SECTIONS:

5. **- Biodiversity**
6. **- Legal and Institutional**
7. **- Socio-Economic Studies and Environmental Education**
8. **- Sediment Discharge and Its Consequences**
9. **- Pollution In International Waters and Its Effects On Biodiversity**
10. **- Fishing Practices and Biodiversity**

11. **Cross-Sectoral and Sustainable Activities**
12. **Training and Capacity Building.**

The final **Section 13** provides a brief outline of future steps.

Under each of the Special Studies sections, details are provided on the following aspects:

- An introduction and background to each study area
- A summary of the main points from the Baseline Review
- A summary of the main country-specific features
- Synthesis of the main outputs of the Inception Workshop
- Compendium of main national institutions to be involved
- Prospective Work Plan for the Special Study

Further detailed plans (including more detail of institutional and individual responsibilities) will be developed during the special study groups' work visits taking place during August and September and will be further considered under the Preliminary Strategic Plan.

Reference is made throughout the text to several Annexes which are also provided. These include the following:

1. Interagency Agreement on Lake Circulation (UNOPS/FAO)
2. Workshop Country statements from Burundi, Zaire and Zambia (Tanzania awaited)
3. List of participants at Inception Workshop
4. Revised Logical Framework
5. Job descriptions for Project Co-ordinator and Scientific Liaison Officer
6. Outline Specifications of the Research Vessel Tanganyika Explorer.

2.3 Background to the Project

The project has its origin at The First International Conference on the Conservation and Biodiversity of Lake Tanganyika held in Bujumbura on 11-13 March 1991. At this meeting a large group of regional and international scientists identified and expressed concern at the increasing threats to the lake's unique and economically important resources. Subsequently, steps were taken to attract the interest of international funding agencies in order to secure funding for a regional project to address the problems identified.

In late 1991 UNDP/ Global Environmental Facility (GEF) mounted a project appraisal mission. The mission canvassed the views of key individuals and assessed the interest and capacities of the principal governmental institutions and NGOs likely to be involved in a project aimed at assessing the threats to the lake and developing mechanisms to monitor and ameliorate the threats. After some delay in the project approval process, by February 1995 a **Project Document** had been signed by all riparian countries, the funding agency UNDP/GEF and the executing agency United Nations Office for Project Services (UNOPS).

At the 1992 Rio conference, the GEF was endorsed as a mechanism for financing activities which generate global environmental benefits. The GEF operates in four theme areas: Climate Change, Ozone Depletion, International Waters, and Biodiversity and was thus a natural source of funding for the current project and was one of the first projects to be approved under the GEF pilot phase. Although originally conceived as primarily a biodiversity project, it corresponds to GEF interests in both biodiversity and international waters. In terms of the new GEF operational programmes it corresponds to a "freshwater ecosystem" (biodiversity) programme, a "water body based programme" (international waters), and since many of the problems in the lake are associated with sedimentation from land runoff, it is considered to be an "integrated land and water multiple focal area" programme.

In December 1994, UNOPS invited the Natural Resource Institute (NRI) to tender for the project as a result of NRI's previously having expressed interest on behalf of the current Consortium. As a result of the tender, the Consortium was duly selected as the Primary Implementing Subcontractor and the contract took effect from 1 August 1995.

2.3.1 Project Objectives

The ultimate objective of the project as stated in the Project Document is:

"to demonstrate an effective regional approach to control pollution and to prevent the loss of the exceptional diversity of Lake Tanganyika's international waters. For this purpose, the development objective which has to be met is the creation of the capacity

in the four participating countries to manage the lake on a regional basis as a sound and sustainable environment."[4]

More specifically, the project aims to:

- establish a regional long term management programme for pollution control, conservation and maintenance of biodiversity in Lake Tanganyika.
- formulate a regional legal framework for co-operative management of the lake environment.
- establish a programme of environmental education and training for Lake Tanganyika and its basin.
- establish tested mechanisms for regional co-ordination in conservation management of the Lake Tanganyika basin.
- produce a comprehensive strategic plan for long-term application to be based upon the results of a series of special studies aimed at improving the understanding of the lake as a whole. Information derived from these studies will be fundamental in the development of long-term management strategies and will in some cases, provide the baseline and framework for long-term research and monitoring programmes.
- implement sustainable activities within the Lake Tanganyika Strategic Plan and incorporated environmental management proposals.

To achieve this, the project aims firstly to improve the understanding of the ecosystem through the implementation of scientific and socio-economic research in the lake basin. Based upon the knowledge gained, the intention is to address the main problems through developing a cross-cutting, regional and sustainable strategy for managing conservation.

The project documentation recognises the complexity that the preparation of such a strategy involves (see following Section). In particular, little of long-term value will be achieved without engendering ownership and commitment by the principal "stakeholders" within the riparian countries - the **national institutions** which have the ultimate responsibility for implementation of the strategy and managing the environment into the future; and the many **communities** living around the lake whose livelihoods depend upon its natural resources.

With reference to the latter, the use of rigorous participatory approaches in any interventions is of paramount importance in order to mitigate against any potential threats to livelihoods. Thus, the socio-economic and environmental awareness components of the project focused on the lakeside communities will be crucial in developing an understanding of the need to protect the environment and foster the future of the lake.

[4] During the project inception workshop the project objective was summarised into the definitive project purpose as part of the logical framework as: *"A Coordinated Approach to the Sustainable Management of Lake Tanganyika"*.

GEF support is intended to be a catalyst to a continuing process - the problems facing Lake Tanganyika and its basin cannot be resolved through a single, time-bound intervention such as this project. The current GEF project must, therefore, be seen as the first step in a long process of developing regional capacity to provide sustained and effective environmental management and should aim to identify mechanisms through which appropriate activities may continue into the future. The project must ensure that any processes and mechanisms established are financially and socially, as well as environmentally, sustainable. This will require (through the Preliminary Strategic Planning process) establishing mechanisms for early prioritisation of major existing and potential threats to the integrity of the lake and formulating viable strategies for future co-ordinated management. Effective regional mechanisms will feed into the Final Strategic Plan.

The development of human capital resources in the region through project activities will play a key role in ensuring sustainability.

2.3.2 Context/constraints

The following constraints to project success have been identified in the Project Document and are reiterated here as it is within the context of these constraints that the project must achieve results:

- **Geopolitical:** The size of the Lake, the poor communications and the different backgrounds and languages of the countries concerned add considerably to the difficulties of implementing the project. There are also disparities between the four countries in terms of resource exploitation and their perceptions of developmental and environmental issues. The line ministries and institutions of the participating countries also have different aspirations and expectations of the project and it is essential to minimise any conflict of interest.
- **Social:** No conservation plan will succeed without the co-operation of the people. There will be a clear need to identify areas of conflict between the need for conservation and the expectations of local communities. In areas where problems are identified, proposed management interventions will call for detailed local discussion on local needs and potential for encouraging socio-economic benefits. It is considered inappropriate simply to impose conservation measures on communities: not only would these be ineffective, they may also have the opposite effect than intended.
- **Technical:** The special studies themes are very much needed in order to add to the knowledge of the Lake ecosystem. The intended coverage of the studies is great and careful planning and management of activities will be necessary. The special studies must also be seen in the context of the project objectives, that of **environmental management**. In this sense, they must begin to prioritise attention on particularly pressing environmental issues, developing information on their current status and then monitoring change in a way which is both sustainable and accessible to key managers and decision makers.
- **Human capacity:** The availability of local/regional staff with the necessary support facilities could also be problematic and may require some augmentation from outside the immediate region while training takes place.

- **Institutional:** Considerable emphasis is given to developing local capacity particularly the four centres proposed at Bujumbura, Kigoma, Kalemie/Uvira and Mpulungu/Nsumbu. In order to achieve sustainability of the project it will be essential to strengthen not only these institutions but other organisations including selected NGOs. The funds allocated to training are substantial and the early development of a human resource development plan which is carefully monitored and managed will be very important.
- **Legal:** The formulation of a legal framework for the co-operative management of the Lake environment is one of the main objectives of the project. The legal systems of the four countries are noticeably different for historical reasons. The existing legislation is different and considerable skills and commitment on behalf of the Governments will be required to harmonise the existing laws or prepare new ones within an international legislative framework.

2.3.3 Interagency Agreement for Circulation Modelling

Prior to UNOPS putting the project out to international tender it was decided that the "Circulation of Lake Waters" (described as activity 5.2.2 in the Project Document) could be carried out most effectively by the FAO/FINNIDA project "Research Project for the Management of the Fisheries on Lake Tanganyika - GCP/RAF/271/FIN" (LTR), which involves all the riparian states. This project which began in early 1992, had already begun preliminary work on lake circulation modelling as part of its mandate.

Although the GEF project requirements for circulation modelling are more rigorous than those undertaken by LTR, requiring the model to have higher resolution, it is nevertheless essentially an extension of the work already underway. A separate inter-agency agreement was therefore signed between UNOPS and FAO to carry out this work on behalf of the GEF project. Details of the work to be performed are given in Annex 1.

3. Main Features of Phase 1

As mentioned above, this Inception Report is based upon the outcome of the major features of Phase 1 activities which have centred upon team building and regional mobilisation, a comprehensive Baseline Review of information on the lake basin, and the Inception Workshop. The following sections provide a summary of each of these activities. The main findings of the Inception Workshop are then discussed separately under Section 4.

3.1 UK-based Management Systems

In August 1995, NRI established an internal Project Management Committee comprising senior representatives from the three Consortium members and other experts as required on an ad-hoc basis. The primary functions of this group include the following:

- to provide administrative back-up to the Project Co-ordination Unit (financial control, invoicing and general administration including travel arrangements);
- to provide technical direction and back-up to the Project Co-ordination Unit on overall project strategy;
- to co-ordinate the activities and technical inputs from the numerous institutions and individuals from outside of the region involved with the project ; and
- to provide advice on the technical inputs required on each of the special study theme areas.

As well as convening regular meetings in UK, ad-hoc meetings of specialists have been called to advise the project special studies groups and PCU on particular aspects of the project such as biodiversity, where a planning workshop was convened by MRAG.

3.2 Mobilisation

Between 25 September and 25 October 1995 the assigned Project Co-ordinator (PC), Dr Andrew Menz and the Project Scientific Liaison Officer (SLO), Dr Keith Banister visited all the riparian countries. The principal purpose of this visit was to meet senior officials in key government departments and the UNDP offices in all four countries, bring them up to date on progress, ascertain current willingness to collaborate and note any constraints. Where not already established, the lead organisations in each country were requested to nominate their National Co-ordinators. The importance of early meetings with key officials had been underlined during the follow-up site visit by Mr Tim Bostock (NRI) in June when it was clear that many of the prospective associate staff members from relevant institutions in the region had not in fact been kept fully informed of the several stages of project approval leading to eventual implementation.

A secondary purpose was to establish house and office accommodation for the PC and the SLO in Dar es Salaam and Kigoma respectively.

The Scientific Liaison Officer took up permanent post in Kigoma on 17 November 1995 and the Project Co-ordinator in Dar es Salaam on 15 December 1995.

3.3 Baseline reviews

The purpose of the baseline review exercise was largely based upon Output 1.1 of the Project Document i.e. to
"*Review all existing relevant data on Lake Tanganyika and its basin to provide a platform for initial formulation of the Strategic Plan for the management of Lake Tanganyika "*. The scope of the Reviews was therefore:

- to review the biological, hydrological and water quality information to establish known patterns of biodiversity in the lake and to determine the extent of degradation in the lake at present,
- to identify gaps in our understanding of the relevant processes and formulate suggested work programmes,
- to review demographic trends from census data and examine all sectoral plans in agriculture, forestry, industry, urbanisation and fisheries, past and present. Ascertain the current status of each sector, in as much as they impinge on the lake, and the likely extent and timing of future developments,
- and to review all legislative aspects including present environmental policies in the four host countries, and any existing or prospective regulations on pollution control and allowable limits. This review will contribute to the eventual drawing up of the legislative framework needed in all four countries to underpin the proper implementation of the programme and its conservation areas.

The exercise comprised a series of studies of secondary information sources and was carried out by specialists in the respective fields drawn from the Consortium. The studies were able to draw largely on published literature and, in some cases, were augmented by visits to the region. This formed a much-needed documentary basis for subsequent detailed discussion and planning at the Inception Workshop. Where information was scant, this was also highlighted in the Reviews as representing potentially large gaps in our current knowledge base. In some cases, information was difficult to obtain for reasons of limited access to certain parts of the region.

Furthermore, taking account of views expressed at the Workshop, the baseline reviews represent the first tier of information in the process of compiling a lake-wide information source or "database".

In summary, by February 1995 the following Baseline Reviews had been produced and distributed to the region and UNOPS/UNDP:

- Biodiversity
- Pollution and its effects on biodiversity
- Sediment discharge and its consequences
- Social, economic and sectoral features

· Legal and Institutional

These were distributed to the key institutions in the region through the Project Co-ordinator and the National Co-ordinators as primary resource documents for the Inception Workshop.

In order to expedite the production and dissemination of the Reviews (especially in the early stages of the project when full translation facilities had not been established), clearance was obtained from the National Co-ordinators to produce the initial versions of the Reviews in English with summaries in French. The literature review sections of these Baseline Reviews are, however, currently being prepared for translation into French and the combined documentation will be published and used as a primary project resource.

3.4 Inception workshop

The Inception Workshop was held in Dar-es-Salaam on 25-28 March 1996, marking a watershed toward the development of local ownership for the project through the active participation of many relevant national institutions. The workshop was hosted by the Department of Environment, Tanzania and the proceedings opened by Mr C. Nyirabu, Principal Secretary at the Vice-Presidents Office, Tanzania. Following the opening each of the four countries presented its comments on the baseline reviews and the project in general and these are given in full in Annex 2 (except Tanzania, which is pending).

The workshop was attended by some 50 delegates comprising scientists and administrators from the region, representatives of the contractors, UNDP, GEF, UNOPS, the PCU and NGOs. A full list of participants is given in Annex 3.

The principal objectives of the workshop were:

· to ensure that the background, purpose and current status of the project were well understood by all;
· to ensure account was taken of the expectations of the four countries (principal beneficiaries), the UNDP/GEF (funding agency) and NRI (project facilitators) regarding the overall objectives the project must achieve;
· to identify the strategy and institutional mechanisms for co-ordination of project activities, principally the subsequent Special Studies; and
· to formulate a preliminary project management framework encompassing the corresponding stakeholder involvement (agencies, ministries, partners) necessary to translate the research findings into realistic management activities during the final implementation phase of the project.

In the light of the need to ensure flexibility during execution and encourage the full participation of delegates, the design of the workshop had deliberately been left "informal" under the control of an independent facilitator recruited from Team Technologies Inc. (US), an organisation regularly used, for example, by the UK Overseas Development Administration in developing project management processes.

Using innovative instruments such as “gallery walk”, much initial scepticism for the workshop design was dispelled and a great deal of productive interaction was generated which, among other things, formed the basis for the production of a logical framework for the project Phase 2 given under Annex 4.

4. Principal Issues Arising from the Workshop

Bearing in mind (a) the number and variety of institutional responsibilities of the participants, (b) the fact that many of the delegates were meeting each other for the first time, (c) the complexity and intrinsic difficulties of implementing a project of this nature, and (d) the long delay between the formal signing of the project document and the start of implementation, the workshop was, nevertheless, considered by all delegates to have successfully achieved its objectives.

In particular, the Workshop was felt to have addressed the need to develop mechanisms to explore and encourage regional participation in project implementation, left the delegates better informed and with a stronger sense of ownership of the project.

The following sections describe the more important outputs of the Workshop and, where appropriate, present some clarification on issues raised.

4.1 Special Studies and Baseline Reviews

The fundamental objectives, approach and proposed work plans for each of the Special Studies (as indicated in the previously prepared Baseline Review documents) were carefully scrutinised, objectives redefined if necessary and the key organisations responsible for the various tasks identified as far as possible.

Understandably this was the most important intended output of the Workshop and the numerous views and recommendations expressed during the four days of the workshop are detailed later in this report under their respective headings **(see Sections 5 to 10).**

4.2 Project Management

During the Inception Workshop clarification was sought by the delegates not only with regard to the hierarchical relationship between Consortium members, but also on proposals for management of the project in the region. Importantly, all delegates were keen to discuss their prospective roles and that of their institutions in the project. These and other issues are discussed below.

4.2.1 Overall Management Structure

As a guide to the following Sections 4.2.2 to 4.2.7, an appropriate structure for the overall management system and key linkages of the project are presented in Figure 4.

4.2.2 Management Responsibilities of Implementing Contractors

The role of the Consortium of primary implementing subcontractors (NRI, MRAG, IFE) and other consultants or agencies subcontracted by them, is to facilitate the achievement of the objectives described in the Project Document together with any subsequently agreed amendments which have arisen through both the tendering and inception processes. The means of doing this will be through providing

methodological advice (principally in the natural and social sciences, but also in general advice on issues arising from the management of multidisciplinary

Insert Fig 4

environmental projects such as this), co-ordination and facilitation services to local institutions, the personnel from which should, in the main, be responsible for carrying out the agreed work plan. Clearly, there will be a strong emphasis on training and institution capacity building which will be achieved through developing close working relationships with colleagues in the region as well as through more “formal” training methods.

Whilst NRI is contractually recognised by UNOPS as the lead organisation in the Consortium and is the organisation with overall administrative responsibility for the project, all members of the Consortium have a mandate for the co-ordination of specific aspects of the work. Although there is a great deal of overlap between the Special Studies requiring considerable multidisciplinary rigour in their management approach, the broad distribution of responsibilities can be represented as follows [5]:

· Mobilisation, baseline studies	NRI/Consortium
· Strategic planning	NRI/Consortium
· Special studies	
Sediment discharge	NRI
Pollution	IFE
Biodiversity	MRAG
Fishing practices	MRAG
(ornamental fish trade)	NRI
Socio-economic and sectoral	NRI
· Training programme	NRI
· Legal framework	MRAG
· Procurement	NRI
· Implementation and sustainability	NRI/Consortium

It was decided that to help clarify the role of the implementing subcontractors the“description of services” in the NRI/UNOPS contract should be distributed to the heads of the country delegations.

UK management

This area has been covered under Section 3.1 above.

Regional Management - Project Co-ordination Unit (PCU)

The PCU is the principal regional focal point for the co-ordination of all project activities. It is intended to administer and facilitate project operations in the region and, most importantly, to act as a link and information conduit between countries, institutions and other related projects.

Concern was raised at the Workshop with regard both to the location of the PCU in Tanzania (as opposed to the original proposal to locate this in Bujumbura), and to the

[5] From NRI/Consortium [illegible]

location of the PC's office in The British Council in Dar es Salaam. A discussion on the points raised now follows.

Project location: Tanzania or Burundi?
The original Consortium proposal had recommended that the administrative site for the project be located in Bujumbura and it is recognised that this would for several reasons (not least logistic and proximity to the lake) have been an ideal location. However, prior to final contract negotiations NRI was informed by UNOPS that, owing to the deteriorating security situation in Burundi, the UN security classification for the country had been raised to Phase 3. Under UN rules this precluded the initiation of a new project base in that location. As a result, NRI was asked to re-evaluate their proposal basing the Project Co-ordination Unit in Tanzania.

Due to the different responsibilities and job descriptions of the principal staff of the PCU, it was considered necessary to split the PCU, basing the PC in Dar es Salaam (from where the obligations for regional travel and co-ordination could more easily be met) and the SLO in Kigoma on the lake shore (from where the lake wide scientific operations could be orchestrated). Although this adds considerably to the burdens of internal project co-ordination and administration (i.e. between Dar and Kigoma), no other alternative offers a better solution.

Burundi government officials have expressed their disapproval of this change as indicated in the Inception Workshop country statements at Annex 2. However, as project activities develop and with hoped for improvements in the security situation in Burundi, it was agreed that the location of the PCU would in due course be reviewed by the Project Steering Committee (see below). Nevertheless the overriding consideration should be to ensure its most effective performance under the prevailing requirements of the project.

Footnote: In view of the continued unrest in the area, the Steering Committee decided that the definitive location of the Project Co-ordination Unit should be Tanzania to avoid any future disruption.

PCU location at The British Council
It was emphasised that there is no link between the location of the PCU and the seat of any future "Lake Basin Management secretariat" or other such organ mandated with the eventual responsibility for environmental management. The office of the PCU is essentially the **contractor's regional office** the role of which is to facilitate the emergence of an agreement on a Strategic Plan for the management of the lake basin. This is likely to comprise a regional co-ordinating body with its own secretariat and office. The PCU office is in no way a precursor to this.

The PCU office was therefore located to enable it to function with maximum efficiency in providing support to not only all countries but also to all departments and institutions involved, without favouring any one over any of the others. These were the criterion employed when originally placing the Project co-ordinators

component of the unit under commercial terms in The British Council's building Dar es Salaam which provided all required services at a reasonable cost.

As several objections to this location were raised by delegates at the Inception Workshop, the **Dar es Salaam headquarters of the PCU will be relocated to another office but at an increased cost to the project**

Note: The P.C. office is now located at 1st Floor, Life House, Sokoine / Ohio Street, PO Box 5956, Dar Es Salaam . Tel 255 51 118201,Fax 118202, mobile 0812 278614

The criteria for the office of the PCU do not, of course, apply to project field stations on the lake shore because activities there are an integral part of the institutional building aspects of the project and therefore make use of existing institutional infrastructure where possible. However, during the early stages of implementation, the project envisages the need to establish "devolved" PCU scientific administrators sourced through the Consortium in each field station. The role of these persons would be primarily to oversee any sub-contracted activities as well as provide financial and administrative support.

4.2.3 Management Roles of Regional Institutions

Many different institutions will of course be involved in such a broadly based project, some throughout the project and others for specific periods. All will, however, need to be kept fully informed throughout the project implementation period. Within each of the four riparian states the lead organisations are as follows:

- **Burundi** Institute for the Environment and Conservation of Nature
- **Tanzania** Division of Environment, Office of Vice-President.
- **Zambia** Environmental Council for Zambia
- **Zaire** Dept. for Management of Renewable Natural Resources. Ministry of the Environment, Conservation of Nature and Tourism.

The Project Document, Section E and Annex VIII details the agreed contributions in kind by the riparian states to the project. However far more important is that the ministries and institutions involved make a clear and lasting commitment to the project purpose to generate and maintain the necessary motivation of, and support to, the individuals assigned to the project and to ensure that the project does not become ensnared in unnecessary bureaucracy. Good communication between institutions will be most important and is often best achieved during formal or semiformal meetings of individuals from different departments and institutions.

