### Project Identifiers

<table>
<thead>
<tr>
<th>1. Project name:</th>
<th>Lake Dianchi Freshwater Biodiversity Restoration Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. GEF Implementing Agency:</td>
<td>The World Bank</td>
</tr>
<tr>
<td>3. Country or countries in which the project is being implemented:</td>
<td>People's Republic of China</td>
</tr>
<tr>
<td>4. Country eligibility:</td>
<td>China ratified the Convention on Biological Diversity on May 1, 1993</td>
</tr>
<tr>
<td>5. GEF focal area(s):</td>
<td>Biodiversity</td>
</tr>
<tr>
<td>6. Operational program:</td>
<td>OP2 - Freshwater Ecosystems</td>
</tr>
</tbody>
</table>

### Project Summary

**Project Objectives and Activities**

**9. Project rationale and objectives:**
The project is taking advantage of the major Yunnan Environment Project which has been serving to improve water quality conditions in the lake, and applying a biodiversity ‘overlay’ to its infrastructural, policy and regulatory measures by restoring natural habitats and other activities which will conserve a number of highly range-restricted endemic species.

The Lake Dianchi basin lies just south of Kunming, the capital of Yunnan Province, China. The basin is a ‘hotspot’ of freshwater biodiversity with 24 indigenous fish species, at least 11 of which are endemic, and dozens of endemic mollusc and crustacean species. These are found in the lake itself and also in adjacent springs, often associated with Buddhist temples. Since the 1950s however, some 31 fish species, and a variety of plant species have been introduced, although not all of these have persisted. Declining water quality (especially high phosphorus and nitrogen), loss of natural habitats, competition from exotic species for food and living space, and possibly introduced diseases and parasites have combined to threaten the indigenous fauna and flora, resulting in the apparent extinction of at least some of the endemic species. Surveys since 1994 indicate that at least seven endemic and five other indigenous fish species are still extant, but it should be noted that surveys of the type and intensity necessary to give an accurate lake-wide picture of the distribution and status of habitats and endemic species have not yet been conducted.

The World Bank has been assisting the provincial government in addressing some of the water quality problems through the US$300 million Yunnan Environment Project (YEP); some $200 million of this is estimated to provide water quality benefits to the lake. Specific objectives of the YEP are to: 1) strengthen policies, regulations and institutional arrangements for pollution control, and municipal water, wastewater, solid waste and nightsoil management; 2) support the improvement of the lake environment in Gejiu and Kunming in order to allow the waters to be used for potable supply, industry or agriculture, as appropriate; 3) facilitate complementary sustainable investments in pollution control and municipally-provided urban environmental services; and 4) introduce a comprehensive approach to
planning, prioritization, management, and financing of urban environmental infrastructure investments. The components of YEP are: 1) Lake Dianchi basin water quality recovery; 2) industrial pollution control; 3) provincial urban environmental services; 4) environmental and water quality monitoring; and 5) institutional development, training and construction supervision.

With such a major and comprehensive effort in place, it is worthwhile to give attention to the lake’s biodiversity. In mid-1996 the World Bank instigated a brief study of the baseline ecological conditions of the lake (funded by UK-ODA). The resulting proposals on means of improving the Lake’s biological environment and on how biological processes could support the objectives of the YEP were supported by the Yunnan Provincial Government, and are the basis for this project.

The objective of the proposed four-year GEF project is to restore and manage habitats around the lake in order to secure the conservation of the remaining endemic species of Lake Dianchi and its immediate tributaries. This will be achieved by providing suitable breeding habitat, comprehensively surveying the biological environment of the Lake and its immediate tributaries, establishing a program to monitor lake quality improvements (using the presence/abundance of the endemic species as indicators of improved ecosystem health), and improving public awareness of the Lake region’s unique biological environment.

<table>
<thead>
<tr>
<th>10. Project outcomes:</th>
<th>Indicators:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restoration of at least three lengths of shoreline to some semblance of their ‘natural state’</td>
<td>Incidence of native species increases in the restoration sites</td>
</tr>
<tr>
<td>Plans for management and restoration interventions integrated with broader local government plans</td>
<td>Kunming Municipal Planning Bureau allocates resources for lakeshore restoration in spatial plans and highlights the need for conservation in development documents.</td>
</tr>
<tr>
<td>On-going environmental degradation of the lake shore and tributary ecosystems slowed down and reversed in at least three areas</td>
<td>The length of sloping shoreline remains constant or increases, and regular testing at the restoration sites shows water quality improvements better than those elsewhere in the lake (measured by YEP)</td>
</tr>
<tr>
<td>Good quality and fundamental ecological information provided</td>
<td>Project and broader lake management decisions explicitly based on this new data.</td>
</tr>
<tr>
<td>Appropriate training will be provided for local Government officials, university staff in adaptive wetlands management and biodiversity conservation</td>
<td>Trainees using new skills and knowledge for the benefit of the native biodiversity of Lake Dianchi</td>
</tr>
<tr>
<td>Public support for, and interest in, the biodiversity of Lake Dianchi generated</td>
<td>Knowledge, attitudes and behavior relating to the Dianchi freshwater biodiversity change in positive ways</td>
</tr>
<tr>
<td>Cooperation developed with the local office of the Buddhist Association.</td>
<td>Buddhist temple staff adopt appropriate conservation management plans</td>
</tr>
</tbody>
</table>
11. Project activities to achieve outcomes (including cost in US$ of each activity):

Start up period (Total: $180,315)

1 – Component 1 – Wetland Management and Restoration Total: $635,065; Requested from GEF US$399,000

Indicators:
Project Implementation Unit established
At least three lengths of shoreline remodelled, planted with macrophytes, and re-populated with bivalve molluscs

2 – Component 2 – Surveys, Monitoring and Species Conservation Total: $276,500; Requested from GEF US$155,500

Indicators:
Rigorous monitoring protocols established, regular monitoring undertaken, and recovery plans written for selected species

3 – Component 3 – Capacity Building and Training Total: $320,000; Requested from GEF US$265,000

Indicators:
Suitable trainees identified and provided with appropriate, wetland management-orientated training in-country and overseas

4 – Component 4 – Public Awareness Knowledge, attitudes and behavior surveys Total: $420,550; Requested from GEF Undertaken and awareness messages identified and disseminated, and lakeside Visitor Center with displays established

US$155,550

Indicators:


GEF: 997,550 (includes 22,500 PDF A)

Co-financing:
Yunnan Minorities Peoples’ Village 92,865
Yunnan Scientific Committee 224,560
Alliance for Religions and Conservation/Buddhist Association 5,000
Govt of PR China 537,995

TOTAL 1,857,970

13. Information on project proposer:
The Kunming Institute of Zoology (KIZ) is one of two specifically zoological institutions under the Chinese Academy of Sciences and was founded in 1959. It focuses on conservation biology, primatology and evolutionary biology but also has a special interest in the conservation and sustainable utilization of animal resources. It is active in a range of ecological projects in Yunnan and has extensive experience in monitoring biological communities. There are 280 staff members, including 160 scientists and most of the younger scientists have undergone long-term training in Europe or North America. Since the establishment of the Institute, 82 monographs and more than 300 scientific papers have been published. The Department of Systematic Zoology within the KIZ has long focused on the taxonomy, fauna, and evolution of vertebrates and on monitoring of vertebrate populations in some important areas such as the major lakes of Yunnan. It has received grants from WWF, the MacArthur Foundation, and the Asian Development Bank.

