PARADIGM CASES TO ILLUSTRATE THE APPLICATION OF THE INCREMENTAL COST ASSESSMENT TO BIODIVERSITY

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1. INTRODUCTION AND OVERVIEW TO THE PARADIGM CASES

1.1 The Need for Incremental Cost Assessment

The underlying rationale for support of all GEF projects is that some global environmental benefit is at stake, and the project seeks to address the threat(s) or need(s) to ensure that the global environmental benefit is conserved, or sustainably used and managed.

GEF financing is based on incremental costs. Paragraph 2 of the *Instrument* states that, the GEF shall operate, on the basis of collaboration and partnership among the Implementing Agencies, as a mechanism for international cooperation for the purpose of providing *new and additional* grant and concessional funding to meet *the agreed incremental costs* of measures to achieve agreed global environmental benefits in the following focal areas: climate change, biological diversity, international waters, and ozone layer depletion. The GEF policy on estimating agreed incremental costs is presented in document GEF/C.7/Inf. 5.

1.2 The Strategic Approach to Incremental Cost Assessment

The original motivation for undertaking incremental cost assessment was to meet formal financing requirements. The assessment of incremental costs, however, is not only important as the basis for GEF funding but also as a way of structuring a genuinely strategic approach to proposed interventions to remove threats of biodiversity loss. Conversely, the analytical and strategic approach behind a project design leads to incremental cost-assessment. The rationale for supporting a project through GEF funding is not different from the rationale used for the estimation of these incremental costs. In fact, the arguments are parallel. There is a strong and definite link between good project design and incremental cost assessment.

Figure 1 provides a strategic approach to incremental cost assessment (as applied to biodiversity, in this instance). The first question which needs to be addressed is if there is any unique biodiversity in the project site which is of global importance and/or priority. If yes, then is it threatened? What are the causes of threat? What is the trend of these threats? The threats emerge from the analysis of the baseline situation. This analysis will help to determine if the baseline is sustainable, and how it relates to the broad development goals of the country.

The next set of relevant questions relates to what course(s) of action can be taken which could remove these threats to ensure that the biodiversity of importance could be conserved or rehabilitated to sustainable levels of use and management. This should help to define the alternative strategy or the GEF intervention. The main cause and effects of adopting the alternative strategy should help define the scope of the analysis (or "system boundary") in physical, spatial and economic terms. Figure 2 demonstrates the application of this strategic approach to one of the paradigm cases, Insulae Piscatoriae. Just as the baseline identifies the threats to biodiversity or the actual causes of current loss, so the alternative should address the threats and remove the causes. One of the main benefits of this strategic approach to incremental cost assessment is that it requires this link to be made explicit.

It is increasingly apparent that a well-prepared project that shows how the activity (or activities) will "make a difference" to the global environment is relatively easy to cast in incremental terms, whereas poorly conceived projects are not too easily costed. A highly erroneous practice is to conduct the incremental cost assessment at the tail-end of the project formulation, undertaken simply to satisfy the formal GEF requirement. In this later case, the incremental cost matrix becomes the focus of the analysis, and filling up the cells the target. This is most counter-effective and cumbersome, to say the least.

The strategic approach and vision to incremental cost assessment affirms the incremental cost reasoning to be part of the "mainstream" thinking of good project design, and not an add-on activity. Despite the logic behind this strategic approach it has seldom been articulated or made explicit. This gap needs urgently to be rectified.

1.3 Aim of the paper

The application of the incremental cost assessment to biodiversity has always been uncertain. This paper seeks to demonstrate that the concept is a workable one in biodiversity. This paper has a twofold aim:

1. to make explicit the strategic and logical approach to incremental cost assessment
   - to demonstrate that it is replicable and applicable to all GEF projects

1. to apply this strategic and logical approach to specific case examples (or paradigm cases)
   - these paradigms will provide operational guidance at the more practical level

Most GEF projects to date have been conservation type projects, more amenable to rapid incremental cost procedures than to full treatment, and we have not been able to find good project examples where full incremental cost assessment has been demonstrated well. We are still finalizing some case studies for consideration and dissemination. In the meanwhile, we are presenting here some hypothetical paradigms which have been developed out of real cases. The paradigm cases represent different operational programs, and geographical regions and the data source for each could be (i) actual GEF projects; (ii) case studies; or (iii) hypothetical cases, based on experience.

Table 1 provides a summary of the six paradigm cases elaborated in the text. These paradigm cases are to assist in full incremental cost analyses in accordance with the required project format, generally needed for sustainable development activities and for the removal of the causes of biodiversity loss found in the productive sectors of the economy. These activities are modifications of the normal way of doing business, or substitute activities for economic development in a globally environmentally friendly way. There is clearly a baseline of economic activity in these cases, and the costs of these baseline activities are not eligible for GEF support. This more sophisticated assessment is required to separate baseline from incremental costs in these situations.

Ultimately this portfolio of paradigm cases should be used for dissemination and outreach to fill the urgent need for guidelines to Implementing Agency Staff and Task Managers on how incremental cost should be operationalised. The portfolio will be improved over time as we draw useful lessons from experience, and more cases will be developed to address existing gaps in information.

This undertaking is part of the PRINCE initiative. In addition to this there is ancillary material in the form of case studies and paradigm cases that have been prepared by PRINCE, with the help of Implementing Agencies.

1.4 Clarifications and Caveats

The focus and emphasis of the paradigm cases is on the logic of the incremental cost argument, the clarity with which the argument is made, and on addressing issues of special significance associated with each case to demonstrate how these would influence the assessment of costs. Table 2 provides a summary of the issues addressed through each case.

As mentioned, the emphasis is on highlighting the essential incremental cost reasoning in each paradigm case without distracting (the reader) with obviously ecological or operationally unrealistic aspects. So as to achieve this most effectively, the cases have deliberately been kept short, clear and concise. Operational details mentioned are those essential for understanding the incremental cost logic. We mention here some issues which we may have not dealt with in great detail because they go beyond the incremental cost reasoning itself, but interact implicitly with the calculation of the costs. Actual projects would need consider these issues more fully. Finally, so as not to mislead we also set out caveats to the application of these paradigm cases to actual projects.

(a) Global benefits

Each of the paradigm cases makes some difference to global biodiversity conservation. In some cases this may be more explicitly stated (e.g. Insulae Piscatoriae where the alternative strategy seeks to protect a particular fish species), whilst in other cases the biodiversity benefits are at a more aggregate level (e.g. Porticus, Bovinia). We recognize that global environmental benefits are the basis of GEF projects, but do not dwell on this issue. It is assumed here that the project has been accepted conceptually: in which case it satisfies the criterion of achieving globally important biodiversity conservation, and that the rationale of this would be more fully expounded in the Project Document.

(b) Ecological realism

Issues of ecology are fundamental to biodiversity projects, and need to be discussed during project formulation by ecologists, biologists, wildlife managers, and other stakeholders; and all of this should be detailed in the Project Document. So as not to distract the reader from the aim of illustrating the incremental costs assessment, we do not go to great lengths to discuss the ecology of the protected area and/or the species (for e.g., what the effect of wildlife-friendly corridors in the Bovinia case would have on the carrying capacity of the cattle in the long term) or ecological designs (such as the size or mix of the biological corridors in the case of the Porticus). We have kept the ecological descriptions of the sites to a minimum, but without sacrificing ecological realism or fact.

(c) Discount rate

The discount rate used in all the paradigm cases is 10% throughout. This is an arbitrary rate chosen for the purpose of analysis (although it falls within the average rate used in most developing countries). The specific discount rate chosen in any project would reflect the opportunity cost of capital in that country, and may often also be tied to another project (if the GEF project is a component of a larger project).

(d) Funding modalities

The paradigm cases illustrated here do not promote any particular funding modality, but simply seek to demonstrate how good project design, and funding modalities are integrally linked to the project site and national system of governance. For example, in the case of Porticus it is recommended that the recurrent cost of compensating land-owners for opportunity costs foregone in shifting from the *de*-facto land use to the GEF alternative be managed through a trust fund. This funding modality is simply to demonstrate the use of an innovative form of fund disbursement to ensure that the land-owners comply with the rules of the ‘game’ throughout the project period: it does not imply a GEF policy recommendation. The learning value of the exercise is to demonstrate that funding modalities in a project should emerge from the unique features of the project, the socio-economic and political situation in the country. In real projects this would be guided by any special GEF policies on funding modalities.

(e) Temporal dimension: project duration

The project duration is generally defined by the Implementing Agency in conjunction with the government. But for good project design it would seem that the project should see itself to either environmental and/or financial sustainability. This is important otherwise GEF projects could see themselves running into ‘second phase’ funding, or if the project aims are not achieved, the previous GEF investment could be a waste! In the paradigm cases here no claim is made of the fact that the project duration would ensure either environmental or financial sustainability. This issue would need to be addressed closely in actual projects.

(f) "Cookie cutter"

The primary intention here is to use these paradigm cases as teaching cum demonstration tools. These paradigms should not be used in the "cookie cutter" approach, because each project is unique and will have to be presented on its own merits. Any attempt to apply these paradigm cases in *toto*, is likely to lead to confusion and pitfalls.

(e) Application to larger, complex projects

Projects vary in their size, complexity and especially in relation to the national governance structure, and of necessity the incremental cost assessment is likely to be more elaborate than presented here. But we maintain that the rationale and approach remains the same. The incorporation of this thinking from the early stages of concept formulation and the preparation of projects through PDFs A, B or C through to work programs will be eased if one maintains this logical and strategic thinking process.

TABLE 1: PARADIGM CASES TO DEMONSTRATE INCREMENTAL COST ASSESSMENT FOR THE BIODIVERSITY FOCAL AREA

OPERATIONAL PROGRAM #	**PARADIGM CASE**	**ALTERNATIVE STRATEGY**
1. Arid and semi arid zone ecosystems	• Bovinia	• 2 alternatives explored: (I) replacing veterinary fences with wildlife friendly fences; and (II) annual vaccination of cattle
2. Coastal, Marine and Freshwater ecosystems	• Insulae Piscatoriae	• 2 alternatives explored: (I) replacing traditional hook and line fishing method with modern version 'fish aggregation devices' (FADs); and (II) FADs plus eco-tourism activity

3. Forest ecosystems	• Arboria	• alternative: augmenting the baseline of commercial inventories to include bio-inventory for a 'hot-spot' megadiversity country
3. Forest ecosystems	• Sylvania	• alternative: shift in logging method to ensure survival of endemic fish populations and overall peat forests biodiversity
2, 3 & 4: Coastal, Marine, Freshwater; Forest and Mountains ecosystems	• Porticus	• alternative: including biological corridors to enhance biodiversity conservation of globally threatened and endemic species and facilitate biodiversity conservation between continental land masses.
2, 3 & 4: Coastal, Marine, Freshwater; Forest and Mountains ecosystems	• Titicaca	• alternative: complementing the baseline development activities in the Titicaca basin to ensure conservation of unique and threatened biodiversity though hydrobiological programs and alternative sustainable livelihoods.

2. BACKGROUND AND SUMMARY OF THE PARADIGM CASES

2.1 Background of each paradigm case

This section provides a brief background of each of the paradigm cases, and highlights the interesting features of the project with respect to incremental cost assessment (see also Table 1). The details are provided in the paradigm case itself.

I. INSULAE PISCATORIAE: Provision of Fish Aggregation Devices to Protect a Threatened and Unique Fish Family, the *Piscus unicus*

a. This case study is based on part of a larger project in the Comoros Islands. The aim of the project is to conserve a unique and threatened family of fish, by promoting the use of a modernized version of hooks and lines (referred to here as fish aggregation devices) as an alternative fishing strategy to the prevalent traditional hook and lines.
b. The risk associated with any potential over-harvest through excessive use of FADs is countered by the inclusion of a second alternative which combines the use of FADs with the facilitation of eco-tourism to ensure that baseline domestic benefits are not undermined.
c. The results reveal that although the least-cost option may be favored in economic terms, the long term sustainability of the project and natural resources may favor the second alternative scenario. The GEF grant should cover the full incremental costs of the project.

II. BOVINIA: Moderating the Impact of Veterinary Fences to the Wildlife and Ecosystem of the Bos Delta

a. This case study is broadly based on a proposal for PDF Block B funding, although the scope and details have been modified to provide for additional features to be included in the development of the paradigm case. The study site is located in Botswana’s Okavango delta ecosystem. Background details are provided in the preliminary draft document .
b. The case study explores two alternative strategies to moderating the impact of the baseline situation which employs veterinary fences to contain the spread of the "lung disease", as well as ensuring that the unique wildlife of the delta ecosystem is able to migrate from core wetlands to the outer dispersal areas.
c. Alternative 1 which involves the use of annual vaccinations to contain the disease, and does away with the need for fences represents a cheaper option than Alternative 2 which employs the construction and maintenance of ‘wildllife-friendly’ fences. Both of these would provide the global benefit of ensuring long-term wildlife survival, as well as ensure that the same physical stock of cattle are available for export.

d. An advantage of investigating more than one alternative is that it makes the causal linkages more explicit The interesting result of the investigation here is that although Alternative 1 represents the least-cost option, it does not make the best economic sense for the country. This is because of the restrictions placed by importing countries: there is a ban on the import of cattle which has been vaccinated, for up to a period of two years. This raises interesting questions on the export scenario. Currently herdsmen who have free ranging cattle are excluded from this lucrative export market.
e. The potential cost-savings that may accrue from the use of bushmeat for subsistence use is currently not monetised and has not been included in the analysis. The use of bushmeat has often been mentioned as an important alternative source of meat (also healthier and less contaminated.) The higher population of wild animals which could be achieved under the alternative situation would ensure a more steady supply of bushmeat for local, subsistence consumption. This would then imply a cost savings in terms meat purchased from cattle ranches, which tends to be more expensive. Because of the lack of empirical information available we have not quantified any cost savings, but this could potentially by the end of the project period provide reasonable 'costs-avoided' and contribute towards the financial sustainability for the project.
f. It is requested that the capital costs be granted in full, whilst the annual recurrent costs be systematically disbursed on an annual basis to ensure that the wildlife corridors are properly constructed and well maintained.