The nominated National Co-ordinators for the project are:

- Burundi: **Dr Gaspard Bikwemu** - Director General, Institute for the Environment and Conservation of Nature

- Tanzania: **Mr Rawson Yonazi** - Division of Environment, Office of the Vice-President.
- Zambia: **Mr James S. Phiri** - Director, Environmental Council for Zambia
- Zaire: **Mr Mady Amule** - Director, Dept. for Management of Renewable Natural Resources, Ministry of Environment, Conservation of Nature and Tourism

The National Co-ordinators are expected to play key roles in project implementation. The Project Document states that "it is the role of the National Co-ordinator to effectively make available the information and experience gained by the project to relevant national institutions and departments." They will also act as the link between government institutions and the Project Co-ordinator and as a point of contact between governmental institutions and NGOs working on the project. They thus have **a vital function in project co-ordination, communication and facilitation within their respective countries**.

4.2.4 National Working/Steering Groups

Co-ordination and communication within each country will be done primarily through the medium of the National Working Groups led by the National Co-ordinators. Their principal role will be to bring together the principal institutional stakeholders at senior level, and other interested parties who might not necessarily be directly involved , in order to exchange information and views ensure a collaborative approach.

It was decided that the working groups should have a core membership of 10 to be determined by the individual countries and that additional members could be c0-opted on an *ad-hoc* basis as required. To ensure effective co-ordination the groups should meet 4 times per year. It was stressed that the role of the National Co-ordinators was vital in ensuring the effective functioning of the National Working Groups.

4.2.5 Regional Steering Committee

In order to ensure compatibility of objectives and outputs, the Project Document correctly points out that project must incorporate the interests of the senior development co-ordinating ministries, the environment ministries and councils, the various natural resource sectoral agencies and the local interests of other agencies representing people in the basin. In order to address this, a project Steering Committee will be formed with the following terms of reference:

- provide overall direction of the project;
- review the progress of the project and the various national activities, ensuring a regionally integrated approach;

- direct on policy matters, and monitor the utilisation and availability of counterpart staff;
- approve future planning, and make recommendations to the executing agency as to changes in project timetables, inputs and budgets which may be necessary from time to time;
- provide guidance and support to the Technical Advisory Committee and Project Co-ordinator.

The Steering Committee will comprise members appointed by each country, from the lead agencies or ministries , preferably at Director General or Permanent Secretary level, as well as the designated National Co-ordinators from each country. Representatives of UNDP and of the Consortium will also be members. Arrangement for persons who can contribute special expertise to become members will be made on an *ad hoc* basis. The Project Co-ordinator will serve as executive secretary to the Committee which will meet at least once a year.

The detailed composition of the Steering Committee was the subject of some discussion among national co-ordinators and other governmental officials at the Inception Workshop. Some countries proposed two representatives per country while others proposed three; these would be in addition to the four National Co-ordinators, the Project Co-ordinator and representatives from UNOPS, GEF and, at the first meeting, NRI. It was later agreed that the final composition would be decided at the initial meeting of the Steering Committee at which the committee would be formally established. Whereupon each country delegation should consist of a maximum of four members headed by the Permanent Secretary from the lead ministry in each country supported by the National Co-ordinator and two other senior officials. It was further agreed that UNDP would convene and chair this first meeting but that once agreement had been reached on the structure and chairmanship of the committee, UNDP could formally hand over to the countries. It was recommended that subsequently the committee be chaired by each of the countries on a rotational basis. To ensure that decisions are binding on all parties it was decided that UNDP representatives from the four countries should be full members of the Committee as indicated in the Project Document. It was noted that the role of the Project Co-ordinator is to serve as secretary to the Steering Committee and that the role of the National Co-ordinators is similarly supporting and not decision making in the Steering Committee.

4.2.6 Project Technical Advisory Committee (TAC)

The Project Document also called for a project Technical Advisory Committee with the following mandate:

- general supervision of the implementation of the technical work program, with periodic review and revision within the terms of the project document and budget;

- evaluating the technical work carried out by the project, drawing conclusions and recommendations for appropriate further action, and reporting as required to the Steering Committee;

- providing technical support and advice to the project.

As envisaged by the Project Document, the TAC will consist of the technical experts from the agencies actively involved in the project; these are expected to be the Fisheries, Parks, Wildlife, Environment, Water and Pollution Control Departments from each country. Project staff and representatives of the Consortium of implementing agencies would be invited to meetings to advise, as appropriate, on current activities. The Project Co-ordinator will chair the Committee, which will meet at least twice a year.

The role and composition of this committee was also briefly discussed during the Inception Workshop. It was eventually decided that it should comprise:

Four senior environmental scientists (one from each country)
The lead consortium co-ordinators for the following three special study combinations;
socioeconomic and environmental education
sediment and pollution and biodiversity
biodiversity and fishing practices
Senior research officers of the four lake-shore bases
The National Co-ordinators
The Project Co-ordination Unit.

Thus the core committee would consist of 17 members . Other experts could be co-opted on an *ad-hoc* basis as required. The committee should meet twice a year and it was not be chaired by the project co-ordinator as stated in the project document but by an eminent environmentalist elected from the Technical Advisory Committee.

It was pointed out, however, that country representation *per se* was not relevant to the TAC since its role was to ensure that the project is guided by the best available scientific advice.

4.2.7 Regional task forces

In addition to the above it is expected that specific regional task forces will be created to bring together regional experts under the main themes of project activity, to exchange, compile and analyse data, plan future work and receive methodological advice and training. It is at this level that inputs from the Consortium consultants and NGOs are expected to be most active. Task forces in the following areas are envisaged: Biodiversity (assessment, protection etc.), Sedimentation and Pollution (measurement, assessment of impact on biodiversity etc.), Legal and Institutional (Legislation, parks, groundwork for lake management framework etc.), Socio-economic and Environmental education, Training and Capacity building. Details of these groupings their composition and function should be a part of the Preliminary Strategic Plan.

4.3 *Research Vessel "Tanganyika Explorer"*

There was some confusion among delegates at the Workshop regarding the use of the research vessel the R/V Tanganyika Explorer which it is anticipated will be used for a number of lake wide surveys by the project. The following points provide clarification.

The FAO signed a contract with La Tanganyikaise S.A.R.L. Explorations and Shipping in 1993 for services in connection with the execution of project 'Research for the Management of Fisheries on Lake Tanganyika' (LTR). Under the terms of this contract La Tanganyikaise constructed, according to FAO specifications, a 26m long stern trawler R/V Tanganyika Explorer. The construction started in November 1993 and the vessel was commissioned in January and March 1995 and finally delivered and accepted by LTR on 28 April 1995.

The period of charter is 36 months i.e. from 28 April 1995 to 27 April 1998. The FAO has the right to extend the charter by periods of one year on the then prevailing terms and conditions, provided a written request will have been received by La Tanganyikaise at least six calendar months before the end of the current charter.

R/V Tanganyika Explorer (outline specifications and principal particulars in Annex 6) is used to carry out research investigations (hydrology, acoustics, trawling, limnology, etc.) during lake-wide cruises. During the first year of charter eight lake-wide cruises were executed. The LTR cruise schedule is flexible and determined by both the availability of consultants, equipment and biological factors (seasons, etc.).

Under the terms of the Inter-Agency agreement (IAA 95073) for UNO/RAF/007/GEF between UNOPS and FAO the project LTR will expand its work programme to prepare a more detailed water circulation model of Lake Tanganyika. This task will require the use of R/V Tanganyika Explorer of up to a maximum of 4.5 months. The work programme was already proposed and provided to all concerned.

There is ongoing discussion between the FAO and La Tanganyikaise regarding the terms of Article 9(g) which states that 'the FAO shall not assign this contract nor sub-demise the vessel or grant any option therefore without prior written consent of La Tanganyikaise'. Briefly, La Tanganyikaise insists on a 'supplement' to the existing charter fee as it considers this or any other sub-charter as not directly contracted for by GCF/RAF/271/FIN (LTR). The final decision on these negotiations has still not been taken. Further, La Tanganyikaise requires (as does FAO) that any sub-charter be contracted for a minimum period of one calendar month which would include the cruise mobilisation, actual cruise and 'clean-up' after cruise.

FAO/LTR are currently negotiating the final charter arrangements for the use of the vessel for the additional work under the UNOPS/FAO interagency agreement and the GEF project.

From the outset, it was recognised that the cost of the "Explorer" would prove considerable, and several alternative strategies have been adopted by the project to plan, whenever possible, the use of smaller vessels available at some stations (e.g. RV "Echo" in Kigoma) or privately hired fishing boats

4.4 GIS and remote sensing component

A well organised Geographic Information System (GIS) was seen as an important component of the project to provide the regional authorities with a tool to organise existing data together with data to be collected during the special studies in such a way as to enable the tracking of progress of such features as erosion and deforestation, as well as the extent of sediment plumes and phytoplankton productivity in the water.

The NRI/Consortium tender proposal provided more detail of how the GIS would be configured and in addition recommended the use of a 'Local Application of Remote Sensing Techniques' (LARST) system. The main component of this system is an easy to use, robust low cost satellite data receiver for NOAA and Meteosat satellites. These receiver system will be installed at Kigoma for optimum coverage of the lake and will provide real time access to data thereby allowing the direct application of satellite observations to improving monitoring and management of the Lake. (see Section 11.2 special studies)

5. SPECIAL STUDIES - *Biodiversity*

5.1 Introduction

The fact that Lake Tanganyika is the second richest lake in the world in terms of numbers of recorded species is one of the principal justifications for the Lake Tanganyika Biodiversity project. There are many challenging questions to be asked about the biodiversity of the lake and its origins. In the context of the present project, the objective is to identify and focus on those particular questions to which answers are required immediately, in order to provide a viable plan for the integrated conservation and sustainable management of the lake and its resources. A corollary of this objective is that the conditions will be created so that work on the fundamental questions in biodiversity raised by Lake Tanganyika can be carried out into the foreseeable future.

The lake should and will continue to provide benefits for present and future generations within the riparian states. Future economic development will inevitably lead to an increase in potentially damaging processes which can decrease the biodiversity of the lake. As shown in Sections 5.3, 5.4 and in the baseline reviews, these processes, such as catchment area degradation and industrial pollution, are already happening and are having an impact on the lake. Clearly there is a need to understand qualitatively and quantitatively the damage and impacts these processes are having on the biodiversity. The description and analysis of these processes is the subject of the other special studies and it is the need to understand the cause and effect of the impacts which determines the unified approach within the project. An estimate of the most probable scale of increase of these potentially damaging processes , which can be determined from trends and sectoral plans for agriculture, forestry and industrial growth, amongst others, will then enable the potential impacts on biodiversity in the future to be estimated. Only when the risks have been evaluated can the investment required for mitigation be estimated and justified for the Strategic Plan.

At the same time, we need to know what is being conserved and find the best way of doing it. To achieve this we must understand some of the more fundamental features of biodiversity in the lake. The most obvious method of conservation is the establishment of protected areas such as national parks, for which there is the provision for the setting up of some within the project. The establishment of protected areas is really a proactive measure of mitigation, ensuring that some essentially unmodified sites will always exist. In these cases, therefore, there will be a need to know what exists in the area and also what information must be provided for the protected area to be gazetted as defined within the Legal component.

Habitat diversity almost certainly underpins biodiversity, and therefore its interaction with species distribution must be a factor to examine, since it can affect the strategy of conservation adopted within the plan. The same will also be true, for example, of the

patchiness of species distribution, a feature which may also influence overall strategy. Work on pristine, unimpacted sites must, therefore, also be a feature of the biodiversity investigations.

A final outcome of this special study will need to be criteria by which the changes in biodiversity can be judged. A long-term, cost-effective monitoring programme will need to be initiated (see Figure 3), which must provide the Lake Basin Management Committee or its equivalent, with information on the status of biodiversity from which they can judge if the management plan is being implemented effectively. This is a further fundamental issue which needs to be addressed

5.2 Background

The co-ordination of the Biodiversity Special Study is primarily the responsibility of MRAG within the project Consortium. The Baseline Review was commissioned in October 1994 with a view to providing a concise summary of the state of existing knowledge of biodiversity around the lake. This was to act as a framework for discussion on the needs for the study amongst national and regional participants at the Inception Workshop, and into the future.

Prior to the preparation of the Baseline Review, direct contribution was commissioned from a panel of recognised international experts in line with the commitment made in the NRI proposal document including Dr George Coulter, Dr Rosemary Lowe-McConnell, Dr Frits Roest, Dr Andrew Cohen and Dr Jacques Moreau. Their comments were incorporated into the Baseline Review. Rosemary Lowe-McConnell and Frits Roest also have extensive personal libraries of papers on Lake Tanganyika owing to their long-standing involvement in the international work on the lake, and both gave open access to these papers to assist in the preparation of the review. The collection of Rosemary Lowe-McConnell was documented as a special annex of the Baseline Review.

During the Inception Workshop, this framework was built upon since it provided the occasion to itemise national, regional and international needs, concerns and expectations. This was the first opportunity to institute a work plan for the study and to define its content.

5.3 Baseline Review

The reputation for high biodiversity in Lake Tanganyika is best demonstrated by fish of the family Cichlidae and the molluscs. Both of these speciose groups have a high level of endemicity as well as a considerable genetic variability within a species. As would be anticipated from such variability, their identification and taxonomy presents significant difficulties and has yet to be completed despite them having been the most intensively studied groups in the lake.

Specification amongst non-cichlid fishes has not been quite so prolific as that of the cichlids, but there is a high proportion of endemism, with species flocks being found in the bagrid and chrysichthid catfishes and the spiny eels of the Mastacembelidae.

Most of the non-cichlids, however, are distributed around the whole lake and not in the rather patchy and local fashion to be found amongst some of the cichlids.

A high diversity is not uniformly found through all other groups of organisms in the lake. Of the algae, phytoplankton for example do not have a high number of species, there are no endemic species and, in fact, many are cosmopolitan or pan-tropical in their distribution. The zooplankton is not particularly rich in number of species, although there is a high proportion of endemic or characteristic species, including the well-known freshwater jelly fish. The same is also true of another well studied invertebrate group, the ostracods. Even amongst the fishes, those of the open water regions are not diverse at all, being essentially composed of just the six species, which form the bulk of the commercial fishery in the lake.

The invertebrates of the benthic regions, including the crabs and shrimp, appear to be characteristic of the lake and important in its functioning, but their contribution is not really understood. Certainly the shrimps appear to support a significant proportion of the fish communities. The macro invertebrates generally seem to have been poorly studied. This is particularly true of the insects which play a major role in many African lakes, but scarcely seem to have been mentioned in connection with the food webs of Lake Tanganyika. This is either an oversight or the functioning of Lake Tanganyika is fundamentally different to that of most of the other African Great Lakes. This requires urgent attention. Indeed the overall composition and role of the macro-invertebrate benthic community deserves a prominent place in the biodiversity studies since they are particularly good indicators of the blanketing effects of sediment deposition and also of chemical pollution. They may well feature as a crucial indicator in the final monitoring programme. The same is also true of the "aufwuchs", the thin algal felt which covers most rocks and other hard surfaces in the littoral region of the lake. This is known to be important in the diet of over one third of the fish species in the lake and it is likely to be vulnerable to blanketing by sediment, although its diversity and productivity is very poorly understood.

There is a need to map and classify the habitats around the lake, since it is the dimensions of the habitat, the "environmental mosaic", which underpins the biological diversity of the lake. A preliminary map of rock, rock/sand and shallow areas has been prepared**.** Habitats also vary with depth, being divided into the littoral, sub-littoral, benthic and bathypelagic zones. Each has its own characteristic communities, with the littoral being richest in species and the bathypelagic the most distinctive and the least known. Below the thermocline (100-200 m) conditions are completely anoxic, thereby rendering around 75% of the volume of the lake abiotic.

Amongst the habitat types, marginal vegetation is particularly sparse in its distribution, being confined to swamps at the mouths of the Malagarasi and Ruzizi rivers, as well as patches around the mouths of some of the smaller rivers. These limited areas, however, could be vital for the fish and fisheries of the lake because they appear to act as nursery grounds for some key species, such as those of *Lates*. This link between the shallow areas and the pelagic zone needs to be investigated.

The general variability within and between natural habitats at different sites must be understood, firstly in order to help judge the difference between pristine and impacted sites, and secondly to determine the optimum strategy for conservation. A high variability between habitats will pose different problems to a more consistent distribution of diversity. For fishes, the south western quarter of the lake appears to be the most species rich, whilst for all groups the western shores are the least well known.

The strategy must also be linked to the establishment of conservation areas. The biodiversity component must help to select important areas and to inventory and map these locations for gazetting and managing as national parks (see Section 4.7).

Fishing is the greatest single economic activity in the lake and it is bound to have a significant impact on biodiversity. However, the main commercial fishery is based on the six pelagic species, although only two are now commercially viable in some places. Impact from commercial fishing can be derived from results of the FAO/FINNIDA project. The impact of artisanal fishing around the lake will be a major component of the Fishing Impact Special Study (see Section 10). There will be overlap with Biodiversity, however, in understanding the link between littoral and pelagic zones.

Finally, it should be borne in mind that the lake actually occupies only 32,000 km^2 of the total basin area of 237,000 km^2. Much of what happens to the lake will, therefore, be a function of developments within the basin. The Malagarasi sub-basin alone accounts for 130,000 km^2. In future, therefore, the Malagarasi and its swamps could be the greatest single influence on the lake, with the river delta being its principal point of impact. A further major point of influence on the lake and its biodiversity is likely to be Bujumbura, with its growing population and increasing industrial development. Both of these may need to be included in the studies in biodiversity and the subsequent monitoring programme.

5.4 Country Summaries

5.4.1 Zaire

Zaire has the largest, but least well documented, coastline of the riparian states, but probably the least well documented (see Biodiversity Baseline Review). The country presentation at the Inception Workshop accepted that studies along this coastline would be amongst the most difficult, but that these studies should include:

- construction of a good database of the resources of the lake;
- studies on loss of biodiversity;
- local participation in the studies;
- more focus on the crustacea and other groups in comparison with the more well known fishes and molluscs.

The lack of an institutional base in the southern half of the Zaire sector is a major obstacle to more widespread study.

In addition to species distribution, habitat variability should also be documented particularly through the selection of representative sites. Amongst specific habitats it was considered imperative that work on river estuaries be continued and also on any suspected nursery areas for fishes. Links with FAO/FINNIDA LTR project are important here since some work has already been conducted on nursery areas. The effects of present and future refugee problems on habitat and environmental degradation also needs to be considered.

Specific concerns included the potential establishment of water hyacinth and other floating weeds in conjunction with future eutrophication, and effects of capture and export trade in fish for ornamental purposes in the lake which currently exists in Zaire.

A number of national activities are presently taking place which relate to the present study. A monograph on biodiversity within Zaire is being prepared, which will include a thorough documentation of what is known of biodiversity in Lake Tanganyika. In addition, both regional and provincial activities across the country are being drawn together as part of a sectoral survey culminating in a national Environmental Action Plan (EAP). This EAP will outline the basic strategy but will need to be properly orientated and extended to the Lake Tanganyika Basin. This will clearly need to be taken into account within the Preliminary Strategic Plan from the present project.

5.4.2 Burundi

Burundi is the smallest, most densely populated of the lake states, but has the most immediate stake in the lake resources and their well-being. With an area of 13,000 km^2 and a population of 1.3 million people, up to a third of whom rely upon fish from the lake as a major protein source, and also the only capital city on the lake, the economic and environmental significance is clear. The processes which are having an impact on biodiversity as well as other features, both at present and in the future, have been prioritised as:

- deforestation;
- expansion of agriculture and pastoralism
- overpopulation
- refugees
- pollution

Forest reserves are already established in the catchment area and managed in a fashion to help try to stabilise some of these processes. The Ruzizi National Park which includes the wetlands and swamps of the Ruzizi Delta, is probably the area managed most specifically for the maintenance of biodiversity in association with the IUCN.

There are a number of institutions within the country concerned with the lake and its resources. Consequently the Burundi sector is probably the best known from the biodiversity point of view (see Biodiversity Baseline Reviews). These institutions have also supported a number of international collaborative projects which have contributed to the process.

In addition to the shared concerns of most of the country delegates, it was considered essential that within the Biodiversity programme, methods should be standardised across all work teams and that studies should be carried out simultaneously.

5.4.3 Tanzania

Tanzania has a long, sparsely populated, relatively varied coastline with an urban and institutional centre at Kigoma and some institutional support at Kipili. There are two established national parks along the shores, Gombe, north of Kigoma and the Mahale Mountains at the junction of the north and south basins of the lake. There have been a number of national and internationally supported studies at various points so that the Tanzania sector is moderately documented (see Baseline Review).

The most significant feature of the basin in Tanzania is the Malagarasi river with its swamps and wetlands. There are regarded as requiring particular attention, both with regard to potential influences on the lake and because of the characteristic fauna and flora of the river system itself.

With regard to general features causing degradation of the catchment area with potential negative impacts on biodiversity, the influence of refugees needs consideration.

Specific concerns with regard to biodiversity, apart from more improved inventories of representative sites, are the protection of the lake from the spread of water hyacinth and also concern that the ornamental fish trade needs to be monitored more closely and possibly reduced.

5.4.4 Zambia

Zambia has the smallest sector of the lake but the southern waters are amongst the most prolific for the fishery, as well as being amongst the most diverse. This is also the portion of the lake with the most extensive shallow area, i.e. less than 200 m. There is a well-established national park at Nsumbu and a major fishing port at Mpulungu. The present national park already includes a 1.6 km strip of the lake within its boundaries, whilst concessions have been made to the traditional rights of some fishing communities.

National and international surveys based around Nsumbu over the last 30 years have made this area relatively well known. Diversity of fish taken off Cape Kapimbi is reputed to be amongst the highest recorded anywhere in the lake. Diversity of fishes generally appears to be high in this sector and most is known of the deeper water communities from the shelf of this region.

There is an awareness in Zambia that conservation in the lake must be closely linked to conservation of surrounding catchment area. In this connection, new wetlands and agriculture lands policies await ratification. There is also a National Environmental Action Plan, although this refers mainly to pollution control rather than conservation of biodiversity *per se*.

Operation of a popular national park which includes a portion of the lake has demonstrated the need to take the widest view of biodiversity. Groups such as mammals and reptiles must also be taken into account, since they can have a high public profile.

5.5 Inception Workshop Results

5.5.1 General Concerns Expressed

Some of the national concerns regarding biodiversity were touched upon in the country presentations at the Inception Workshop (Section 5.4). Other general points were made during the initial open sessions by individual delegates as summarised below.

(i) Broad areas of concern:

- Protect catchment areas as quickly as possible;
- Include broad coverage of organisms in studies and in conservation approach;
- Increase regional capacity for compiling taxonomic inventories;
- Need improved national capacities to manage biodiversity.

(ii) For Fisheries: the need for harmonisation of protection measures, for example:

- Closed season in nursery areas of vegetation;
- Needs assessment of differential impact of the different fishing methods used in each country around the lake.