14. Information on proposed executing agency (if different from above)

15. Date of initial submission of project concept
PDF A approved by GEF on November 30, 1999.
16. **Project identification number**: P068239

17. **Implementing Agency contact persons**:
   Tony Whitten, twhitten@worldbank.org, tel:+1-202-458-2253

18. **Project linkage to Implementing Agency program**:
One of the five major themes of the Bank’s Country Assistance Strategy for China is environmental protection and is assisting the government in strengthening institutions, developing more effective instruments, and investing in priority and realistic agendas. The Bank’s recent Environmental Strategy for China stresses the importance of improved natural resource management, especially biodiversity. The project is a formal part of the China work program and seeks to add an important biodiversity element to a $150 million loan for water quality improvements in Lake Dianchi.
Lake Dianchi
Freshwater Biodiversity Restoration Project
Yunnan, China

1. PROJECT DESCRIPTION

1.1 PROJECT RATIONALE AND OBJECTIVES

The Lake Dianchi basin lies just south of Kunming, the capital of Yunnan Province, China. The basin is a ‘hotspot’ of freshwater biodiversity with 24 indigenous fish species, at least 11 of which are endemic, and dozens of endemic mollusc and crustacean species. These are found in the lake itself and also in adjacent springs, often associated with Buddhist temples. Until the mid 1960s, the main species exploited for commercial purposes were endemic species such as the small carp, white minnows, yellow tail, and golden line fish. Since the 1950s however, some 31 fish species, and a variety of plant species have been introduced although not all of these have persisted. Declining water quality (especially high phosphorus and nitrogen), loss of natural habitats, competition for food and living space, and possibly introduced diseases and parasites have combined to threaten the indigenous fauna and flora, resulting in the apparent extinction of at least some of the endemic species. Surveys since 1994 indicate that at least seven endemic and five other indigenous fish species are still extant, but it should be noted that surveys of the type and intensity likely to give an accurate picture of the endemics' distribution and status have not yet been conducted.

Environmental improvements in Lake Dianchi and its watershed are a major national priority - its water quality data are reported to SEPA on a monthly basis. It is one of the lakes in the national multi-sectoral program known as "Three Lakes, Three Rivers" and thus is attracting national, provincial and donor support. Both the Agenda 21 (approved by the State Council in 1994) and the China National Wetland Conservation Action Plan (endorsed by 17 ministries and agencies in 1995), lists Lake Dianchi as a priority site for action. The China Biodiversity Conservation Action Plan (approved by State Council in 1994) does not (in keeping with many similar documents of that time) give much attention to the threats to and conservation of freshwater biodiversity, but some of the endemic fishes of the Lake are listed as Priority Species. China now has a new policy to promote development in western China (including Yunnan), stressing early attention to environmental protection.

The World Bank has been assisting the provincial government in addressing some of the water quality problems through the US$300 million Yunnan Environment Project (YEP) (P003599, $150 million loan, Board date June 1996, closure December 2002). This project is part of a phased development program of Yunnan Province to improve environmental conditions and sustain urban services management. The principal objective of the project is to provide a sustainable environmental framework for the long term economic and social development of the province, while providing a conducive foundation for industrial growth. Specific objectives of the project are to: 1) strengthen policies, regulations and institutional arrangements for pollution control, and municipal water, wastewater, solid waste and nightsoil management; 2) support the improvement of the lake

1 In order: Cyprinus micristilus micristi, Anabarilius alburnops, Anabarilius polylepis, Xenocypris yunnanensis, and Sinocyclocheilus grahami grahami.

2 The surveys conducted under the PDF A grant and other recent short surveys have confirmed that there are seven definitely extant endemic species: Anabarilius alburnops, Pseudobagrus medianalis, Sinocyclocheilus grahami, Schizothorax grahami, Triplphysa grahami, Yunnanilus discoloris, and Yunnanilus sp., a new species discovered during the PDF A surveys. During that same survey the endemic shrimp Caridina gregoriana, believed extinct, was rediscovered. The Dianchi populations of Discogobio yunnanensis and Yunnanilus pleurotaenia are likely to 'become' endemic when the appropriate taxonomic work is completed.
environment in Gejiu and Kunming in order to allow the waters to be used for potable supply, industry or agriculture, as appropriate; 3) facilitate complementary sustainable investments in pollution control and municipally-provided urban environmental services; and 4) introduce a comprehensive approach to planning, prioritization, management, and financing of urban environmental infrastructure investments. The components of YEP are: 1) Lake Dianchi basin water quality recovery; 2) industrial pollution control; 3) provincial urban environmental services; 4) environmental and water quality monitoring; and 5) institutional development, training and construction supervision.

With such a comprehensive effort in place, other environmental activities can build on it. In mid-1996 the World Bank instigated a brief study of the baseline ecological conditions of the lake (funded by UK-ODA). The resulting proposals on means of improving the Lake’s biological environment and on how biological processes could support the objectives of the YEP were supported by the Yunnan Provincial Government, and means investigated to implement them.

The objective of the proposed four-year GEF project is to restore and manage habitats around the lake in order to secure the conservation of the remaining endemic species of Lake Dianchi and its immediate tributaries. This will be achieved by providing suitable breeding habitat, comprehensively surveying the biological environment of the Lake and its immediate tributaries, establishing a program to monitor lake quality improvements (using the presence/abundance of the endemic species as indicators of improved ecosystem health), and improving public awareness of the Lake region’s unique biological environment. By so doing, it is expected to achieve the goals of:

- The conservation of a community of internationally significant, threatened and severely range-restricted species;
- A demonstration of the utility of restoration for freshwater biodiversity conservation;
- The innovative use of biological indicator species for pollution bioremediation and monitoring;
- A greater awareness locally, nationally and globally of threats, challenges and opportunities related to Lake Dianchi in particular and freshwater biodiversity in general; and
- Increased capacity to survey and identify freshwater biodiversity in Yunnan and elsewhere in China.

The project is in accord with the China National Wetland Conservation Action Plan (CNWCAP) and will assist PR China to meet its obligations under international conventions such as the Convention on Biological Diversity and the Convention on Wetlands of International Importance (Ramsar, 1971). On a global scale the project addresses the GEF Biodiversity Operational Program #2: Marine, Coastal and Freshwaters (including wetlands).

In order to achieve the goals and aims of the program it is proposed that the Lake Dianchi Freshwater Biodiversity Restoration Project implements four complementary components (Figure 1).
1.2 Current Situation

1.2.1 Provincial setting

Yunnan Province is situated in the south west of the People's Republic of China. To the north, Yunnan is bordered by Sichuan Province and to the east, by the Provinces of Guizhou and Guangxi. To the south and west it is bordered by Vietnam, Lao PDR and Myanmar. The population is about 40 million and the total land area of Yunnan is 394,000 km² with an average population density of about 100 people km². The economy is dominated by the capital city of the Province, Kunming, which has a population of over 3 million.

The south-eastern Himalaya dominates the north west of the province. Three major river sources are found in this area: 1) the Jinshajiang (which discharges into the Changjiang); 2) the Lancangjiang (Mekong) and 3) the Nujiang (Salween). The source of the Nanpanjiang is found in the north east of the Province. The south of Yunnan Province is tropical whereas the central and eastern areas comprise a plateau and fertile lake basins at an elevation of 2000 metres.

1.2.2 Dianchi Basin

The Dianchi basin is 2920 km² in extent and is located between the watersheds of the Jinshajiang-Yangtze, Honghe and Pearl rivers at an altitude of 1990 m. In addition to Kunming there are within it 18 towns and 22 villages with 2,103,599 people. The area is largely agricultural and populated almost exclusively by people of Han ethnic origin. The local climate is subtropical with a mean annual temperature of 15°C. Mean annual rainfall is about 1000 mm. With an area of nearly 300 km² Lake Dianchi is one of the largest freshwater lakes in Yunnan and the sixth largest in China. It is approximately 40 km long (north to south) and 12.5 km at its widest point. The mean depth is 4.7 metres and the maximum depth is 10 metres. The lake is divided into two parts, the small northern Cao Hai (inner lake – about 3% of the volume) and the much larger Wai Hai (outer lake). These have now been separated by the construction of a causeway. There are 17 rivers draining into the lake. The outflow from the Wai Hai is to the Tanglangchuan River at the southwest of the lake and overflow from the small Cao Hai flows west through the recently constructed Xi Yuan Tunnel and thence to the Tanglangchuan River and the Jinshajiang/Yangtze.