III. PORTICUS: Creation and Management of Biological Corridors between Protected Areas to Facilitate Biodiversity Conservation between Continental Land Masses

a. This case study is based on a project proposal from Guatemala, although the details for the incremental cost assessment were not included in the original project document.
b. The case explores the incremental costs for an alternative strategy which builds upon the national strategy of improving the management of Protected Areas within the country (the baseline). The alternative calls for activities to complement the baseline through the creation, establishment and management of biological corridors between the Protected Areas to enhance global biodiversity conservation within the country and between the continental land masses to its north and south. In such a case there is a need for re-acquisition of lands and/or negotiations which ensure that the *de-facto* development of the potential biological corridors (the baseline) be conducted in a controlled manner, compatible with the concept of biological corridors.
c. The case for incremental costs is made interesting by the need for the design, implementation and management of incentives if the alternative is to be successful, otherwise the stakeholders may continue their 'business as usual' scenario.
d. The GEF funds would be disbursed as a full grant for the capital costs, and as a trust fund for the recurrent cum development expenses in the subsequent years. As mentioned in the text, the suggestion of a trust fund does not reflect current GEF policy, but is used to demonstrate that funding modalities should be innovative towards achieving the desired objectives.

IV. ARBORIA: Incorporating 'Indicator' Biodiversity Inventorying into Existing Commercial Inventorying

a. This case study is based on a hypothetical but realistic situation that is being explored in Malaysia. It is proposed here that the existing system of inventorying which takes place both prior to and after commercial felling, be extended to include 'indicator' bio-inventories. The commercial inventories are confined to commercial timber species, and rattan and bamboo. Augmenting these with bio-inventories would provide global biodiversity information on one of the megadiversity 'hot-spot' countries, and provide the basis for the design of conservation measures in the medium and long term.
b. The alternative proposed here is additional to the baseline. It demonstrates how cost savings are factored into the analysis.
c. The incremental cost, which are estimated at $ 0.53 million could be financed through the medium-sized grant facility.
d. Biodiversity inventory protocols have specific sampling needs (such as capturing and sampling methods, frequency of visits etc.), which would to a large extent depend on the number and type of taxa chose. In practice, it is important that the biodiversity inventory protocol should be designed as far as possible to complement the commercial inventories, and to keep the incremental costs moderate.

V. SYLVANIA: Reducing Forest Fragmentation to Protect the Biodiversity of the Peat Swamp Forest

a. This case is based on a PRINCE case study undertaken collaboratively with Wetlands International to apply the concept of incremental cost to biodiversity conservation in wetland areas in the Asia and Pacific region. The study site is located in the peat forests of Malaysia and the full details of the study are provided in Kumari, 1996.
b. The case explores the incremental costs of shifting from a less environmentally benign method (the baseline) of logging to a more benign one (the alternative), in order to help conserve an endangered species of rhino that uses the forests as part of their home range. This paradigm case use the rhinos as an indicator of the most extreme case of biodiversity loss in the global context.
c. The boundary of the study (and hence the 'Scope of the Analysis') is defined not by the forest itself but by all significant changes brought about by the shift in logging method. In this study there are two other significant changes that affect the incremental costs incurred by the country, these are the forest rehabilitation costs and the costs of water treatment incurred by the authorities down stream. Hence the incremental cost analysis

will go beyond the comparison of logging costs for the baseline and alternative to include these issues.

d. The result indicate that the incremental costs are negative which means that it is in the interest of the country to shift to the alternative.
e. Besides the aggregate incremental costs, the incremental cost assessment sheds light on the costs (and cost savings) borne by the different stakeholders (the private logger, the Government and society). In this case the incremental costs to the private logger is positive, and that to society negative.
f. The study highlights special insights which can be made into a prevalent situation through the application of the incremental cost framework. This information could provide a powerful rational for the reallocation of the budget at the baseline position, and investigation into the needs for barrier removals. These are discussed in the case study.

VI. PERU-BOLIVIA: Biodiversity Conservation of the Titicaca-Desaguadero-Poopo- Salar De Coipasa (TDPS) Waterbasin

a. This case is based on a joint proposal from Peru and Bolivia to help save and conserve the unique and threatened freshwater and montane biodiversity at the Titicaca-Desaguadero-Poopo-Salar de Coipasa (TDPS) waterbasin. The conservation measures in the alternative are actions which are "additional" to the baseline.
b. This case study provides an excellent example of a situation which demonstrates that a well constructed root cause analysis helps towards good project design and subsequently the assessment of incremental costs. The need for the removal of these threats to achieve defined biodiversity benefits then allows a corresponding identification of those actions which would be conducted through the baseline (i.e. in national/domestic interests, and in line with the broad development goals) and those which are additional (would benefit the global community). This information would feed into the incremental cost matrix and allow for an assessment of the costs.
c. The case study also demonstrates a good example of the complementarity of the actions in the baseline and the alternative. Although the actions recommended under the proposed alternative are ‘additional’ to the baseline, the root cause analysis demonstrates that achievement of the baseline as critical towards achieving the objectives of the proposed alternative (e.g. the limit on the abstraction of water from the lake). Specifically, this requires a phasing of the actions
d. This study also distinguishes between biological diversity and biological resources. That is it illustrates the need to modify the baseline development activities that would strive only towards the sustainability in terms of the biological resource of economic importance, that is of the exotic fish.., to ensure that the unique and threatened fish biodiversity and its components which may be of less economic importance are also managed sustainably.

2.2 Main features and issues addressed through the paradigm cases.

Table 2 provides a summary of the main features and issues addressed through the paradigm cases. These issues in themselves may not be exhaustive, but rather illustrative. The aim is to demonstrate how the incremental cost methodology deals with these range of issues, and in turn how the incremental costs estimated would be influenced by the comprehensive treatment of issues involved.

TABLE 2: SUMMARY MATRIX OF THE MAIN FEATURES AND ISSUES ADDRESSED

FEATURES/ISSUES	**#1 Insulae Pisca-toriae**	**#2 Bovinia**	**#3 Porticus**	**#4 Arboria**	**#5 Sylva-nia**	**#6 Peru-Bolivia**
1. Operational program coverage	2	1	2,3,4	3	3	2,3,4
2. Global biodiversity benefits	x			x	x	x
○ species specific		x		x		x
○ ecosystem/special habitat						
○ general conservation		x	x	x		x
3. Spatial scale of conservation	x			x	x	
○ local/provincial	x	x	x			x
○ national						
○ regional			x			x
4. Domestic benefits	x	x	x	x	x	
○ same physical outputs	x	x	x	x	x	x
○ same economic outputs						
○ greater benefits (see costs avoided/ scope of analysis)						x
5. Scope of analysis			x	x		
○ confined to project	x	x	x		x	x
○ beyond project area						
6.Baseline strategy/activity				x	x	
○ sustainable	x	x				
○ not sustainable						
○ trend: towards sustainable			x			x

7. Alternative strategy/activity ○ substitution to baseline ○ additional to baseline	x x	x	 x	 x	x	
8. Threat analysis ○ proximate ○ intermediate ○ ultimate	x	x	 x x		x x	x x
9. Stakeholder issues ○ addressed explicitly ○ implicitly addressed ○ not addressed ○ should be addressed	x	 x x	 x x	 x	x	x x
10. Incremental costs ○ positive ○ negative ○ break-even	x	 x	x	x	 x	x
11. Financing issues ○ grant ■ capital costs ■ recurrent cum development costs ○ trust fund ○ with conventional loan ○ re-allocation of baseline budget	 x x	 x x	 x x x	 x x	 x x	 x x x
12. Source of material for case study ○ PRINCE case study ○ actual project (including PDFs) ○ hypothetical but realistic situation	 x	 x	 x	 x	x	 x

3. PARADIGM CASES ILLUSTRATED

I. INSULAE PISCATORIAE: Provision of Fish Aggregation Devices to Protect a Threatened and Unique Fish Family, the *Piscus unicus*
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CASE # 1

PARADIGM CASE ON INCREMENTAL COSTS FOR BIODIVERSITY

INSULAE PISCATORIAE: Provision of Fish Aggregation Devices to Protect a Threatened and Unique Fish Family, the *Piscus unicus*

#OP 2: Coastal, Marine and Freshwater Ecosystem

A. PROJECT BACKGROUND

The aim of this project is conserve a globally unique and threatened family of fish, the *Piscus unicus*, by promoting the use of modernized hooks and lines (referred to here as fish aggregation devices) as an alternative fishing strategy to the prevalent traditional hooks and lines, in the coastal waters of Insulae Piscatoriae.

The GEF grant for this project is $ 4.5 million.

B. INCREMENTAL COST ASSESSMENT

1. Broad Development Goals

1.1 The archipelago of Insulae Piscatoriae is located in the Maritime Ocean and consists of four islands of volcanic origin. The country has endorsed its National Environmental Action Plan at the highest level of government, which calls for, among other things, a concerted, rational management of the national heritage. It is also a signatory of several international conventions, including the Convention on Biological Diversity, Ramsar Convention, and CITES.

1.2 The Government is committed to biodiversity conservation, but with limited financial resources, a rapidly increasing population, and recent currency devaluation, the country is not able to fully finance the biodiversity conservation activities it wishes to undertake. Endemic species and their habitats are facing severe unprecedented threats due to human population pressure and unsustainable resource exploitation.

2. Global Biodiversity Objective

2.1 The Insulae Piscatoriae biogeographical region is of global significance in view of its outstanding biodiversity and high degree of endemism. In the marine environment, of global, ecological and scientific interest is the threatened *Piscus unicus,* known only from fossil records until rediscovered about 10 years ago, and subsequent sightings have been sporadic and process arduous. This fish first appeared in the fossil records in the Silurian era, some 400 million years ago, long before there were any land animals.

2.2 A fairly recent expedition with new and sophisticated submarines established that the fish spend the day in small groups deep inside caves on the side of a volcano which constitutes part of Insulae Piscatoriae islands. The caves, located some 200 meters deep, are at the shallow end of the range of the *Piscus unicus*. In fact by night these fish make expeditions to depths greater than 800 meters. There is strong evidence also from these expeditions that the number of these fish have in the last 10 years been reduced by almost half, to a few hundred fish. The only known reason for this decline is ‘fishing pressure’. The *Piscus unicus* gets caught accidentally in the conventional hooks and lines when the fishermen fish in waters of depth greater than 100 meters. Continued use of this method of fishing is putting tremendous pressure on the already dwindling numbers of the *Piscus unicus*.

2.3 Because of the urgency of the situation the project here is confined to the conservation of the *Piscus unicus* fish although Insulae Piscatoriae supports other significant and important marine (and also terrestrial) biological diversity.

3. Baseline

3.1 Fishing is an important livelihood strategy for the rural community that lives along the coastal waters. With regards to the fishery sector the broad development goal is to continue to procure sustainable harvest of edible and commercially attractive fish. The current laws in the country require sustainable harvest of fish, although '*sustained yield harvest'* has never been determined scientifically. To ensure that good practices are maintained, and that its goal is potentially achieved, there is a regulation that prohibits the harvest and sale of fish below a certain minimum size.

3.2 The fishermen have to purchase annual fishing permits, and these permits could be revoked if they are found to contravene the size regulation more than three times. The enforcement of these measures is not entirely satisfactory, although they do act as deterrents. The fishermen are free to adopt and adapt their fishing methods.

3.3 The most prevalent method is the traditional hook and line, which represents a fairly conservative and rudimentary method. This is the "baseline". Presently the fishermen confine their activities to the near shore of the islands since they do not have the means (they operate small paddle boats) or skills to fish further offshore. These waters have been increasingly harvested, and the fishermen have had to resort to fish deeper and deeper into the waters. The problems posed by the baseline are anticipated to become worse over time. Other traditional fishing techniques such as poison and dynamite are also becoming popular along the coast. Although both these techniques are rudimentary they are at the same time destructive, and overused, can result in overfishing and overkilling.

3.4 The baseline, as it is operating currently (in deeper and deeper waters), cannot protect the *Piscus unicus* which gets accidentally caught in the hooks. Because the *Piscus unicus* has no commercial value and is not eaten, it is simply discarded by the fishermen upon being caught. The population of Insulae Piscatoriae is growing rapidly and more fishing permits are being issued each year. This in turn is putting more pressure on the endangered fish.

4. The Proposed Alternative(s)

4.1 In order to minimize the threat to the *Piscus unicus*, the accidental killing through the use of the baseline hook and line fishing method must be replaced, or modified, so as to protect this unique fish, *but still maintain a sustainable fish harvest*. This may be accomplished by providing an alternative to the local population which would dissuade them from fishing below 100 meters. One could conceive of imposing a ban on the use of the hook and line method, but it is likely to impose high opportunity costs on the locals, and is also not likely to be acceptable to the national government; because conservation of the *Piscus unicus* has little domestic advantage. Although there are potential eco-tourism benefits, these have not been explored at the domestic level. A further alternative would be to put a limit (say of 100 meters) on the depth to which the hook and line could be set, but similar arguments would hold true and it would be difficult to enforce.

4.2 A plausible alternative strategy which would discourage the fishermen from deep fishing is through the use of a ‘Fish Aggregation Device’ (FAD), which is a modified version of the hook and line. This modern equivalent consists of a strong rope anchored offshore in deep water (about 1,000 meters), the top end of which is attached to a buoy on the surface. From a depth of some 40 meters to the surface, long strips of nylon are attached. These FADs, being the only shelter in the open sea, attract small fish, and they in turn attract the big fish. These devices have been known to work, and attract valuable open water fish like tuna and swordfish. The fishermen would work in groups, and normally each FAD could accommodate the needs of 10-15 fishermen.

4.3 The alternative proposed here would be executed in the deeper waters of the high seas, away from the coastal volcanic deep waters which the *Piscus unicus* use. There is evidence which suggests that the high seas off the shores of Insulae Piscatoriae are largely under-exploited, but local fishermen have not been able to tap these resources because they have neither the means nor the skills and equipment required to do so..

4.4 There are two potential risks in shifting to the alternative: (i) that the optimum number of FADs would be exceeded when fishermen move from baseline hook and line method to the alternative FADs, and (ii) that the optimum number of FADs is not able to accommodate the needs of all the fishermen. To address these risks, it would be necessary for the alternative strategy to supplement the introduction of FADs with some other income generating activity, to meet that shortfall of domestic benefits. The proposed alternative, in this case, addresses these risks by including a component for the development of eco-tourism at the local level, with support provided to the training of guides, production of material and eco-tourism facilities. The provision of a Visitor’s center from which people can look into a *Piscus unicus* cave via an electronic camera mounted in one of the caves will attract tourists to the villages. By providing these alternative income generating activities which are economically feasible and environmentally friendly, the threat to the species and the ecosystem as a whole will be reduced. Communities will be free to choose from among different livelihood alternatives, and will be further empowered through training and greater economic opportunities.