(iii) Selection of a protected area in Zaire is a priority.

5.5.2 Overall Approach to Biodiversity Special Study

The points given below are those transcribed from the open session on the planning of this study:

Pristine and *impacted* sites are needed for biodiversity assessment.

Pristine sites are needed for *fundamental* work as well as to act as reference points for impact work.

Initial pilot work over the first eighteen months will lead to a systematic study.

Collation of all existing patterns of diversity from literature and national records.

Compile list of locations for which previous surveys / time series have been made.

Standardisation of methods and timing for teams (international, regional teams).

Locate priorities within inventories from pilot sampling at each locality.

Budget suggests approximately 10-12 localities for detailed biodiversity work around the lake, together with some opportune sampling.

Locality is an area containing a range of "habitats" where a range of sampling can be carried out.

Criteria for assessment of biodiversity to be devised for monitoring programme.

Community variability within and between unmodified habitat sites to be assessed.

Creating baseline inventory and community structure on pristine sites, with criteria developed for assessment to feed into cost effective monitoring.

Make qualitative and quantitative assessment of effects on biodiversity at impacted sites.

Assess "charismatic species" in link with tourism, for example crocodiles, etc.

Support for conservation activities including new national parks, especially restricted habitats in certain areas, e.g. by collecting data for gazetting as soon as possible.

5.5.3 Pristine Sites

Pristine or least modified sites will be identified from rapid assessment of pilot surveys together with analysis of compiled species data forms. There is the strong feeling that some, at least, should coincide with the lake parks to be instigated under the project (see Section 11.1) and that subsequent studies can radiate out from the parks thereby using them as a springboard. If the new lake parks are an extension of the existing terrestrial parks, then the catchment area will have been protected for some time and will help to assure their pristine or least modified status.

These sites would also provide the localities for fundamental work of variability within habitats, development of criteria for assessing biodiversity across a broad range of taxa and development of a long-term cost effective monitoring programme. Special lakeside studies on "charismatic" or "flagship" species may be required. General mapping of species or group distributions for least disturbed sites around the lake may be advantageous.

5.5.4 Impacted Sites

All four riparian nations expressed concerns over the negative and degradation processes affecting biodiversity around the lake. To assess priorities in this respect, participants were asked to list all impacts that might be significant and the national delegations were requested to score those impacts for each country (Table 5.1). From this it is apparent that fishing activity is seen as the greatest threat to biodiversity by every country. Increased sediment loads from catchment area degradation scored second overall, but there was a big difference in perception of the threat at the northern and southern ends of the lake. Burundi rates it the greatest single damaging influence, whilst in Zambia it appears to be only of moderate importance. There is a similar pattern for industrial pollution whilst eutrophication, the over-enrichment of lake waters by nutrient laden inflows or effluents, is not seen to be a problem at all in Zaire and Zambia. In the final analysis, the total threats to biodiversity from all sources are rated nearly twice as high in Burundi waters, compared to those of Zambia (Table 5.1). Interestingly enough, dangers from introduced fish species appear non existent at present, a complete contrast to the situation in Lake Victoria where the impact of the introduced Nile Perch has been devastating. There were minor concerns over some fish keepers in Bujumbura allowing exotic species to escape into the lake, and the lesson of Lake Victoria must be a major consideration within the Strategic Management Plan.

Refugee problems in the region may be considered under the unpredictable "catastrophic" heading in future.

The matrix in Table 5.1 only records national perceptions but it does, in itself, represent a valuable contribution to the initial planning process.

Country delegates were also asked to provide a provisional list of sites or localities where examples of particular impacts may be seen. These are given in Table 5.2.

Table 5.1 Description Matrix of Impacts on Biodiversity: scores allocated 1-5 with increasing impact by national delegates

Description	Zaire	Zambia	Tanzania	Burundi	Total
Sediment	4	2	3	5	14
Eutrophication	-	-	3	3	6
Fishing	4	4	3	4	15
Industrial Pollution	2	1	2	4	9
Shipping Pollution	3	3	3	3	12
Domestic Pollution	1	2	3	3	9
Fish Transfer	3	1	1	2	7
Fish Extraction	4	2	4	2	12
Fish Introduction					
Global Warming				?	?
Water Abstraction				1	1
Catastrophes			1	1	2
National Totals	21	15	22	28	

Table 5.2 Sites of impact on biodiversity around Lake Tanganyika

Sediment sites	Eutrophication sites	Industrial pollution	Shipping pollution	Domestic pollution	Aquarium species	Introduced species
Malagarasi Ruzizi Lufubu Ntahangwa (Burundi) - (domestic and sediment) Mutambala (Zaire)	Kigoma Kipili Bujumbura	Kalemie Ruzizi Delta Uvinza Bujumbura Kigoma Ujiji Rumonge Mpulungu	6 ports (and natural seepage of oil)	Major cities and shipping routes	Zaire: 5 to 6 centres (widespread) Zambia: 2 centres (not so widespread) Tanzania: Kigoma and sites in the south.	Minimal (possibly water hyacinth)

5.6 National Agencies

Not all agencies with a potential role in the Biodiversity Study, particularly NGOs may so far have been identified. Those expressing interest are listed below:

Burundi

1 Institut Département des Eaux, Pêche et Pisciculture
2 Université de Burundi, Département de Biologie
3 Centre Regional de Recherches en Hydrobiologie Appliquee (Burundi)
4 FAO/FINNIDA LTR project

Zaire

1 Centre Recherche d'Hydrobiologique (Zaire)/Uvira
2 Service National de la Pêche
3 Universities of Kinshasa, Lubumbashi and Kisangani

Tanzania

1 Tanzanian Fisheries Research Institute
2 University of Dar-es-Salaam, Zoology Department
3 Tanzanian National Parks Authority
4 Department of Wildlife
5 Department of Fisheries
6 Frontier (NGO)

Zambia

1 University of Zambia (Lusaka)
2 Fisheries Department
3 National Parks and Wildlife Department

5.7 Work Plan

An outline work plan for the Biodiversity Special Studies was agreed at the Inception Workshop. Essentially this consisted of three phases:

1 **Collation** of detailed existing species and group data by locality and habitat at national and international level. Duration 3 months (early to mid 1996).

2 **Pilot Phase**: using rapid assessment to check promising localities, particularly in conjunction with creation of new protected areas and to find representative pristine and impacted sites. Duration 18 months (mid 1996 to late 1997).

3 **Detailed Studies**: examination of representative sites in 10-12 localities around the lake to investigate, for example, within habitat variability, criteria

for assessment of biodiversity, extent and causes of recent changes in biodiversity as well as the role of certain habitats such as marginal vegetation. Duration 18 months (mid 1997 to late 1998).

The first phase represents the awareness that much disparate information already exists amongst national and international groups which can be collected and collated to provide an overview of the detailed distribution of species around the lake by locality and habitat. If this can be successfully collated, building upon the initial broad survey and source compilation in the Baseline Review, a first overall appreciation of the distribution of biodiversity around the lake and its relative patchiness, both spatially and taxonomically, would result. This information can be used to start a regional database. It was also decided that this, and all project data bases, should the include the local names for the fauna and flora as well as the scientific names.

The pilot phase would include rapid surveys to augment the compiled existing data. In particular, however, it would concentrate on providing the information on the animals and plants needed for gazetting of the national parks, a process which needs to be initiated rapidly. Pristine and impacted sites would be located during this phase.

The detailed studies would be in-depth investigations at a limited number of localities to examine those aspects of biodiversity essential to providing a sound conservation strategy, in relation to the most probable future development processes and resource use throughout the lake basin. This conservation strategy will be available for incorporation into the Strategic Management Plan. The detailed studies would need to be carried out at pristine and impacted sites and some studies would necessarily be carried out in conjunction with other special studies.

6. SPECIAL STUDIES - *Legal and Institutional*

6.1 Introduction

The Lake Tanganyika Biodiversity Project is essentially an institutional project. Many of the activities are directed toward promoting research and understanding through technical special studies to develop a Final Strategic Plan for the sustainable management of all resources in the Lake Tanganyika basin with the conservation of biodiversity (Figure 3). Nevertheless, no matter how good the research in filling gaps or how sound the resulting Strategic Plan may be, without a regional mechanism such as a Lake Basin Management Committee to take up regional ownership and to implement the plan, the project will be unable to fulfil its objectives. Implementation of the plan will also need institutional and technical criteria for subsequent Monitoring and Evaluation procedures required to inform the management on the progress of the plan (see Figure 3).

The institutional development necessary to implement the plan must therefore be carried on in parallel with the technical activities. There are two elements to this institutional development: firstly the establishment of a framework of legal understanding and authorisation for consensus decisions to be implemented, and secondly, increased capacity to carry out the plan. This second element would largely be achieved through international collaboration and through the training component (see Section 12).

The harmonisation or co-ordination of relevant laws amongst the four partner riparian countries is essential for enabling common decisions to be implemented, potential conflicts to be resolved and for appropriate processes to be regulated. The extent of any overall agreement is, of course, a political decision between the partner states.

6.2 Background

This component is primarily the responsibility of MRAG within the Consortium. It is not so much a special study as a facilitation and institutional support activity to the riparian partners. Time inputs available are therefore rather limited compared to the technical special studies.

The Baseline Review was commissioned in October 1995 with a remit to review the laws on all sectors involved in resource use within the lake basin for all four countries, together with a review of the international agreements and obligations which might be appropriate in the present instance. In fact all four partners have a long history of participation in environmental initiatives within the international community. The Legal Section of FAO, Rome collaborated extensively in the country and international reviews.

Within the Inception Workshop legislators were probably the least well represented amongst the participants, which hampered progress on this component.

6.3 Baseline Review

If the biodiversity of Lake Tanganyika is to be conserved and its resources sustainably utilised and bequeathed to future generations, it is essential that it be properly managed. As development pressures on the Lake increase so do the needs for more active management. Experience throughout the world indicates that if management policies are to be effective and sustainable they require an appropriate institutional framework established by the authority and power of the law.

Devising an appropriate regulatory regime for the Lake presents enormous challenges, many of which arise from the physical realities of the lake itself. Some key points in this respect include:

- the lake itself spans the borders of Burundi, Zaire, Tanzania and Zambia (the riparian states);

- regulation and management of the lake cannot be separated from the management of the entire drainage basin covering some 231,000 km^2;

- a wide range of human activities occurs within the lake basin, including fishing, agriculture, pastoralism, mining, water transport, forestry, urbanisation with each sector having an impact on the lake and likely to do so into the future;

- in each country, the responsibility for regulation can range among a variety of different sectoral and inter-sectoral government agencies which complicates the process of formulating and implementing an integrated policy or plan;

- there are several hundred national laws which govern these sectoral activities and which are potentially relevant in some way to the sustainable development of the lake and the adequacy and effectiveness of these laws and the extent to which they are enforced, varies widely;

- the ability of national governments to implement laws and policies for the environmentally sound management of the lake basin is often severely hampered by a lack of funds and institutional capacity;

- the primary instrument for the management and conservation of the lake basin should be an international treaty or agreement of co-operation amongst the riparian states.

A further complication to the institutional diversity of the four states is that there is a fundamental division with respect to legal systems. The two Francophone countries follow civil law traditions, whilst the two anglophone countries have a system based on common law, although all are also influenced by customary African law. The basic tenets and operation of the two systems are different but this should only affect the

mechanisms which need to be enacted rather than the common objectives that need to be upheld.

The principal laws and institutions governing those sectors likely to have an impact on the lake, as itemised above, have been summarised for each of the riparian states. As in most countries, the environmental agencies tend to be relatively new and legislation in this sector in particular, is changing rapidly. The working of some of this sectoral legislation must be examined in detail within the region to assess the need for harmonisation or co-ordination of legal objectives. This is the case particularly with regard to detailed regulations, such as allowable limits for pollutants or limits on fishing gear or practices within fisheries legislation.

On the international front all four riparian states have assumed international environmental obligations by becoming signatories to a number of treaties.

These include:

- The African Convention on the Conservation of Nature and Natural Resources ("The African Nature Convention") 1968;

- Convention for the Protection of the World Cultural and Natural Heritage ("The World Heritage Convention") 1975.

- Convention on International Trade in Endangered Species of Wild Flora and Fauna ("CITES") 1980.

- Convention on Biological Diversity ("The Biodiversity Convention") 1993.

- Communauté Economique des Pays des Grands Lacs ("CEPGL") 1976, Zaire and Burundi only;

- Convention of Wetlands of International Importance ("The Ramsar Convention") 1975, Zambia only.

There are a number of obligations for signatories of these treaties which are relevant to the present project. These obligations can provide valuable guidelines as to the overall pursuance of the project and their application under the Lake Tanganyika GEF will be seen as fulfilment of those obligations under international environmental law. The obligations under these treaties are:

Biodiversity:

1 To co-operate with one another as far as possible and as appropriate for the conservation and sustainable use of biological diversity (Biodiversity Convention, Article 5);

2 To develop or adopt national strategies, plans or programmes for the conservation and sustainable use of biodiversity in accordance with its particular conditions and capabilities (Biodiversity Convention, Article 6(a));

3 To increase special protection to animal and plant species which are or may become, threatened with extinction and to the habitat necessary for their survival (African Nature Convention, Article VIII (i)).

Protected Areas

4 To establish a system of protected areas where special measures need to be taken to conserve biological diversity as far as possible and as appropriate (Biodiversity Convention, Article 8 (a)).

5 To establish, where necessary, zones around conservation areas within which activities detrimental to the protected natural resources are controlled (African Nature Convention, Article X(2)) and promote environmentally sound and sustainable development in areas adjacent to protected areas to further the protection of these areas (Biodiversity Convention, Article 8(e)).

Customary Rights

6 To take all necessary legislative measures to reconcile customary rights with the provisions of the Convention (African Nature Convention, Article XI).

In one instance, at least, there is a serious gap in the international obligations no species of Lake Tanganyika fish appears on the CITES list of any riparian country.

Finally, there is the question over the nature of the agreement that might enable management of the lake basin to be conducted in a co-operative fashion. There is a considerable concern over the management of international river and lake basins at the present time and most major international donors have well-defined policies and guidelines as to what might be expected in the control and management of international waterways. There are, consequently, a number of international models, such as the Mekong Committee, for this type of co-operative legislation and management.

Nationally, amongst the riparian states, the management of river or lake basins is already a major element of water resources policy in some countries, such as Tanzania. Regionally, however, there are already at least two examples of international agreements over river basins. These are:

1 Agreement for the Establishment of the Organisation for the Management and Development of the Kagera River Basin ("The Kagera Basin Agreement") 1977, between Burundi, Tanzania and Rwanda.

2 Agreement on the Action Plan with Environmentally Sound Management of the Zambezi River System ("the Zambezi Agreement") 1987, amongst eight participating states, including Zambia and Tanzania.

Such agreements can be as loose or as specific as required but are essentially enabling mechanisms to allow co-operation to take place and to authorise or define the role of the co-ordinating regional body.

6.4 Country Summaries

Zaire is currently in the process of reviewing the legislation in several natural resource sectors including fisheries and environment. Any modifications suggested by the present Lake Tanganyika GEF project could most easily be accommodated now rather than after the new drafts have been ratified.

It is clear, however, that a timely response from the project would be ideal, since once the present review is completed and enacted, that it will be much more difficult to change any further the legislation. Ultimately, the new national Environmental Action Plan will become a principal instrument of national environment policy.

The delegation of Burundi expressed an awareness of the need for a programme of common legislation.

The delegation of Tanzania emphasised the need for a legal body, constituted on a regional basis, to manage the lake..

The Tanzania delegation expressed some reservations about the Legal and Institutional Baseline Review, particularly over the perceived statement that Tanzania has no tourism policy. The report does not say this and refers, in fact, to the Tanzania National Tourism Board Act 1962 as amended by Act No. 18 of 1992 and the powers that this provides for promoting tourism.

Zambia was able to provide some updated information on new and forthcoming legislation. A Water Sector Policy Master Plan has just been enacted which recognises the importance of water resources nationally. There are other acts currently in preparation to control water quality and which will also have an EIA provision. The National Environment Action Plan of 1994 also outlined policy on pollution control.

Several legal changes have recently taken place in Zambia with regard to land tenure and mining. Allocation of land must now include some land for conservation. In the agriculture sector there is now an Agriculture Investment Plan. This relates to land use and is linked to catchment area use, and includes community related activities. The new Mining Act of 1995 contains two articles of significance:

(i) a new EIA for all mining projects (although it was not clear if this also included drilling for oil) and;

(ii) a rehabilitation plan must be prepared for restoration of mining sites.

A Wetlands Policy document has been drawn up by the Government of Zambia which now awaits ratification. There may be elements of this appropriate to wider legislation over the lake.

The Zambian delegation drew the distinction between "co-ordinated" and "integrated" management of the lake. This implies a spectrum of possibilities of authority for the lake basin management body from a more or less advisory role, co-ordinating effort and legislation between countries and a more closely integrated legal authority of its own, possibly even including enforcement. These are obviously important elements that will need to be discussed amongst the states as this component proceeds.

It was noted by the UNDP/GEF Co-ordinator that a wide variety of approaches have been used to create Lake Basin management frameworks. Where these have consisted of large “top down” authorities they have so far failed. The successful models are generally patterned on some form of inter-governmental steering committee with a small secretariat co-ordinating and guiding, not directing, the planning and actions of existing national institutions and organisations.

6.5 Inception Workshop Results

6.5.1 Summary of Conclusion

There was a general consensus amongst delegates on the importance of harmonisation and co-ordination of laws relating to the management of Lake Tanganyika, and a concern that this should be started rapidly. This was particularly true for the viewpoint of Zaire where many of the laws are currently under review, so that any recommendations could be more effectively adapted now rather than after the laws have been ratified.

There was also a general understanding that some form of management body, such as a Lake Basin Management Committee would be needed and that this may stem from the Lake Tanganyika GEF Steering Committee which is presently being formed to oversee the present project. The international agreement and the management body need both to be either in place or in progress by the time the Final Strategic Plan is formalised in 3 years time. There are further reasons for commencing the legal and institutional activities as soon as possible. It was, however, accepted that the formal agreement may not necessarily need to be finalised before a Lake Basin Management Committee can be constituted and begin implementation of the Plan.

There were a number of specific points raised by delegates in open sessions:

Summary of Legal and Institutional Points

1 Groupings of national and international legal experts to conduct legal analysis of existing laws at national, regional and international level to:

· devise model legislation (or objectives) for modification and ratification by each country (needed rapidly for Zaire);

· legislation must take into account the interests of local communities;

· work out time schedule for legislation.

2 There is little in-country capacity in international environmental law and therefore a training programme needs to be set up.

3 The project should facilitate inter-governmental co-operation which would, for example, make travelling between countries easier for government officers.

There was a general suggestion that there should be a legal and institutional workshop within 2 to 3 months with representative lawyers from each country. The lawyers should be selected from amongst those who actually draft laws in their respective countries.

There was concern that people should not be disadvantaged by any action of the project, particularly those relating to the creation of protected areas. This could cause conflict where the creation of national parks is linked to a complete non-extractive policy, as it is in at least one of the riparian states. However, there can be legal solutions to these apparent conflicts since, as the Legal Baseline Review indicates, all countries have a range of types of conservation areas, each with their own legal criteria. Such potential conflicts may therefore be solved by selecting the most appropriate legal and institutional option amongst the types of protected areas. Thinking more broadly than simply in terms of national parks also helps to prepare the way for a wider zoning of the lake for the Strategic Plan. It is also consistent with the concept of areas of controlled activities around major conservation areas enshrined in the African Nature Convention Article X (See Section 6.3).

6.6 National Agencies

Following are those institutions expressing interest at the Inception Workshop; others may need to be identified.

Burundi
Institute for the Environment and Conservation of Nature (Burundi)

Zaire
Ministry of Environment, Conservation of Nature and Tourism
University of Kinshasa, Faculty of Law

Tanzania

Ministry of Water, Legal Unit
Faculty of Law, University of Dar-es-Salaam
Ministry of Environment
Tanzanian National Parks Authority

Zambia
Ministry of Legal Affairs
Law Association, Zambia
Lawyers Environmental Action Team

6.7 Work Plan

The legal and institutional component is not a special study but a support action for the project, and consequently the time allocations for this are limited and geared to specific interventions.

Two initial actions are clearly required. The first is to begin a regional analysis of relevant laws together with the provision of a framework within international environmental law. The second is to explore the requirements for an international, regional treaty of agreement covering conservation and management of the lake. Owing to the time schedules of the project, these activities should commence as soon as possible.

A clear starting point will be to convene a Lake Tanganyika Biodiversity Project Legal and Institutional Workshop within the first few months following the Inception Workshop. This will be a relatively small working group of national and international lawyers who will look at the scope and timetable of future legal issues that may need to be addressed to ensure legal harmonisation to underpin the Management Plan. They will also explore models and mechanisms for an international agreement. Future inputs into this component would be defined from the workshop.

7. SPECIAL STUDIES - *Socio-Economic Studies and Environmental Education*

7.1 Introduction

An adequate assessment of socio-economic conditions, and human interactions with the natural environment in the Lake Tanganyika basin is an essential basis for strategic planning and sustainable management of the resource. Accordingly, the project document specified the need for special studies in a number of areas, including fisheries, tourism, and sectoral themes such as agriculture, land use, forestry and wood energy, drawing on the disciplines of anthropology, rural sociology and economics. An environment education component was also envisaged, involving NGOs, to help strengthen public awareness and community involvement in project activities.

The proposals from NRI and the project Consortium, as technical advisors, have developed this approach, emphasising the importance of establishing a process of stakeholder participation, especially at community level, as studies proceed and pilot activities begin, by way of a dynamic link between the socio-economic and environment education components. This will be especially important with regard to the identification and management of aquatic protected areas, assessing the costs and benefits for local people of biodiversity protection, and, where necessary, in developing opportunities for alternative incomes and livelihoods, for instance where over-fishing is occurring. Accordingly, there have been wide- ranging discussions of social and economic issues both in the baseline reviews and at the Inception Workshop. These have not been confined to technical questions of socio-economic analysis but instead consider the whole range of human resource use activities in the lake basin and their environmental impacts. This Section reflects these broad issues, and it considers both socio-economic studies and environment education as interweaving strands of activity, which are critical to project success.

7.2 Background

Responsibility for co-ordination of both the socio-economic and environment education components of the project rests with NRI, which has access to a team of specialists from NRI itself, from MRAG, and, for Environment Education, from ICCE. The role of these external specialists however, was clearly articulated by the Inception Workshop, as one of facilitation, co-ordination, supervision and methodology support for studies and pilot activities to be carried out primarily by national institutions, including government departments, research bodies and NGOs. Regrettably, these institutions were not involved significantly in either project preparation, or during the baseline review phase. The Inception Workshop represents a watershed for the project however, at which the need for active stakeholder participation was emphasised. The project thus faces a challenge, to develop a process of active engagement in the socio-economic special studies, and education activities by the relevant national institutions, and by local stakeholders and communities at specific pilot sites. The more effective this process can be, early

on in the project, the stronger the basis for strategic planning and sustainable management of the Lake's resources in the future.