To date, the biological surveys of the lake have been somewhat ad hoc in terms of their objectives, format, methodology and intensity. As a consequence, results of the different surveys are usually incompatible and comparisons rather meaningless and providing poor baseline information by which to track or judge the impact of any project intervention.
The Yunnan Environment Institute has recently completed a successful pilot for macrophyte restoration in Lake Dianchi. The project site is Hui Wan Bay and has an area of 6.7 ha. The implementation period was from April 1998 until December 2000 and a variety of species were planted⁴. A recent evaluation of the pilot project found that within the bay, light penetration was twice, and nitrate and phosphate levels were half what they were in neighboring sites, demonstrating the overall improvements in habitat quality possible through this means. The project will build upon this pilot.

1.2.3 · Summary of threats to the freshwater biodiversity of the Lake Dianchi

The main threat to the freshwater biodiversity of the Lake Dianchi is habitat degradation, the root causes of which relate to the significant socio-economic development in the Dianchi basin over the last few decades; that is:

- The reclamation of lakeside land and floodplain areas for urban and agricultural usage;
- The construction of lake perimeter dykes;
- The destruction of macrophyte beds during dredging for bivalve molluscs;
- Increasing human intervention and disruption of the natural water cycle;
- Water pollution from industrial, domestic and agricultural sources;
- Increasing turbidity owing to deforestation for local industry in the catchment;
- Introduction of exotic fish, shrimp and plant species.

These threats are discussed below and summarized in Figure 2 which explains the relevance of the proposed project interventions.

---

Figure 2: Lake Dianchi - Root Cause Analysis of Threats

**CORE PROBLEM**

- Deforestation for fuel for small industry and domestic use
- High usage of agrochemicals
- Reclamation of lake shore
- Changes in landuse

**IMMEDIATE THREATS UNDERLYING OR ROOT CAUSE**

- Few other options available for agriculture, fuel and water supply
- Lack of alternatives for wastewater disposal
- Lack of basic information for policy making and management decisions for resource and biodiversity conservation and local participation
- Lack of effective legal instruments, lack of enforcement mechanisms
- Poorly-coordinated and funded conservation and management protection activities
- Limited resources available to provide monitoring, control and surveillance.
- Weak technical capacity and limited training opportunities

**UNDERLYING OR ROOT CAUSE**

- Loss of phosphate
- Deforestation for fuel and agriculture
- High residual phosphates
- Introduction of exotic species
- Increasing human intervention in hydrological cycle
- Loss of sloping and natural shoreline

**LOSS OF BIODIVERSITY IN LAKE DIANCHI**

**Habitat Degradation**

**INTERVENTIONS**

- Improve habitat for indigenous species in Lake Dianchi through wetland management and restoration
- Establish up-to-date baseline inventory of species and diversity/composition in Lake Dianchi
- Raise awareness of all local stakeholders and especially Government on the value of wetlands and the importance of wise use
- Strengthen the technical capacity of all users and stakeholders to better manage resources to conserve biodiversity and ecosystem stability
- Train local inhabitants and develop capacity to help conserve and manage Lake Dianchi
1.2.4 Water Quality in the Lake and YEP Interventions

Kunming has limited available water resources and increasing water demands have necessitated meeting a substantial proportion of these by abstracting water from Lake Dianchi. Much of the water the lake receives is untreated wastewater from Kunming and as a consequence the lake has become polluted and increasingly eutrophic, particularly at the northern end in Cao Hai. However, given the limited water resources of the Dianchi Basin, the demands for water abstraction from Dianchi are such that they could not be met without the return of wastewater to the lake. The water quality concerns are exacerbated by earlier developments and reclamation around the lake shoreline that have destroyed its natural ecological environment and changed its shape (Figure 3). The water quality problems of the lake are therefore a combination of increasing nutrient loads and a decreasing capacity for assimilation of these nutrients. The urgent need for, and priority given to, water quality improvements of Lake Dianchi is reflected in the high proportion of the YEP funding allocated to components targeted at achieving this objective, principally the reduction in the loads of nutrients (particularly phosphorus) entering the lake.

The point source phosphorus loads (between 60% and 80% of total loads) to the Cao Hai and Wai Hai were approximately 150 t/year and 210 t/year respectively in 1995. In the absence of any further pollution control interventions, these levels have been calculated to increase to 205 t/year and 424 t/year by 2010. Priority in the YEP was given in project design to the reduction of phosphorus loads to the larger Wai Hai, because it supports all the abstractions for municipal water supply, and to point-source loads in view of their dominance and the relative difficulty and cost of control of non-point sources on an equivalent load basis.

The YEP components targeted at reducing phosphorus loads to the main Wai Hai part of the lake comprise a combination of two new municipal wastewater treatment plants, upgrading another, sewerage networks in Kunming, building small wastewater treatment plants for smaller towns in the Lake Dianchi catchment, and upgrading and wastewater treatment at two fertilizer production plants. Although the load reductions achieved by the YEP components

![Figure 3](image-url)  

**Figure 3.** Changes in shape and macrophyte distribution between the 1950s, 1980s and 1990s.
are substantial and would reduce the problems in water treatment, the residual loads remain significant and the degree to which recovery of the lake will be achieved is influenced also by its capacity to assimilate phosphorus. This has been reduced as a consequence of the disruption of the natural ecology and present phosphorus loads greatly exceed this capacity.

Mathematical modeling of water quality in Lake Dianchi, taking into account natural processes such as sedimentation and uptake by fish, showed that the YEP components would arrest the process of decline in Wai Hai water quality (caused by increasing phosphorus concentrations) but would not, by themselves, result in a substantial reduction in phosphorus concentrations. The results of this modeling indicate that, if discharges of phosphorus had been totally prevented from 1995 onwards, the lake would take 20 years to achieve the low phosphorus concentrations that were observed prior to 1980. In any case, the mean residence period of water in the larger Wai Hai is in the order of 3 years and most of the load reductions have occurred only recently, so it would not be expected that the impact of load reductions would yet be detected.

Thus, conditions are in place for water quality improvements in the Lake and it is now possible to consider investing in the conservation of the globally-important biodiversity.

1.2.5 Introduction of exotic species

Since the 1950s, a total of 31 exotic fish species have been introduced into the lake from other provinces in China in the hope of increasing the fishery yield of the lake. In mid 1960s, the four major farmed carps, namely the Blue carp (Mylopharyngodon piceus), Grass carp (Ctenopharyngodon idellus), Silver carp (Hypophthalmichthys molitrix) and Big head carp (Aristichthys nobilis) were introduced into Lake Dianchi. These carp became the major fish caught in the lake and their introduction accidentally resulted in the introduction of some small egg-eating fishes such as the goby (Ctenogobius giurinus) and small minnows (Pseudorasbora parva). These fishes fed on the eggs laid by the endemic and other native species. As a result of this, since the mid 1960s, the populations of endemic and other native fishes of Lake Dianchi have been drastically reduced.

In the 1970s, the Goldfish carp (Carassius auratus auratus) became the dominant fish in Lake Dianchi. At the same time, shrimps such as Macrobrachium nipponense and Palaemon modestus were introduced and outcompeted the native species. This situation prevailed until about 1985 when the salangid fish Neosalanx taiwensis was introduced into Lake Dianchi. Carassius and Neosalanx became the co-dominant fish in the Lake. As a result of this increased competition the endemic and other native species went in to further decline. In the 1990s, the minnow Cultrichthys erythropterus was introduced into Lake Dianchi and later became the dominant fish species, out-competing the carp varieties. At the same time, the numbers of Neosalanx also declined.