4.5 The village communities are highly coherent, disciplined groups, accustomed to take and implement collective decisions. Indigenous associations and NGOs currently operational in the locality have successfully carried out numerous environmental initiatives at the grassroots level, and have great potential for further action and co-ordination.

4.6 A caution here is to ensure that with the use of FADs over-fishing of these valuable fish does not occur, and also that the smaller fish do not get harvested or killed in the process. The use of FADs should also guard against the harvest of presently less endangerd marine resource. It is important to establish the optimum number of FADs, through sustained yield indicators for the fish, which should be installed under this alternative strategy to ensure against any over-harvest or unsustainability of resource harvest. In this context, targeted research to answer these specific questions will be conducted as part of the alternative.

4.7 In summary, two alternatives will be investigated here: Alternative 1: shift from traditional hook and line (baseline) to their modern version FADs, and Alternative 2: shift from baseline to FADs plus eco-tourism activity.

5. Scope of the Analysis

5.1 The scope of the analysis includes all the significant changes caused by the decision to undertake the alternative(s) instead of the baseline both within and beyond the project area. In this example, there is at least one other significant change that would affect the incremental costs incurred by the country. The use of the FADs could increase fish yields sufficiently for the local fishermen to go beyond their subsistence level, and enable them to sell these to the urban markets. Although this is an incidental domestic benefit to the fishermen, it would in the larger economy mean a reduced import of alternative sources of protein, or raising of other livestock for urban needs. This is a cost avoided to the country. Because these avoided costs are uncertain, difficult to quantify, and probably small, they have not been included explicitly in the analysis.

5.2 To facilitate eco-tourism which is integral to the second alternative, the country may need to increase basic facilities and utilities, and improve infrastructure, all of which would incur costs. It may be difficult, however, to differentiate what level of these expenses can be attributed solely to the tourism activity, or to determine what costs (if any) are not offset by additional tourism benefits. For these reasons, such additional costs are not included in the analysis.

6. Costs

6.1 The main cost components associated with the baseline and each of the alternative scenarios is presented in Table 1. The analysis is done only for main island, Insula Magna, which is closest to the existing and known population of *Piscus unicus*, and these results are then extrapolated to the other three islands. The costs are presented as capital costs and recurrent costs. The present value is calculated at a discount rate of 10%, and the project period taken as 10 years.

6.2 There are 50 fishing communities on this main island and each community has about 10 to 15 fishermen, giving a total of 625 fishermen. For the baseline situation the main costs incurred by the fishermen include the paddle boats, hooks and line, and the bait. The first two items are self-constructed and it is only for the purchase of material and bait for which they incur a cost, these are estimated at $15 per annum for the entire project period.

6.3 For Alternative 1, the fishermen are organized to use FADs instead of the traditional hook and line method. Each FAD can accommodate up to 10 to 15 fishermen, suggesting that a total of 50 FADs would be needed for the whole of Insula Magna. This is less than the maximum number of FADs for maintaining the sustainable yield harvest of fish. The main cost components associated with this option include: purchase of FADs, motorized boats to take the fishermen to the deep sea area, boat launching ramps to secure boats at the village sites, and cold-storage facilities since the fishermen would be out for longer, and public education for the villagers (and officials) to keep them informed and involved.

6.4 The capital costs for Alternative 1 are estimated at $ 415,000, compared to $ 9,375 for the baseline. The recurrent costs of maintenance for Alternative 1 are $ 45,000 - about fivefold those for the baseline situation. The present value of the incremental costs of Alternative 1 over the baseline for this island is estimated at $ 205,165.

6.5 There is preliminary evidence that not more than 40 FADs should be deployed in the offshore waters of this main island, although this optimum number should be verified through targeted research. This research would cost about $ 100,000 and will be undertaken in the first year of the project by international researchers as no such specialization exists in the country.

6.6 The preliminary estimate of 40 FADs as the optimum number which should be deployed is used to calculate the incremental costs for the scenario of Alternative 2. These figures may have to be revised if the research results suggest such a need. A limit of 40 FADs would in practical terms provide direct employment for up to 500 fishermen. The remaining 125 fishermen would have to be provided with alternative employment, which is provided for under Alternative 2 through the eco-tourism component. It is envisaged that these fishermen would be invited on a voluntary basis to work in tourism.

6.7 The capital costs for Alternative 2 are estimated at $ 630,000, which is double that of Alternative 1. Additional cost components under this alternative include: Visitor’s center, training of guides and production of information material. The recurrent expenses for these are $ 98,000 for each succeeding year. The present value of the incremental costs of Alternative 2 over the baseline are $ 510,393.

7. Results

7.1 The results show the present value of the incremental costs for both the alternatives to be positive, and those for Alternative 2 estimated at $ 1.31 million is more than double that for Alternative 1 ($ 0.61 million). These costs are for Insula Magna. The other three islands of Insulae Piscatoriae have fairly similar characteristics to this island, and the costs estimated here are extrapolated to get an indication of the total incremental costs if the alternative strategy was extended nation-wide. The present value of the total incremental costs to Insulae Piscatoriae to shift away from the baseline to Alternative 1 and 2 is $ 2.4 million and $ 4.5 million, respectively.

7.2 Alternative 1 represents the least cost option under the current assumptions and would be the favored option to fund. However, the first step would be to do the targeted research to establish the optimum number of FADs which can be deployed for the alternative strategy. These results are critical towards making a decision on how many FADs can be deployed. Based on these results a decision could be made whether the least cost Alternative 1 is feasible, or whether it would be necessary to fund Alternative 2. On the other hand, the decision could be made to fund

Alternative 2 even if Alternative 1 is feasible and more cost-effective. The rationale being that it assures a better sense of long-term conservation of the endangered fish (and other biodiversity) in question. Incorporating alternative livelihood through the ecotourism initiative would alleviate the pressure on harvest of natural resources.

7.3 The GEF grant should cover the full incremental costs of the project, both for the capital costs and the recurrent costs. The added advantage of Alternative 2 is that at the end of the project period of 10 years the ecotourism initiative may develop well enough, and the knock-on effect may result in the establishment of several service related industries. Also the sustained harvest of fish could generate significant costs savings through the availability of an assured supply of protein, sufficient to offset any future recurrent costs.

TABLE 1: INCREMENTAL COST MATRIX FOR INSULAE PISCATORIAE

	Baseline (B) **(Hook and line)**	**Alternative 1 (A1)** **(FADs)**	**Alternative 2 (A2)** **(FADs plus ecotourism)**	**Increment 1 : (A1-B)**	**Increment 2 : (A2 - B)**
Global Biodiversity Benefits	• *Piscus unicus* fish mortality high, due to accidentally being caught' • other unique species and ecosystems not especially protected	• *Piscus unicus* fish mortality reduced • other unique species and ecosystems maintained	• *Piscus unicus* fish mortality reduced • other unique species and ecosystems maintained	• risk of *Piscus unicus* fish numbers dwindling (to extinction) reduced improved protection for other marine biodiversity	• risk of *Piscus unicus* fish numbers dwindling (to extinction) reduced improved protection for other marine biodiversity
Domestic Benefits	• no limitation on access to fish/marine resources • fish harvested, no small fish • no ecotourism	• restricted access to resources in the marine habitats • fish harvested, no small fish	• restricted access to resources in the marine habitats • fish harvested, no small fish • limited ecotourism		• increased revenues from ecotourism
Capital Costs	**1. Hook and line method** • traditional boats = 0 (self constructed) • hooks and lines = 0 (self constructed) • repair and maintenance of boats = 0 (self-done) • material + bait	**1. Targeted research on FADs** = $ 100,000 **2. FADs (50)** • purchase of 50 boats = $ 150,000 (50 @ $3000 each) • purchase of FADs = 75,000 (50 @ $1,500 each) • boat launching pads = 25,000	**1. Targeted research on FADs** = $ 100,000 **2. FADs (40)** • purchase of 40 boats = $ 120,000 (40 @ $3000 each) • purchase of FADs = $ 60,000 • boat launching pads = $ 20,000 • cold storage facility = $ 20,000 **3. Public education** • for villagers and official staff		

	= $ 9,375 (@$15 p.a./ fisherman	(50 @ $500 each) • cold storage facility = 25,000 (50 @ $ 500 each) **3. Public education** • for villagers and official staff = $ 40,000 **$ 415,000**	= $ 40,000 4. **Ecotourism** • visitor center = $ 200,000 • training of guides = $ 50,000 • production of material = $ 20,000 **$ 630,000**		
Total capital costs	**$9,375**			**$ 405,,625**	**$ 620,,625**

cont'd...

	Baseline (B) (Hook and line)	Alternative 1 (A1) (FADs)	Alternative 2 (A2) (FADs plus ecotourism)	Increment 1 : (A1-B)	Increment 2 : (A2 - B)
Recurrent cum development costs	• repair and maintenance of boats = 0 (self done) • material + bait = $ 9,375 (@$15 p.a./ fisherman	• maintenance of boats = $ 17,500 (@ 350 each) • maintenance of FADs = $ 10,000 (@ $ 200 each) • maintenance of cold storage = $ 5,000 (@ $ 100 each) • maintenance of launch pads (@ $ 50 each) = $ 2,500 • public education = $ 10,000 $ 45,000 **$ 259,156**	• maintenance of boats = $ 14,000 • maintenance of FADs = $ 8,000 • maintenance of cold storage = $ 4,000 • maintenance of launch pads = $ 2,000 • public education = $ 10,000 • ecotourism = $ 60,000 98,000 **$ 564,384**		

Total recurrent costs **PV (yr 2-10, 10% d.r.)**	$ 9,375 **$ 53,991**			$ 35,625 **$ 205,165**	$ 88,625 **$ 510,393**
PV Incremental costs **(10 yr., 10% d.r.)**	**$ 63,366**	**$ 674,156**	**$ 1,194,384**	**$ 610,790**	**$ 1,131,018**

* the PV incremental costs for all the 4 islands of Insulae Piscatoriae which have fairly similar characteristics would be $ 2.4 mil. and $ 4.5 mil. for Alternative 1 and 2, respectively.

CASE # 2

PARADIGM CASE ON INCREMENTAL COSTS FOR BIODIVERSITY

BOVINIA: Moderating the Impact of Veterinary Fences to the Wildlife and Ecosystem of the Bos Delta

#OP 1: Arid and Semi-arid Zone Ecosystem

A. PROJECT BACKGROUND

The Government of Bovinia has erected a series of new veterinary fences in the Bos Delta ecosystem in response to an outbreak of Contagious Bovine Pleuropneumonia (commonly known as the "lung disease'). Whilst these fences have been effective in containing the disease, they bisect important wildlife corridors in the Bos Delta ecosystem, which is one of the most biologically rich wetland areas in the arid part of the region. One of the major ecological features of the delta is the migration of wildlife from core wetlands to outside dispersal areas. It is proposed here that these existing veterinary fences be replaced with alternative fence construction methods, which are more "wildlife friendly" and which would allow wildlife to pass through based on differences in physiology, leaping ability, and size between wildlife and cattle. These fence should ensure the long-term, sustainable conservation of the Bos ecosystem and its wildlife.

The GEF grant for a 10 year project period is $ 2.7 million, of which $ 2.1 million are capital costs, and $ 0.6 million recurrent costs.

B. INCREMENTAL COST ASSESSMENT

1. Broad Development Goals

1.1 Livestock trade is an important part of the revenue of Bovinia. It is one of the few countries in its region that has a livestock export quota into the European market. Hence the country has to comply with the high standards of veterinary hygiene and disease management as prescribed by the European Union, if the country is to continue its trading partnership. These requirements set the tone of the development goals with respect to the livestock industry.

2. Global Biodiversity Objective

2.1 The Bos Delta is one of the world’s premiere wetland conservation priorities. The delta is embedded in the Bos ecosystem, and the migration of wildlife from core wetlands to outside dispersal areas is one of its major ecological features. This wildlife movement, or transhumance, from the arid lands towards the Bos delta is seasonal and reflects the urgency for food and water. The specific global environmental benefit here refers to the maintenance and conservation of the indigenous biodiversity associated with the unique inland wetland Bos Delta biome situated in an arid setting.

3. Baseline

3.1 The primary objective with regard to the raising of livestock in Bovinia is to ensure that the cattle are raised hygienically, and without disease. The Contagious Bovine Pleuropneumonia (CBP or "lung disease") is an endemic virus in this region, and because it is contagious and air-borne, it is easily transmitted between the cattle themselves once there is an outbreak, and can quickly reach epidemic proportions. Hence there is a need to separate the cattle into smaller groups so that the disease does not spread rapidly. CBP is an example of severe livestock disease which so far has not been transmitted naturally or experimentally to wildlife. Wildlife has a natural resistance to the CBP and it is neither a reservoir of infection, nor vector of transmission. The primary concern of the Government is for the health and hygiene of the cattle, wildlife health is much less of a priority.

3.2 The outbreak of CBP some years back saw the Government of Bovinia acting swiftly to contain the disease by erecting a series of new veterinary fences in the Bos Delta ecosystem. These fences were installed without prior environmental impact studies, and although they helped save the greater part of the cattle industry, well over 250,000 head of cattle were still destroyed in northern Bovinia. Thus the "baseline" which ensures that the cattle are not infected or re-infected, and that the livestock industry is ‘disease-free’, would consist of veterinary fences within the cattle rangeland located in the Bos Delta ecosystem.

3.3 The continued presence of fences is necessary to prevent further outbreaks, and potential spread, of the CBP, but their impact on wildlife has been adverse. Several wildlife species were strangulated by these fences (especially those which are fast-moving and gregarious e.g. wildebeest). The Bos Delta sits on the migration path of the wildlife from core wetlands to outside dispersal areas. The veterinary fences obstruct this wildlife movement and bisect dispersal areas surrounding the delta. If nothing is done there may be a permanent deterioration in the wildlife populations of the Bos Delta. Understanding and mitigating the impact of the fences on wildlife is of urgent priority if the globally unique biodiversity of the Bos Delta ecosystem is to be conserved.