7.3 Baseline Reviews

The Socio-economic Baseline Reviews identified the general demographic and socio-economic features of the Lake basin area. Studies were undertaken of agricultural land use and agrarian change, forest resource use, fisheries, conservation and protected areas, tourism, the refugee situation and environmental education. These were based on a thorough review of available literature; at that early stage in project development, and in view of uncertain transport logistics, field visits were not undertaken. Detailed analysis was possible for Tanzania, because of the vast range of literature available, and to a lesser extent for Zambia. Very little literature was identified for Burundi and Zaire, however, and because of the lack of contact with key institutions and sources in-country, the Baseline Review was deficient with respect to these countries.

The Project document and Baseline Reviews identified key environmental problems affecting the lake and the lake basin, resulting from human resource utilisation in the area:

· High population densities in the northern part of the basin, compounded by low incomes, lack of employment and population displacement affecting Zaire, Tanzania and Burundi

· Overfishing, damaging fishing practices, and risks of biodiversity loss

· Intensive agricultural land use in some areas, involving deforestation and degradation of vegetation cover, leading to erosion of lake catchments and sedimentation

· High energy and wood-product demands associated with urban and refugee settlements, and the demands of domestic use and fish-processing

· Pollution associated with urban and lakeshore industries, discharge of agrochemicals and the by-products of agro-processing discharge

· Risks resulting from current and future infrastructural, transport and industrial development, including transit of and exploration for oil, and small scale mining

· Upper catchment degradation in inland areas of the basin, with potential impacts on wetlands and their capacity to act as buffers for sediment and pollutants

Country reports at the inception workshop provided additional information, and highlighted the needs to fill the gaps in the baseline reviews as a basis for project development, and the willingness of delegates to collaborate in these exercises. As a result, information gathering in-country, and planning for national implementation of

the socio-economic special studies, are to be undertaken in conjunction with initial field visits by NRI /Consortium social scientists and environmental education specialists to each country. (see workplan below Pg 62).

7.4 Country Summaries

In order to provide adequate background to the findings and proposals of the Inception Workshop, and the work planning for the special studies, country summaries are provided here, based on information provided by delegates, and contained in the Baseline Review.

7.4.1 Burundi

The Burundian portion of the lake basin comprises approximately 13,300 km^2 , and contains an estimated 1,300,000 people. The area also includes some exceptionally varied lacustrine plant and animal habitats, under the protection of INECN. These include the wetlands of the 9,000 ha Ruzizi National Park, and the adjacent 600 ha Kigwena Reserve, the easternmost fragment of Guinea-Congolian forest, along the eastern lakeshore. In addition there are important watershed forests, including Kibira, straddling the Nile / Congo watershed divide, Bururi and Rumonge forests (of the *miombo* type), whose waters flow westwards to the lake.

The diversity and uniqueness of Burundi's natural habitats, as well as the lakeshore itself provide important tourist attractions. Bujumbura also lies on east-west trans-Africa routes, although tourism is presently underdeveloped.

Lake Tanganyika's fisheries provide a major source of animal protein for one third of Burundi's population. The principal threats to lake resources, and to these habitats, derive from deforestation, agro-pastoral practices, demographic pressure, overexploitation of the fisheries, and pollution.

INECN is responsible for the management of National Parks and natural resources in Burundi, and for undertaking research and environmental education. A number of important conservation and management projects are underway, and the development of agroforestry and beekeeping activities in a buffer zone are proving successful in containing pressure on the National Parks. Beekeeping and edible mushroom development by local women's groups are being supported by GTZ in Kigwena and Rumonge forests, and there is a joint INECN / GTZ project to develop a multiple-use zonal system for the area surrounding the Ruzizi National Park, to allow for resource utilisation by local people. Catholic Relief Services are promoting agroforestry and seedling distribution in the eastern *Brachystegia* (*miombo*) forests.

On pollution control, a waste water treatment plant is under construction for Bujumbura, where a variety of industries discharge pollutants into the Ruzizi river.

Burundi possesses rich agricultural systems which involve the cultivation of coffee, cotton, oil palm, rice, and a wide variety of subsistence crops. Cattle raising is also

important. High population densities and land scarcity, however, mean that agriculture has considerable negative impacts on the natural environment.

In many places, steep topography, hillside cultivation and livestock contribute to catchment degradation and soil erosion. There are a number of agro-industrial schemes operating in the Imbo region, which forms the eastern floodplain of the Ruzizi, including rice, cotton, seed replication and nursery projects. These, especially cotton, are sources of agrochemical contamination of the hydrological system. In addition, coastal and wetland sedimentation has a negative impact on fish nurseries, and erosion control is also required, especially where lakeshore agriculture and oil palm cultivation are practised, as in the Rumonge agricultural development project.

Land use inventory in Burundi was reported to be partially out of date because of population growth and movements, and INECN has identified priority tasks of undertaking assessments of land occupation, land utilisation, and the relationship of the population to lake resource use.

7.4.2 Tanzania

The vast proportion of the lake Tanganyika basin's land area lies within Tanzania, covering the administrative regions of Kigoma, Rukwa, the greater part of Tabora, and parts of Shinyanga, Kagera and Mwanza. As a result, long term developments and changes in land use in western Tanzania have a very significant bearing on the biodiversity and resource potential of the basin and the lake itself. The environmental and socio-economic problems of the area were well documented in the baseline review on the basis of the very wide range of available literature, and not significantly elaborated at the Inception Workshop. Nevertheless they are summarised below.

Subsistence farming is the principal livelihood activity of the region, and fishing is an important secondary occupation on the lakeshore. Principal subsistence crops are cassava, maize, beans, sweet potatoes, with bananas being important in the northern areas and rice on lakeshore coastal terraces. Cash crops include small-scale production of oil palm, coffee and cotton, again principally in the northern areas.

Workshop delegates reported continuing overfishing in Tanzania's northern portion of the lake, and a growing shift of industrial and artisanal fishing activity towards the south. The Regional Fisheries Department operates an extension programme aimed at improving fishing and fish processing methods, although credit provision still encourages entry to the fishery.

Agricultural land use is intensive in the densely populated Kasulu highlands bordering Burundi and on the Rukwa plateau to the south; these areas have been entirely deforested. Clearance proceeds in *miombo* woodland areas which dominate the region, as tobacco cultivation and cattle keeping expand, notably in Tabora region. Deforestation is associated with the agglomeration of the rural population in *Ujamaa* villages, during the 1970s, and with land clearance in the areas surrounding coastal fishing villages and urban centres.

The impacts on lake resources of sedimentation, and agrochemical pollution originating in the upper catchments are mitigated by the very extensive Malagarasi / Moyowosi swamp system in the centre of the lake basin area. The extent to which these wetlands may themselves be under threat of environmental degradation, and accordingly, the significance of upper catchment degradation as a factor impacting on the lake itself, are important questions for the project to address. Until these questions can be answered, short term project investigations and action programmes are likely to concentrate on lakeshore areas, and those catchments which drain directly into the lake.

There are two important national parks located on the lake shore, Gombe and Mahale, both of which are refuge habitats for chimpanzees and plant species otherwise unrepresented in east Africa. TANAPA's Community Conservation Services have begun to work with local communities living adjacent to the parks and socio-economic appraisal will be required in order to assess the feasibility of creating aquatic national parks in the coastal areas. There are also a number of Game Reserves in the inland basin area, where there may be some scope for the development of community based wildlife management. There is currently little scope for significant tourist development in the area however, because of lack of infrastructure.

Although villagisation campaigns involved the transformation of traditional shifting agricultural practices, leading to localised land degradation, and the erosion of indigenous systems of government at local level, there is now renewed emphasis on the need for decentralisation and improved local resource management systems.

Despite some out-migration from the lake area, there has been significant population growth, and in-migration of refugees into the northern parts of the lake basin, increasing pressure on both terrestrial and aquatic resources. Correspondingly, the needs for longer term development of urban / industrial infrastructure and improved transport links in the region poses some threats to the lake basin's natural resources. Pollution from urban waste and the by-products of agro-industries originate currently from the Kigoma / Ujiji area.

7.4.3 Zaire

In the last two years Zaire has seen some positive evolution of political will to address the understanding and management of natural resources, and hopes to develop a National Environment Action Plan. Specific regional action plans are also expected, and there has been some coverage of Lake Tanganyika in background documents. The project should contribute to the elaboration of local action plans within the NEAP.

Moreover there is strong interest amongst local agencies and NGOs on the lake coast in addressing environmental problems and taking a participatory approach, regarding environmental education as indispensable. UNESCO has recommended the incorporation of EE at all levels of education in Zaire, and NGOs in South Kivu have

started rural radio stations, including EE programmes, inspired by 20 years of rural radio experience elsewhere in Zaire.

Both North Kivu and South Kivu (which reaches the lake shore), are seriously affected by refugees from Rwanda and Burundi. This has led to severe deforestation, shortage of agricultural land, erosion and sedimentation of coastal habitats, and increasing take up of fishing by people seeking livelihoods. The refugee situation is dynamic and subject to change. Considerable agrarian change has also taken place in South Kivu and Shaba provinces. Delegates recommended incorporation of agricultural extension in the EE process.

Forest resources and coastal habitats are relatively intact in the Shaba province parts of the basin, south of Kalemie. IZCN holds information on the management of protected areas hunting reserves in the region none are actually located within the lake basin), and would be willing to share this. CRH, Uvira have collected good socio-economic fisheries data, through working on the LTR project, and are in a position to suggest possible aquatic protected areas.

Population data is held by regional administrative offices. Despite a complex political and economic situation, it should be possible to obtain the data and sort it out.

7.4.4 Zambia

The Zambian portion of the lake basin is relatively small, but it includes the town of Mpulungu, a centre for fish marketing and various industries, and the Nsumbu National Park, which implements a closed season for fishing from November to June in the protected aquatic area, extending 1.6 km from the shore. The park contains important tourist attractions, and because of the existing national tourist market and infrastructure, the Zambian shoreline offers the greatest potential for tourist development in the short term.

Zambia's lake fisheries are diverse, including a substantial industrial fishing fleet, and extensive artisanal and traditional fishing. The industrial fishery has faced declining catches in recent years, and the continuing industrial harvest also impacts the resource base of the smaller scale fisheries. Fishing practices are regarded as important targets for environmental education programmes.

The surrounding hinterland is primarily agricultural, but with relatively poor soils, and some *tsetse* infestation of uncleared *miombo* woodland areas. The principal urban centre is the town of Mbala, some 40 km from the lakeshore. Traditional shifting cultivation systems, based on *chitemene* ash gardens created by loping and burning miombo woodland have proved relatively inefficient as population has grown, and there has been a shift away from millet, towards cassava and hybrid maize.

There has been significant demographic and agrarian change in the Zambian portion of the lake basin during the last fifty years, involving male outmigration to the mines of the copperbelt, and the introduction of new seeds, inorganic fertilisers and improved

marketing arrangements for the rural population, through a system of co-operatives. Unlike Tanzania, however, indigenous patterns of settlement and land management systems remain in place. Although the area is not at risk of rapid growth of population and corresponding land and resource pressure, Zambian delegates reported to the workshop that there was still a need to improve land use practices in order to reduce the threats to lakeshore habitats resulting from deforestation, sedimentation and pollution.

Zambia's National Environmental Action Plan, adopted in 1994, provides a framework in which action can be taken to improve the management of lake and lake basin resources. The Agricultural Sector Investment Programme, which contains environmental mitigation provisions is also a good basis for project activities. These strategies should encourage the development of a co-ordinated approach amongst national agencies, which is necessary because of the diversity of natural resource utilisation in the lake basin area.

Other recent policy developments reported to the Inception Workshop include: the Control of Pollutants and Environment Act of 1990; the 1995 Mining Act, which requires EIAs and management plans for final rehabilitation of mines; the development of water and wetlands policies; and a land policy which creates scope for conservation use of land under leasehold or private ownership.

In the conservation sector, Zambia has significant and instructive experiences in the development of community-based approaches through the ADMADE programme, of value to the project, including wetlands management for multiple use in the Kafue Flats

7.5 Inception Workshop Results

7.5.1 Natural Resource Issues in the Lake Basin

The principal natural resource problems for socio-economic investigation as identified at the inception workshop are:

I. Fisheries

· overharvesting of fish populations
· the impact of fishing practices on fish populations and habitats
· tropical fish collection also needs to be considered
· these issues are of particular importance in relation to potential aquatic protected areas
· the identification of tangible benefits for local communities from improved practices and new opportunities

In relation to fisheries, despite extensive documentation, the overall trends in terms of fishing pressure and the incidences of "overfishing" are not clear. There may be considerable room for fisheries development, and it is therefore likely that there will be a need to link new opportunities with improved fisheries regulation in sensitive

areas. The costs and benefits of improved fisheries methods and proposed new regulations and aquatic protected areas at community level will need to be assessed carefully.

II. Wood energy demand and deforestation

· the impacts of high population levels and refugee demands for fuel and shelter
· the demands of fisheries on wood resources, especially for fish processing
· the importance of agroforestry and the tree planting
· possibilities of wood energy demand reduction by energy saving and substitute fuels
· forest clearance by extensive, rotational (or shifting) cultivation methods

III. Agricultural land use and livestock

· the impact of steep slope cultivation, especially near the lakeshore and for catchments draining directly into the lake
· the difficulties posed by:
  - people's habituation to their customary farming methods
  - the question of wider and upper catchment degradation, and the problem of upstream land users who do not bear the downstream costs
· the risks and impacts of agrochemical pollution, (especially in the Ruzizi catchment in Burundi, associated with cotton production) and discharges from agroprocessing activities

IV. Population and economic development

· the importance of gaining clearer pictures of population distribution, demographic trends, including migration, and land occupation, in relation to lakeshore resources
· the scarcity of land use inventories for lakeshore and catchment areas and areas subject to population movements

There are a number of environmental risks associated with prospective economic and infrastructural development in the lake basin, presented briefly to the workshop but not really discussed, including transport development. While development, will be important to bring increased trade, prosperity, and employment opportunities to these isolated regions of all four countries, good environmental impact assessment and mitigation planning will be necessary.

7.5.2 Socio-economic Special Studies

The baseline studies were the result of literature review, rather than field investigation, and as a result there is a need to fill the gaps in background information, especially for Zaire and Burundi. The workshop also agreed that it would be necessary to develop a good practical analysis and geographical characterisation of resource use problems on a country by country basis, and identify national institutions and resources for undertaking the special studies, and beginning environmental education work.

A two stage approach will therefore be needed:

· I. Initial field investigations and discussions in each country, to include visits by project social scientists and environment educationalists, to make a practical assessment and draw up plans for:

· II. In depth, participatory investigations at community level for selected sites, involving national agencies, local experts, environmental educationalists, and community members. Workshop participants also highlighted the important role of community-base organisations (CBOs) including local clubs, associations and churches

The workshop identified the first three of the themes discussed as the principal topics for in-depth socio-economic investigation at local level:

· Fisheries livelihoods and fishing practices

· Agricultural and livestock

· Deforestation and energy

In line with the purpose of the project, the purpose of the studies is to define a strategy to change and improve destructive natural resource utilisation practices which have negative impacts on lake resources, in each country.

The following broad steps would be involved in conducting the special studies:

1. Identify human resource use and environmental problems and characterise them geographically

2. Identify pilot sites and carry out in-depth investigations at community level.

3. Identify possible solutions, by assessing alternative options available.

4. Determine the best solution for each site, and begin local action programmes

5. Synthesis, review and comparison of results, and analysis of the implications for strategic planning on a national and regional basis.

At the inception workshop a discussion group worked through and agreed the steps required to achieve the socio-economic special studies' purpose, for the fisheries thematic area. A similar set of steps can be carried out for the other themes; in fact the local participatory enquiries and follow-up action programmes would in practice combine two or more themes.

Defining a strategy to change and improve destructive fishing practices at local level: results of workshop discussions

Investigations would involve the following steps:

STAGE I

1. Identify fishing problems and characterise them geographically, in planning for subsequent steps

- overharvesting
- use of destructive fishing gear
- impacts on valuable habitats

STAGE II

2. Identify pilot sites and carry out in-depth investigations at community level. These will assess the causes of fishing problems in a participatory way, investigating:

- local people's knowledge of the fisheries resource,
- their perceptions of resource and livelihood problems
- local fishing practices, identifying both positive and negative aspects

3. Identify possible solutions, by assessing alternative options available:

- improved fishing practices
- alternative livelihoods / income sources
- assess the resources available to address the problems

4. Determine the best solution for each site, and begin local action programmes.

In stage I, for each country, the project will need to:

- review the documentation and understanding of fishing problems along the lakeshore
- assist in production of a national analysis of the problems and the action likely to be needed
- identify sites, and develop teams to conduct the participatory learning and action programmes.

In stage II:

- The sites selected may need to include potential aquatic protected areas.
- The socio-economic impacts of proposed new fisheries regulations, gear restrictions and closures of certain areas will need to be assessed.
- The results of these investigations and action programmes will need to be monitored and reviewed in order to assess their relevance and implications for other sites on the lake shore

Although the workshop did not have time to follow through a similar set of steps for the other thematic areas, and examine the implications, fuller terms of reference for the special studies as a whole will be developed and proposed for the preliminary strategic plan.

Linkages with the project's environmental education component

In order to develop community participation, a participatory diagnostic process, an enabling institutional framework, adequate skills and capacity amongst project partners, and sufficient incentives for communities to be come involved in local pilot activities will all be required. The special studies will need to contribute to the development of that capacity, and identify the incentives and constraints for practical action.

For successful pilot activities, especially in lakeshore communities dependent on both agriculture and fishing, there will be need for close collaboration between different government departments involved in research and extension, and NGOs. The special study process should foster these linkages.

Within the project, environmental education will have a critical role in working towards sustainable approaches to natural resource management within the Lake Tanganyika basin, by targeting national project stakeholders, implementing agencies and local people, and fostering dialogue amongst them about the development and conservation needs of the region.

As far as possible, the special studies will in fact be a participatory rural appraisal (PRA) process involving the government agencies and NGOs involved in the project, in the villages located in or near the sites under investigation. Francophone participatory appraisal methodologies, (applied in Zaire and Burundi), utilising different concepts, but involving similar approaches, are also very relevant, and the project may also benefit from some cross-fertilisation of the methods used. The results of the PRA work would feed into the design of both local pilot activities, and the wider strategic planing process for the lake basin a whole; the special studies would thus be a vehicle for participatory learning and action (PLA) at various levels. They would draw on, and be part of the environmental education component of the project, and should have a capacity building function for the institutions and staff involved.

The studies will need the support of a regional socio-economic co-ordinator, and the national EE co-ordinators proposed for each country, who may be from either governmental or non-governmental organisations. As the project develops, it is expected to contribute towards building national EE capacity, for the lake basin regions. The early stages of field enquiry for the socio-economic special studies, and the environmental education component, will be closely linked, in order to assess the perception of environmental problems at community level, the opportunities and constraints for local participation in resource management, and define the next steps in education activities.

7.5.3 Environmental Education (EE)

The purpose of EE

All countries agreed that EE provision is vital for the success of the Lake Tanganyika Project in terms of realising the goal of protecting the Lake's biodiversity.

EE is important because
* it empowers people with the knowledge, skills, attitudes and values that enables their participation in present and future environmental management of the lake.
* it is the major precursor to environmental action and the main way of ensuring that the project's goal is sustainable in the long-term.
* it is one of the primary mechanisms to achieve unification of project strands and integration of these to present the project as a holistic one.

At the inception workshop representatives of all four countries agreed that EE programmes should focus on :

* lake polluters - including industry, urban and agricultural industries, and lake transporters.
* resource users - including fishermen (both on the industrial and artisanal levels), farmers, pastoralists, and lakeside communities (with emphasis on special groups like women and administrators).
* young people through schools and clubs.
* officials of relevant government departments.

How the various groups can be reached and involved ?

Numerous communication media can be used as appropriate. Those mentioned at the workshop comprised:
* seminars for policy and decision makers.
* training of trainer programmes for extension workers and teachers.
* use of mass media like radio, TV and newspapers.
* the establishment of local level institutions for women, youth church groups and others.
* the establishment of environmental clubs in secondary schools.

The importance of involving local people at the start and throughout the duration of EE programmes was especially noted. Without this, the long term sustainability of the project might be seriously compromised.

The workshop also noted that, as the project period and budget is finite, the most effective way of proceeding will be to build capacity of existing appropriate government and NGO EE initiatives in the region.

7.5.4 Outline workplan for Environmental Education

As with other project components, the definition of the next steps in the EE activities will be made by the four riparian countries. The roles of the NRI/ICCE are advisory, co-ordinating and facilitative. Because each country has local needs, it is imperative to appoint national EE co-ordinators. The Inception Workshop agreed that this should

be achieved by mid 1996 for each country. National EE co-ordinators should conduct EE and socio-economic rapid diagnostic research in selected lakeside communities before the end of 1996. The aim of this is to :

* involve local stakeholders as soon as possible
* make rapid assessments of levels of environmental knowledge and awareness, including
* assessment of training and awareness needs of staff in government and other EE implementing agencies, and
* initial assessments of perceptions of local environmental problems and possible solutions,
* identify the most appropriate ways of communicating directly and through media

The first stage of socio-economic assessments in each country, also planned for June - December 1996, will characterise the environmental, and socio-economic problems associated with human livelihoods, population distribution and economic development activities in each country. These assessments will provide working documents (and a basis of training materials development) for initial country workshops / seminars involving environmental educators and staff of project implementing agencies

Field baseline research in the socio-economic special studies, drawing on local EE expertise, will make more detailed assessments of local knowledge, resource management practices, and perceptions of problems, and possible solutions, in order to identify ways forward for specific ongoing and future EE programmes. This will lead on to the planning, implementation and evaluation of pilot EE activities and the further development of support materials and resources.

Specific EE programmes will be undertaken during 1997 and 98. Local and regionally integrated evaluations will be completed by the end of 98, on order to contribute to strategic plan development in early 1999.

7.6 National Agencies

7.6.1 Socio-economic studies

Burundi

INECN would lead, having identified three key, interlinked, activities:

- land occupation study
- land use assessment
- population study in relation to lake resources

The possible roles of University departments, and NGOs such as ODEB and TSF remains to be identified in discussion with the national co-ordinator.