For the majority of these introduced species it is not possible to ascertain their precise impact on the indigenous populations in the lake, although experience from elsewhere would suggest that higher competitiveness for food and space, direct predation, low resistance to diseases introduced with the fish, and the ability to benefit from the ‘poorer’ environment would be major factors. The exception to this is impact on the aquatic macrophytes of the herbivorous grass carp. The grass carp is a very effective species in the control of weeds and unwanted macrophytes in canals and reservoirs. Although its effect on the macrophytes in Lake Dianchi has not been studied specifically, the striking reduction in these aquatic plants since the introduction of the carp is
unquestionable. The correlation between these factors and its known preference for aquatic macrophytes as food provides circumstantial evidence, although increased turbidity would also have restricted light penetration and prevented submerged plants from growing, and it is also possible that dredging for the bivalve molluscs also destroyed areas of macrophytes. Warnings about the potential impacts of this fish were given in 1975 and as a result the annual restocking of the carp was discontinued. Since the species cannot breed naturally in the lake it was anticipated that the species would die out. This has not occurred because individuals escape into the lake from cage culture systems, although the population is greatly reduced.

In addition to species of carp the large freshwater prawn, *Macrobrachium nipponense*, was deliberately introduced in 1958 as a potential commercial species. This seems to have been a highly successful competitor against the endemic shrimp *Caridinia gregoriana* and this is now (very) rare (rediscovered during the preparation surveys). This shrimp appears to have been the primary food of the small fish *Yunnanilus nigromaculatus* which is also now very rare.

### 1.2.6 Fisheries Management

The fisheries legislation was reformed in the early 1980s with the introduction of an 8-month closed season. The duration of the open fishing period is from the July 1 until October 31. During this period a licensed fleet of some 1100 boats operate on the lake with no restrictions on catch size. Fishers are able to operate at all hours of the day or night, seven days a week. The license fee is between 600-800 yuan ($80-100) and typically net profits at the end of the season are about 2000 yuan ($250) per boat. Thus this can be seen as subsistence fishing. Interestingly though, since the introduction of the closed season there has been an increase in recorded catch of 70% - despite there being no restrictions in place during the open season. This can be explained by the fact that fish are being allowed to breed and mature during the closed season and thus they are available for capture in the open season.

A total of about 300 ha of Lake Dianchi has been set aside as Fish Sanctuary Areas with total protection from fishing activities under the jurisdiction of the Kunming Department of Fishery Management. This area is distributed among seven bays with at least one in each of the four counties around the lake. Each county has assigned an office with responsibility for the monitoring, control and surveillance of its area. To carry out its task, each office has one large and three small vessels.

Thus, it is clear that the use of the lake for fisheries is well regulated, that the concept of protection of certain areas for purely commercial reasons is established, and further protected areas identified by project surveys of habitats and species are feasible.

### 1.2.7 Management and Legislation

The current system of management for Dianchi is multi-departmental, including the Provincial Environment Protection Administration, Provincial Water Conservancy Department, Provincial Agriculture Department, Provincial Fishery Department. These departments are of equal rank and there exists the potential for conflicts and contradictions among them. In recent years the Government of China has promulgated a series of laws and regulations that are related to natural resources and environmental protection, including some 15 laws that are specifically related to wetland conservation. The main laws applicable to Dianchi are Environment Protection Laws of P.R. of China and Dianchi Management Regulations. Lake Dianchi has its own specific protection
act that was established in 1988, and other laws and regulations applicable to the Dianchi Basin management are the Fishery Law (1983), Environment Protection Law (1989), and Water and Soil Conservation Law (1991). However, enforcement of these regulations is problematic. One reason is the lack of a supervising and monitoring system. As a result the current main management problems are as follows:

1.3 **Expected Project Outcomes with Underlying Assumptions and Context**

The project outputs will be generated through four integrated components, namely: Wetland Management and Restoration, Surveys and Monitoring and Species Conservation, Capacity Building and Training, and Public Awareness.

The overall outcome by the end of the project will be that the globally-important biodiversity of Lake Dianchi will have been conserved and maintained and/or enhanced. Local and national awareness of and support for conserving such a unique biological community in a peri-urban setting will have been enhanced to the extent that development agencies will incorporate its needs into their plans.

The underlying assumption for all the components is that the currently favourable political and budgetary climate towards such interventions will continue and possibly improve if they add to the overall objective of improving the environmental condition of the lake.

**Outcomes of Component 1 – Wetland management and restoration**

This component will deliver practical and long-lasting benefits to the indigenous biodiversity of the Lake by restoring areas to some semblance of their 'natural state'. The plans for management and restoration interventions will be integrated with broader local government plans and, starting modestly, these will also act as 'capacity builders' to demonstrate what can be done and, if successful, replicated over a larger area. By working as closely as possible with local governments it is expected that the project, through the agency of the Steering Committee, will assist in harmonizing the relationships and strengthening the cooperation among the various departments responsible for different aspects of Lake Dianchi management. The project will thus cause the slow down and to reverse of the environmental degradation of the lakeshore and tributary ecosystems. Through financing from the local government the programme will conduct an environmental impact assessment of the proposed restoration activities. It is envisaged that the restoration activities and restructuring of shoreline (civil works) will cover approximately 24000 sq. metres of shoreline and 15 hectares of replanted macrophytes.

In addition to these global benefits there will also be local benefits in the form of increased touristic values, the provision of green manure and fiber from harvested macrophytes and lakeshore vegetation. The interventions will lead to a reduced incidence of algal blooms, fish kills and odor that are all related to high nutrient loads.

**Outcomes of Component 2 – Surveys, monitoring and species conservation**

This component will provide fundamental information on habitats and species, give recommendations on protected areas and management, feed into the awareness component, as well as collect the monitoring data to provide feedback on project impact and recommendations for adapting plans and for expanding and/or fine tuning of interventions. The information gathered and interpreted will assist the design and focus of the project as it proceeds, assist those
concerned to understand better the biological/environmental processes at work in the lake, and how GEF interventions should be best applied. The surveying and monitoring will not be restricted to just the lake but will extend to the springs, tributaries and reservoirs upstream of the Lake Dianchi.

The surveys of the Lake Dianchi basin will be developed to identify important habitats, species and biodiversity hotspots, and will provide the framework for coordinated research and survey and will feed directly into a centralized monitoring and data storage system and into specific species conservation plans.

The survey results on the status of the endemic species and critical habitats will highlight those in need of detailed attention. This is expected, for certain species, to lead to protection ordinances at local and perhaps national levels, to local initiatives for area conservation, and to _ex situ_ conservation efforts (non-GEF) in the Kunming Institute of Zoology and perhaps elsewhere.

**Outcomes of Component 3 – Capacity building and training**

This component will support all the other components. Training needs will be ascertained in terms of skills and subjects required and respective depths. It will develop in the various offices and agencies represented on the Steering Committee a cadre of motivated and professional staff with strong capabilities in adaptive wetland management. Adaptive management recognizes that systems are complex and evolve over time due to changed circumstances and new information, and therefore aims to make practitioners more responsive to change. This output will be achieved through training combining teaching, practical study tasks and English-language training using materials chosen to introduce concepts from the wider conservation literature.

This component will deliver training for senior- and middle-level staff of fisheries offices, urban planning offices, university staff and students, who can collectively assist in the dissemination of knowledge through Component 4. They will also seek to use the knowledge gained to recognize problems and opportunities and turn these into effective on-the-ground action. Mixing trainees from a wide range of backgrounds is expected to have the benefits of cross-fertilizing ideas. It is planned to hold the training in the facility offered to the project by the Yunnan Minorities Peoples’ Village.

The project will also enable good and/or well-placed individuals to benefit from national and foreign study tours, exchanges and field visits. In addition, a small number of good students will benefit from being part-supervised by foreign wetland managers and biodiversity specialists.