4. The Proposed Alternative

4.1 In order to minimize the threat to wildlife movement and dispersal in the Bos Delta ecosystem, the obstacle presented by the veterinary fences must be removed or replaced by another ‘technology’. There are two alternatives to the current baseline of ‘veterinary fences’ to contain the CBP.

4.2 The first is through the application of an annual vaccination which is understood to be very effective. However, the crucial part of the vaccination process is that the vaccine must be kept frozen up to the point of inoculation, otherwise the vaccine will be yielded ineffective by ambient temperatures. The use of any serum which is not from the deep freeze could result in further outbreaks of the disease. Nevertheless, if conducted with great care, this method should alleviate the need for the fences to isolate the population of cattle for CBP.

4.3 The second alternative is that of modifying the design of the existing veterinary fences. The Bovinian Department of Wildlife and National Parks has studied the possible alternative fence construction methods and has issued a report on these technologies. These include "wildlife friendly" fences which allow wildlife to pass through fence sections based on differences in physiology, leaping ability and size between wildlife and cattle. Other technologies allow "one way" passage of wildlife in one direction but inhibit cattle movement, or the inclusion of double-fencing which allows the wildlife to pass through the external passage. Designs incorporating automatic or manual fence controls have also been studied. Testing of different wildlife friendly fences is required to determine the actual effectiveness of different designs in the Bos dispersal ecosystem so that the most effective alternative fence technology is selected. Provision of wildlife friendly fences should ensure the long-term, sustainable conservation of the Bos ecosystem.

4.4 The impact of these alternative treatments on the wildlife populations must be closely monitored against the carrying capacity of the habitat for the cattle and wildlife taken together. This should ensure that the "saved" wildlife through either one of the alternative practices does not suffer mortality anyway because of the seasonal differences in carrying capacity.

4.5 These two potential alternatives, of vaccination and wildlife friendly fences, are compared for their cost-effectiveness.

5. Scope of the Analysis

5.1 The scope of the analysis should include all other significant changes by the decision to undertake the alternative(s) instead of the baseline both inside the boundary of the project area and outside. In this example, there are is one potential change that could affect the incremental costs incurred by the country.

5.5 The shift to either of the two alternatives would have positive effects on the wildlife populations. The importance of bushmeat as a source of food and income has been debated for some time now, but it is understood that controlled hunting of wildlife can be an important source of protein for the local people. This could result in cost savings in terms of additional supply of meat for the local communities.

5.6 A possible impact of the vaccination alternative is that the cattle-carrying capacity on lands where more wildlife is able to graze will be less than on lands where wildlife is minimal. For example, in southwest Zimbabwe, farmers are going out of the cattle business and restocking their lands with big game, as this is potentially more profitable (through tourism). If the latter is the case, then it would be a baseline shift and not a GEF project anyway. If, however, the reduction in cattle carrying capacity meant a loss of income from the baseline, then it would need to be addressed through the alternative to ensure that the farmers are not worse off. This issue is not part of the analysis, but would need to be included if there was sufficient evidence that the latter was the case.

6. Costs

6.1 The incremental cost matrix for Bovinia is shown in Table 1. The main cost and benefit components associated with the baseline and each of the alternatives are presented. With regard to global benefits, shifting from the baseline to an alternative strategy will provide for improved survival of wildlife and allow for migration to their natural dispersal areas. The stakeholder of these benefits is the global community. The baseline domestic benefits remain the same, in that in each case the disease is contained and the animals can be exported to earn foreign exchange.

6.2 Only costs that are different between the baseline and the alternative(s) are shown. The costs are presented as capital costs and recurrent costs. For the baseline situation, of veterinary fences, the main cost components include construction and maintenance of the veterinary fences, monitoring these for strangulated wildlife and their subsequent removal.

6.3 The main cost activities for the vaccination alternative include: vaccine supply, refrigeration facilities, veterinarians and skilled technicians to undertake the operation, storage facilities, and transportation from rangeland to rangeland. The total cattle numbers in the country is 2.6 million, but of these 0.5 million are on freehold cattle ranches in the area under consideration. Vaccination and overhead costs have been estimated at $2.00 per head of cattle.

6.4 The second alternative of using wildlife friendly fences should incur cost in similar components as the baseline, except that the cost of these alternate fences would be more expensive because of their specialized design to ensure that wildlife movement is neither impaired or threatened. Construction costs of fences was estimated to be approximately $ 900/km for veterinary fences and $ 3,000/km for wildlife-friendly fences. It is estimated that the area for the rangeland described a total of 1,000 km of fencing is envisaged. There is also a research component necessary to ensure that the most effective design of fences are used in each case, which will be undertaken in year 1, and should cost about $50,000.

6.5 The cost of the individual components and incremental costs are presented in Table 1.

7. Results

7.1 The results show that the capital costs of undertaking Alternative 2 is high (at $ 3million) because of the specialized wildlife-friendly fences, but the recurrent costs associated with these are only about 10% of the capital costs. In contrast, for Alternative 1, the capital costs are in the order of $ 1 million (and fairly similar to the baseline costs of $ 0.9 million), but the recurrent costs associated with the need for annual vaccinations are 40% of its capital costs. The present value of these recurrent costs is $ 2.3 million and $ 1.7 million respectively for Alternative 1 and Alternative 2. Despite these higher recurrent costs, the aggregate incremental cost (over the 10 year project period) for Alternative 1 at $ 1.3 million is lower than the $ 2.7 million for Alternative 2. The present value of both the Alternatives incur incremental costs above the baseline situation (Table 1).

7.2 Thus the results suggest that the most cost effective way to achieve the global biodiversity benefits, whilst maintaining the domestic benefits, would be through the shift to Alternative 1. Generally the least-cost option is the preferred option, but there may be a need to take broader considerations into account. For example, the European Union prohibits the import of vaccinated cattle for up to two years after vaccination, and it insists on fences to contain the disease in endemic areas.

7.3 This brings into discussion an important facet of domestic benefits. In this case undertaking Alternative 1 (vaccinations), the country would have the same number of cattle disease-free (same physical stock of domestic benefits as in the baseline), but it would interfere with the trade of an important export item which brings in valuable foreign exchange (i.e. economic benefits would be less). It would seem that there are two ways of handling this. In the first instance, it could have been omitted entirely from the analysis because it would not provide the same domestic (economic) benefits to the country. Or it can be included, but the loss of foreign exchange would mean that the country incurs an additional cost which must be factored into the analysis. For example, we could check to see what is the differential revenue if the vaccinated cattle were exported to other countries in the region, compared to their export to the European Union. These losses (or cost incurred) should be deducted from the incremental cost of $1.1 million of pursuing this option.

7.4 Approximately 85% of the country's beef production is exported and both producer and consumer prices reflect the returns from overseas sales. Realisations from the European market tend on average to be 25-30% higher than other markets and as such exert the largest effect on farmgate prices.

7.5 The average national offtake for cattle is about 10%. That means that of the 0.5 million cattle, about 50,000 will be slaughtered annually for export. On average each head of cattle weighs about 250 kg and the price for it is $250 each (i.e. $1/kg). But if it is sold to the European Union it would fetch an equivalent price of at least $ 312. The differential price for the total offtake would be $ 3.1 million for just year 1 (Alternative 1: meat sold to domestic or regional markets giving a total revenue of $ 12.5 million. Alternative 2: meat sold to European markets giving a total revenue of $ 15.6 million.) This in itself would make Alternative 1 an uneconomic option.

7.6 The project illustrates the advantage of analysing more than one alternative and not making *a-priori* judgements towards the least-cost option. Another major potential advantage of shifting to either of the Alternatives is that they would ensure higher population numbers of wild animals which could provide a steady supply of bushmeat for local, subsistence consumption. Bushmeat has often been mentioned as an important alternative source of meat, which is also healthier and less contaminated. This would then imply a cost savings in terms meat purchased from cattle ranches, which tends to be more expensive. Because of the lack of empirical information available we have not quantified any cost savings, but this could potentially by the end of the project period provide reasonable ‘costs-avoided’ and contribute towards the financial sustainability for the project.

7.7 The GEF grant for a 10 year project period is $ 2.7 million, of which $ 2.1 million are capital costs, and 0.6 million recurrent costs. It is requested that the $ 2.1 million capital costs be granted in full, whilst the annual recurrent costs be systematically disbursed on an annual basis to ensure that the wildlife corridors are well maintained.

TABLE 1: INCREMENTAL COST MATRIX FOR BOS DELTA ECOSYSTEM IN BOVINIA

	Baseline (B) **(veterinary fences)**	**Alternative 1 (A1)** **(annual vaccination, no fences)**	**Alternative 2 (A2) (wildlife friendly fences)**	**Increment 1 (A1-B)**	**Increment 2 (A2-B)**
Domestic Benefits	• cattle isolated, and threat of CBP contained • less free-rangin wildlife	• cattle isolated, and threat of CBP contained • more free-ranging wildlife	• cattle isolated, and threat of CBP contained • more free-ranging wildlife	• 0 • more bushmeat for local consumptio n	• 0 • more bushmeat for local consumptio n
Global Biodiversity Benefits	• strangulation of wildlife and disruption of migration paths	• movement and migration of wildlife not curtailed, threatened	• movement and migration of wildlife not curtailed, threatened	• improved probability of survival of wildlife and migration to dispersal areas	• improved probability of survival of wildlife and migration to dispersal areas
Capital Costs	• material costs and construction of veterinary fences • cost of installation of veterinary fences	• preparation of vaccination serum; laboratory facilities • refrigeration facilities plus storage • vehicles for transport	• material costs and construction of wildlife-friendly fences • cost of installation of wildlife friendly fences • research to compare effectiveness of baseline & alternative		

	1000km @$ 900/km = $ 900,000 **$ 900,000**	0.5 mil cattle (@$ 2 each) = $ 1,000,000 **$ 1,000,000**	fences 1000 km @$ 3,000/km = $ 3,000,000 research: $50,000 **$ 3,050,000**		
Total capital costs				**$ 100,000**	**$ 2,050,000**
Recurrent Costs	• monitoring of fences • maintenance of fences • removal of strangulated wildlife 1000km @ $200/km = $ 200,000	• veterinarians and laboratory technicians time • transportation - fuel • purchase of vaccination serum 0.5 mil cattle (@$0.80) = $ 400,000	• monitoring of fences • maintenance of fences • removal of strangulated wildlife 1000 km @ $ 300/km = $ 300,000		
Total recurrent costs **PV (yr 2-10,10%)**	**$ 1,151,805**	**$ 2,303,610**	**$ 1,727,707**	$ 200,000	$ 100,000

				$ 1,151,805	**$ 575,902**
Increment PV	**$ 2,051,805**	**$ 3,303,610**	**$ 4,777,707**	**$ 1,252,805**	**$ 2,725,902**

CASE # 3

PARADIGM CASE ON INCREMENTAL COSTS FOR BIODIVERSITY

PORTICUS: Creation and Management of Biological Corridors between Protected Areas to Facilitate Biodiversity Conservation between Continental Land-masses

#OP 2,3,4: Coastal, Marine and Freshwater; Forest; and Mountain Ecosystems

A. PROJECT BACKGROUND

As part of it's commitment towards biodiversity conservation and sustainable development the Government of Porticus plans to embark on a series of programs to improve and enhance the management of its Protected Areas which are currently threatened by various threats including insecure status, illegal poaching and encroachment. Although the formulation and management of a Protected Area system in Porticus will meet defined national goals of sustainable development cum biodiversity conservation, the alternative proposed here is one which builds upon this national strategy. Specifically, the alternative advocates the creation, establishment and management of biological corridors between these Protected Areas, to enhance global biodiversity benefits.

The GEF grant for a 5 year project period is $ 47 million. The capital costs of $ 15 million are requested as a full grant, and $ 37 million to be set up as a trust fund to meet the development cum recurrent management costs.

B. INCREMENTAL COST ASSESSMENT

1. Broad Development Goals

1.1 The Government of Porticus has proposed to strengthen and consolidate its system of Protected Areas (PAs) by combining their protection and management to improve the quality of life of the communities who are reliant upon these areas. The conservation and environment scene in Porticus, which was unsatisfactory before 1992, has improved considerably since that year when the legal and institutional instruments for Protected Area constitution and management came into effect. These improvements must be interpreted with the caveat that unless those areas still under the ‘proposed’ status get gazetted at the national level, and are accorded adequate conservation management, the various threats to biodiversity and natural resources would continue to degrade these areas and undermine the potential for achieving sustainable development and utilization over the long-term. Existing Protected Areas should also be managed accordingly.

1.2 Despite these recent initiatives and official commitment, the current economic situation in Porticus does not allow for adequate financing for the continued conservation efforts needed at the national level.

1.3 Besides these national initiatives, there is also regional commitment by the Presidents of Isthmos Region, of which Porticus is a member country. In 1994, the Presidents collectively signed the *'Agreement for the Conservation of Biodiversity and Protection of Priority Wildlands Areas in Isthmos'* at their Fourth Regional Summit Meeting.

2. Global Biodiversity Objective

2.1 Due mainly to its position as an isthmus, its mountainous landscape and close proximity to the two oceans, the Isthmos region is characterized by an extraordinary diversity of wildlife. The region includes species originating in East Isthmos, like the deer and weasel, and West Isthmos species like dantas, sloths, anteaters and monkeys. Most specialists agree on a range of 6-12%, as the proportion of the world's biodiversity corresponding to the Isthmos region. The nations of Isthmos, although individually small, collectively have custody of a global resource of immense significance. The region as a whole is suffering rapid loss of biodiversity from deforestation, soil erosion, destruction of coastal and marine resource, pesticide misuse, pollution, poaching and illegal wildlife trade.

2.2 Porticus has a central position within this larger regional context. More than 7,000 of the 13,000 species of plants found in Isthmos exist in Porticus. Of these, many are unique to Porticus, for example, of the 600 species of orchids 47 taxa are endemic. Porticus is an important transitional zone: it represents the westernmost limit of some of the eastern land-mass diversity, and the eastern limit of the western land-mass species. This characteristic itself provides one of the strongest arguments in favour of its conservation in the most effective form possible. This Isthmos region relies on continued linkages through the forests and waterways of Porticus if its biodiversity is to overcome the adverse effects of habitat fragmentation and isolation as predicted by the theory of island biogeography. An international study looking at the mapping of the potential corridors for the Isthmos region confirmed Porticus's system of Protected Areas cum biological corridors to be the critical link between the east and west of the region.