Zaire

CRH, Uvira, has a team of three socio-economists working on the fisheries sector, and as a result expertise is readily available in three areas of activity:

- socio-economic survey
- fisheries statistics
- fishing practices

Alongside its technical specialisms, the Centre is interested in developing its interdisciplinary, pragmatic approach to resource management issues, in collaboration with the project and local NGOs

CADIC, a leading local NGO is undertaking 3 programmes in collaboration with community groups in the south Kivu coastal areas:

- improved fishing practices and alternative income generation
- agroforestry and land management
- energy saving and fuel supply

National universities' social science departments may also be able to play a role.

Tanzania
Institute of Resource Assessment, University of Dar-es-Salaam

Regional Fisheries Department Extension Services (?)

Zambia
Department of Agricultural Research (Ministry of Agriculture)

7.6.2 National agencies who could undertake project EE work

Workshop delegates identified appropriate government, parastatal and non-governmental organisations for each riparian country as follows:

Burundi
Ministries of Education and Agriculture, INECN (Bikwemu Gaspard), INECAL, BEER (primary education,), BEPES (secondary education), RTNB (radio TV national du Burundi), ODEB (NGO), Terre Sans Frontieres (TSF).

Tanzania
Ministries of Education and Agriculture (Education has an EE contact person), NEMC, WWF, TANAPA - CCS, WCST, JET, AGENDA (works on EE with the business community), TSF.

Zaire
CADIC, SNV (government services), Ministry of Education, SENADEP, IZCN, TSF, churches.

Zambia

Ministry of Agriculture, Food and Fisheries - Departments of irrigation and land husbandry (through extension workers), forestry, water affairs, wildlife; ECZ, ZEEP, National Agricultural Information Services (NAIS), Mwekera Forestry School.

7.7 Work Plan

June - December 1996

1. Initial socio-economic investigations to fill gaps in baseline reviews, and prepare for in-depth local studies and pilot action

2. Appointment of national EE co-ordinators

3. Initial assessment by EE co-ordinators and collaborators of environmental education and training needs, including those of staff in project implementing agencies

4. Recruitment of regional socio-economic co-ordinator

5. Site / team identification, methodology development, preparation and training for in-depth investigations at community level.

In each country special study plans will need to be nationally / locally defined; the processes and approaches may differ according to the needs and resources identified; timing is also likely to differ, despite the objective of starting activities simultaneously in all four countries. Point 5. above may thus run on into 1997.

Initial field investigations may lead to identification of further study and data collection requirements in each of the main sectoral thematic areas, to support and complement the local participatory work.

There will be a need for the cross referral of socio-economic findings with those of the biodiversity, sedimentation and pollution studies, in preparing for the in-depth and site-specific special studies.

December 1996 - December 1998

6. Development of country EE plans, probably best achieved through country EE workshops

7. In-depth local appraisals at community level for selected sites

8. Follow-up action programmes at community level for selected sites; ongoing monitoring and review

9. Ongoing country EE activities

10. Socio-economic / education appraisal of shortlist of proposed aquatic protected areas and other recommendations of technical / scientific studies

11. Review and synthesis of special study results

12. Preparation of inputs to strategic planning process.

7.8 Linkages with other Special Study areas

Site selection for in depth socio-economic investigation in each country will in part be guided by existing knowledge of biodiversity and habitat distribution, and of sources of sedimentation and pollution. As technical studies progress, interim results should permit the initiation of some joint investigations involving natural and social scientists, during the later stages of the special studies. Feedback and co-ordination amongst the studies should ensure:

- that national socio-economic investigations of resource use take into account the principal sources and environmental impacts of pollution and sedimentation;

- that the causal factors of biodiversity loss, for instance the relative significance of land degradation in the upper and lower catchments, and of threats to the integrity of swamps and wetlands can be identified, disaggregated, and given due weight in terms of further study and strategy development;

- that joint strategies can be developed for environmental education and practical action in these areas, targeting resource users and polluters, for instance through stakeholder workshops;

- practical co-ordination of field investigations of fishing communities and of the impact of fishing practices and biodiversity, so that the findings can be translated into effective pilot projects to demonstrate and promote alternative, low impact practices;

- Socio-economic appraisal in feasibility studies for the declaration of new aquatic protected areas, and the identification of the costs and benefits for local people of conservation activities and opportunities for alternative livelihoods;

- the active promotion of interdisciplinary discussion amongst resource managers, and natural and social scientists in the development of the Lake Tanganyika Strategic Plan, as the special studies draw to a close.

8. SPECIAL STUDIES - *Sediment Discharge and Its Consequences*

8.1 Introduction

Lake Tanganyika is the largest of the African rift lakes and is also one of the richest and most unusual biotic resources on earth. The most serious immediate problems facing the Lake Tanganyika ecosystem result from increasing deforestation and population growth within the lake basin and the impacts associated with this. This has resulted in excessive suspended sediment input into the lake. Increasing sedimentation, particularly in the northern basin, has lead to widespread modification of the Lake's ecosystem through local species extinctions and seriously reduced complexity of species interactions within the lake.

The special study on 'Sediment Discharge and Its Consequences' recognises that increased sediment input to the lake is likely to have an important impact on the biodiversity of this unique system. It also recognises that this may lead to a deterioration in the resource value of the lake, principally to those people living close to the lake shore who are dependant on the lake for their livelihood.

The principal objective of this Special Study is to understand and quantify the impact of suspended sediments on the biodiversity of the lake and to provide the means and rationale to institute a long-term monitoring programme to provide the data required to assess the future impact.

This particular component of the Inception report summarises the process that has arrived at a set of priorities for the special study on Sediment Discharge And Its Consequences, which fits in with the broader plan for the project as a whole. These priorities will lead to the production of the Preliminary Strategic Plan for the project which will define the specific requirements of the Special Study (personnel, laboratory requirements, boat time, etc.) to fit in with the broader priorities identified by the Inception process.

8.2 Background

The co-ordination of the Sediment Discharge And Its Consequences Special Study is primarily the responsibility of Natural Resources Institute within the project Consortium.

The broad aims of the Sediment Discharge And Its Consequences Special Study were outlined in the initial Project Document. These are summarised as follows:

· Investigation of deforestation within the lake catchment area and the effect of land use changes on the rate of sediment inflow to the lake.

· Quantification of the sediments currently entering the lake with indication of seasonal variations.

· Tracing the fate of particles entering the lake (vertical and horizontal transport).

· An investigation of the nature of sediment particles and a consideration of the effect of catchment geology, climate and vegetation on the nature of the sediment input.

· Analysing the impact of sediments on the water column, including the effect of sediments on important limnological parameters which may influence the planktonic communities. This will include impact of sediments directly on these organisms as well as reaching an understanding as to how planktonic communities are affected. .

· Analysing the impact of sediments on the benthic environment including the effect on benthic processes as well as the benthic organisms. This will include taking short cores of sediment to establish timing, background fluctuation and rates of reductions in biodiversity.

· To consider long term effects of current (and possibly increasing) rates of sediment input to the lake and to consider its likely impact.

The first stage in this study was the production of a Baseline Review aimed to provide a concise summary of the state of existing knowledge related to the points listed above.

8.3 Baseline Review

The objective of the Baseline Review was to set out clearly current knowledge and some suggestion as to actions to be taken by the Special Study on 'Sediment Discharge and Its Consequences' aimed at ameliorating the decline in health of the lake. It was to act as an information document for discussion on the needs for the study amongst national and regional participants at the Inception Workshop held in Dar es Salaam on 25-28 March 1996. This Baseline Review was produced in January 1996 and circulated to all participants prior to the Inception Workshop.

Of the 247 citations given within the Baseline Review on Sediment Discharge And Its Consequences, only a very small number refer directly to the nature and impact of sediments on Lake Tanganyika itself. This reflects the paucity of information on this lake. They do represent, however, an extremely thorough review of all the available literature pertaining to the topic and they highlight the areas (gaps in knowledge) where the special study is to be directed. This information was brought to the Inception Workshop for discussion and prioritisation. Work strategies, based on principal gaps in knowledge, are given below.

Country reports at the inception workshop provided additional information to the Baseline Review and these are reflected in this Inception Report. It is clear that

further information gathering in-country, and planning for national implementation of the Sediment Discharge and Its Consequences Special Study, should be undertaken in the near future. This will involve field visits by project scientists and specialists to each of the four riparian countries (see Section 8.6).

8.4 Country summaries

Table 5.1 (Biodiversity Section) records national perceptions on threats to the lake and shows that, with respect to sediment input to the lake, Burundi regards this as a major problem while Zaire, Tanzania and Zambia regard sediment input as a less severe problem. This, no doubt, relates directly to the amount of human activity close to the lake shore with Burundi clearly having the greatest human population close to the lakeshore and greatest pressure on land close to the lake. All riparian countries, however, recognised that loss of vegetation throughout the lake catchment had led to increased sediment loads in rivers and this problem was likely to increase in the near future in all parts of the lake.

The country delegates have identified some particular regions of the lake which, due to the nature of the catchment, lend themselves to concentrated study - these are particularly the areas of the lake adjacent to the mouths of the major rivers entering the lake. It will be necessary to focus work on these areas as well as making comparative studies on relatively pristine areas. To understand the effect of catchment characteristics on sediment movement the concept of paired catchments was considered to be a way of focusing effort. These matters are discussed in more detail in Section 8.5.1 on site selection.

8.5 Inception Workshop Results.

The follow up to this Inception Report will be the Preliminary Strategic Plan. This will define specific workplans to tackle the issues established as priorities. A first attempt to produce a more general workplan is, however, included as a part of this report (Section 8.7).

Specific objectives of the Special Study, identified by the Inception Workshop as priorities, are given below:

- To give a broad view (by use of low resolution remote sensing) of vegetation changes within the catchment of Lake Tanganyika and their likely effects on rate of sediment input to the lake.

- To produce high resolution imagery of areas of special significance (identified during the preliminary studies of riverine inputs) for time series analysis.

- Upgrading and/or introducing river gauging in a number of specific areas in order to understand amount and seasonality of sediment input. Measurement of flow, sediment load and chemical nature of suspensoids would be included.

- Non-point sources of suspended sediment will be investigated. These would include shoreline runoff during storm events and, perhaps more importantly, run off from major land disturbance areas e.g. road building sites. A before-and-after impact assessment of such a disturbance during the period of the project would provide a model for predicting the impact of future schemes. Since these may occur in 'pristine' areas they may have a very high relative importance.

- Consideration of the near shore hydrology to understand the fate of sediments entering the lake (links to the production of lake circulation model - see Section 8.8 on Special Study Linkages). In addition the NOAA satellite receiver will be used to give daily values of lake surface temperature. Knowledge of water density derived in these temperature estimates can be used to predict the likely fate of river water entering the lake (where the relative density of gauged river water is also measured).

- Analysis of sediment physico-chemical nature (which may vary in time or between catchments).

- To consider the limnological processes (nutrient fluxes and light) near shore and the effect of high sediment loads on these processes.

- To examine how sediments affect nutrients in the water column. This would look at the interaction between phosphates, nitrates and the suspended Iron-hydroxides and clay minerals in the water column. Increased suspended material in the water column may lead to large sedimentary sinks of nutrients from the Lake Tanganyika metalimnion resulting in an overall lowering of the nutrient status of the lake. This could have a very important impact on the pelagic fishery in the lake.

- To perform a whole lake (rapid assessment) survey of sediment (shallow coring). This will derive maps of sediment types, estimations of rate of change of sediment input (by dating cores), a measure of the extent of influence from major river inputs and maps of diversity of benthic organisms.

- To focus on sites to do more detailed dating of cores. Dating will be done using a range of radioisotope methods. Carbon-14, Caesium-137 and Lead-210 methods will be used. Perhaps using the very short lived Beryllium-7 isotope for microstratigraphic dating of cores could be incorporated.

- Use of sediment traps to identify current rates of sedimentation and horizontal distribution. This will allow assessment of seasonal variation in the amount of sediment entering the lake as well as an understanding of the distance from the shoreline that sediment input would be likely to have an impact.

- To consider the role of important wetlands of the catchment in an attempt to consider the impact of their possible destruction on the sediment load of inflowing rivers.

- To understand the effect of high sediment loads on the distribution and populations of key indicator species in the lake. The distribution of sessile organisms will be used to understand the distance from a point source that suspended sediments have a significant impact.

8.5.1 Site selection

Some initial discussion of site selection for study was made at the workshop. There are a number of ways of developing this further; from guidance from local institutions, site visits and from remotely sensed imagery. The principal inputs of suspended materials to the lake are obviously the major rivers draining the large catchments. These include:

Malagarasi River
Ruzizi River
Motumbala River
Lufubu River

The major rivers will obviously receive close attention. These rivers, however, have a long history of carrying large sediment loads into the lake. Areas where increased impact may be occurring is likely to be the smaller rivers where major changes are occurring in the catchments. Particularly short, fast-flowing rivers are likely to have a major impact on the near-shore biota of the lake.

Since the project will be unable to survey all point sources (or river mouths) then the concept of researching paired catchments will be used. In this case a number of rivers will be selected and paired based on criteria such as catchment size, state of vegetation cover in catchment, catchment geology, steepness of river and rainfall. These rivers will be gauged and researched as indicated above. It is hoped that from careful site selection of this type then it will be possible to interpret the data obtained to sites which are not studied but catchment details can be easily obtained (from a combination of remote sensing and hydrological data for example).

The use of sites with relatively pristine catchments will assess the benefit of catchment protection. At least some of these sites should coincide with the lake parks to be initiated under the project. Adjacent catchments inside and outside a protected area would be an obvious example of a paired catchment study.

As noted above non-point sources of suspended material may be important. The project should be ready to respond to any major engineering works (e.g. road building) and to make an impact assessment.

Areas of wetlands within the course of major rivers (such as the major wetlands in the Malagarasi catchment) may play a vital role in reducing river-borne sediments. An assessment of their role, as well as the threat related to their destruction, will be assessed. Specific sites will be selected on this basis.

Site selection will be an important part of the Initiation Phase of the Special study (Section 8.7).

8.6 National Agencies

Not all agencies with a potential role in the Sediment Discharge and Its Consequences Study may so far have been identified. Those expressing interest at the Inception Workshop are listed below. As part of the Initiation Phase of the Workplan (Section 8.7), effort will be made to establish links to these, and other agencies, who will have a role to play in the Special Study.

Burundi

- Institut Département des Eaux, Pêche et Pisciculture
- University of Burundi, Department of Earth Sciences
- Centre Regional de Recherches en Hydrobiologie Appliquee (Burundi)
- FAO/FINNIDA LTR project
- l'Institut Geographique du Burundi (Bujumbura)

Zaire

- Centre Recherche d'Hydrobiologique /Uvira
- Universities of Kinshasa, Lubumbashi and Kisangani

Tanzania

- Tanzanian Fisheries Research Institute
- University of Dar-es-Salaam
- Tanzanian National Parks Authority
- Department of Wildlife
- Department of Fisheries
- Frontier Tanzania (NGO)

Zambia

- University of Zambia, Lusaka
- Fisheries Department
- National Parks and Wildlife Department
- Ministry of Water
- Soil conservation unit of Dept of Irrigation and Land Husbandry

8.7 Work Plan

An outline work plan for the Sediment Discharge and Its Consequences Special Studies was considered at the Inception Workshop. Details of this programme will be given in the Preliminary Strategic Plan. It will essentially consist of three phases:

Phase 1 **Initiation phase.** This period will be used to establish links between the project and the national agencies who will co-operate in the Special Study. It will also

involve and examination of existing data which will reside in the archives of the national institutions. Duration 5 months (late 1996).

Phase 2 **Pilot Phase.** Using rapid assessment to check promising localities, this will involve field visits by Consortium and counterpart scientists and specialists to each country, as well as the production of maps/GIS systems. This phase will also involve the establishment of a network of river gauging in, at least, the principal rivers. Coring programmes will be initiated during this phase. The critical part of the Pilot Phase is site selection for more detailed study. Training activities during this phase are important to ensure that a cadre of scientists are available who can carry out the work required during the Detailed Study Phase. Duration 12 months (late 1996 to late 1997).

Phase 3 **Detailed Studies.** Identification of approximately 12 catchments (see the concept of paired catchments in Section 8.5.1) for detailed study of the important aspects of Sediment discharge and its impacts identified above in Section. Duration 22 months (mid 1997 to early 1999 - this period involves some overlap with the pilot phase as some studies will be more advanced than others).

Towards the end of the 'Detailed Studies' Phase it is hoped that routine monitoring programmes can be handed over to Government Institutions and that activities can become increasingly directed towards those to be suggested in the Final Strategic Plan, where an open-ended and sustainable programme of investigation can be established.

8.8 Linkages with other Special Studies

Though the project has, for convenience, been divided into a number of special studies, of which 'Sediment Discharge and Its Consequences' is only one, it is recognised that co-ordination of activities is critical to the success of the project. This section outlines some key issues relating to the interaction of 'Sediment Discharge and Its Consequences' with the other special studies.

All special studies will seek to harmonise data collection and handling techniques. The development of a project GIS will have an important role in facilitating this (see Section 10.2).

Socio-economic and environmental education study. Land use practices clearly have a strong impact on sediment input to the lake. Particularly in marginal areas and riverine swamps, the levels of human activity could have an enormous impact on the amount of suspended sediment carried down the river. The socio-economic baseline study identified two sets of sediment sources and land degradation issues, which need to be differentiated in terms of in-depth studies and practical action promoted by the project:

- Land degradation and erosion in catchments draining directly into the lake, leading to sedimentation damage

· Upper catchment degradation in inland areas of the basin, with potential impacts on wetlands and their capacity to act as buffers for sediment and pollutants.

Within the framework of environmental education, the impact of land-use practices on erosion and soil loss should be stressed.

Biodiversity study. The distinction is made that the 'Special Study on Sediment Discharge and Its Consequences' seeks to consider distribution and populations of organisms (particularly sessile organisms) in order to understand the nature and extent of the impact of sediment input to the lake. It is hoped to focus on key indicator species in order to understand the impact of suspended sediments on ecosystems and biodiversity. This does not consider biodiversity *per se* but seeks to understand the limnological and physiological factors which affect organisms and therefore diversity.

Pollution study. Since suspended sediment could be defined as a pollutant itself the overlap with the pollution study is obvious. Since, in many cases, we will be dealing with the same point sources of sediment and other pollutants then sample site selection and harmonisation is a necessity. An obvious example is the sharing of lake cores to measure both pollutant concentrations as well as the rate of sedimentation.

Lake circulation model. This element of the project will be carried out by the FAO/FINNIDA project. The input of sediments (and other pollutants) to the lake, and their fate, will be specifically affected by near-shore hydrology (i.e. close to the principal point sources of these pollutants). We will guide the lake circulation studies to examine near-shore hydrology, particularly in regions where sediment input studies are occurring.

Training. The Baseline Review has placed considerable emphasis on training. Training in techniques clearly should be to allow participants to be involved in more than one special study. Much cross over and interaction will be encouraged to ensure the multi-disciplinary nature of this project.

9. SPECIAL STUDIES - *Pollution In International Waters and Its Effects On Biodiversity In Lake Tanganyika*

9.1 Introduction

The aspect of the Lake Tanganyika biodiversity project that will attend to pollution and certain aspects of its effects on biodiversity, is crucial to the success of the programme (and attainment of the goal of protecting biodiversity in this lake) in the following respects:

- in establishing whether pollution is a threat to biodiversity; in this connection the work may need to (i) rank the 'value' of an organism on criteria such as its significance as a food source for another species, or its commercial value, and (ii) decide whether organisms that will almost definitely appear/burgeon (as a result of pollution by extending the existing spectra of physical and/or chemical conditions in the lake), are enhancing or threatening biodiversity

· in contributing to the process of selecting sites for reserve status

· in developing through training and education a programme of pollution and associated biodiversity monitoring that can (i) be sustained by the region and (ii) influence policies on pollution control, fisheries management and conservation

· by enhancing knowledge world-wide on the relationships between lacustrine pollution and biodiversity

This component of the Inception Report firstly provides background information using material from the Project Document relating to pollution. This indicates the general tenor of the work proposed at the outset. Secondly, it outlines the findings - especially gaps in knowledge - about pollution and its effects on biodiversity identified by the Baseline Review; albeit a mere summary of the review, which should be consulted for more detail. Thirdly, the section deals with what has been done since the production of the Baseline Review i.e. achieved during the Inception Workshop. The next part deals primarily with future steps envisaged at this stage. Following a Work Plan, some comments are made on what country actions are required. Finally, some links between the different Special Studies that are vital to the success of the whole programme are outlined.

9.2 Background

The work proposed from the outset in the section of the Project Document concerned with pollution-biodiversity issues reflects the interests and expertise of the UK's Freshwater Biological Association (FBA founded in 1929 and featuring prominently in the field of African limnology over many decades) and Institute of Freshwater Ecology (IFE - a component of the UK's Natural Environment Research Council, founded in 1964). The main elements envisaged were as follows:

- a proper description and explanation (with special reference to pollution in this case) of the observed distribution of the freshwater biota over various spatial and temporal scales

- a multi-disciplinary approach with research and extensive training in physical, chemical and biological aspects.

- a constant focus on the application of the 'research' to the better management of the lake, and the prediction of the effects of future changes in e.g. climate and land use.

- skilled handling and interpreting of data.

- appreciation of the especially strong interdependence of organisms and the physical and chemical features of their environment in aquatic ecosystems i.e. through processes driven from the 'bottom-up' (by photic, kinetic and chemical energy), and from 'top-down (by predator-prey and other biotic interactions); this being the case, initial surveys of physical and chemical conditions and the nature of the biota, could be based on either physical factors such as water depth and substrate, or known distributions of major fish species.

- that, in some areas at least, the study should attempt to assess spatial and temporal variation in total species diversity i.e. of planktonic and substrate/attached assemblages of micro-algae, macrophytic vegetation, invertebrates and vertebrate species (including birds and mammals); trophic interactions should also be assessed by means of gut analyses in order to identify what may prove to be key food species and feeding habitats and ones which might be under pressure and thus of priority conservation interest/value.

- following on from the above, that data on physical features (e.g. water depth, movement and clarity) and chemical factors (e.g. nutrient and major ion status as well as pollutants) need to be included - not just because of the prevailing view that sedimentation and pollutants constitute a threat to biodiversity, but because the very nature/structure of biotic assemblages is determined by the basic physics and chemistry of the system; in assessing the sources and biological impacts of pollutants and excess sediment loads, the project will also examine the relative importance to benthic biodiversity, for example, of physical factors such as substrate availability on the one hand, and pollution *per se* on the other.

- that sampling procedures are varied according to such features as the distribution in time and space, and the size and dynamics of the biota and biotic assemblages concerned; nevertheless, lakewide or whole-shoreline synopses and monitoring programmes will be generally tackled using stratified random and regular (grid) sampling strategies; zones known or suspected to be 'special' in terms of e.g. biodiversity, fragility, pollution status, in the harbouring rare or otherwise important species, will receive appropriately specific attention.