**Outcomes of Component 4 – Public awareness**

This component will establish public support for, and interest in, the biodiversity of Lake Dianchi heeding lessons on approaches from elsewhere (such as through the UNDP GEF China Wetlands project). The project will commission a marketing and awareness strategy from a marketing company established in China in order to identify target audiences, messages and activities. This strategy will also establish the baseline situation of knowledge, attitudes and behaviour in Kunming and towns and villages around the Lake concerning conservation and the Lake, and identify steps to change public attitudes and practice. The strategy will thus guide the development of a public awareness program that will be implemented by consultants with cooperation from the various media. A mobile exhibition/education facility will also be developed for use in the relatively remote villages, and it is expected that the project will assist in the production of a bi-lingual book on the lake and its biodiversity.
A major outcome of the project will be the establishment of a strategically-located public awareness and education centre, the building for which is provided by the Yunnan Minorities Peoples' Village just 8 km from Kunming on the northeast shore of the lake. This park attracts over 1 million visitors each year and from it visitors can travel by cable car southwest across the lake to the temples on Dragon Gate Mountain from which there are the best views of the lake. The awareness centre will house an exhibition, living specimens of unthreatened species, and a lecture hall, and be the base for the interpretation staff who will take visitors to the lakeside to explain the means and objectives of the restoration and other interventions.

A significant outcome of the project will be the cooperation with the local office of the Buddhist Association of China. This is necessary because a number of springs known to have populations of endemic species (some springs are the only known site for some species) are associated with Buddhist temples. Using teaching materials developed in Buddhist monasteries elsewhere in China with the help of the Alliance for Religions and Conservation, the project will partner with monks and adherents to ensure the safety of these sites.

1.4 ACTIVITIES AND FINANCIAL INPUTS NEEDED TO ENABLE CHANGE

Start up period/PIU

Total: $180,315; GEF Contribution: US$ 0

It is expected that with an agency unaccustomed to World Bank projects a start-up period will be required to establish the modus operandi to enable the swift processing and initiation of project activities. A project Steering Committee will be established by KIZ (see Section 1.6).

The project will establish a Project Implementation Unit (PIU) which will be staffed by a Project Director and a Project Coordinator. It is expected that the Project Director will be a wetlands manager with extensive experience. The Project Coordinator will be an experienced staff member from the Kunming Institute of Zoology with an in-depth knowledge of Lake Dianchi, its environs and the local user groups. The funds for the PIU will be drawn from KIZ and the Government of China. For the purposes of this project these funds will be seen as co-funding.

Other programs affecting the Lake Dianchi basin have been identified during preparation. The proposed project will proactively seek to form sound working relationships with each.

Component 1 - Wetland Management and Restoration

Total: $635,605; Requested from GEF US$399,000

1a. Develop an integrated, phased plan of activities. Through discussions with local government and lakeside communities, a detailed plan of what should be attempted and where will be developed. This will integrate with existing plans and will seek local support. This will cover also the means of strengthening reinforcement mechanisms and patrol management, and develop mechanisms for establishing co-management system with local communities. As well as the global benefits, it will be explained that the reconstruction and revegetation will benefit all freshwater species. The shoreline reconstruction plans will be subject to appropriate environmental impact assessments.

1b. Reconstruct Lengths of Littoral Zone. The sharp-angled shoreline will, in agreed areas, be remodelled to form gentle slopes to provide refuge for fry and small fish, and to provide
breeding habitat. These will form some of the sites for macrophyte replanting and bivalve restocking—see 1d and 1e.

It has been calculated that the total volume of soil to moved to reshape the shoreline will be approximately as 10,000 cubic metres (5 sites and 2000 cubic metres of soil will be moved at each site).

1c. **Reconstruct Emergent Littoral Fringe.** Lengths of the shore will be planted with emergent reeds, rushes, and trees to provide shading, allochthonous sources of nutrients and organic matter to be benefit of various organisms such as aquatic insect larvae that would be common food for fish.

1d. **Restore Macrophyte Beds.** A variety of species of submerged and floating-leafed species will be planted in the reconstructed areas heeding lessons from the Yunnan Environment Institute pilot. The growth of plants in these areas (and the appearance of propagules in neighboring control areas) will be monitored.

1e. **Restock Areas with Indigenous/Endemic Bivalves.** Using global best practice, habitat restoration will be enhanced with species of indigenous/endemic bivalves seeded into appropriate sediments. These organisms are bottom-living with great filtering capacity. This assimilates nutrients and removes suspended sediment and plankton thus reducing turbidity and increasing environmental quality for macrophyte growth.

**Component 2 – Surveys, Monitoring and Species Conservation**

Total: $276,500; Requested from GEF US$155,500

2a. **Survey Littoral and Tributary Habitats.** Based on the results of the PDF A surveys and other surveys, biodiversity hotspots within the Lake basin will be identified, classified and mapped. This may include important spawning areas or nursery grounds for endemic and/or rare fish, migration areas for birds or particularly diverse examples of freshwater macrophyte communities. Categorization of habitats will be according to those used by the Ramsar Convention on Wetlands of International Importance. Areas with habitats believed to be important to the conservation of the indigenous/endemic fauna will be recommended for formal protection.

2b. **Survey Endemic Fishes.** Led by the results of the PDF A surveys and habitat survey above a selection of likely sites will be surveyed for the protection of the endemic species of fish and bivalve molluscs and to better understand their status and distribution.

2c. **Establish a database of Dianchi biodiversity.** A straightforward database, probably using Access, will be built to receive and retrieve spatial, species, habitat and other data, and to facilitate the monitoring of trends. The project will build on databases already in existence in Fisheries, Urban Planning and other agencies to ensure the maximum fit possible.

2d. **Monitor Habitats and Species.** Based on the experience in the above surveys, and using experience from elsewhere, the project will devise protocols for cost-effective monitoring of species and habitats ensuring that data collected are comparable with previous surveys.

2e. **Recommend Protection Actions.** By the mid-term review it is expected to be possible to make some argued cases for actions needed to ensure the conservation of some of the threatened
endemic species (by affording ‘protected species’ status, or by instituting protection measures on their habitats). The project, through the Kunming Institute of Zoology, will present these to the Kunming Government requesting that they are taken to national level if necessary.

2f. **Develop and Execute a Program of ex situ Conservation.** (Non-GEF). The Kunming Institute of Zoology has some success in keeping and captive breeding a few of the endemic fish species of the lake. After wide-ranging within and outside the country as to the costs and benefits and specific means of such actions, the project will facilitate the translocation, captive breeding, dissemination, and reintroduction of some species.

Component 3 – Capacity Building and Training
Total:$320,000; Requested from GEF US$265,000

3a. **Assess Training Needs.** It was clear from the work under the PDF A studies that local capacity is limited. Thus a comprehensive training needs analysis will be conducted in the initial phases of the program implementation to better identify who needs the training, what training is required, where could the training be conducted, and how often should the training take place.

3b. **Conduct Technical Skill-Based Training Workshops.** These would be conducted in the Kunming Institute of Zoology or in the lakeside Education Center (see above) and be based around the need to build staff capacity in a particular specialist area or to solve management problems. It is proposed at this stage that there will be four main areas of training provided, thus:
- Environmental monitoring (with YEP);
- Wetlands and biodiversity protection and management;
- Adaptive management;
- Nature interpretation.

3c. **National Study Tours/Field Visits and Exchanges.** These would be targeted towards wetland site managers who will benefit from the information exchange, ideas and technology relating to specific wetland management issues. The advantage of national study tours is that they will develop networking capability. The duration for such tours would not exceed 2 weeks and would involve up to 25 participants. In this way the program will also develop working linkages to other wetland programs in China.