3. Baseline

3.1 Assessment of the baseline may be helped by considering current and historical trends of Protected Area management within the country. Porticus has twelve areas under varying levels of protection, legal status, land ownership, management status etc. Of the twelve, five have confirmed protection status under Law of Protected Areas. Each of these Protected Areas has a different designation (National Park, Biosphere reserve etc.) and is managed by a defined agency (government, NGOs, universities etc.), but all of them are coordinated through the National Council for Protected Areas.

3.2 By definition the baseline position refers to one which concurs with the broad development goals of the country. The current position of the Government is that Protected Area status will be accorded to those on the ‘proposed list’ only if the agency submitting the proposal is able to satisfy some key requirements, among which is the existence of a (provisional) management plan, and evidence of sound financial and human resources to manage the area. There is a need in this instance for ‘barrier removal’, i.e. to get the country to par with its goals and committment towards Protectd Area endorsement and management. In this context some of the NGOs have sought and received technical assistance from international organisations (e.g. the Nature Conservancy) to help set up and put in place Protected Areas. There may be a need for GEF to facilitate through co-financing or other means to remove this barrier towards achieving the broad development goals.

3.3 Currently the situation can be described as one which has moved away from previous unregulated practices, but which has not yet reached the *full* baseline requirement of Protected Areas as envisioned under national development goals. For the purpose of this analysis, the baseline will be taken as the ‘full baseline position’, with the caveat that this requires the designation of Protected Area status to the remaining proposed areas without delay, if the national cum domestic development goal of conservation and sustainable use of natural resources is to be achieved (and maintained).

3.4 The main threats to biodiversity operating at each site depend on its specific location, land-ownership patterns, and official status. Nevertheless the major threats to biodiversity can be summarized as: (i) agricultural encroachment, (ii) over-harvest and inadequate restoration of previously felled or cleared areas and their fragmentation, and (iii) isolation of the individual Protected Areas. The first and second of these threats will be addressed by the Government of Porticus through the ‘full’ baseline. By according these areas protection status coupled with defined management plans which include provisions for the local groups through participatory activities, the conservation and sustainable development of these sites will be better assured. The threat of isolation of Protected Areas within Porticus (and the Isthmos region) undermines biodiversity at a more aggregate level, and is of global concern. This is not a domestic priority, and will not be addressed by the nation, left to itself.

4. The Proposed Alternative

4.1 The call for safeguarding of global biodiversity benefits is formulated as an alternative strategy through a network of biological corridors between the Protected Areas in Porticus (and ultimately with similar corridors in the other Isthmos nations). Biological corridors are interconnecting lands that connect protected areas, where activities which use or impinge on natural resources will be guided by master and operating plans that assure the management of critical resources for the Protected Areas that they connect. These corridors are needed to **increase security** in the protection provided by the reserves and that this increased security cannot be expected to be covered by local funding and therefore GEF can assist.

4.2 This alternative includes the creation, establishment and management of biological corridors between the Protected Areas within the country. The rationale is that if this initiative is conducted carefully it should ensure the survival of endangered, endemic and other important species. Within practical constraints, such a strategy represents the least-cost option of meeting both domestic and global environmental objectives.

4.3 The scientific and ecological basis for biological corridors is well established through the theory of island biogeography. Although the debate is still an ongoing one, it is fairly well accepted that if all other considerations are equal, then the best long-term strategy is for the largest size of reserve. The reality is that the extent to which a country is willing to set aside forests as protected areas, strictly for biodiversity conservation, is limited; hence an integrated approach which combines protected areas with biological corridors has much to offer.

4.4 Positive evidence in support for biological corridors within Porticus is availabe for some key species. Insula Insita, a protected area, set aside specially for the conservation of *Avis rara*, a highly endangered bird, is only slightly larger than 900 ha. In the biodiversity context, this Protected Area would be considered an 'island' and fairly unstable as a long term conservation site for the bird. An NGO, Nature's Guards has evidence (obtained using telemetry) that the *Avis rara* do migrate between this site and Patrocinium Park, another protected area which is the largest reserved area within the country. The movement of this bird operating through the natural (informal) corridor link between the two protected areas is critical for the long-term survival of the *Avis rara*. Formalising the biological corridor is urgent if the survival probabilities of this highly endangered species is to be assured.

4.5 The same NGO also has records of a unique species of primate which migrates between Patrocinium Park and a proposed protected area, Presidium Park. The land use between the two sites is, however, increasingly being used for agriculture. The NGO has taken the initiative to convince private landowners (up to 3 of them) to reafforest their lands with trees to facilitate the movement of these primates (currently up to 60 ha have been afforested). Although these initiatives by the private landowners are promising, again, the establishment of a formal corridor system, with incentives, would ensure longer term security. The gazettement of Presidium Park should also be formalised. A similar case for corridor can be made for the conservation of the highly endangered manatee which, although not confirmed, may be moving along the water ways of the Lake Decorus through to Bonus Bay, linking the poplation of manatee at two other Protected Area sites and possibly the proposed Presidium Park.

4.6 Besides these established migration patterns, there may be many cases of unestablished or unknown movements. The scientific and ecological work to confirm the migration of these and other species would require long-term monitoring through carefully planned research programs. Such investigations need committment of research funds and trained researchers, and should be part of the activity program under the alternative strategy. Waiting till there is sufficient information may mean that the potential corridor areas may be so altered that the execution of the alternative strategy itself may not be plausible. To be most effective the alternative strategy should be undertaken simultaneously with the baseline plan, as the two reinforce each other towards meeting conservation and sustainable development goals nationally, regionally and globally.

4.7 The alternative strategy for this project requires the establishment of eight biological corridors to connect the twelve Protected Areas, and the current land use of these identified areas should be kept free of cultivation. Those lands which are privately owned may have to be re-acquired, and incentive systems may also need to be designed to encourage its utilization to be compatible with the corridor concept. Public or communal lands will also have to be converted.

5. Scope of the Analysis

5.1 The scope of the analysis should include all other significant changes brought on by the decision to undertake the alternative instead of the baseline. In the current context, the proposed alternative of including biological corridors to enhance the Protected Area system means that the country would incur some costs in terms of foregone opportunities, but it is also likely to benefit over the long term through the provision of goods and services from these largely natural systems. However, under the time-scale of this project (5 years) there will not be any significant additional benefits or cost savings for Porticus.

6. Incremental Cost Matrix

6.1 The full complement of Protected Areas (including currently proposed sites) within Porticus constitutes the baseline and the formulation and creation of biological corridors between these Protected Areas the alternative strategy. The incremental cost matrix for Porticus is shown in Table 1, where the main costs and benefit components associated with the baseline and alternative strategies are presented.

6.2 With regard to global benefits, replacing the baseline with the proposed alternative strategy will reduce isolation and fragmentation of the Protected Areas which in turn would enhance the survival probabilities of several endangered and endemic species, as well as improve the overall biodiversity status of the country.

6.3 For the baseline domestic benefits, we have to consider the situation if the areas between the Protected Areas (i.e. the potential biological corridors) were developed in a *de facto* manner for agriculture, industry, or human settlement. In the alternative proposed, the biological corridors would be developed in a manner which is more compatible with the natural environment, such as for agroforestry, forestry and harvest of non-timber forest products, and possibly eco-tourism. The domestic benefits under this alternative strategy will be much the same in the short term, but likely to be greater over the long term.

6.4 The project period here is taken as 5 years, and a 10% discount rate is used in estimating the present value. Table 1 shows the costs for the baseline and proposed alternative, presented here as capital costs (for year 1) and development cum recurrent management costs (year 2 to 5).

6.5 The baseline situation considers first the cost of development of the national system of Protected Areas (including proposed Protected Areas). This requires specific actions which are listed in Table 1, and is estimated to cost about $ 30 million for the total of twelve protected areas, each of which requires varying levels of attention. Under the baseline we have also to consider the

cost of developing and managing the 'potential' biological corridors in the *de facto* fashion. That is to say one would have to consider the costs that would be incurred if these 'potential' biological corridors were retained under current use or put to some new land use. In the analysis here it is assumed that these areas are developed as a mix of agricultural, industrial and human settlement use. The costs of doing so are estimated as $ 22 million, giving the total capital costs for the baseline situation as $ 52 million (Table 1).

6.6 There are five main cost components which need to be addressed for the estimation of capital costs of the alternative strategy, these include:

i. development of Protected areas (including the proposed Protected Areas)
ii. setting up of biological corridors
iii. controlled development of biological corridors
iv. compensation and land acquisition measures
v. designing incentive strategies.

6.7 The process of development of Protected Areas is the same as that required under the baseline situation, but it is envisaged that there would be some cost savings if these areas were developed concurrently with the biological corridors. These costs avoided would be at least 10% of the total estimated in the baseline, giving the capital costs for this component as $ 27 million.

6.8 Setting-up the biological corridors is the crux of the alternative strategy: it would provide the framework and operational basis. The corridors will represent a mix of land uses ranging from strict conservation, extractive reserves (Protected Areas) through to alternative kinds of production. The essence of corridor design is to minimise impact of biodiversity loss in all sytems and retain as much as possible of remaining natural habitats as possible. This component requires specialised attention, including the scientific work, and design of the corridors and management plans for them. The rehabilitation and restoration of these areas to comply with the principle of biological corridors is extremely important and is likely in some cases to be expensive. It is estimated here to cost about $ 10 million.

6.9 Controlled development of biological corridors would be undertaken as recommended in the management plans. This would generically call for reduction in agriculture and human settlements, exclusion of industry, for more land under forestry and agroforestry, and the development of eco-tourism facilities to encourage tourism. There would be a need for the productive sectors to take biodiversity considerations into account in the design and management of their lands. For example, agricultural areas should retain a matrix of natural habitat within their plantation design to ensure integrity of the system as a whole. The cost of setting up the alternate land uses as required for the biological corridors is estimated at $ 15 million, which is less than that under the baseline *de-facto* arrangements because of the less intensive development and use of labor under the alternative strategy. These are estimated to cost $ 15 million.

6.10 In making this shift from the baseline to the alternative, the costs of doing so would be borne by different stakeholders (e.g. the landowners) whilst the benefits may accrue to different stakeholders (e.g. local communities, society, the Government). In the case of the land-owners of productive lands there are opportunity costs foregone in terms of revenue that could be generated under the more intensive land use such as agriculture and industry. To ensure that the stakeholders do not lose out, and to ensure that they either do not shift back to their original land use/plans, two further components have been included in the design of the alternative. The first is a lump sum compensation to the landowner for immediate losses in revenue, which is estimated here at $ 12 million. The second is the design of incentive strategies to be included in the subsequent years of the project. This would call for planning and strategic negotiations between the stakeholders and the donors, and is expected to cost about $ 3 million. These incentives measure would include, amongst other: reforestation incentives, carbon offsets and eco-tourism franchises. At the same time there would be a need for disincentives to be put in place (e.g. penalties, punishment and other forms of law enforcement accompanied by public information).

6.11 The annual development cum recurrent costs are presented for year 2-5 for the baseline and alternative situations. For Protected Areas these recurrent costs are estimated to be about 30% of the capital costs, which would approximate to $ 9 million for the baseline, and about $ 8 million for the alternative (assuming similar avoided costs). For the *de-facto* development of corridors, the subsequent development costs were estimated at about $ 9 million, and those for the alternative strategy which is less intensively developed, about $ 5 million (including costs for long term research and monitoring.

6.12 As mentioned above, an important part of the alternative strategy is to keep the right incentives in place, if the long term security of the corridors is to be assured. The incentives developed in year 1 should be implemented i.e. the cash would need to be disbursed. Examples of disbursement include: (i) reforestation incentive where land owners who chose to keep their land under forestry (or agroforestry), or convert their land to such compatible use, will be given tax credit, and (ii) help land-owners finance a shift to agroforestry, forestry or reforestation in exchange for credit for carbon saved or sequestered by the funded forestry activity. These could be funded through the GEF grant (or joint implementation). Management of these incentive structures is likely to be a major cost component in the subsequent years. The management and disbursement costs of this activity is estimated at $ 15 million annually for the next four years.

7. Results

7.1 The results are presented in Table 1. The total capital cost for the alternative strategy is

$ 67 million compared to $ 52 million at the baseline, giving an increment of $ 15 million for year 1. The recurrent costs for the alternative at $ 28 million are $ 10 million higher annually than those of the baseline. The latter requires more intensive management, but the alternative has costs associated with compensation as well as the development of incentives. The present value of these development costs is $ 57 million and $ 89 million respectively for the baseline and alternative strategy, and the increment $ 32 million (and if the project duration is extended to 10 years, this increases to $ 58 million).

7.2 The aggregate present value of the incremental cost for adopting the alternative strategy is estimated at $ 47 million. The full incremental costs of adopting the alternative strategy, over and above those being incurred under the complete baseline practices are eligible for GEF financing. The incremental capital costs of $ 15 million should be given as a full grant. The recurrent cum development costs have a present value of about $ 32 million, and could facilitated through a trust fund, and disbursed year to year depending on state of biological corridors and compliance of the landowners in meeting with the aims and objectives of the alternate land use and incentive arrangement

7.3 The baseline and the alternative activities in this project are not really options, but rather complementary activities which need to be pursued simultaneously. The project presented here employs a two-pronged approach to maximize biodiversity conservation: first, that of improved and enhanced management of the Protected Areas in Porticus and second, the creation and management of biological corridors between the Protected Areas in Porticus. The latter activity is of concern to the GEF. This integrated management of the Protected Area network must be pursued simultaneously to maximize (global) biodiversity benefits.

7.4 The costings in this case are indicative (or illustrative) and may need to be further refined, especially in the context of re-acquisition of land and disbursements for incentives as these would depend on the market prices at the time of negotiation.

7.5 The project period set at 5 years because it is envisaged that over time there will be significant cost savings resulting from the conservation and sustainable development activities, and beyond that time frame the situation should be financially sustainable, or would need to be re-assessed.

