7. MONITORING

7.1 Monitoring will be carried out throughout the period of Programme implementation through a combination of two different mechanisms. First, a major TREFIP activity component is establishment and operation of an expanded LTFMP, which originated under the LTR Project.

7.2 Secondly, a Monitoring and Evaluation (M&E) routine will operate within the PIU in order to track and assess progress within the different TREFIP activity areas. The Socio-Economist will prepare in an electronic spreadsheet format a data base system capable of being updated on a quarterly basis by each of the Programme sub-offices.

7.3 TREFIP sub-offices will provide such quarterly updates for each of the activities programmed within their respective national sectors, e.g.: formation of Local Fisheries Councils, establishment and operation of fund raising for micro-credit schemes, data on fish production, construction of village facilities or marketing/distribution infrastructure, and EE sessions.

7.4 Using these updates, the PIU will issue quarterly M&E reports detailing the percentage of physical and financial realisation of Programme outputs compared to the goals set in the annual work plans. Main issues and bottlenecks will be identified and steps will be taken to resolve any difficulties and adjust the programme accordingly.

7.5 The PIU quarterly reports will then be transmitted to the Bank, the Directors of Fisheries, and the National Fisheries Councils. They will also be tabled at the annual meeting of the Regional Fisheries Council for deliberation and appropriate follow-up action.

A. MONITORING THE PHYSICAL ENVIRONMENT

7.6 TREFIP will work through its Output 4 activities to upgrade and maintain national institutional capacities to monitor the physical environment of Lake Tanganyika. Simple and cost-effective measurement techniques applied at selected sites will provide the Programme with background information on weather and hydrophysical events controlling biological production.

7.7 Physical environment parameters to be covered under the expanded LTFMP include, *inter alia:*

- Wind patterns (direction, strength, and gust by using upgraded whether stations of LTR or national institutions);
- Rainfall (amount at each substation);
- Solar radiation (by using upgraded weather stations of LTR or national institutions);
- Radiation measurements in water (as part of limnological monitoring);
- Water transparency, temperature and pH (as part of limnological monitoring);
- Water level (as measured at fixed stations in harbours); and
- Other parameters as agreed.

7.8 Considerable information was compiled during the LTR SSP on water level, thermal stratification, wave motions, water current profiles, and meteorological measurements

(three weather stations). These data were used in modelling lake hydrophysics and processes regulating other trophic levels of lake ecosystem.

7.9 Current physical monitoring is based on this earlier modelling. A software package known as 'Tangpath,' specifically designed for the LTFMP, has been distributed to all LTR field stations. The expanded monitoring activity will be able to take full advantage of this package.

7.10 Evaluation of LTFMP (Mölsä, 2000a) provides a good baseline for planning future monitoring of the physical environment through TREFIP, taking into account the different research/monitoring needs and interests around the lake as well as available institutional capacity.

B. MONITORING THE BIOLOGICAL ENVIRONMENT

7.11 TREFIP will upgrade and maintain institutional capacities to monitor the biological environment of the lake and the state of its commercial stocks and biological diversity.

7.12 Experience with national execution of the current LTFMP has shown that, whilst most of the scientific and technical personnel in the four LTR/LTBP sub-stations are motivated and committed, the programme is vulnerable to technical failures and institutional weaknesses (Mölsä, 2000a). The need for ongoing external technical and financial input is evident.

7.13 Biological environment parameters to be covered under the expanded LTFMP include, *inter alia:*

- Effects of temperature, nutrient and oxygen distribution resulting from major up-welling, vertical mixing, and horizontal flows;
- Primary and secondary production of macro-zooplankton and meso-zooplankton as key species in the pelagic food chain;
- Fish population characteristics as determined through catch samples of the major pelagic target species (using an appropriate sampling strategy to avoid errors that can arise from light-attraction fishing – the dominant method employed in the commercial fisheries of the lake);
- Trends and evolution of catch size and composition in all fishery sub-sectors;
- Catch analyses (catch assessment surveys);
- principal biodiversity indicators (techniques developed by the LTBP Biodiversity Special Study team); and
- Other parameters as agreed.

C. MONITORING THE SOCIO-ECONOMIC ENVIRONMENT

7.14 The expanded LTFMP will allow for an effective coupling of scientific advice and management decision-making through much-increased emphasis on socio-economic and catch assessment studies. Many of the indicators investigated during the 1997 LTR lakewide community survey would be of relevance here. The information base will be further strengthened by interactions and shared observations with participants in the CFMZ and LFC operations.

7.15 Socio-economic environment parameters to be covered under the expanded LTFMP and complementary monitoring work include, *inter alia:*

- For individual villages/landing sites: availability of basic services/amenities, population estimates, housing conditions, etc.
- For fisher informants: fishing unit affiliation, basic biodata, attitudes and opinions related to development/management issues -- perceptions of state of fisheries, possible regulatory mechanisms, etc.
- For trader/processor informants: type of enterprise, basic biodata, attitudes and opinions related to development/management issues -- perceptions of state of fisheries, possible regulatory mechanisms, etc.
- Community participation in Programme activities (including decision-making within LFCs and membership composition) such as the Micro-credit Scheme, upgrading of village facilities/services, infrastructure improvement (roads, jetties, markets, electrification, fresh fish marketing systems), ecotourism development, environmental education, etc.
- effects of roads and other civil works on population movements and patterns of extractive activities (timber, charcoal production, etc.); and
- ecotourism productivity and other economic diversification activities, including effects on lacustrine and terrestrial ecosystems and local perceptions.

7.16 Special efforts would be devoted to enhancing information flow through all managerial mechanisms, whether local (LFC, CFMZ), national (fisheries research and administrative authorities and National Tanganyika Fisheries Councils) or regional (Lake Tanganyika Fisheries Centre and Regional Fisheries Council).

7.17 Following the lines of Mackinson & Nøttestad (1998) an 'expert system' would be created to build mutual respect and co-operation between resource users, scientists and managers. This would facilitate multi-dimensional and multi-disciplinary appreciation of complex bio-social events under conditions characterised by statistical, process, and observational uncertainties (see. Caddy & Mahon, 1995), insufficient or even data-less information (Johannes 1998), and need for flexible policy options (Hilborn & Silbert, 1988).

7.18 Given the greatly fluctuating pelagic fish stocks on L. Tanganyika and the limited monitoring capabilities of the respective research institutes, 'Stock Assessment Driven' monitoring and management are not practical tools for managerial decisions. 'Management Oriented Paradigm' approaches are far more appropriate (see Pauly 1995; de la Mare, 1998). In CCRF terms, it becomes a question of perceiving management as a process involving flexible accommodation to circumstance and change and periodic review and revision of resource conservation and use strategies in partnership with community based stakeholder groups.