3d. **Academic Supervisors** (Non-GEF) International academics will be sought to offer supervision of young KIZ staff/students and other students to assist with research on areas of wetlands restoration at Lake Dianchi, such as the use of macrophytes to bolster ecosystem services of wetlands, and of bivalve molluscs in the bioremediation of water. A maximum of 12 students over the four years would be considered. Donor funding for this is being sought.

Component 4 – Public Awareness
Total:$420,550; Requested from GEF $155,550

4a. **Conduct a Survey of Knowledge, Attitudes and Behavior Among Stakeholders.** A professional marketing company will be hired to conduct the requisite surveys among different target groups in Kunming and around the lake (fishers, government officials, tourist companies, school children, etc.). Informed of the objective of the project the company will be required to propose a strategy (target groups, messages, etc.) to make the most effective use of the public awareness funds, and to establish a protocol for monitoring changes.
4b. **Develop the Program for Public Awareness.** The program will be based on the recommendations of the above survey and is likely to focus on the key groups who can best bring about changes in the management of the Lake and who would best support its conservation. It may also include a mobile unit to take ‘the message’ to villages around the lake.

4c. **Monitor Changes in Knowledge, Attitudes and Behavior.** See above. This will be done around the mid-point of the project and also before the project closes.

4d. **Establish the Public Awareness Center and Produce Materials.** While the Yunnan Minorities Village Park is providing space, it is essential that the space is used to best effect, and that materials identified under the strategy and program are produced in a professional but cost-effective manner. The Kunming Institute of Zoology already has considerable material related to the biodiversity of Lake Dianchi, and gaps will have to be filled. The most effective materials will be identified by the company above, but are likely to include videos, posters, TV programs, songs, etc.

4e. **Disseminate the information about the biodiversity of Lake Dianchi.** The biology, threats and management of the Lake will be disseminated to audiences elsewhere in China and internationally.

4f. **Form Partnership with the Local Office Buddhist Association of China.** Because some species are known only from small springs in areas next to Buddhist temples it is vital to develop maximum cooperation with the Buddhist authorities, probably through the Buddhist Association of China which, elsewhere in China, has been shown to be very responsive to the conservation message. This will entail both the instilling of appropriate management of the springs, and also using the Buddhist teachings to further convince that conservation of the endemic fauna is an desirable end. Some co-financing is expected from the Alliance for Religions and Conservation (Manchester, UK).

1.5 **SUSTAINABILITY AND RISK ANALYSIS**

The prospects for sustainability for the proposed project are good.

1.5.1 **Financial Sustainability**
Since the Dianchi basin is considered at national level to be a critical watershed, as exemplified by the $300 million Yunnan Environment Project, it will likely receive more financial support from national, provincial as well as international agencies in the future to build upon the efforts of the last five years.

1.5.2 **Ecological Sustainability**
It is expected that the project will establish permanent lakeshore habitat fringes close to the natural habitat which most likely will support the indigenous/endemic fauna. The area/length/depth of such fringes is expected to increase through natural processes and thus sustain the project benefits.

1.5.3 **Social Sustainability**
Given the cultural significance of Lake Dianchi it is likely that much local support above and beyond that which is already confirmed, will be generated. It is envisaged that once the visitor's center at the Yunnan Minorities People Village is completed there will be a surge of interest in
the Lake, its environs and the proposed program of restoration interventions and public awareness. The awareness program and related activities will raise the knowledge of the lake's biodiversity from a virtually non-existent baseline. This will ensure that by the end of the project there is sustained support for the conservation of Dianchi's indigenous/endemic biodiversity.

1.5.4 Institutional Sustainability
The Kunming Institute of Zoology has contacted many local organizations, individuals and groups who are or who would be potential stakeholders in this project. All have expressed their ongoing interest in the program and have been helpful in discussing the proposed components of the project to ensure that key concerns are taken in to account at the design phase.

1.5.2 Risks
Primary risks for the project have been identified as follows:

- **Government officials, institutions stakeholders lack the will to cooperate to achieve the project goals.** It is felt that a lack of will to make the project happen is unlikely. At all meetings it has been noted that all concerned parties are enthusiastic and have an interest in the outcome of all project interventions. Furthermore, all stakeholders are well-educated and motivated and are keen to develop their knowledge and skills.

- **That technical capacity will not be sufficient to carry on the project interventions.** In order to develop capacity as best as possible, the program has been designed with study tours and education programs to be available for selected program staff. Related to this will measures to enable staff to see the wider picture of the program this building awareness amongst staff.

- **That knowledge and technical expertise developed by this program will not be utilized.** Since Lake Dianchi is of such importance in terms of its biodiversity and cultural aspects it is considered unlikely that the responsible institutions in Yunnan will not take advantage of whatever new skills and knowledge become available. Indeed, such is the plight of Lake Dianchi that there will calls for further knowledge and research beyond the lifespan of this program.

- **That public awareness, education and outreach will be ineffective.** Experience has shown that in other countries public awareness, education and outreach programs can be most effective. People are usually naturally inquisitive and therefore are likely to express an interest in such programs.

- **That program activities will be unsustainable.** Given that the proposed project is scheduled to last for four years suitable funding will need to be identified during the course of the program to enable its ongoing sustainability.

- **That outside root causes of biodiversity loss will rise and swamp any benefit of the project.** Given the national-level attention to Lake Dianchi's environmental condition, the huge investments already made, China's ability to make major decisions to support environmental protection, and the imminent increase in public awareness of the problems and solutions, it is considered that this risk, though real, can be contained.

1.6 Stakeholder Involvement
The project has been developed with the assistance of a PDF A grant and with the participation of a wide range of relevant stakeholders. Project preparation included: a) meetings and interviews with relevant government agencies and donor projects; b) informal discussions with villager leaders, young people, shop-owners, and farmers in their houses, fields, and in coffee shops; and c) two workshops held at the Kunming Institute for Zoology. In addition to the staff and students of the KIZ with experience in Lake Dianchi, the major active stakeholders have included:
**Yunnan Environment Institute** is the provincial environment monitoring center. It has about 110 staff members and has monitored the important areas of Yunnan for more than 40 years. It has developed the monitoring experience and skills for water quality analysis of Lake Dianchi and biodiversity over this time. It has recently initiated an aquatic plant restoration experiment in the Huiwang area of Lake Dianchi. This experiment suggests that aquatic restoration is operational and water quality improvement is obvious.

**Kunming Fishery Management Department** is a unit under the Kunming Municipal Government, responsible for the daily management of fishery in Dianchi. This department focuses on fisheries management, public education and conservation awareness training. Although it has no interest in non-commercial aquatic resources, recognizes that its seven sanctuary areas around the lake can be restored to the benefit of both the commercial and other species, and has assisted in design and costings. The Department has 57 staff in the main offices and two stations comprising the administrative, market and police offices and the Fishery and Monitoring stations. The Market office has responsibility for the management, inspection of markets and conservation of aquatic wildlife. The Fisheries office is responsible for routine patrolling in the lake. The Monitoring Station is responsible for the aquatic product resources and water quality.

**Yunnan Nationalities Village** is a major tourist attraction with an average of 1.1 million visitors. The Directorship has for some time been looking for useful and interesting ways of using some of their buildings which are currently dominated by shops and restaurants.

KIZ has during the preparation sought comments and advice from many scientists from China and abroad and particularly from **Wetlands International**, both in the regional office (Kuala Lumpur) and the China Program Office in Beijing. This has itself increased the constituency of support for Lake Dianchi conservation.

The local office of the **Buddhism Association of Kunming** and the **Religion Affairs Bureau** in Shongmin have agreed to work with the project. Buddhism has played an unconscious role in the conservation of freshwater biodiversity around Lake Dianchi since protection of the temples at springs at Black Dragon Pool, Blue Dragon Pool in Baiyi town, Dragon Spring at Guangdu district, have protected the rare endemic fish *Sinocyclocheilus grahami grahami*, *Schizothorax grahami*, *Discogobio yunnanensis* and *Yunnanilus pleurotaenia*. But these sites are now threatened by increasing intensity of land use.