7.6 The incentive system addresses the ‘additional’ costs borne by the different stakeholders and seeks to internalize these within the project. On the other hand the benefits of shifting to the alternative strategy need also to be addressed. Some of these may be ‘incidental’, and can be ignored. But over the longer term, especially beyond the project period, the divergence between who bears the costs and who benefits need to be addressed. Once these alternate land uses are in place, it is likely that the principal beneficiaries of these ‘natural and sustainable systems’ would be downstream farmers and urban and industrial centers who are for e.g. protected from floods or assured of a naturally regulated and larger, cleaner quantities of water. In this case the situation may call for the reallocation of the budget at the baseline position, as the stakeholders who benefit should also bear some of the costs. For example, watershed value of forests could be captured and internalized to the local population through efficient water and hydropower pricing that includes a water protection charge

TABLE 1: INCREMENTAL COST MATRIX FOR PORTICUS

	Baseline (B) **(system of PAs plus *de facto* development of potential biological corridors)**	**Alternative (A)** **(system of PAs plus biological corridors)**	**Increment (A-B)**
Global Biodiversity Benefits	• isolation of Protected Areas • reduced survival probabilities of endangered and endemic species	• increased and improved connection between Protected Areas • protection of endangered and endemic species enhanced	• enhanced biodiversity conservation through reduced effects of isolation between Protected Areas • overall biodiversity enhanced
Domestic Benefits	*De facto* development of potential biological corridors • agriculture • industry • human settlements • infrastructure and facilities	Biological corridors, compatibly developed for • forestry • agroforestry • utilization and harvest of non-timber forest products • eco-tourism	• 0
Capital costs	1. Development of Protected Areas (7) and proposed Protected Areas (5) • institutional strengthening and human resource development • regulatory framework • staff and personnel • training • management plans • infrastructure and facilities • day-to-day management ($ 30 million)	1. Development of Protected Areas (7) and proposed Protected Areas (5) • institutional strengthening and human resource development • regulatory framework • staff and personnel • training • management plans • infrastructure and facilities • day-to-day management ($ 27 million) 2. Setting up biological corridors: • institutional strengthening and human resource development • project personnel and specialist fee equipment (maps, GIS and satellite information etc.) • research, inventory and mapping of the eight biological corridors	

Total capital costs	2. *De-facto* development of biological corridors: • agriculture • industry • human settlement • infrastructure • overhead costs ($ 22 million) **$ 52 million**	• national & local workshops • design of the 8 biological corridors and strategic & management plans ($ 10 million) 3.Controlled development of biological corridors: • forestry • agriculture • agroforestry • human settlements • infrastructure • overhead costs • ecotourism faclities ($ 15 million) 4. Compensation and land acquisition (12 million) 5. Incentive strategies • carbon offsets • reforestation incentives (3 million) **$ 67 million**	

			$ 15 million

cont'd..

	Baseline (B) **(system of PAs plus *de facto* development of potential biological corridors)**	**Alternative (A)** **(system of PAs plus biological corridors)**	**Increment (A-B)**
Annual development cum recurrent management costs	1. Protected Areas • management costs • development costs • recurrent costs ($ 9 million) 2. *De facto* development of biological corridors management and recurrent costs • agriculture • industry • human settlement • infrastructure • overhead costs ($ 9 million) $ 18 million	1. Protected Areas • management costs • development costs • recurrent costs ($ 8 million) 2. Biological corridors management and recurrent costs • agriculture • agroforestry • human settlements • infrastructure • overhead costs • forestry • long term research and monitoring of corridors ($ 5 million) 3. Incentive disbursment and management ($ 15 million) $ 28 million **$ 89 million**	

Total development cum management costs **PV of costs (yr 2-5, 10% d.r.)**	**$ 57 million**		$ 10 million **$ 32 million**
Increment (PV) **(5 yr. 10% d.r.)**	**$ 109 million**	**$ 156 million**	**$ 47 million**

CASE # 4

PARADIGM CASE ON INCREMENTAL COSTS FOR BIODIVERSITY

ARBORIA: Incorporating Comprehensive/'Indicator' Biodiversity Inventorying into Existing Commercial Inventorying

#OP 3: Forest Ecosystems (Medium-sized grant)

A. PROJECT BACKGROUND

Arboria is a country rich in tropical forests, and the harvest and export of timber is one of its main economic activities. As part of its goal to ensure sustained timber harvests, the Forest Department undertakes systematic and comprehensive inventories in the logging compartments both prior to and after logging. Currently these inventories focus largely on commercial timber species and some of the more popular non-timber forest products, such as rattan and bamboo. It is proposed here that the existing system of commercial inventorying (which constitutes the baseline) be extended to include a comprehensive (or 'indicator') inventory of the remaining biodiversity. Arboria is one of the ten 'hot spots' of biodiversity, and a knowledge of what is in the forest is an indispensable part of the global biodiversity information, if appropriate medium and long-term conservation measures are to be devised. This alternative strategy of expanded bio-inventory is piloted here for one province of the country, and has the potential for being replicated in the remaining provinces, as well as other tropical forested countries where similar system of inventorying exists.

The GEF medium sized grant for this project for 5 years is $ 0.53 million.

B. INCREMENTAL COST ASSESSMENT

1. Broad Development Goals

1.1 Arboria is country rich in tropical forests. A total of 5 million ha of forests, which constitutes about 35% of the land area of the country, is legally classified as Permanent Forest Estate. About two-thirds of this Permanent Forest Estate has been set aside for production of timber. These production forests are largely natural forests which are selectively logged out for the larger commercial trees and then left to rehabilitate for a period of 40 to 55 years (depending on the log-cycle recommended for the area concerned) before they are logged again. After felling, restoration activities may be conducted, if necessary, to stimulate or encourage the regeneration of the commercially attractive species.

1.2 The key operative rule in these production forests is that of 'sustained timber yield'. Although the practice of this has not been entirely satisfactory in the past, the forthcoming requirement for the country to conform to the ITTA (International Tropical Timber Agreement) requirements (i.e. of ensuring that all timber harvested is from sustainably managed forests) has resulted in the country undertaking several measures to ensure that these requirements are complied with. The ITTA deadline is for the year 2000, but several steps are already underway in most production forests.

2. Global Biodiversity Objective

2.1 In an attempt to identify global conservation areas of critical importance, Arboria was identified as one of the ten 'hot spots' - these being characterized by a high concentration of endemic species - and which are experiencing unusually rapid rates of habitat modification.

2.2 These 'hot spots' were identified at an aggregate level and the range or wealth of biodiversity within these 'hot spot' countries is often not known. There is an urgent need to take stock of the biodiversity claims within these 'hot spot' areas. Such a measure would achieve two objectives at the global front: (i) would provide key 'global biodiversity information, (ii) it would provide global testing methodologies which could be replicated elsewhere, and (iii) it would provide an opportunity to increase the appreciation of value of biological resources, which could generate economic activity. In the long term such information would be crucial in formulating a convincing case for the conservation of this biodiversity, as well as appropriate strategies for their conservation.

2.3 ‘Totally protected areas’ constitute only 4% of Arboria (and range between 3-10% worldwide). Production or modified forests constitute a large proportion of the remaining forests, both in Arboria and in the rest of the tropics. Hence it would be realistic over the long term to understand the ‘state of biodiversity’ in production or modified forests. More specifically, should the inventories reveal the occurrence or presence of unique species or habitats, then the necessary steps could be taken towards their more effective conservation.

3. Baseline: Commercial Inventories

3.1 One of the most important and critical activities undertaken by the provincial Forest Departments in Arboria to ensure the sustainable harvest of timber, is the pre- and post-felling inventories. During the pre-felling inventory there is a ‘stock-taking’ of the commercially viable timber trees within the compartment (or block), and all those trees with a girth of 45cm dbh (diameter at breast height) or greater are marked for logging. In the post-felling inventory, the forest compartment is inspected again and the need for restoration activities noted and, where necessary, undertaken. These latter activities include: enrichment planting and silvicultural treatment - both of these being targeted towards optimizing commercial timber harvests. In recent years, the forest departments have introduced into the inventory process a limited range of commercially attractive non-timber forest products, such as rattan and bamboo. Thus the baseline situation of commercial inventories is one where pre- and post-felling inventories are undertaken for commercial timber species to ensure that sustained timber yield principles are complied with, and includes the inventory of two key non-timber forest products (rattan and bamboo).

3.2 The need to comply with the ITTA requirements is putting a fair amount of pressure on the human resources to undertake these tasks. The continued economic growth in Arboria, and a flurry of available jobs in other sectors has resulted in the outward mobility of staff, especially the lower ranks who undertake such inventories, thus creating a shortage of trained skilled and semi-skilled labor. To overcome this shortage, the Forest Departments have on occasion contracted out these jobs, and the currently the commercial inventorying is often done with a combination of trained staff and contracted staff.

4. The Proposed Alternative: Commercial Inventories plus Bio-inventories

4.1 In order to document global biodiversity information for the Arboria ‘hot-spot’ of megadiversity it is proposed here that the current commercial inventory system be expanded to include ‘bio-inventorying’. This will be done on a pilot basis for Materia Province, with the possibility of extension to other provinces in the country. This bio-inventory would go beyond commercial species, rattan and bamboo to include other non-timber forest products, medicinal plants, herbaceous plants, fungi etc.. This expanded inventorying will be confined to production forests where current felling inventory systems are already in place.

4.2 The rationale for GEF involvement in this proposed alternative is that, left on its own, Arboria is unlikely to incorporate these additional features into their existing commercial inventories (i.e. the baseline situation), beyond the few that are already commercially viable as non-timber forest products. This is for several reasons: (i) there are no immediate and/or significant economic advantages for them to do so; (ii) they do not have the necessary skills to undertake these additional inventories; and (iii) they are already being pushed to the limits to meet the ITTA requirements.

4.3 The advantage for GEF to support these bio-inventories is: (i) a system of inventorying is already in place, and is undertaken with a fair degree of meticulousness; (ii) the ITTA requirement means that these activities are likely to be stepped up; and (iii) it would be a cost-effective way to acquire key and vital biodiversity information on a ‘hot-spot’ megadiversity area, and production (modified) forests which constitute the bulk of remaining tropical forests.

4.4 Biodiversity inventory protocols have specific sampling needs (such as capturing and sampling methods, frequency of visits etc.), which would to a large extent depend on the number and type of taxa chose. In practice, it is important that the biodiversity inventory protocol should be designed as far as possible to complement the commercial inventories, and to keep the incremental costs moderate.

4.5 Some fundamental decisions must be made on this alternative of bio-inventorying with regard to: (i) the inventory strategy, (ii) the training strategy, and (iii) the equipment and facilities, as each of these would influence the cost analysis.

4.6 With regard to the inventory strategy there are two possible approaches which could be adopted. The first is a comprehensive bio-inventory process, which would seek to enumerate as many of the known species as possible, and the second to select ‘indicator’ species or ‘sample families/species’ approach. The latter approach is probably more realistic, as the former is likely to be too complex and arduous to be introduced into the existing framework, as well as prohibitively expensive. Tropical biodiversity specialists would identify key indicators for enumeration and collection, and the information compiled for training and dissemination. As an example, ectomycorrhizal fungi are known to be essential for the health of the forest and play an important role as indicators of ecosystem health, monitors of soil disturbance and of environmental pollution. In a neighboring country, epiphytic lichens of seasonal forests have been used to show long term and short term environmental changes.

4.7 On the training strategy, there are several issues which need to be tackled. First, there will be a need for more staff as the workload created through these additional inventory work would not be insignificant. Second, the training component for bio-inventorying may be included into the existing training program as a special/additional module into the training for new recruits as well as for refresher coursed conducted for existing staff. The module will train the staff in the identification of ‘non-timber’ species and specialized information collection techniques. If ‘indicator’ inventorying is to be used, then a much larger group of people could be trained. Bio-inventorying is a specialist task, and is more likely to be affected by loss of staff than thecommercial inventories. A possible way to tackle this problem would be to have a small core of trained ‘contract’ workers who would move from one site to another. This may be more efficient as it would reduce the need to train a large number of staff. The training of the skilled and semi-skilled staff would give them a ‘value-added’, but some ways (incentives) need to be devised so that they are not lost to other job markets.

4.8 Provision of data-base facilities, a system for the recording and dissemination of such information, both locally and globally should be an integral part of this alternative strategy, and the necessary hardware, software, training and staff should be included.

5. Scope of the Analysis

5.1 The scope of the analysis should include all other significant changes by the decision to undertake the alternative instead of the baseline. There are costs that are incurred by the province in the baseline but are partially avoided (because of overlap of tasks) with the alternative strategy. These relate to transportation and training costs, as well as some management and administration costs. This will be included in the analysis as avoided costs in the baseline under the alternative strategy.

5.2 If the proposed alternative of augmenting current inventory systems to include ‘bio-inventories’ should go ahead the country would benefit from the ensemblement of a ‘data-base’ of biodiversity in production forests, as well as a pool of trained personnel and staff. Herbaria facilities and a computerized data-base would also be acquired. These, however, are incidental domestic benefits that accrue to the province (and country), and do not have an associated avoided cost. Hence this will not be taken into account.

6. Costs

6.1 The incremental cost matrix for Materia Province, Arboria is shown in Table 1. The main cost and benefit components associated with the baseline and the alternative are presented. With regard to global benefits, shifting from the baseline to an alternative strategy will provide a more comprehensive biodiversity information system for a ‘hot-spot’ megadiversity area of the world. The stakeholder of these benefits is the global community. The baseline domestic benefits remain the same, in that the it achieves the targets associated with the pre- and post-felling inventories for commercial species.

6.2 The costs are presented as capital costs and recurrent costs, and are calculated for the project duration of 5 years, and present values calculated using a 10% discount rate. Of the 5 million ha in Arboria, 3.3 million ha are under production forests, and with an average logging cycle of 50 years, 66,000 ha are logged each year. The incremental costs are calculated here only for Materia Province, where about 660 ha is subject to the commercial felling inventory each year.

6.3 Existing commercial inventories cost about $110/ha which covers the cost of staff time, training, equipment and transportation ($ 85/ha) and management and administration (@ $ 25/ha). These inventories are already in place and hence the costs of these for the forests logged annually are $ 72,600 from year 1 (represented here as capital costs) to year 5 (represented as recurrent costs for year 2 - 5).