- that, in contrast to the original project design which suggested that the pollution Special Study should not begin until the results of the sediment plume work are known, all of the main 'lakewide' programmes start as soon as possible and be executed together; at the very least, this would simplify some aspects of data interpretation, and make best use of particularly the large vessels.

- that the catchment-lake studies are organised on the basis of the following simple relationship:

pressures + sensitivity = responses

where: the pressures are determined by catchment characteristics (land use, topography, climate) giving rise to eutrophication and 'classic' pollution; the factors determining the sensitivity of the systems to the pressures include a wide variety of physical and chemical features as well as the nature of the 'resident' biota; and the responses are the physical, chemical and (especially) biotic features of the lake; in this way an attempt can be made to assess the fluxes of eutrophicating elements and traditional pollutants from the land to the water, between the water and the sediments, and between water, sediments and biota.

- that species identification and the quantitative assessment of biodiversity present exciting challenges

- that there is a real possibility of making available the following instrumentation to the project for short- to medium-term investigations at least, was highlighted: probes and deployable buoys for depth profiling and the instantaneous recording of temperature, light intensity and spectral characteristics, turbidity, conductivity, dissolved oxygen content, pH; and the continuous recording of weather and limnological parameters facilitating the real-time description of changes in water column stability; and pumped-intake systems for collecting plankton samples integrated over measured sectors of the lake.

- that the 'state-of-the-art' gear outlined above will be invaluable especially in the early stages of the work, when there will be a major need for extensive and rapid surveys; however, wherever possible and appropriate, however, the accent in the long-term will be on simpler techniques: thus, in the field, Secchi discs rather than photometers, and plastic tubes rather than closing water bottles for example, and in the laboratory, microbial abundance estimation using conventional rather than inverted microscopes.

- that a GIS-configured database of the major classes of land use and topographical features of the catchment, and information on the numbers, distribution and dispersion patterns of people, would facilitate estimates of inputs of certain nutrients and e.g. silt to the lake from the surrounding land; in parallel, analysis of water and sediment samples collected primarily from the mouths of the major feeder rivers throughout the year, would provide actual measurements of the loadings; supplementary samples would also be taken from known outfalls/emissions of

nutrients and conventional pollutants associated with factories, villages and townships.

- that particulate and dissolved fractions of the following in the lake water, sediment and biota will be measured: major ions, nutrients, suspended solids, pesticide residues, acid-extractable metals, boat and ship fuels; the dispersion of sampling sites will take account of the FAO/FINNIDA LTR findings on lake circulation; in this connection the advantages and disadvantages of hiring rather than purchasing expensive chemical analytical instrumentation e.g. AAS, GC, ICPMS, will need to be decided.

- that in addition to multivariate analysis of chemical and biological data, distribution/contour maps of the nature and concentrations of pollutants including nutrients, will be superimposed on corresponding charts of the biota, in order to establish the links between biodiversity and pollution.

9.3 Baseline Review

The following is the summary of the Baseline Review.

1. This study aims to:

- identify the main sources of pollution to Lake Tanganyika and, where possible, quantify the pollutant inputs

- obtain a lakewide assessment of pollution and its effects on lower organism biodiversity

- evolve systematic programmes of pollution and biodiversity description and monitoring that are repeatable - such that change (or lack of change) can be determined with confidence

- develop (in each of the riparian countries) teams capable of maintaining the investigations from planning and executing field and laboratory programmes, to analysing data, and reporting on the findings in the most appropriate ways to fellow scientists, lake managers and policy-makers

- develop pollution control strategies as necessary.

2. 'Pollution' in this study is taken as the anthropogenically accelerated inputs of nutrients (eutrophication), organic (oxygen-demanding) components of sewage and e.g. sugar cane factory wastes, heavy metals, pesticides and compounds likely to stem from oil exploration and shipping. As far as possible, 'biodiversity' will be taken as the total range of organisms present/detected - that is, excluding fish which are more appropriately handled by the sister studies on biodiversity per se.

3. The extraordinary number of species in the lake is attributed very much to the large size of the lake, to its great age and 1.8M-y isolation, and to the ecological diversity. In addition, however, a number of physical features such as large size and depth, also render the lake susceptible to pollution as they result in it retaining very high percentages of the water- and wind-borne pollutants entering it. As in many lacustrine systems, there is always the possibility too, of the 'cascade' effect of pollution on one species affecting species at other trophic levels relatively quickly.

4. From databases comprising more than 3,000 titles relating to Lake Tanganyika, approximately 200 are cited. Very few of these refer to either 'pollution' or 'biodiversity', and documentation on the effects of the one on the other is scant indeed. Moreover, with very few exceptions, papers on 'species diversity' are of somewhat limited value. First, they are restricted to relatively few phylogenetic groups and second, they usually amount to little more than lists with no indication of the 'effort' invested in generating the species data; the new project aims to address these shortcomings by (i) attempting - at some sampling sites at least - to describe species diversity *in toto* i.e. from the sub-micron picoplankton to lower organisms and rooted plants decimetres and metres in greatest dimension, and (ii) providing information on sample size, such that future workers can generate comparable datasets.

5. Many of the references cited are of inestimable value however, in providing information that aids decision-making on the arrays of measurands, the numbers and locations of sampling sites, the sampling schedules, and the human and equipment resources needed to carry out the work. As a basis for discussion, the following areas are considered in need of priority attention:

- -eutrophication in the Kigoma (Tanzania) and Bujumbura (Burundi) areas
- - atmospheric pollution lakewide
- - pesticide inputs from cotton plantations in the Ruzizi catchment (Burundi)
- - heavy metals from diamond mining in the Malagarasi catchment (Tanzania)
- - waste from sugar cane processing in Uvira area (Zaire)
- - oil pollution lakewide.

6a. Open and in-shore waters will be investigated, and samples of water and biota representative of the water column from the surface to the sediment, the sediment itself surface will be collected and analysed for pollution and biodiversity status. In order to establish the effects of pollution on biodiversity, the species composition/richness/diversity at approximately 10 polluted sites (visited on average 8 times per year) will be compared with that found at 10 unpolluted sites similarly sampled, and corresponding as far as possible in features such as aspect, exposure, water depth, bottom substrate, and proximity to shore or inflow.

6b. The range of physico-chemical determinants presently envisaged is as follows:

- - light, temperature, transparency, total suspended particulates
- - conductivity/salinity, dissolved oxygen, pH, alkalinity
- - calcium, sulphate, fluoride, silica (reactive and total)
- - ammonia, nitrate, nitrite, organic nitrogen

- - phosphorus (P), including the soluble (dissolved) reactive and unreactive phosphate fractions, and the total P present
- - organic matter (dissolved and total)
- - chlorophyll a
- - oils (fuel, bilge etc.) in water, sediments, and the tissues of selected molluscs, crustaceans and fish
- - pesticides and PCBs in fish tissues and molluscs (possibly also PAHs)
- - trace elements, Cu, Zn, Mn, Fe, Pb, Cd, Hg (in molluscan, crustacean and fish tissues)

9.4 Inception Workshop Results

The co-ordinators of the Pollution Special Study approached the Workshop with the following major views in mind:

- that we do not know as yet to what extent pollution is affecting biodiversity in Lake Tanganyika.

- that sampling and data recording activities within each of the Special Studies (and those of pollution, sedimentation and biodiversity in particular) need to be very strongly linked and harmonised.

- that methods relating to all stages and activities of the pollution-biodiversity programme must be standardised for all 4 countries

- above all, each team, regardless of its major pre-occupation (e.g. in sediment pollution or biodiversity) must be able to collect samples (water, sediment, biota) for the other groups, since there will be no margin for sites to be visited by more than one team on any one occasion - particularly where remote open water sites are concerned

Four aims characterised the discussions held over the 5 days. They are as follows:

- to establish a common consensus as to what constitute the main issues at this stage of the project
- to prioritise the pollution issues to be investigated
- to progress with the selection of sampling sites
- to identify the organisations/institutions that will carry out the work.

9.4.1 Establishing a common consensus as to what constitute the main issues

The first concern was to explore with all 4 riparian countries whether there were any aspects/statements in the Baseline Review which were unclear, or with which the regional personnel disagreed. There was a need too, to establish whether the topics selected by the authors of the Pollution Baseline Review were also considered of priority importance by the country personnel - and therefore of major significance in the workshop. In the event, the country presentations identified few gaps in the Baseline

Review on pollution and its effects on biodiversity; indeed, the overall response was very encouraging and indeed, complimentary. However, regional personnel did raise a number of pollution issues that they considered worthy of greater attention than the Review suggests; all of these items are itemised later - since, even though some of them are actually mentioned in the Review, the document was not seen by some of the delegates. They also expressed some doubts regarding the large number of staff estimated for the pollution and pollution-related biodiversity work; however, the Baseline Review had emphasised that - in common with its high estimates of the costs of equipment required - these resources would in large part also cover the requirements of a number of the activities under the Sediment Pollution and Biodiversity programmes.

9.4.2 Prioritisation of the pollution issues to be investigated

The workshop was pre-eminent in assembling the regional expertise. This provided the opportunity for improving on many aspects of the programme design - and especially the prioritisation of pollution and pollution-related biodiversity issues. The following issues (that is, those mainly in addition to the ones already featured in the Review) were thus itemised:

- - *Eichhornia* as a potential threat to the well-being of Lake Tanganyika (although the Review did draw attention to the burgeoning of this plant in Lake Victoria, and the presence, and thus potential problems of another floating macrophyte - *Pistia*- in Lake Tanganyika)
- - afforestation of deforested areas
- - *Pistia* and other floating plants (as potential indicators and filtrators of pollutants e.g. copper)
- - cattle 'ranching' and trampling effects on river margins
- - *Salvinia* infestations (Zambia)
- - poisons used in some fishing practices
- - fertiliser and pesticide runoff - Rukwa area
- - de-forestation - Mpulungu area

It was also suggested that where possible, attention be paid to assessing the combined effects of pollution (on biodiversity) of effluents, discharges and inflows containing a multiplicity of pollutants.

From the total array of pollution issues, the following 8 were selected for priority attention:

- - domestic waste water
- - industrial waste water
- - hydrocarbons, fertilisers and pesticides
- - heavy metals - cobalt and nickel
- - contaminants associated with water- (river-)borne sediment
- - non-human organic waste e.g. from sugar refining operations
- - atmospheric pollution - wet and dry deposition
- - pollutants from shipping operations

9.4.3 Selection of sampling sites

Even at the earliest stages of exploration, sampling sites will provide material on which to test methods of sampling and sample analysis. As importantly, the very processes of sampling and analysis will form the basis of training in all aspects of the work envisaged i.e. planning of field surveys; reaching the sampling sites; collecting water, sediment and biota; the immediate treatment of samples and their transport back to the laboratory; the main analyses of the materials and samples; the logging and analysis of the data; and the interpretation and presentation of the results, as appropriate to policy-makers, fellow scientists, lake managers and conservationists.

Table 9.1 lists the sites selected so far. An attempt was made to identify for each polluted site, a site that is essentially 'pristine', although this exercise is not yet completed. The

Table 9.1: *Preliminary selection of sites to be sampled for the assessment of Pollution in International Waters, and its effects on biodiversity in Lake Tanganyika - as a result of discussions in Dar es Salaam, 27 March 1996.* (B=Burundi, T=Tanzania, Zb=Zambia, Zr=Zaire).

Pollutant	Study site	'Pristine' site
Domestic waste water	B: Bujumbura, Rumonge	B: Kigwena
	T: Kigoma	T:
	Zb: Mpulungu	Zb: Nsumbu
	Zr: Uvira, Kalemie	Za: Penba
Industrial waste-water	B: Bujumbura	
	T: Kigoma	
	Zb:	
	Zr: Uvira, Kalemie	Penba
HC's, fertilisers; pesticides in runoff	B: Bujumbura, Ruzizi mouth	Kigwena
	T: Malagarasi	
	Zb: Mpulungu, Lufubu	Yungu
	Zr: Uvira, Kalemie	
Heavy metals	B: Bujumbura	Kigwena
	T: Malagarasi	
	Zb:	
	Zr: Uvira, Kalemie	
Contaminants associated with river borne sediment	B: Ruzizi + smaller rivers to be added later	Kigwena
	T: Malagarasi	Mvua
	Zb: Lufubu	
	Zr: Moba	
Non-human organic waste e.g. sugar cane	B:	
	T:	
	Zb:	
	Zr: Uvira	
Shipping operations	lake-wide but esp. major ports	

Baseline Review enlarges on this approach, but the main thinking behind it is that attention by the project to un-polluted areas is as important as that given to polluted zones. The idea of paired sites is attractive, in that it provides an opportunity to investigate pollution and biodiversity in areas which will be, ideally, the same in terms of e.g. aspect, substrate and water depth, but contrasted with respect to 'pollution'; this is significant in the context of international co-operation in that in some cases the polluted site and the unpolluted equivalent are in different countries. Such an approach also

avoids potential problems such as those perceived along the Burundi shoreline where relatively few 'pristine' areas are apparent. Of course, the same dataset generated from this array of sites can also be analysed to assess biodiversity variation over the whole pollution spectrum, or over sites characterised by one particular pollutant, type of pollution, or combination of pollutants. The delimitation of a sampling 'site' can only be determined from field surveys and sampling trials, but in a number of cases, where a pollutant issues by way of a pipe or feeder water from the catchment, sampling along variously angled transects passing along the shore, and from the shore to open water are envisaged. In this way, variation in the association between biodiversity and pollution over a number 'within-site' spatial scales can be investigated, and the results can be compared with any variation in pollution-biodiversity associations found between sites and over the lake as a whole.

It was recommended that the pollution programme measure pollutant levels at their sources, and not just where they enter the lake (unless the source enters the lake directly).

It was also stressed that while pollution issues of major concern to the riparian countries were prioritised, all plans are accepted as provisional. This makes sense considering that the approaches will certainly be modified in any event, but especially after the first year or so which is to be considered as providing the basis for training rather than the generation of information/data in the more or less routine manner envisaged for the 'final' version of the monitoring scheme. Thus, a series of 'pilot', synoptic' and 'scoping' exercises would be mounted as soon as equipment and staff are in place; then the process of finalising sampling schedules can be initiated; a figure of approximately 12 localities (not necessarily comprising a single type of habitat) was considered to be a useful starting point; in any event, 'opportunist' and sampling focused on places that are already considered to be important, would be attempted in addition to the planned network of areas selected on a stratified random basis; difficulties over the selection of sites due to wind- and current-related dispersal of pollutants were recognised.

9.5 National Agencies

The national delegates proposed the following organisations for involvement in the work:

Burundi:
The University of Burundi - Chemistry Department
The University of Burundi - Biology Department
CRRHA, Bujumbura
FAO FINNIDA LTR station, Bujumbura (plus links with Uvira)
INECN, Bujumbura

***Tanzania*:**
Ministry of Water, Environment and Minerals, Tanzania
TAFIRI

NEMC

Zaire:
The Universities of Kinshasa, Lubumbashi and Kisangani .
Centre Recherche d'Hydrobiologique, Uvira
Centre de Recherche en Science Naturelle, Lwiro
Zambia:
UNZA
National Council of Scientific Research, Lusaka (especially for Analytical Quality Control)

ECZ
Food and Drug Laboratory
Department of Water Affairs

A number of curriculum vitae of persons wishing to be involved at, especially, the field and laboratory levels, have been received. This is encouraging bearing in mind that while fish and fisheries aspects are well-resourced in East Africa, capacity building in the areas of pollution and biodiversity are still rudimentary in comparison.

The Institute of Freshwater Ecology's involvement will be by way of training as well as co-ordination of the work in collaboration with the National and Regional Co-ordinators. In addition, it is hoped that a number of short-term student placements mainly (though by no means solely) from Africa to UK/Europe, can be accommodated and arranged as soon as possible - in order to enhance expertise and experience in the planning and execution of field and laboratory activities and establish baseline data on the pollution and biodiversity status of the lake.

In relation to training, many of the country delegates, highlighted the need for resourcing by way of literature. In this connection the FBA has produced manuals for the determination of adult and larval stages of approximately 30 major freshwater invertebrate groups; while these focus on UK species, the criteria on which the organisms are classified are likely to be applicable to the African situation. Under the Curatorship of Dr J W G Lund FRS, the Windermere Laboratory also houses the Fritsch Collection of (currently) more than 500,000 illustrations of algae and some Protozoa originating from approximately 20,000 of the publications held in its library. Micro-fiche versions of the Collection can be made available to the project.

9.6 Work plan

The following schedule of activities is the version presented in the Baseline Review, modified in the light of discussions at the Inception Workshop mainly by bringing the date for the completion of the Special Studies forward to end 3/99 as opposed to the end of 10/99.

The proposed schedule is now as follows, the :

- main 'exploratory', thrust for the pollution-biodiversity work is 5/96 to 3/99 inclusive, by about which time the FLTSP has to be completed; the following targets are set within this period:

8/96 to 6/97 inc. - 'settling in' and establishment of laboratory bases; procurement of equipment; furnishing of laboratories; appointment of local personnel; African-UK collaboration and training in field, laboratory and office methods practices, using material collected from the lake and catchment waters; preliminary selection and establishment of sampling sites; first installations of recording equipment e.g. staff gauges.

6/97 to 9/97 inc. - 'trial' analyses, reporting and presentation of data generated from 'practice' samples; revision (where appropriate) of sample sites, and first decisions regarding the schedules/frequencies of sampling.

9/97 to 12/98 approx. - routine sampling schedules - with options for adjustment/modification as appropriate; on-going sample analysis, data logging and analysis and writing-up.

12/98 approx. to 3/99 inc. - production of final report.

3/99 on contribution to (i) the plans and recommendations on sustainability and future monitoring of pollution etc., (ii) the selection and management of 'reserves', (iii) establishment of a 'research-to-management' policy and co-ordination of activities at the regional level.

9.7 Linkages with other Special Studies

Some of these issues have been covered. However, the need for standardisation and harmonisation of methods of chemical and biological analyses and techniques used in the field and in the laboratory cannot be over-emphasised. In this connection, reasons have also been given for ensuring that field teams are capable of recording observations, and collecting data and samples relating to each of the main Studies regardless of whether the personnel are primarily concerned with e.g. pollution or biodiversity. The Study co-ordinators also need to collaborate closely over the logging and analysis of data; a good example relates to the accumulation, storage and presentation of information most appropriately combined in a GIS.

The Baseline Review has placed considerable emphasis on training - and the preference for handling trainees in small, rather than large groups. This does not rule out the involvement of personnel from each of the main Studies at such sessions, indeed, we will facilitate as much inter-collaboration as possible at field and laboratory levels.

10. SPECIAL STUDIES: *Fishing Practices and Biodiversity*

10.1 Introduction

Fishing is the greatest single economic activity dependent upon the lake. It is also perceived to be one of the greatest single threats to biodiversity (see Table 5.1). In recent years between 130,000 and 170,000 t of fish per year have been recorded as being taken from the lake. The removal of such large quantities of fish might be expected to have a direct impact on the biodiversity of fishes in the lake. The great majority of this catch, however, is taken from the open water, pelagic areas of the lake where the fish community consists of a maximum of six species, two small freshwater sardines and four predatory *Lates* species. Typically, the bulk of the catch consists of the small sardine species (dagaa) which because they are readily dried and transported have great nutritional significance in rural and urban communities well beyond the lake region.

This pelagic fishery is conducted on a commercial scale whether using "industrial" or "artisanal" techniques. Whilst this can and does have a direct effect on the existence of the six pelagic fish species, it may also be expected to influence overall community structure, via the food chain, by removing a large biomass of consumers and also to influence the regulatory effects of predators by removing them, i.e. *Lates*, from the system. There have been a number of studies suggesting that the elimination of predators leads to a reduction in biodiversity, and there has been a long-running debate amongst ecologists specifically over the role of predatory fish species in maintaining species diversity in African lakes.

There are also known to be small-scale inshore and benthic/demersal fisheries conducted by local communities around the lake. These are basically for local consumption since many of the settlements have little access to wider markets. They use somewhat simpler techniques such as seine nets, gill nets and small lift nets or dip nets. These fisheries essentially operate in the littoral or benthic zones, where biodiversity is known to be greatest. In some cases their principal target may remain the pelagic species, but because they are operating near the shore, the chances are that they will also take fishes from these much more diverse inshore regions. If many of these inshore species are very local in their distribution, a local but intensive fishing activity could have a disproportionately high impact on the biodiversity. A further feature is that most of the commercial pelagic species have inshore juvenile and nursery phases. Consequently inshore fisheries may jeopardise the early stages of the commercial types. The linkage or interface between the pelagic and inshore fisheries is clearly of considerable importance not only with respect to its potential impact on biodiversity, but also with regard to the sustainability and economic development of the commercial fishery.

The inshore fisheries around the margins of the lake and their actual impacts are largely undocumented and will form the greater part of the subject for the present study. The investigation of the major commercial fishery is already being undertaken

by the FAO/FINNIDA (LTR) project. This work should not be duplicated and close liaison is required with this project. It is envisaged as outlined in the original project document, that the indirect effects of fishing in the remainder of the ecological community and also perhaps in the interaction of the inshore and open water fisheries, would require a modelling approach, perhaps using a community based model such as ECOPATH or a multi-gear, multi-species, guild-based fisheries model such as BEAM4.

There remains one other aspect of fisheries impact to be included in this study. There exists a trade in ornamental fish at various points around the lake. This trade targets the most spectacular, the most unusual and the rarest species for capture and export. Its potential impact on the biodiversity is therefore considerable and requires investigation within this component. This will be primarily co-ordinated by NRI led by the Scientific Liaison Officer in Kigoma.

Finally, in any consideration of fisheries the interests of the people who depend upon those fisheries must be taken into account. This is particularly true in the case of the present project since the interests of conservation may require a trade-off with benefits from the fishery. It will be essential to understand, therefore, what the present benefits are and how they are allocated. These will need to be ascertained.

10.2 Background

The co-ordination of this component is primarily the responsibility of MRAG within the Consortium. The initial review of fishing practices was included in the Baseline Review of Biodiversity and additional material on the social aspects were presented in the Socio-Economic Baseline Review.

A considerable contribution was made to the baseline background material by Dr George Coulter who provided both verbal and written discussions of the fisheries issues on a recent visit. Similarly Dr Frits Roest and Dr Jacques Moreau also made valuable contributions on the fisheries and community modelling aspects respectively.

Within the Inception Workshop all parties expressed their general concern at the role of fisheries with respect to changes in biodiversity and also to the sustainability of the fisheries as an economic activity. In open session, a number of action points were agreed upon for inclusion in the work plan for this study.