Details of the communities/villages and agencies with whom the draft plan was discussed are given below.

**Table 1: Likely Stakeholders in the Project**

<table>
<thead>
<tr>
<th>No.</th>
<th>Address</th>
<th>People participating activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bayi town, shongming county</td>
<td>Farmers, students</td>
</tr>
<tr>
<td>2</td>
<td>Majie town, Xishan district, Kunming</td>
<td>Workers, government officials, farmers</td>
</tr>
<tr>
<td>3</td>
<td>Dragon gate village</td>
<td>Farmers</td>
</tr>
<tr>
<td>4</td>
<td>Xihua village</td>
<td>Farmers, students</td>
</tr>
<tr>
<td>5</td>
<td>Guanyin shan</td>
<td>Farmers, workers, students</td>
</tr>
<tr>
<td>6</td>
<td>Haikou town</td>
<td>Workers, farmers, students</td>
</tr>
<tr>
<td>7</td>
<td>Jinning county</td>
<td>Government officials, farmers, workers</td>
</tr>
<tr>
<td>8</td>
<td>Ancient city town</td>
<td>Farmers, students</td>
</tr>
</tbody>
</table>
ZOPP/PRA/RRA methods were considered inappropriate in the context of this project. For example, access to resources (fish and shrimps) has been constrained (in both time and space) and enforced for 20 years and no additional restrictions are intended. The project will form areas where local people are expected to benefit because of the aquatic restoration initiative (both through improved fishing and through the availability of green mulch/fertilizer in the form of macrophytes harvested from the lake). It is expected that the success of these habitat improvements may lead to adoption of the methods by local communities. The awareness component will reach many people and it is hoped that messages for wise use of the watershed and of water will be retained and acted upon.

Table 2. Expected collaborating agencies

<table>
<thead>
<tr>
<th>Executing Agencies</th>
<th>Collaborating agencies</th>
<th>Expected area of collaboration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kunming Institute of Zoology</td>
<td>Yunnan Environment Institute</td>
<td>Macrophyte and shoreline restoration</td>
</tr>
<tr>
<td>in collaboration with:</td>
<td>Urban Planning Department of Kunming Municipality</td>
<td>Conservation education, management on preserved sites</td>
</tr>
<tr>
<td>Yunnan Minority Village</td>
<td>County government of Chenggong</td>
<td></td>
</tr>
<tr>
<td>Assisted by:</td>
<td>County government of Jinning</td>
<td></td>
</tr>
<tr>
<td>Yunnan Provincial Zoological Society, Municipal Buddhism Association of Kunming</td>
<td>County government of Xishan District government</td>
<td></td>
</tr>
</tbody>
</table>

2 INCREMENTAL COST ANALYSIS

Under the baseline scenario for the Lake Dianchi Basin, no significant wetland habitat restoration will occur. Species conservation will be impossible to monitor as there will be no baseline survey conducted and thus there will be unreliable/outdated reference data. Species conservation will not be implemented as capacity for decision making is low, and species populations will continue to fall, and species extinction more likely. The weak legislative framework will persist. Public awareness of the lake and its associated biodiversity will remain virtually non-existent with consequent lack of public support for any actions. The capacity and training of the staff of government and academic institutions in the field of active wetland management for the conservation of freshwater biodiversity will remain weak with few opportunities for further development.
The purpose of the proposed four-year GEF intervention is to restore and manage habitats around the lake in order to secure the conservation of the remaining endemic species of Lake Dianchi and its immediate tributaries. This will be achieved by providing suitable breeding habitat, comprehensively surveying the biological environment of the Lake and its immediate tributaries, establishing a program to monitor lake quality improvements (using the presence/abundance of the endemic species as indicators of improved ecosystem health), and improving public awareness of the Lake region's unique biological environment.

Under the incremental or alternative scenario it is envisaged that people at all levels would come to recognize Lake Dianchi as an important biophysical unit with a range of intrinsic and instrumental values. The key decision makers and stakeholder groups would be aware of the existence of a program which was designed to reverse the effects of years of physical abuse and the urgent need to conserve the ecosystem for the future benefit of all.

The project is built upon an estimated Government (and others) baseline expenditure of US$631,300 over the four years’ project duration. In addition to this direct baseline funding, the Government of the PR China (using its own finances and a World Bank loan of US$ 200 million for its Yunnan Environment Program) is investing significant resources in baseline activities to improve water management, waste water and pollution treatment and other investments to produce major improvements for environmental management in the Lake Dianchi basin. Investments through the YEP can therefore be considered complementary baseline funding for the project.

Total alternative project costs are estimated at US$2,489,270 (including PDF A and Government of PR China contributions to proposal preparation). Of these, US$1,857,970 is the incremental cost. US$997,550 of this will fund project activities related to achieving global benefits and will therefore be requested from the GEF. The remainder (US$860,420) will fund activities attaining domestic benefits and will therefore be financed by the Government of PR China and other donors.

<table>
<thead>
<tr>
<th></th>
<th>Baseline (PRC and others)</th>
<th>Total Alternative</th>
<th>Increment</th>
<th>GEF</th>
<th>Co-financing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparation</td>
<td>0</td>
<td>25,000</td>
<td>25,000</td>
<td>PDFA 22,500</td>
<td>2,500</td>
</tr>
<tr>
<td>PIU</td>
<td>0</td>
<td>180,315</td>
<td>180,315</td>
<td>0</td>
<td>180,315</td>
</tr>
<tr>
<td>Wetlands Management and Restoration</td>
<td>150,000</td>
<td>785,605</td>
<td>635,605</td>
<td>399,000</td>
<td>236,605</td>
</tr>
<tr>
<td>Surveys/Monitoring Program</td>
<td>240,000</td>
<td>516,500</td>
<td>276,500</td>
<td>155,500</td>
<td>121,000</td>
</tr>
<tr>
<td>Capacity Building</td>
<td>91,300</td>
<td>411,800</td>
<td>320,000</td>
<td>265,000</td>
<td>55,000</td>
</tr>
<tr>
<td>Public Awareness</td>
<td>150,000</td>
<td>570,550</td>
<td>420,550</td>
<td>155,550</td>
<td>265,000</td>
</tr>
<tr>
<td>Total</td>
<td>631,300</td>
<td>2,489,270</td>
<td>1,857,970</td>
<td>997,550</td>
<td>860,420</td>
</tr>
</tbody>
</table>

4 IMPLEMENTATION PLAN

Once the PIU and Steering Committee are established, the first major activities will be the detailed habitat and species surveys. These will set the scene for the wetlands restoration and management which will be conducted as the main body of the program along with public awareness development. It is envisaged that the first year of the program will generate a substantial amount of 'up to the minute' information on the lake's condition. This will be used to formulate public awareness and media campaigns which will evolve in the second and third year.
of the program. The wetlands management and restoration plans will be closely allied to those of species conservation. Both will commence in year two and continue throughout the program. In year three, integration of Lake Dianchi management needs into local planning agendas will be sought.