6.3 The bio-inventorying costs are estimated for the same extent of logged forests at Materia Province. The main capital expenditure components include recruitment of new staff, training of staff, purchase of field equipment, herbaria and computer facility set-up costs. Recruitment of additional staff will be necessary as the additional bio-inventories would take up more time. Assuming a recruitment of 3 staff for the province, each with an annual remuneration of $600 per annum, the total additional remuneration per year would be $ 21,600 (3x12x600). Cost of training (instructors, overheads, materials etc.) was estimated at $10,000, and field equipment (tapes, collection material, binoculars, books, etc.) during inventorying at $5,000. Herbaria and computer facilities would require additional space within existing premises and was estimated at $8,000 each. This gives total capital costs for the alternative strategy for year 1 as $ 125,200 compared to $ 72,600 for the baseline, giving an increment of $ 52,600.

6.4 Bio-inventorying needs more time and special attention (because the species are likely to be less conspicuous than timber trees) is estimated to cost at least $170/ha, giving an annual cost of $ 112,200, for the area logged annually in Materia Province. The other recurrent costs are represented in Table 1. Recurrent expenses would be incurred after the set-up in year 1 i.e. from year 2 onwards. The annual recurrent costs for the bioinventorying is estimated at $ 139,300.

6.5 The overlap between the bio-inventories with the existing commercial inventories means that there are some savings which would accrue for the latter inventories (i.e. for the baseline situation); for example in transportation, training and also on the management and administration of the overall project. Allowing for these cost savings (see Table 1) the commercial inventories cost about $ 56,000, a reduction of almost $ 16,000 annually. These are included as costs avoided in the felling inventories under the alternative option. The present value of these recurrent costs avoided is about $ 62,000, which amounts to more than 10% of the aggregate incremental cost.

7. Results

7.1 The aggregate present value of the incremental costs for Materia Province over the five year project period is $ 531,761. These incremental costs are not very large and could be financed as a full grant through the medium-sized grant facility.

7.2 The present project would serve as a useful pilot which could be extended or replicated in the other provinces of Arboria, or to specific sites to get biodiversity information for representative samples of key ecosystems and habitat types. The incremental costs of extending this project to other sites, if it should proceed, could be done on a reduced incrementality, as there would be further savings because of the availability of the facilities and trained staff. In this case the incremental cost matrix should be adjusted for these additional savings.

7.3 The biodiversity information should be monitored for possible species which have potential for bioprospecting and benefit sharing initiatives.

TABLE 1: INCREMENTAL COST MATRIX FOR MATERIA PROVINCE

	Baseline (B) **(Commercial inventory)**	**Alternative (A)** **(Commercial inventory + Bio-inventory)**	**Increment (A-B)**
Global Biodiversity Benefits	• no inventory of biodiversity beyond commercial species, and rattan and bamboo	• bio-inventory: inventory of 'other' biodiversity and/or 'indicator' species	• more comprehensive inventories to reflect 'hot spot' megadiversity
Domestic Benefits	• pre-felling inventory: 'stock taking' plus marking of commercial trees for logging post-felling inventory: 'stock taking' plus inspection for rehabilitative and restorative activities to ensure sustained timber harvests	• same as baseline • ensemblement of 'data-base' of biodiversity, trained pool of staff, herbaria facilities and computerized data base (incidental benefits)	• > 0
Capital costs (year 1)	• commercial felling inventories: ○ staff time ○ training ○ equipment ○ transportation (@ 85/ha) ○ management & administration (@ 25/ha) = $ 72,600	• commercial felling inventories: ○ staff time ○ training ○ equipment ○ transportation (@ $85/ha) ○ management & administration (@ 25/ha) =$ 72,600 • bio-inventories ○ recruitment of new staff ($21,600) ○ training ($10,000) ○ field equipment ($5,000)	

Total	**$ 72,600**	- herbaria facilities - set up costs ($8,000) - computer database (hardware and software) ($8,000) = $ 52,600 **$ 125,200**	**$ 52,600**

cont'd..

.. cont'd.

	Baseline (B) **(Commercial inventory)**	**Alternative (A)** **(Commercial inventory + Bio-inventory)**	**Increment (A-B)**

Recurrent costs (year 2 to 5)	• commercial felling inventories: ○ staff time ○ training ○ equipment ○ transportation (@ $ 85/ha) ○ management & administration (@ 25/ha) = $ 72,600	• commercial felling inventories (adjusted for costs avoided) ○ staff time ○ training ○ equipment ○ transportation (25% less @ 63.75/ha) ○ management & administration (15% less @ 21.25/ha) $ 56,100 • bio- inventories ○ 'new' staff costs ($ 21,600) ○ inventory cost (= $ 170/ha) (= $ 112,200) ○ refresher training (= $ 1,500) ○ herbarium facilities operations (= $ 2,000)) ○ computer database operations (= $ 2,000)	

Total **PV (yr. 2-5, 10% discount rate)**	**$ 72,600** $ 283,283	= $ 139,300 **$ 195,400** $ 763,444	**$ 122,800** $ 479,161
PV Incremental costs **(5 years, 10% d.r.)**	**$ 355,883**	**$ 887,644**	**$ 531,761**

[+] **all costs are calculated for the annual extent of forests logged in Material Province i.e. 660 ha.**

*** the recurrent cost avoided annually are $ 16,500 which in present value terms is $ 62,041 (which is more than 10% of the aggregarte present value incremental costs).**

CASE # 5

PARADIGM CASE ON INCREMENTAL COSTS FOR BIODIVERSITY

SYLVANIA: Reducing Forest Disturbance to Protect the Biodiversity of the Peat Swamp Forest

#OP 3: Forest Ecosystem

A. PROJECT BACKGROUND

The Government of Sylvania has adopted as part of its broad development goal the principle of ‘sustained timber yield’ for the management of the forests set aside for logging. This principle is to ensure a sufficient stock of mature timber for subsequent logging. There are, however, no conditions imposed on the methods used to log. In the peat swamp forests under discussion here, the loggers use canals to transport the logs out of the forests, and these canals have the resultant effect of fragmenting the habitat and silting the waterways. These disturbances have adverse impacts on the overall biodiversity status in the peat forests, especially on the unique fish which are found in the swamps. It is proposed here that the current method of log extraction be replaced with an alternative method which uses locomotives placed upon removable tramlines. These tramlines are more ‘environmentally friendly’ and would reduce habitat fragmentation and siltation of the waterways, and improve biodiversity conservation in the swamps.

B. INCREMENTAL COST ASSESSMENT

1. Broad Development Goals

1.1 Sylvania has a tract of 75,000 ha of peat swamp forests which lies between the coastal and inland forests. These forests are classified as reserved forests. The current laws of the country allow timber to be extracted from the forests under the guiding principle of ‘sustained timber yield’. From previous history of logging, it has been determined that the period to maturity after logging is 50 years. Under the principle of sustained timber harvests, the government allows for 1500 ha of the peat forests to be logged annually. To ensure that there is a sufficient stock of mature trees for subsequent logging, only trees with a girth greater than 45 cm diameter at breast height are allowed to be logged.

2. Global Biodiversity Objective

2.1 The peat forests have unique biodiversity associated with the ecosystem; being rich in certain species of birds and aquatic fauna (especially fish). Intensive surveys of the freshwater and other aquatic fauna in the blackwaters at the site and adjacent areas revealed a very high biodiversity, including several new species and new records. A total of 101 species of fish were recorded, representing approximately 40% of the known fish species in the country. In addition, species which had been recorded as rare were recorded in large numbers suggesting these peat swamps represent an important stock area for the conservation of fish species. It has been argued that the continued existence of the fish fauna alone would be enough to justify the conservation of this key habitat.

2.2 The peat swamp forests also lie adjacent to a sanctuary for the endangered white rhinoceros. This is the most primitive and the smallest among the five living species of the Rhinocerotidae family. The rhinos, whose population has been declining in the sanctuary also use this peat swamp forest as part of their home range.

2.3 The increasing disturbance and destruction of the forests habitat through the use of canals for log transportation would have adverse impacts on the overall biodiversity status in the peat forests, especially the survival probabilities of the unique fish fauna, and possibly the rhino.

3. Baseline

3.1 At the present time the logging concessionaires comply with the official requirements, that is, they log 1500 ha annually, and only those trees that are $\geq$ 45 cm diameter at breast height. The concessionaires use canals to transport the logs out of the peat swamp forests as this represents the least-cost alternative to the logging company. This then constitutes the baseline situation.

3.2 Canals extend from the log site to the edge of the forest and are constructed by the loggers themselves. First the forest along the path of the proposed canal is cleared, after which the peat is dug out and the spill piled along the edge of the canal on either side. The width of these canals varies from anywhere between 8 feet to 15 feet. Together with the spillage on either side of the canal the total width of the disturbance to the peat forest ranges from 15 to 25 feet.

3.3 The construction of these canal waterways is very destructive on the overall habitat, and increases drastically the siltation of the natural waterways in the peat swamp forests. The use of diesel operated boats further contributes to the pollution of these waterways. Both these impact on the fish fauna and the overall biodiversity of the peat forests. It might appear at first that, because rhinos like to wallow in swamps to cool themselves, they would welcome canals.

Logging canals, however, are stripped of tree covers on either side and therefore do no constitute a preferred spots for rhino wallowing, which is often confined to shady parts of the forest. Although the actual impact of this logging practice on the rhinos is uncertain, the indications are that it reduces optimum habitat for rhinos range movements, and this could have an impact on the long term survival probabilities of the white rhino.

4. The Proposed Alternative

4.1 In order to minimize habitat disturbance and siltation and pollution of the waterways in the peat swamp forests, a more benign way of timber extraction is sought. One could conceive of extraction by helicopters to incur a lot less damage to the forest than canals, but the costs are likely to be prohibitively high.

4.2 A lower cost alternative to helicopters is to use diesel-powered locomotives placed on wooden tramlines to transport the logs out of the forest. This represents a fairly low technology alternative that does not require specialist skills. The width of these tramlines is 3-4 feet and the clearance on either side extends a further 3 feet. Thus the width of the total disturbance is 10 feet as opposed to 15-25 feet in the case of canals, and the area is not stripped of forest cover. Damage to the forest using tramlines is relatively localized and drainage patterns are not significantly altered. As new areas are harvested, old tramlines are removed and extended to new areas. The project estimates the incremental costs of using tramlines instead of canals to extract the same amount of timber from the peat swamp forest.

5. Scope of the Analysis

5.1 The GEF Council Paper mentions that the scope of the analysis should include all the other significant changes by the decision to undertake the alternative instead of the baseline both inside the boundary of the area and outside. In this example, there are two other significant changes that affect the incremental costs incurred by the country -- these are the forest rehabilitation costs and the costs of water treatment incurred by the authorities down stream. Both these must be taken into account. Both result in costs that are incurred by the country in the baseline but are partially avoided in the alternative.

5.2 Presumably there would be other externalities of shifting to the alternative from the baseline, such as on tourism (through improved aesthetics), fish harvest; as well as their impact on different stakeholders, but these have not been included in the analysis here. At the present time fishing is not conducted in the peat forest as entry into reserved forests is considered illegal. Even in the adjacent padi fields it is conducted at very subsistence levels from the irrigation canals.

6. Costs and the Incremental Cost Matrix

6.1 The incremental cost matrix for Sylvania's peat swamp forests is shown in Table 1. The main cost and benefit components associated with the baseline and the alternative are presented.

6.2 With regard to the global benefit, shifting from the baseline to the alternative logging strategy will provide for the improved survival of the unique fish fauna and other biodiversity in the peat forests. The stakeholder of this benefit is the global community. The baseline domestic benefits, that of obtaining timber and water, remain the same in the alternative.

6.3 Only costs that are different between the baseline and the alternative are shown. The costs are presented as annual costs for the main cost components i.e. log extraction and transportation, forest rehabilitation and water treatment.

6.4 The log extraction and transportation costs in the baseline are estimated to be approximately $0.74 million per year (@$492/ha for logging with canals). Similar costs for the alternative are higher, at $1.01 million (@$520/ha for logging with tramlines, $104/ha for tramline capital cost and $48/ha for locomotive capital cost).

6.5 There are several rehabilitative activities that are conducted by the forest department under the baseline situation, including pre- and post-felling inventories, silvicultural treatments and enrichment plantings. These costs amount to $1.32 million annually for the 1500 ha cut annually (@ $880/ha). The alternative requires less intensive rehabilitation because of the reduced disturbance of the forest caused by tramlines. These costs are estimated to be approximately 20% less at approximately $720/ha and amount to $1.08 million annually.

6.6 The final category of costs concern domestic water treatment costs downstream of the peat swamp forest. The treatment costs range from $0.14/cu. m. to $0.2/cu. m. depending on the turbidity of the water. The lower end applies to the situation when the water has to be treated for only the natural coloration by the peat forests. We assume that higher treatment costs apply to the baseline and the lower to the alternative. Six million gallons of water are abstracted for domestic use daily. This amounts to $1.99 million in the baseline and $1.39 million in the alternative.

6.7 Given these costs, it is apparent that the incremental costs for extraction are positive and the costs for forest rehabilitation and water treatment are negative. These are shown in Table 1 below. The incremental costs are dominated by the cost savings in water treatment. Clearly, one would have to conduct further sensitivity analysis on the potential savings in water treatment costs.

6.8 These costs are negative costs for one year. In present value terms, at a discount rate of 10% and for a 10 year project period, the negative incremental costs will amount to $ 3.85 million. Compare this to the present value of incremental costs incurred by loggers of about $1.82 million. The timing of costs and benefits also needs to be taken into consideration. For example, although the costings for each of these activities in this project are constant and recurrent each year, the returns or benefits may have a more skewed distribution.

6.9 Negative incremental costs suggests that society would actually benefit from this shift, and that they should in principle be a part of the 'baseline' and not require any GEF grant support. But on the other hand, there may be barriers which may be obstructing the shift towards the optimal baseline, in the domestic context. These should be looked at closely (see below).

6.10 The incremental cost calculated here for the different stakeholders provides information on the distribution and redistribution of costs in shifting from the baseline to the alternative. The costs and cost savings are borne by different groups. In this study, loggers incur costs while society as a whole is better off. This provides pertinent information to the Government for the reallocation of the budget at the baseline position.