10.3 Baseline Review

There are three broad categories of fishery:

(i) subsistence, often undertaken part-time by farmers to generate some cash or to supplement diets;

(ii) artisanal, full-time fishing, with the aim of generating income, undertaken as small business ventures distributing fish through small, local trading operations, and;

(iii) industrial, capital intensive, mechanised fisheries, generally using purse-seiners and distributing fish through large markets.

Much of the recorded catch comes from the pelagic fishery for the sardines/dagaa, or the predatory *Lates* species. A variety of gears and practices are used to catch these fishes (see Fig. 6 in Baseline Review of Biodiversity). The bulk of the commercial catch is taken by the artisanal and industrial sectors operating in deeper waters. There have been considerable changes in this fishery in recent times. Originally the industrial purse-seiners, based on sardine boats in the Mediterranean were predominant. These are capital intensive ventures and vessels require large crews. However, the advent of the improved "Apollo" lift nets operating from catamarans has shifted the emphasis to the artisanal sector, which is now much more cost-effective. There has also been a shift in the geographical emphasis of the fishery. Traditionally, the commercial fishery has been centred in the north of the lake, but catches have been declining here and more commercial fishing is now taking place in the southern sector of the lake. The southern sector receives the seasonal upwelling of nutrient rich water caused by the tilting of the thermocline.

The pelagic fishery is relatively intensive and even though it was originally based on only six species, the composition has already been affected. The three larger *Lates* species have all been reduced to very low levels, which has led the smaller *L. stappersi* to increase greatly in recent years. This has appeared to occur in two phases in Zambian and Burundian waters. First, the reduction in predators was followed by an increase in sardine catch; then an increase in *L. stappersi* abundance has led to a cyclical relationship between the abundance of one of the sardine species and its predator *L. stappersi*.

In some parts of the lake the pelagic fishery has been reduced to this two species fishery, as the second sardine species *Limnothrissa miodon*, appears to have suffered enormous inshore fishing in its juvenile phase from artisanal beach seines, to the extent that it has virtually disappeared from the fishery. In some sections of the southern region of the lake the sardine *Stolothrissa tanganyikae* has also diminished, to the extent that the fishery has been reduced almost to that of a single species, *L. stappersi*.

There are evidently great changes happening to the species composition of the pelagic community in which a significant role is being played by the inshore fishery. The general impact of the inshore fishery on the pelagic or the littoral communities are undocumented. These activities are responsible for a small, but unknown proportion of total fish landings and have never been adequately assessed. They are likely to have a greater direct impact on biodiversity conservation initiatives than the offshore commercial pelagic fisheries. One of the few studies which have been made showed that a beach seine operating near Kigoma caught 71 species belonging to 48 genera and 15 families. More than half the number of species caught were cichlids, mainly juveniles. This gives some indication of the potential impact these inshore practices can have.

10.4 Country Summaries

There was a general consensus on the potential impact of fisheries on biodiversity and on the points at issue. The findings of the LTR project on the pelagic fishery must be taken into account, but the work on the inshore nursery regions must be extended. Zaire proposed that the fisheries component of the project collected reliable statistics to allow the establishment of a central data file. Both Tanzania and Zaire expressed the need for fisheries in the inflowing rivers to be given some attention. A unanimous call was made to understand the ornamental fish trade and its impacts and for actions to be taken in its monitoring and regulation.

A specific feature of the fisheries in Zaire is that new fishing legislation is proposed which could be relevant to the present project and could be co-ordinated with it.

The point was made by Zambia that traditional fishing rights should be respected in the creation of conservation areas. The National Park at Nsumbu has integrated some fishing activity.

10.5 Inception Workshop Results

During open sessions at the workshop, the following points and concerns were recorded from delegates for inclusion in this study:

1. Effects of small scale village level, coast, artisanal fishing to be assessed.

2. Assess ways in which coastal fishing can be destructive.

3. Survey of gear types and fishing methods to be conducted.

4. Assess species composition by fishing method in each part of the lake and compare through time (historical and future in project) and effects of differential use of methods.

5. Conduct seasonal sampling.

6. Standardise methods for assessment around the lake.

7. Select some sites near rivers to gain data on upstream fisheries, e.g. at spawning time.

8. Vegetation / nursery grounds to be investigated and protected, as a link between coastal and pelagic fisheries. This also links to Biodiversity Study (see Section 5.5).

9. Assess benefit derived by people from fish.

10. Link with socio-economic group in designing PRA or RRA surveys in villages.

11. Survey activities of nomadic fisheries, i.e. itinerant fishing groups.

12. Ensure there is awareness of the need to standardise regulations and laws.

13. Assess status and impacts of aquarium fish trade.

10.6 Workplan

From the project document the overall duration of this component is 18 months. Taking into account the requirements of the project document, the findings of the Baseline Review and the comments and outcome of the Inception Workshop, the following activities will need to be conducted:

1. Collation of existing national, LTR and other international statistics in commercial fisheries to assess direct and indirect effects on lake-wide biodiversity. Duration 3 months (mid 1996).

2. Village surveys of gear use, catch composition by gear and habitat, total catch and fishery structure (with biodiversity component) and role of fishing in the community (with socio-economic component). Duration 12 months (mid 1996 to mid 1997).

3. Surveys using rapid assessment methods of actual fish abundance on fishing grounds (with biodiversity component). Duration 12 months (mid 1996 to mid 1997).

4. Specific inshore habitat studies particularly in vegetated nursery areas and river mouths. Duration variable.

5. Analysis of dynamics of inshore fish populations and linkage with pelagic fishery with models where appropriate. Duration 6 months (late 1996 to mid 1997).

6. Assessment of ornamental fish trade including species and habitats most affected, and potential impacts. Duration 4 months (mid 1996 to late 1996).

11. Cross-Sectoral and Sustainable Activities

11.1 Conservation and Protected Areas

11.1.1 Key Issues

Activities and Sites

The Lake Tanganyika GEF provides support for the identification and establishment of reserves or protected areas within the lake. This support takes the form of funding of management posts and preparatory training, together with some regional and international technical and planning expertise. The technical and planning interventions will be closely linked to the Biodiversity Special Study (Section 5). At present, there are four national parks adjoining the lake, Nsumbu in Zambia, Mahale and Gombe in Tanzania, and Ruzizi in Burundi. Of these only Nsumbu and Mahale National Parks incorporate a part of the lake within the park. All other reserves in the lake will need to be established afresh, either as extensions of existing terrestrial national parks or from completely new sites. A general overview of conservation sites and issues for this component were included in the Biodiversity Baseline Review (see also Sections 5.3 and 5.5).

Legal Aspects

There are considerable legal implications to the setting up of a National Park or any other type of reserve. Within each country a variety of institutions have constitutional responsibilities for monitoring these protected areas. Even within a country this can be quite complicated so that, for example, in Tanzania the parastatal Tanzania National Parks (TANAPA) control national parks while the Government Wildlife Department operates all other grades of conservation area. Beyond this, in fact, there is also a marine conservation area at Mafia Island, covered by a different legal act, which is controlled by the Fisheries Department (see Legal Baseline Review). Even within one country, therefore, there are a number of legal and management options. The gazetting of a conservation area itself often requires specific pieces of information or justification for its creation. These requirements need to be taken into account. Once sites have been finalised and their most apposite status decided upon, the appropriate legislation will need to be drafted and ratified as soon as possible.

It should also be recognised that creating legal entities such as national parks in a lake carries with it particular difficulties. There is the enormous problem of definition and recognition of boundaries in open water and the attendant difficulties of regulating access and enforcement of any restrictions. These concerns must be addressed.

Social Implications

Once their access to previously open areas of resource becomes curtailed or regulated, it is quite likely that those people with customary access to those areas will be disbenefited. The inshore areas of Lake Tanganyika do support local subsistence fisheries, but the scale and importance of these small-scale fisheries, compared to the open water commercial fisheries, is largely unknown (see Section 10.3). If local

people are to collaborate with new conservation and management initiatives, then their customary rights, and the benefits they afford, need to be understood and protected. On Lake Tanganyika, concessions were made to traditional fishers at Nsumbu National Park, and the same was also true at Cape McClear in the Lake Malawi National Park. Both of these examples would provide valuable regional case studies on the mechanisms for integration of customary rights with protected areas.

In discussions at the Inception Workshop, it appeared that the original accord with fishers at Nsumbu was breaking down to some extent, partly because traditional seasonal reciprocal arrangements between fishing communities, with rights inside the park, could not be maintained with communities not included in the original agreement, and also because of the arrival of aggressively professional itinerant groups from outside the region. This intervention of itinerant groups is a common feature of open access fisheries in eastern Africa, and a point which will need particular consideration (see also concerns expressed in Section 10.5).

The general issue of customary fishing in relation to the creation of new protected areas, might be an appropriate circumstance for the use of community or participatory management approaches. This can confirm ownership of certain rights to specified resources and can simplify the enforcement access by agreeing the boundaries to activities. Such approaches are being successfully developed in terrestrial conservation areas around Africa.

Economic Considerations

The establishment of protected areas incur costs in maintenance and operation. They may also generate income if they are planned and laid out to accommodate tourists and visitors. Since these conservation activities should be sustainable beyond the lifetime of the project, the future costs and benefits will need to be considered in those areas established around Lake Tanganyika. The economic impact of conservation measures on local people, and the potential benefits of alternative livelihood activities in the form of new fishing or farming opportunities, and possible sources of employment need to be carefully assessed. Where livelihoods are severely impacted by exclusion from protected areas, this will entail additional costs, to be offset against the overall benefits, in the form of project investments in income generating alternatives or compensation to those affected. Economic analysis should demonstrate the cost and benefits in financial terms, and through the valuation of environmental services to the different stakeholders involved.

11.1.2 Site Selection

The most immediate action required for this component is to select possible sites for protection or conservation. There are two possible approaches, firstly to prospect for completely new sites around the lake, or secondly to use or extend existing terrestrial parks to include sections of the lake.

In a written submission to the project co-ordinators, Dr George Coulter provided a powerful rationale in favour of the second option. Points for initially basing lake conservation areas on existing terrestrial parks include:

- the catchment area is also protected historically, thus minimising impacts on the lake sector;

- basic facilities and access already exist, thereby allowing area to be used as springboard for studies radiating out from the park;

- training, management planning, gazetting can begin rapidly;

- such relatively unspoilt areas may not be on offer by national government in the future.

Thus Nsumbu is well established and clearly a centre of biodiversity (Biodiversity Baseline Review). Mahale Mountains contains the steep, rocky coastline more typical of the western edge of the lake and is strategically placed in that it offers locations in both the northern and southern basins. Gombe Stream Park does not actually extend down to the waters edge and the landward strip is apparently much used by fishing groups, which is something of an initial complication.

The Ruzizi National Park includes the delta of the inflowing river and its constituent wetlands and vegetation. This inflow, however, may not be completely typical of those others around the lake, owing to the apparently anomalous behaviour of chemically distinct river water as it enters the lake. The existing parks, however, do offer a variety of locations and habitats for consideration of lake reserves.

Against these considerations, there is the need to consider the social and economic impacts that existing protected areas have had, historically, on the people of the adjacent areas. In some cases, customary land and resource rights may have be sacrificed to the cause of conservation, and, as a result of exclusion and poor communications, hostility and resentment may have developed between local communities and the conservation authorities. If this is in fact the case, then there may be serious obstacles to the aquatic extension of existing terrestrial conservation areas, especially if local people have taken up coastal fishing as a response to the loss of agricultural land. The social and economic circumstances surrounding protected areas require thorough investigation. Where there is good potential for aquatic protected areas, the active involvement of local people should be actively encouraged through the environmental education component of the project. In the Socio-economic special studies, participatory appraisal techniques and social cost benefit analysis will be important tools.

A particular priority must be the identification of a protected area in Zaire. At present, although the Zaire Sector is the largest on the lake, there are no national parks

along its coast. There is an urgent need to provide protection for some representative part of the coast and lake.

The Zaire delegation to the Inception Workshop provided a list of possible localities for consideration. These included:

- Ruzizi Delta (Zaire side)
- Burton Bay
- Cape Banza to Kazimia Bay
- Yungu to Kalemie

Criteria for protection will probably include conservation value, accessibility , and the socio-economic circumstances of their adjacent areas.

Over the duration of this component the prospect of setting up conservation areas other than national parks should be taken into account. For example, a conservation area set up close to Bujumbura with good educational facilities, would have tremendous educational potential, given the proximity to that centre of population, even if the biodiversity is not exceptional. It could also be that certain areas such as the mouth of the Malagarasi, which could be a point of major impact in the future, or certain vegetated fish nursery areas, may play a vital role in the life of the lake and may benefit by controlled access. This should generally be part of the planning and zoning of the lake as part of the Strategic Plan. There should be a general attempt to include all representative types of habitat in the lake within some form of conservation programme. The Strategic Plan should also finally include mechanisms for further exploration and expansion of protected areas into the future. A list of additional potential sites were included in the Biodiversity Baseline Review.

The most significant protected areas, ultimately, may not necessarily lie within the lake itself. Many of the negative processes are happening in the catchment area. Therefore, for example, legislation and enforcement of laws on soil conservation in the agriculture sector in Burundi may be one of the most effective protection measures for the lake. Or, for example, the Malagarasi swamp in the heart of the largest single basin of the lake catchment may buffer the lake from degradation of the catchment area; protection of the swamp from encroachment and degradation could also prove one of the greatest conservation measures. Conservation measures within the immediate catchment area must also remain under consideration. Despite extensive deforestation, there are already significant forest reserves or controlled areas in the catchment area of Burundi and Tanzania. Some assessment of their current status, their value in protection of the basin would be valuable, in order to identify the place of forest reserves in strategic planning for protection of lake resources.

11.1.3 Work Plan

Main Activities

Conservation activities are due to continue over the lifetime of the project. In the first instance two sets of activities could proceed either in series or in parallel.

1. Primary reserves set up requiring:

rapid ecological and socio-economic surveys to establish approximate inventories, habitat types and conservation value with recommended reserve boundaries, requisite limitations of fisheries, and scope for the involvement of local people, also including basic data required by governments to define and gazette areas as underwater reserves;

conduct of the necessary internal legislative procedures;

training of park managers and staff and arranging the involvement of local communities;

establishment of basic research and educational resource facilities.

2 Promote intensive biodiversity studies in and around the reserves, and plan and facilitate more extensive surveys radiating out from these bases.

Time Schedules

The two sets of activities outlined above require different approaches.

The first involves initial short-term surveys and reporting totalling around 1 - 2 months per reserve, followed by negotiations with fisheries, lands, planning and parks departments, and establishment of training and administrative systems. Since these surveys are required early on in the project, a short list of potential aquatic protected areas should be drawn up as soon as possible in order to allow planning for the necessary survey work.

The second involves more extensive data collection by scientists and park managers and will continue through the project.

Both elements of this work are closely linked to the work programme of the Biodiversity component and much of the requisite survey work would be carried out under this element (see Section 5.7), although co-ordination with the Socio-economic special studies will be essential.

Once the surveys are generating the appropriate detailed information on the attributes of the reserves, the detailed planning and mapping will be needed to help lay out the reserve for educational and economic purposes. Installation of aquatic reserve managers should commence in year two of the project.

11.2 GIS and Remote Sensing

11.2.1 Background

A Geographical Information System (GIS) enables data derived from a wide variety of sources to be integrated together in a common scheme of geographical referencing. Thus, information derived from printed maps, published statistics, field surveys, aerial photographs and satellite images can be geo-referenced in a single system and sophisticated analysis of relationships between factors across geographical space can be performed.

Population pressure, deforestation, erosion, sedimentation and pollution are all impacting the catchment system which drains into Lake Tanganyika. Given the wide range of activities already underway or proposed for Lake Tanganyika, the predominantly land based nature of the environmental problems and the diverse nature (and possible requirements) of the bordering countries, a GIS would certainly provide overall coverage and the holistic view of the Lake as required in the project specifications.

The project document indicates that data collected as part of the activities of the Special Studies are to be co-ordinated and entered into a GIS. This to provide a tool for the baseline and framework for long term research and monitoring programmes.

The specific objectives of the GIS component are not defined explicitly in the project document but there is a clear indication of the need for a GIS system which is truly cross-cutting throughout the project activities. The GIS will be characterised by a wide range of data sources, long timespan of available data, very wide geographical coverage, and the need to handle complex spatio-temporal dynamics. It is anticipated that it will contain valuable data unavailable anywhere else in such an integrated form. Counterparts from the riparian states will need to be trained in analysis techniques, computer mapping and the handling and interpretation of spatial and temporal data in a GIS.

A single GIS initially developed in the UK in consultation with Special Studies leaders and counterpart organisations, and then distributed to a regional centre and the corresponding national units is proposed as the most appropriate option at this stage. However, clarification will be required on the exact nature of the outputs expected from the GIS system as these have not been specified in any detail. All responsible and interested parties in the Special Studies and their corresponding national institutions and work teams would need to be closely consulted throughout to ensure that all their requirements were being met. It is imperative that Special Study teams realise that they need to ensure that any data to be included in the GIS has a suitable spatial reference.

11.2.2 Existing GIS capacity and data sets

During the baseline study period a visit was made to the region in November 1995 to gather information on existing remote sensing and GIS skills, facilities and data

relevant to the scope of the project in the four countries. Much of that information is contained in the section of this report dealing with sediment discharge.

Suitable remote sensing data and products have been identified to enable an evaluation of current land cover in the Tanganyika catchment. Some historical remote sensing data and products have been identified which could be used to identify key areas of change where deforestation, settlement, denudation or erosion are significantly impacting the sediment budget of the catchment. The location of these keys areas will largely be an outcome of the work plans for the special studies teams and their need to make representative physical measurements of lake inputs such as sedimentation rates, river flows, etc.

Available resources with respect to each country are summarised below:

Burundi

The LTR documentation centre at Bujumbura holds technical reports describing the FINNIDA scientific work, including remote sensing and GIS activities. The University of Burundi at Bujumbura, the University of Kuopio, Finland and the Musée Royal de l'Afrique Central, Belgium appear to hold all the relevant (historical) remote sensing and other spatial data (e.g. survey data) of most use to the sedimentation (land cover) special study requirements for GIS.

Tanzania

A site inspection was made at the TAFIRI site in Kigoma in preparation for the installation of a LARST NOAA satellite receiver system, to enable daily acquisition of catchment wide information locally in the region. The information derived from analysis of this data (e.g. vegetation status, lake surface temperature) has potential value for the whole project and should be incorporated into the GIS system. The Kigoma site has a good antenna position but it is a long distance from the proposed GEF offices. The lodge site has good power and no radio problems so this is the preferred site to establish a local satellite data receiver system. The data collected by the receiver will need to be backed up by historical NOAA data to interpret gross land cover changes over time.

The existing topographic map base held at the Survey and Mapping department has major gaps in coverage. New (1:250 K) maps of vegetation cover and drainage are being prepared for all of Tanzania by Huntings at IRA, and the project leader has agreed to facilitate access to these data and maps on request. This will provide up to date information on land cover in Tanzania and the data can be further processed to include parts of Burundi and Zaire. It may be necessary to acquire historical (MSS) data of Tanzania to enable the change detection analysis. The data will need to be processed further to extract any information on sediment loads in the water. The Ardhi institute offers a reasonably good (but very new) training and consultancy capability. There is a fledgling Tanzania GIS users group.

Zambia

An existing NOAA station at the Zambia Meteorological Department has not been acquiring imagery of Lake Tanganyika on a regular basis. The Environment Council of Zambia (ECZ) is co-ordinating all GIS compatible data and organisations. The Survey and Mapping Department is the national focus for remote sensing activity, copies of air-photos can be obtained, but digital remote sensing data is not available. Limited remote sensing and GIS facilities also exist at UNZA. There is a fledgling Zambia GIS users group.

Zaire

Zaire was not visited as part of the capability assessment visit. The Service Permanent d'Inventaire et d'Amenagement Forestiere de l'Environnement has satellite photographs. The Musée Royal de l'Afrique Centrale in Brussels hold a significant collection of air photographs and maps of Burundi, Zaire and Tanzania which needs to be further examined to assess its relevance in this phase. The Airphoto library at the Survey Department, Lusaka, Zambia holds some cover of the Zambia/Zaire border region dating from 1991.

Other Sources

The CSIR receiving station at Hartebeesthoek has an AVHRR archive dating from November 1984. The Hartebeesthoek reception area covers most of Lake Tanganyika so that a back catalogue of monthly (cloud free) samples from the dry season periods of previous years can be acquired. The CSIR station has acquired and archived Landsat MSS data cover of Lake Tanganyika from 1980 to 1990 and also for a short period in 1993. Landsat TM data is available from CSIR from 1989 to the present although not all the scenes required to cover the entire catchment are available. A list of the Landsat coverage has been obtained. No SPOT data is available from CSIR.

The USGS has issued a global digital height model at 1km resolution which could be used to derive coarse slope and land form information of the Lake Tanganyika catchment. The data set is available in the public domain via Internet.

11.2.3 Inception Workshop Results

It was clear from the inception workshop that awareness and knowledge of the use of GIS within the project was low. Also, end user requirements of the system and their plans to use a GIS system were not well formed. Very few national agencies were identified as having capabilities, responsibilities or aspirations in this area. Consequently, it was difficult to extract meaningful specific requirements for the GIS system or to develop particular ideas on the types of data or analysis to be included in the GIS. Indeed, these may only become clearer once the Special Studies are underway and generating data. It was also clear that the temporal and spatial scales of information gathering and analysis within each of the various Special Studies planned for the project was highly variable and would require close integration in order to be efficiently and usefully employed in GIS analyses. A pragmatic approach was

therefore adopted to establish the key, region-wide tasks that would be required of the GIS.

These were identified as follows:

1. Mobilise the NOAA station installation as soon as practicably possible.

2. Start to establish an ARCINFO GIS system for the catchment based on a principle of nested high resolution sub-GIS units set in a coarse scale (c.1:250,000) map base. In this way more detailed studies can be incorporated into regional scale analysis later on as they develop. They will also be able to stand alone and utilise the data and models specific to that study without the interference of other project requirements causing confusion.

3. Obtain coarse scale (1km horizontal) low cost DEM of East Africa. Use this to develop initial altitude, slope and aspect maps for stratifying catchments and identifying likely sites where sampling should be performed. The catchments should then be stratified according to 4 criteria:

- high/low slope
- soft/hard coast
- protected/not protected
- stream order

4. Obtain archive AVHRR data from South Africa. Initial data searches have already been carries out and data can be ordered from the UK. These data will be capable of comparison with data acquired locally using the NOAA receiving station once installed.

5. Obtain land cover mapping from IRA as and when available. The Sediment discharge baseline review clearly identified the availability of high resolution data suitable for providing up to date vegetation cover over most of the catchment. The availability of this data set was confirmed during the workshop.