The Steering Committee will comprise representatives from each stakeholder group (see Figure 4 below). Additionally, the short-term international consultants would be invited to attend meetings to provide guidance on technical issues such as the four program components, but also on matters such as academic development of KIZ staff and development of research programs in-line with the current activities of KIZ or derived from perceived threats to the biodiversity of the lake. The committee will meet quarterly each year to review progress of activities. The implementation schedule is shown in the table overleaf.
Figure 4 To show possible institutional linkages concerning Lake Dianchi
### Duration of Project (in months):

<table>
<thead>
<tr>
<th>Activities</th>
<th>Project-months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ia. Develop an integrated, phased plan of activities.</td>
<td></td>
</tr>
<tr>
<td>Ib. Reconstruct Lengths of Littoral Zone.</td>
<td></td>
</tr>
<tr>
<td>Ic. Reconstruct Emergent Littoral Fringe.</td>
<td></td>
</tr>
<tr>
<td>Id. Plant Macrophytes.</td>
<td></td>
</tr>
<tr>
<td>Ie. Restock Areas with Indigenous Bivalves.</td>
<td></td>
</tr>
<tr>
<td>2a. Survey Littoral and Tributary Habitats.</td>
<td></td>
</tr>
<tr>
<td>2b. Survey Endemic Fishes</td>
<td></td>
</tr>
<tr>
<td>2c. Establish and maintain a database of Dianchi biodiversity.</td>
<td></td>
</tr>
<tr>
<td>2d. Monitor Habitats and Species.</td>
<td></td>
</tr>
<tr>
<td>2e. Recommend Protection Actions. Reformulate as necessary (Adaptive)</td>
<td></td>
</tr>
<tr>
<td>2f. Develop and Execute a Program of Ex situ Conservation.</td>
<td></td>
</tr>
<tr>
<td>3b. Conduct Technical Skill-Based Training Workshops.</td>
<td></td>
</tr>
<tr>
<td>3c. National Study Tours/Field Visits and Exchanges.</td>
<td></td>
</tr>
<tr>
<td>3d. Appoint Academic Supervisors</td>
<td></td>
</tr>
<tr>
<td>4a. Conduct a Survey of Knowledge, Attitudes and Behavior Among Stakeholders</td>
<td></td>
</tr>
<tr>
<td>4b. Develop and implement the Program for Public Awareness.</td>
<td></td>
</tr>
<tr>
<td>4c. Monitor Changes in Knowledge, Attitudes and Behavior.</td>
<td></td>
</tr>
<tr>
<td>4d. Establish the Public Awareness Center and Produce Materials.</td>
<td></td>
</tr>
<tr>
<td>4e. Disseminate the information about the biodiversity of Lake Dianchi</td>
<td></td>
</tr>
<tr>
<td>4f. Form and maintain Partnership with the Local Office Buddhist Association of China</td>
<td></td>
</tr>
</tbody>
</table>

### PUBLIC INVOLVEMENT PLAN

The public will be encouraged to engage with project activities through the various forms of the awareness program as well as through the Visitor Center at the Minorities Village. Suggestions and reactions from the public will be invited and will be compiled and summarized for discussion at Steering Committee meetings. Before this can happen though it will be necessary in assess the level of understanding of the issues pertaining to Lake Dianchi. This will be achieved by a knowledge assessment study undertaken by a commercial marketing company. Once the
assessment has been done the company will be invited to develop a strategy that will make best use of available funds.

One of the key areas for public involvement will the development of the Visitor's Centre. For the public to have a focal point where they can see the issues in context and fully described will be of immense value.

Given the importance of religion and culture it is seen as important to develop linkages with the Buddhist Association of China. Some Buddhist temples are sited next to pools that are of great importance for the endemic biodiversity contained therein. The Buddhist Association has been very responsive to the conservation message and the use of this will be reinforce the perceived need for conservation of endemic and fauna.

6. MONITORING AND EVALUATION PLAN

Monitoring will be conducted mainly of habitats and species. Early in the project the baseline condition of the endemic and other indigenous species will be measured and the effects of different activities will be assessed at least annually. As has been stated elsewhere, although surveys of Dianchi freshwater biodiversity have been undertaken in the past, methods have been neither standardized, nor have focused on the endemic and other indigenous species. Growth and development of the restoration areas will be monitored through the use of fixed-point photography in addition to periodic quantitative measurements.

Since one of the project objectives is to increase awareness of the biodiversity in Lake Dianchi, so the knowledge of this among the general public and of certain target groups (such as municipal government staff) will be assessed at the beginning, middle and end of the project as per the initial phase of the Public Awareness Component (component 4).

The project will liaise with the staff of the Municipal Government and the Yunnan Environment Institute through the Steering Committee to keep informed about major land use changes around the lake, particularly in the wetland habitats identified in the habitats survey of the first year 2002.

7. BUDGET

A summary budget for the GEF-financed component is presented below. Overhead costs for managing and administering the project are incorporated in personnel costs. The overall annual budget for conservation activities in the Lake Dianchi project over the four-year period is estimated below.

<table>
<thead>
<tr>
<th>Financing Plan for Lake Dianchi Aquatic Restoration Project</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>GEF</td>
</tr>
<tr>
<td>Start up Period</td>
</tr>
<tr>
<td>PDF A Year 1 Year 2 Year 3 Year 4 Total</td>
</tr>
<tr>
<td>------------------------------------------------------------------</td>
</tr>
<tr>
<td>GEF 22,500 320,000 280,000 185,000 189,920 997,550</td>
</tr>
<tr>
<td>Chinese Academy of Sciences 177,815 2,500 89,420 89,420 89,420 537,995</td>
</tr>
<tr>
<td>Yunnan 23,217 23,216 23,216 23,216 92,865</td>
</tr>
</tbody>
</table>

27
<table>
<thead>
<tr>
<th>Nationalities</th>
<th>Village</th>
<th>Yunnan</th>
<th>Scientific</th>
<th>Committee</th>
<th>Alliance for</th>
<th>Religions and</th>
<th>Conservation</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>56,140</td>
<td>56,140</td>
<td>56,140</td>
<td></td>
<td>5,000</td>
<td></td>
<td>224,560</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>177,815</td>
<td>25,000</td>
<td>488,778</td>
<td>453,778</td>
<td>353,779</td>
<td>358,700</td>
<td>1,857,970</td>
</tr>
</tbody>
</table>

Expenditure budget for GEF-financed components.

<table>
<thead>
<tr>
<th>Preparation/PIU</th>
<th>Wetlands Management and Restoration</th>
<th>Surveys and Monitoring</th>
<th>Capacity Building and Training</th>
<th>Public Awareness</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personnel</td>
<td>80,000</td>
<td>45,000</td>
<td>70,000</td>
<td>35,000</td>
<td>230,000</td>
</tr>
<tr>
<td>Small Works</td>
<td>204,000</td>
<td>45,000</td>
<td>45,000</td>
<td>10,000</td>
<td>434,000</td>
</tr>
<tr>
<td>Capacity Building</td>
<td>45,000</td>
<td>45,000</td>
<td>170,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment</td>
<td>23,000</td>
<td>40,000</td>
<td>150</td>
<td>25,550</td>
<td>90,050</td>
</tr>
<tr>
<td>Publications and Media</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>70,000</td>
</tr>
<tr>
<td>Travel/Subsistence</td>
<td>25,000</td>
<td>25,000</td>
<td>46,000</td>
<td>15,000</td>
<td>160,050</td>
</tr>
<tr>
<td>PDF A</td>
<td>22,500</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>22,500</td>
</tr>
<tr>
<td>Total</td>
<td>22,500</td>
<td>377,000</td>
<td>155,000</td>
<td>287,500</td>
<td>997,550</td>
</tr>
</tbody>
</table>

28
Map 1 to show the distribution of endemic species in Lake Dianchi.

The distribution of the endemic fishes in Dianchi lake, the arrow points the direction of the habitat loss of the indigenous fishes. □ Anabarilius albipinnis, □ Sinocyclocheilus grahami, □ Acrossocheilus yunnanensis, □ Discogobio yunnanensis, □ Schistothorax grahami, □ Carassius auratus auratus, □ Yunnanilus pleurotaenia, □ Yunnanilus discoloris, □ Misgurnus anguillicaudatus, □ Pseudobagrus medianalis, □ Monopterus albus, □ Protected area from fishing.
Map 2. County boundaries around Lake Dianchi
Map 3 to show location of proposed Public Awareness/Education sites around Lake Dianchi

The distribution of the environment education sites