6. Collate information form the special studies to nominate and circulate a regional list of known sites of:

- pollution
- biodiversity studies
- sedimentation studies

This will assist in prioritising the selection of sampling sites for the special studies.

7. Obtain boundary and attribute information on the regions National Parks, protected areas, coastline type, etc. This is basic information that will already have been captured for GIS and which should be available.

8. Consider the types of socio-economic GIS analysis that may be required for national level or site specific studies, including proposed protected areas.

9. Create an inventory database - i.e. database of data holdings (this is not a GIS).

10. find out what models are required
- dispersal
- stock dynamics
- network analysis
- seasonal variation
- water circulation
- socio-economic linkages
- others

11.2.4 National Agencies

Good linkage with relevant national agencies is essential and these are to be identified by the Special Studies work teams. Provisionally, the agencies likely to be involved in GIS development and data analysis are identified as follows:

Burundi
University of Burundi, Bujumbura

Tanzania
TAFIRI, Kigoma
Institute of Resource Assessment (University of Dar es Salaam)
Ardhi Institute, Dar es Salaam

Zaire
Centre for Hydrobiological research, Uvira
University of Kinshasa

Zambia
Environment Council of Zambia (National Co-ordinator, Lusaka)

11.2.5 Work Plan

The requirements described above require a flexible approach to implementing a GIS. This will be provided by a strategy of working at low resolution, coarse scale to provide the overall regional spatial framework to identify key areas of interests followed by a process of gradually refining the focus in a more high resolution approach to particular issues and/or sites. This will be done over time in association with the progress of the respective special studies. A definitive work schedule will be implemented in the draft strategic plan.

Because there is no specific GIS and remote sensing Special Study as such, a flexible workplan will need to be adopted that can develop in line with particular Special Study requirements, progress and outputs. However, at an early stage, a coarse scale (catchment wide GIS can be created to enable strategic planning of Special Study activities, site selection, etc. as part of the preliminary strategic plan. This would also enable the promotion of discussion regarding what types of data are to be collected and combined in such a framework as well as the types of spatio-temporal analyses that will be required.

The use of the GIS and remote sensing techniques as components of the Sediment Discharge Special Study is the most likely starting point for establishing higher resolution (finer scale) GIS requirements and starting to build one of the specific "nested" databases within a catchment wide GIS framework. The use of GIS in the Pollution Special Study is also a key area to be followed up to ensure efficient integration of activities. The activities associated with this objective for the sediment discharge special study are:

- Satellite monitoring of lake catchment deforestation and sediment discharge into the lake
- Quantification of sediments currently entering the lake
- Tracing the fate of particles discharged into the lake
- Detailed sedimentation and sediment impact studies
- All data to be added to the Lake Tanganyika database/GIS system

In all of this, the mandatory first step is to clarify (through consultation) the objectives and outputs of the project GIS development. The production of maps, spatial and temporal analysis, etc, is all possible but specific requirements and priorities are yet to be defined. For the time being it is possible to project a work plan for data acquisition and analysis in three main phases:

Phase 1 - Setting Up

Establish region wide, low resolution data sets for identifying key areas of investigation. This will include:

Activity	**Purpose**
Installation of NOAA receiver at Kigoma	Local (free) reception of low resolution satellite data for whole catchment
Creation of data inventory system to record available spatial data and indicate when/how it can be incorporated into the project GIS	Useful meta-data base Catalogue of GIS contents (actual and potential) Tool for monitoring progress of GIS
Acquisition of NOAA archive data from South Africa	Establish seasonal trends in vegetation status and lake surface temperature from past time series
Acquisition of low resolution DEM from USGS	Generation of altitude, slope and aspect maps for stratifying catchments within Tanganyika system
Acquisition of IRA vegetation map coverages	Up to date vegetation maps already in GIS compatible form for large part of the Tanganyika system
Acquisition of national boundaries, park limits, administration units etc., where they already exist in digital (GIS compatible) form.	Basic data required for later analysis relevant to national agencies
Acquisition of LTR bathymetry data	Basic data required for later analysis relevant to national agencies plus enable access to LTR circulation models. Reciprocal supply of NOAA data to support LTR circulation models
Establish low resolution (1:250,000) GIS framework	Regional GIS framework.
Identify regions where nested high resolution GIS sub projects will be required	Drive the definition of high resolution data requirements for GIS.

Phase 2 - Data Stratification

Provide particular GIS analysis to assist localisation of Special Studies planning. This will include:

Activity	Purpose
Generation of altitude, slope and aspect maps for stratifying catchments within Tanganyika system	To assist the selection of paired catchments for sampling strategy definition and data analysis
Maintenance of data inventory system to record available spatial data and indicate when/how it can be incorporated into the project GIS	Useful meta-data base - ongoing activity Catalogue of GIS contents (actual and potential) Tool for monitoring progress of GIS
Analysis of NOAA archive data from South Africa and NOAA data from local receiver	Establish and monitor seasonal trends in vegetation status and lake surface temperature
Analysis of IRA vegetation map coverages in relation to paired catchments	refined selection of sampling and study sites
Consultation on linkages between data sets as they are incorporated	Establish what models or other data analysis techniques are required Establish the relevance of GIS analysis to project socio-economic studies (stakeholder meetings, co-ordination at local levels, education and awareness, etc.)
Development of high resolution GIS sub projects "nested" within the coarse scale (catchment wide) GIS framework will be required	Incorporate detailed data from specific sites/studies into the GIS.

Phase 3 - Outputs and Uptake

Generation of outputs from particular GIS analysis. This will include:

Activity	Purpose
Map and report production	Inclusion in reports, presentations, etc.
Maintenance of data inventory system to record available spatial data and indicate when/how it can be incorporated into the project GIS	Useful meta-data base - ongoing activity Catalogue of GIS contents (actual and potential) Tool for monitoring progress of GIS
Training in GIS data handling and analysis	Reinforce local capabilities and provide a dissemination and transfer pathway

12. Training and Capacity Building

12.1 Objectives

As indicated in the original Consortium Proposal Document, the objectives of the training and capacity building programme are to strengthen **national institutional capabilities** and **community participation** relevant to achievement of overall project aims. This will focus on two main areas:

- Environmental Education Programme (EE); and
- National Institutional Capacity Building

12.2 Environmental Education

Within the project, environmental education will play a critical role in working towards sustainable approaches to natural resource management within the Lake Tanganyika basin, by targeting national project stakeholders, implementing agencies and local people, and fostering dialogue amongst them about the development and conservation needs of the region. The programme aims to improve general awareness of important environmental issues, empowering people with the knowledge, skills and values that enable effective participation in environmental management. It is a major preliminary activity to ensuring that the project's goal is sustainable and is seen as one of the primary mechanisms of ensuring the integration of project activities.

The EE programmes are to focus on :

- Sources of lake pollution - including industry, urban and agricultural industries, and lake transporters.
- Users of lake resources - including fishermen (both on the industrial and artisanal levels), farmers, pastoralists, and lakeside communities (with emphasis on special groups like women and administrators).
- Community groups especially children through schools and clubs.
- Officials of relevant government departments (see below).

(Section 7 provides a full discussion of this subject.)

12.2.1 IDEAL

The project is developing linkages with other international efforts aimed at conservation in this region. In particular, an organisation which is expected to have an increasing impact on skills development in the several scientific disciplines is the Inernational Decade for East African Lakes (IDEAL) The project proposes to work closely with IDEAL which plans to provide a series of 6 week courses (3-4 weeks lecture/lab plus 2-3 weeks supervised independent research projects) based at Kigoma. These courses are designed to allow both US-based and African-based trainees to gain skills in tropical limnology and would accept up to 8-10 nominees from the UNDP/GEF project per year for up to 5 years; National Science Foundation (US)

have strongly indicated that they would pay the 3 instructors' salaries[6] , most capital costs and supplies and would also consider extending the program beyond 5 years if it is successful. The project proposes to cover African student support costs and access to project facilities (for example about 10-15 days of boat time on the RV Echo per year) and use of more substantial research items (e.g. corers, winches, CTD).

12.3 National Institutional Capacity Building

The availability of human capital adequately trained in the various fields of professional expertise required by the project is recognised as being insufficient in all four countries both in terms of meeting the current demands of the project and the future needs of sustainability. The project intends, therefore, to develop and strengthen national capability in the fields of natural and social sciences research, environmental monitoring and environmental management / strategy aiming at the relevant areas of biodiversity preservation and pollution control. The skills developed would be put to work within a developing framework of activities aimed at management of the lake basin.

Examples of specific activities have been proposed in the project documentation to produce a cadre of trained environmental scientists and technicians:

- Establish an in-service / on-the-job training programme for technical staff to learn skills from project staff and visiting specialists relating to lake environmental management.
- Provide relevant support to the national universities to help them upgrade their programmes inter alia in aquatic conservation biology and limnology.
- Provide fellowship support to undergraduate, graduate and post-graduate students working on projects relating to the Lake Tanganyika environment, and train African scientists in aquatic sciences.
- Provide on-the-job training for present and new parks managers on the management of the protected areas.

It is also expected to hold ad hoc and specific training courses through visiting specialists. Involvement of project staff from appropriate national institutions in other regional courses and workshops will be encouraged (e.g. Remote Sensing workshop- below). The involvement of representatives from 2 other GEF projects at the Inception Workshop (Lake Malawi and Lake Victoria) as well as the FAO LTR, should help in ensuring future collaboration in joining forces in organising cost-effective regional training activities and workshops. It is expected that the project will play a pivotal role in this.

Southern Africa Remote Sensing Workshop

[6] A team of 3 instructors (Pierre-Denis Plisnier, Ellinor Michel and Mike Soreghan tentatively)

The Commonwealth Science council and the UK ODA are sponsoring a Remote Sensing and GIS workshop at the University of Fort Hare in South Africa on 11-27 November at which it is hoped to include the attendance of representatives of relevant national institutions.

12.4 Management of Training and EE

The intended approach for implementation of these programmes involves the recruitment of a project Training Officer as well as sub-contracting the services of the British Council to provide administrative support where required, especially in the organisation and development of specific training courses. The project's putative Training Officer and proposed National EE Advisers, would co-ordinate with the British Council where necessary.

If deemed advantageous, a short-term visit by a training specialist, in conjunction with the incumbent in the region could be mounted, the purpose of which would be:

- to review existing information on training and education needs
- to assist in identification of possible candidates for the project Training Officer post if not already achieved
- to elicit views of National Co-ordinators and other interested parties on training and education requirements
- to liaise with British Council offices over arrangements for recruitment of the project Training Officer and implementation of the training and education programme
- to draw up a draft plan for the training and education programme for eventual incorporation into a human resources development plan.

The training and education programme will be implemented over the life of the project in accordance with the specific needs established in the human resources development plan. It is not possible at this stage, therefore, to specify the balance between in-country, regional or overseas training nor between technical, undergraduate or postgraduate training. As much as possible of the training will be organised locally or in the region in order to contribute to capacity building. It is anticipated, however, that there will be at least some requirement for masters awards conducted in French or English at universities in Europe.

13. Next steps

As detailed in the above descriptions for the respective Special Studies, July and August will see visits to the region by all the major study group advisers to finalise details of activities and establish clear responsibilities with local counterpart government institutions and NGOs. Running concurrently (the above mentioned visits being inter alia part of the process), will be the preparation of the Preliminary Strategic Plan (see Figures 2 and 3 under Section 1 of this report).

At the same time the PCU unit and National Co-ordinators will, with national institutions involved be consolidating the project centre in Kigoma as well as establishing further project centres in Bujumbura, Mpulungu and Kalemie, such that field studies can begin as soon as possible.

The intention now is that the Preliminary Strategic Plan for the co-ordinated regional approach to sustainable management of Lake Tanganyika will be complete and work on the special studies begun in all four countries by August of this year.

A Regional Steering Committee meeting is due to be held in Zambia during September (Section 4.2.5) where it is hoped that the findings and recommendations of this Inception Report will be accepted and ratified.

LIST OF ANNEXES

Annex 1

Interagency Agreement

Annex 2

Country presentation papers from Inception Workshop

Annex 3

List of participants at Inception Workshop

Annex 4

Logical Framework

LAKE TANGANYIKA BIODIVERSITY PROJECT

DRAFT LOGFRAME: PHASE TWO (SPECIAL STUDIES AND STRATEGIC PLANNING) (Updated 2 May 1996)

Narrative Summary	**Objectively Verifiable Indicators (OVIs)**	**Means of verification (MoVs)**	**Assumptions**
Goal: Protection of the biodiversity of Lake Tanganyika			
Purpose: A co-ordinated approach to the sustainable management of Lake Tanganyika	1. Strategic Plan developed on basis of special studies, accepted by Mid 1999 2. Institutional and legal framework for future management in place by Mid 1999 3. Nationally defined action programmes underway by 2,000	1. Strategy document discussed endorsed officially by 4 lacustrine states 2. Key legal measures and institutional mechanisms published in government gazettes 3. Working plans and records of key national institutions	*(purpose to goal)* Extra-project funding available for national and regional action programmes beyond 2,000 Political instability and conflict do not impede regional co-operation National institutions perform effectively in implementing strategic plan; Legal measures and national action programmes successfully control lake basin environmental degradation

Narrative Summary	**Objectively Verifiable Indicators (OVIs)**	**Means of verification (MoVs)**	**Assumptions**
Outputs			*(output to purpose)*
1. Regional legal framework established	1.1 Draft legal framework written and circulated by 8/97 1.2 Proposals for harmonisation agreed and amended national legislation drafted by 1999	1.1 Draft legal framework plus government discussion documents x 4 1.2 Formal proposals to government and draft legislation	Regional legal requirements can be effectively translated into national legislation; Legislative instruments effective in controlling environmental damage and curbing degradation;
2. Regional co-ordination mechanism established	2.1 Proposals developed by 1999 for ongoing extra-project funding of necessary regional co-ordination and transnational action plans; 2.2 National action plans incorporate co-ordinated activities for trans-national management of lakewide issues by 1999	2.1 sub-project documents prepared by regional steering group 2.2 National Lake Tanganyika action plans and agency working documents	Regional management problems, e.g. lake transport, fisheries, population growth and displacement can be addressed through co-ordinated national activities
3. Special studies completed as basis for strategic plan	3.1 Socio-economic studies completed and strategic implications assessed by 12/98 3.2 Biodiversity studies completed & strategic implications assessed by 12/98 3.3 & 3.4 Pollution and sedimentation studies completed & strategic implications assessed by 12/98	3.1 Participatory action research programmes underway at specific sites in each country by 1997; 3.2 - 3.3 specific MoVs to be identified 3.1 - 3.4 Special study reports and strategic discussion documents for each thematic area produced and circulated by each country by 9/98	Studies successfully identify opportunities and constraints for biodiversity protection through pollution and sedimentation control and stakeholder participation; lessons of participatory action research incorporated into wider strategic planning by key agencies; recommendations of studies accepted by national governments
4. Environment Education programme established	4. National environment education programmes x 4 underway by 1997, including NGOs and Government agencies reviewed by 1999, including: 4.1 pilot community level activities with monitoring system in place; 4.2 training programmes for staff of national institutions;	4. National EE Workshop reports and workplans x 4 ; programme review reports	Incentives exist for local people to change degrading resource use practices; Enhanced awareness results in adoption of environmentally and institutionally sustainable strategies and improved co-ordination by key agencies; Major regional population **:** land resource imbalances can be

			overcome

Activities 1.1 Legal studies 1.2 Draft regional legal framework developed 1.3 Harmonised national legislation proposed 2.1 National responsibilities and lead agencies identified 2.2 Regional co-ordination mechanism discussed and agreed 2.3 National action plans on lakewide issues drawn up 3.1 Regional socio-economic co-ordinator recruited 3.2 Initial field investigations to fill gaps in baseline reviews, draw up work plan and methodologies for detailed studies by December 1996 3.3 National agencies commissioned to undertake special study components by 4/1997 3.4 Interim reports by 12/97 and 6/98, ongoing supervision, co-ordination and technical support by PCU/NRI 3.5 Shortest of aquatic protected areas drawn up by 12/97, feasibility assessed by 9/98 3.6 National synthesis and thematic overview reports by 9/98 3.7 Strategic implications of special studies reviewed by 12/98 4.1 National EE coordinators identified 4.2 Initial assessment of EE training needs 4.2 National EE workshops held and programmes draw up 4.3 Participatory investigations and awareness raising at village level; implementation and monitoring of pilot action programmes 4.4 Training and awareness programmes for staff of implementing agencies, including cross-lake exchange visits and study tours 4.5 Public awareness and schools EE programmes	

Annex 5

Job descriptions for Project Co-ordinator and Scientific Liaison Officer

Project Co-ordinator

The Project Co-ordinator provides the leadership for the successful implementation and completion of the project, within the framework of the project document. He/she is responsible to the designated office at UNDP Headquarters, discharging his duties in accordance with UNDP regulations and procedures. Specifically he/she is responsible for:

- direction and supervision of the activities of project staff,
- supervision and facilitation of the activities of contractors,
- maintaining close working relationships between project staff, contractors and national agencies,
- administration of the Project and its finances,
- organisation of conferences and meetings,
- preparation of such reports and accounts as may be required.

He/she is Secretary of the Steering committee, and Chairman of the Technical Committee. He/she will visit on a regular basis each of the project national centres to ensure satisfactory progress, and also travel extensively in the region as necessary.

Scientific Liaison Officer

- The Scientific Liaison Officer provides the operational link in the field with the various consultants serving the project. He/she will:
- support and facilitate the implementation of scientific work,
- ensure the smooth operation of scientific programmes at the four national centres, and elsewhere on the lake
- ensure the satisfactory involvement of scientific counterpart staff with contracted activities,
- supervise the selection, care, maintenance and allocation of scientific equipment among project activities,
- carry out such other tasks as may be properly assigned by the Project Co-ordinator.

Annex 6

Outline Specifications of the Research Vessel "Tanganyika Explorer"

R/V TANGANYIKA EXPLORER was constructed over the period 1993/94 to meet the requirements of a scientific project carrying out research on Lake Tanganyika. The vessel is a steel, single decked, single screw motor ship with partial double bottom, having the following specifications:

Length overall		about 25.30 m
Breadth moulded		about 6.86 m
Depth moulded		about 3.10 m
Draft		about 2.00 m
Displacement, lightship		about 100 t
Fuel capacity		about 12 m^3
Accommodation:	scientists	8
	officers	4
	deck hands	4
Endurance, minimum		10 days
Wet laboratory		7 m^2

Main engine:	Cummins KTA 19M developing 425 HP continuous at 1800 RPM Twin Disc MG 516C reduction/reverse gearbox (4.5.1)
Generators	Two Cummins diesel generators, each having continuous output 40kVA 220V
Deck equipment	Two split winches, 1.5 t pull at 60 m/min on mid drum One 2.5 m^3 net drum winch, 5.0 t at 40 m/min One hydrographic winch with 250 m, 4 mm stainless wire. Trawl sonde. Electro-hydraulic windlass
Electronics	Radar, SS8, VHF Ecosounder, sonar, Simrad echointegrator Autopilot, GPS

The vessel was built to the rules of the American Bureau of Shipping (ABS) with drawings approval (without entering into class); safety equipment and stability complies with the IMO/FAO/ILO recommendations.

ANNEX 7

List of Acronyms

ACRONYMS IN THE INCEPTION REPORT

AAS
ADMADE Administrative Management Design
AGENDA
APRN-GTZ
ARCINFO
ASIP Agricultural Sector Investment Programme (Zambia)
AVHRR
BEAM4 A bioeconomy software package produced by FAO
BEER
BEPES
CADIC An NGO based in Uvira
CBO Community Based Organisation
CITES Convention on International Trade in Endangered Species
COGERCO Cotton growing regional council in Burundi
CRH Centre de Recherche Hydrobiologique (Uvira, Zaire)
CRONG Council Regional des Organisations non-Gouvernmentales (Zaire)
CRRHA Centre Regional de Recherche en Hydrobiologie Applique (Burundi)
CSIR
CTD Conductivity, temperature,depth
DEM
EAP Environmental Action Plan
ECOPATH A software package of ecosystem modelling produced by ICLARM
ECZ Environmental Council of Zambia
EE Environmental Education
EIA Environmental Impact Assessment
EMP Environmental Management Plans
ESP Environmental Support Programme (Zambia)
FAO Food and Agriculture Organisation (UN)
FBA Freshwater Biolgical Association (UK)
FINNIDA Finnish Development Agency
FLTSP
GC
GEF Global Environment Facility
GIS Geographic Information System

GTZ German Technical Assistance
ICCE International Centre for Conservation Education (GB)
ICPMS
IDEAL International Decade of East African Lakes
IFE Institute of Freshwater Ecology (UK)
IGEBU Institut Geographique du Burundi
INECAL
INECN Institut National pour l'Environnement et la Conservation de la Nature (Burundi)
IRA Institute for Resource Assessment
IUCN International Union for the Conservation of Nature
IZCN Institut Zairois pour la Conservation de la Nature
JET Journalists Environmental Association Of Tanzania
LARST Local Application of Remote Sensing Techniques
LTBP Lake Tanganyika Biodiversity Project
LTR Lake Tanganyika Research
MOV Means of Verification
MRAG Marine Resources Assessment Group
MSS
NAIS National Agricultural Information Services (Zambia)
NEAP National Environmental Action Plan (Zambia)
NEMC National Environmental Management Council (Tanzania)
NGO Non Governmental Organisation
NOAA National Oceanic and Atmospheric Administration
NRI Natural Resources Institute (N.R. International)
ODA Overseas Development Administration (UK)
ODEB Organisation pour la Defense de l'Environnement au Burundi
OVI Objectively Verifiable Indicators
PAH
PC Project Co-ordinator
PCB Polychlorinatedbiphenols
PCU Project Co-ordination Unit
PLA Participatory learning and action
PRA Participatory Rural Appraisal
RTNB Radio Television National du Burundi
RV Research Vessel
SARL
SENADEP Service National de la Promotion et du Developpement de la Peche (Zaire)
SLO Scientific Liason Oficer
SNEB/PAE (Burundi)
SNV
SPOT
SSG Special Study Group
TAC Technical Advisory Committee
TAFIRI Tanzanian Fisheries Research Institute

TANAPA Tanzanian National Parks Authority
TM
TSF Terre sans Frontieres
UK United Kingdom
UN United Nations
UNDP United Nations Development Programme
UNESCO United Nations Organisation for Education and Science
UNOPS United Nations Office for Project Services
UNZA University of Zambia, Lusaka
USGS
WCST Wildlife Conservation Society of Tanzania
WWF World Wildlife Fund
ZALUPP Zambian Agriculture Land Use Planning Programme
ZEEP Zambian Environmental Education Programme