7. Other considerations

7.1 Incremental costs assessment could provide very useful insights into a prevalent situation (i.e. the baseline), and which could help direct future action. We will discuss a couple of these here.

(i) Forest issues

Besides the aggregate incremental costs, the incremental cost assessment sheds light on the costs (and cost savings) borne by the different stakeholders. Negative incremental costs suggests that society is better off, and this provides a powerful rational for the reallocation of the budget at the baseline position.

So the question here is, should the government undertake this initiative? One could argue that the cost savings to forest rehabilitation (incurred by the State Government) could be used to subsidize the cost of the improved logging methods (incurred by the private logger). However, it is also well accepted the rent capture by the government from logging operations through the system of royalties and taxes is low, and it is the loggers who capture the larger share of this, making windfall profits. So the counter-argument here could be that it is still within the loggers profit margin to make this shift.

These issues, however, have to be addressed through a wider forum because the rules of logging are set state/nation wide, and cannot be enforced for specific sites in question. The interesting part of the analysis is that the case emphasizes the positive way in which an incremental cost assessment could shed light on some of the root causes of the problem which prevents the operation of an optimal baseline in the wider context.

(ii) Water treatment costs

The same point could be made for the costs savings incurred through decreased water treatment costs: the need for a reallocation of the baseline budget. This could be done through the creation of a domestic water-use scheme which goes into a fund, and which could be used to support the shift to more sustainable logging practices. The logistics, both administrative and institutional, are likely to be complex because forests and water are natural resources which fall under the jurisdiction of different agencies. Also the water users are charged at a standard 'national' water rate, which would prove more difficult to adjust for the scale of this study.

(iii) Barrier removal

The question for GEF then is how they could act to remove barriers towards the correction of the baseline so that the global environmental benefits could be secured. For example, in this case there may be a need to assess the system of taxation and royalties for timber harvest to internalize some of the environmental damage incurred by loggers. Although this would be beyond the scope of the immediate project it may serve to secure global benefits in a wider context such as carbon sink value and overall reduction of biodiversity conservation in one of the 'hotspots' of the world.

(iv) System boundary/Neighbourhood analysis

This case illustrates the important need to define the system boundary well. This would ensure that the main effects of the alternative strategy are addressed and if possible 'internalized' into the decision making process.

The analysis and the system boundary is often very case specific. Let's say for argument sake that there was no community living downstream of the forests, in which case there would be no water treatment costs, or savings. In this case the analysis would be confined to the activities of logging and forest rehabilitation, and the incremental costs will be positive ($0.03 million). Issues of stakeholder analysis still remain pertinent.

TABLE 1: INCREMENTAL COST MATRIX FOR SYLVANIA'S PEAT SWAMP FOREST

	Baseline (B) **(Canals)**	**Alternative (A)** **(Tramlines)**	**Increment (A-B)**
Global Biodiversity **Benefits**	Habitat for unique fish fauna threatened.	Disturbance of the habitat is minimized.	Odds of protecting unique fish fauna are increased.
Domestic Benefits	1. Timber from trees (> 45 cms girth) from 1500 ha/yr. 2. Six million gallons of clear water per day.	1. Timber from trees (>45 cms girth) from 1500 ha/yr. 2. Six million gallons of clear water per day.	0
Annual Costs Timber Extraction Forest Rehabilitation Water Treatment **Total**	$0.74 million $1.32 million $1.99 million **$4.05 million**	$1.01 million $1.08 million $1.39 million **$3.48 million**	+$0.27 million -$0.24 million -$0.60 million **-$0.57 million**
Present value Timber Extraction Forest	 $5.00 million	$6.83 million $7.30 million	$1.82 million -$1.62 million

Rehabilitation	$8.92 million	$9.40 million	-$4.06 million
Water Treatment	$13.45 million		
Present value (10%d.r., 10 years)	**$ 27.37 million**	**$ 23.52 million**	**- $ 3.85 million**

CASE # 6

PARADIGM CASE ON INCREMENTAL COSTS FOR BIODIVERSITY

PERU AND BOLIVIA: Biodiversity Conservation Of The Titicaca-Desaguadero-Poopo-Salar De Coipasa (Tdps) Waterbasin

#OP 2,3,4: Freshwater, Forest and Mountain ecosystems

A. PROJECT BACKGROUND

The Titicaca-Desaguadero-Poopo-Salar de Coipasa Water Basin (TDPS) sits astride the Andean altiplano of two countries: Bolivia and Peru. This unique endorrheic system houses outstanding aquatic and terrestrial biodiversity with numerous endemic species as well as globally threatened and endangered species including the well known condor, vicuna and guanaco. The aquatic biodiversity is under threat from introduction of exotic species and overfishing, suffers from water pollution especially from untreated sewage at specific locations of the TDPS, and sedimentation resulting from near and upland economic activities. The montane terrestrial biodiversity is pressured by inappropriate land-use practices, and overgrazing.

The governments of Peru and Bolivia have developed a Binational Strategic Plan (BSP) to provide for the control, conservation and adequate use of the various resources of the TDPS, in view of the joint and individual use of such resources by the two countries. The focus of the BSP is very much in line with national and binational priorities, especially to address the problem of extreme climatological events associated with droughts and floods through improved management of hydrological resources in the TDPS, without negatively affecting the ecology of the lakes. The Plan provides for flood prevention and provision of irrigation facilities to improve agriculture and livestock production and has hydrobiological, social and environmental programs. However, the Plan does not seek explicitly to rehabilitate and restore the unique biological resources of the Basin.

The aim of the project here is to help save and conserve the unique and threatened freshwater and montane biodiversity at the TDPS by facilitating the inclusion of specific biodiversity conservation measures as well as supporting a regulatory framework and complement measures towards the installation of institutional capacities which are presently either insufficient or conflicting.

The incremental costs of this project are $ 4.0 million, the GEF grant requested is for $ 3.11 million. The remainder is to be co-financed.

B. INCREMENTAL COST ASSESSMENT

1. Broad Development Goals

1.1 Since 1990 Bolivia and Peru have formalized their commitment towards biodiversity conservation and Protected Area management. In 1990, Bolivia created the National Environment Fund and in 1992 an Environmental Law was enacted following which the Ministry of Sustainable Development and Natural Resources, Environment Secretariat and the National Biodiversity Conservation Directorate were also installed. A Biodiversity Conservation law that would provide a stronger and clearer legal framework for the management and control of the National System of Protected Areas is currently under review. Presently there are six protected areas within the TDPS, of which only two are legally established and operational.

1.2 Likewise in Peru, conservation has taken an increasingly important position in government priorities. In 1990, the Environmental Statute was enacted, and there is presently a proposal for a Forestry and Wildife Law. Institutionally, the main responsibility for biodiversity conservation falls upon the National Institute for Natural Resources. Despite these advances many of the protected areas remain insufficiently funded at the operational level. Within the TDPS of Peru, there is only one Protected Area, and another newly declared one.

1.3 Beyond the system of protected areas, a major initiative by the two governments within the TDPS region is that of the formulation of the Binational Strategic Plan (BSP). The final plan, entitled "Binational Strategic Plan for Flood Protection and Prevention and Exploitation of TDPS Resources" was completed in 1995 and approved by the two governments. This Plan is to provide a comprehensive framework for future development of the region.

2. Global Biodiversity Objective

2.1 The biodiversity significance of the TDPS is described in the project document (Section B.1 and B.2). Here we provide a brief overview and highlight the issues of importance.

2.2 By world standards, TDPS is not a region of extremely high levels of biological diversity. However, it is important because of its environmental uniqueness, its binational location and its importance to the Andean mountain culture and ecosystem. In a conservation assessment of the terrestrial ecoregions of Latin America and the Caribbean, this ecoregion of montane grasslands, termed the Central Andean puna, was accorded a Level I rating. This implies that it should be accorded the highest priority at a regional scale. This unique system houses globally outstanding terrestrial and endangered species including the well-known Andean condor (*Vultur gryphus*), vicuna (*Vicugno vicugno)* and guanaco (*Lama guanicoe*).

2.3 The above terrestrial assessment, however, did not take water bodies into consideration. The lakes and lagoons of the TDPS form a unique endorrheic waterbasin encompassing 143,900 km^2 in the Andean altiplano. The specialized and unique conditions of Lake Titicaca with their low water temperatures and oxygen content, high radiation and daily range of temperature has resulted in a high degree of endemism. The area of highest aquatic biodiversity is Lake Titicaca itself. One hundred percent of the sponges, 91% of the amphipods, 88% of the fish, 62% of the molluscs, 32% of the aquatic insects and 29% of the amphibians associated with the lake are endemic. Specifically, the deep waters of the more than one million years old Lake Titicaca harbor two endemic genera of fish *Orestes* (boga and karachi) and *Trichomycterus* (mauri and suche), and the famous giant lake frog, huankele (*Telmatobius culeus*) which are especially threatened. There are forty species of birds, fifteen of which are endemic to TDPS, and there also are a variety of migratory species which use the lake as a critical feeding and resting point in their migratory routes. Among the threatened or endangered species are two species of flamenco (*Flamenco jamesi* and F. *andino*), suri (*Pterocnemia pennata*), the Lake Titicaca short-winged-duck *(Rollandia microptera)* and the Andean condor.

2.4 In terms of flora, three macrophytes are endemic to the lake ecosystem (*Elodea potamotgeton, Myriophyllum elatinoides* and *Lilaeopsis andina)*. The emergent water reed "totora" (*Schoenoplectus tatora*), is dominant in the shallow waters of the lake, and plays a critical role within the lake’s ecosystem, providing food and breeding habitat at some point of their life cycle for many native fish and birds. It also protects the shoreline from the action of destructive waves. This reed has held a key position in traditional communities for centuries and is still used in the area by traditional and local communities for livestock fodder, handicrafts, boats, fuel and general domestic use.

2.5 This unique biodiversity at the TDPS is increasingly under threat, and these threats are described in a fair amount of detail in the Project document (Section B, 2). Table 1 summarizes the main threats to this biodiversity, and classifies the threats as proximate, intermediate and causal. In general, terrestrial biodiversity is pressurized by inappropriate land-use practices, and overgrazing by introduced species (cattle and sheep) resulting in loss of vegetation cover and soil erosion. Aquatic biodiversity is being lost as a result of the introduction of exotic species of fish into lakes and rivers, overfishing, and overharvest of some critical aquatic vegetation (such as the totora and llachu).

2.6 Water pollution is not yet a widespread problem. However, untreated sewage and sediments from soil erosion in near-shore and upland areas threaten specific areas along the lakeside (e.g. Puno). This has the effect of upsetting the biological balance and also increases the danger of pathogen and parasite transmissions, though the fish, aquatic vegetation and water which may be abstracted from this part of the lake. The subsequent eutrophication of this part of the lake would have adverse impacts on the ecology of the lake. Other areas, such as Lake Poopo and Uru-uru suffer from physical and chemical pollution (from mining etc.) which must be addressed through the BSP.

2.7 Although information on the flora-fauna (plankton, benthos, fish) relationships in the Lake is not known to the same level of detail as the physical operation of the Lake (sedimentation, primary productivity), it has been pointed out that the reduction in the extent of totora, *llachu*, and cattail (main vegetal associations in the lake) have had adverse impacts on the fish and avifauna. The reed banks on the Peruvian side have shrank from about 60,000 ha to 40,000 ha between 1970 and 1992. All of these pressures operating through the various threats are exacerbated by weak institutional capacities for biodiversity conservation and management in the countries and insufficient or conflicting regulatory frameworks.

2.8 The initiatives to conserve biodiversity or to give it importance, in both Peru and Bolivia, are fairly recent (as described under the ‘broad development goals’), whilst the threats to biodiversity and the environment in general have been ongoing over the years. Unless these threats, and the trends of these threats are contained and reversed, some of the unique biodiversity will be irretrievably lost. This will be a loss to the global community. It will also represent a lost opportunity for the locals, because quite a few of these species could be sustainably used and managed once the species’ are restored to stable biological levels.

3. Baseline

3.1 Agriculture and livestock rearing are the principal sources of income within the TDPS. Cattle and sheep rearing use the aquatic ‘totora’ reed for fattening: this is a principle economic activity. Fishing constitutes a less important economic activity in the TDPS. It is mainly based on small-scale fishing previously using traditional capture techniques but increasingly relying on more predatory methods such as drag nets. The impact of traditional fishing as currently practiced is destructive because it is largely confined to the near shore ‘totora beds’ which are important nursery and feeding habitat for the young fry.

3.2 The productive activities of the TDPS are severely limited by the harsh climatic conditions: the dry cyclones, floods and frost impose a seasonal characteristic on agricultural activities. These events put a great toll on the harvest of natural resources. It is important, however, to bear in mind that although the droughts and floods are linked to the natural rainfall and water-flow patterns, they are considerably exacerbated by imbalances caused by the diminished regulating capacity of the basins resulting from bad land use and the inappropriate location of productive activities and infrastructure over time. Recognizing these constraints, the governments of Peru and Bolivia developed the BSP with an emphasis on the management of the hydrological resources in the Titicaca Basin. The BSP is critical in defining the baseline situation in the TDPS, as it provides important information on the state of affairs at the moment.

3.3 One of the principal conclusions of the Plan is that *only 20*m^3*/sec of water from Lake Titicaca can be exploited for economic-productive uses, if the long term balance and ecology of the lake systems is to be assured*. Preliminary studies have revealed that the potential water demand is four times greater than the available water, suggesting an important and urgent need for long-term planning of all hydrologically related projects. Thus the principal limit on the exploitation of the water resources will not be a lack of water in the basin *per se*, but the restriction imposed by this limit.

3.4 The BSP sets out a framework for sectoral development in the region and includes a broad portfolio of projects and programs focuses on the basin's hydrological resources for flood prevention and irrigation as well as infrastructure development, environmental, social and hydrobiological programs. The environment program is currently being detailed through a UNEP-OAS study which is addressing the following components: (i) erosion and soil conservation, (ii) control of water pollution, (iii) control of river sedimentation and (iv) creation of protected areas. The investment needs of this program have not yet been estimated.

3.5 The hydrobiological management program of the BSP has two main components: (i) program for sustainable development of fishing (including the extraction, evaluation of biomass, protection, protection of reproduction phases) and (ii) program for aquatic vegetation management. The BSP as it stands now does not include specific initiatives to conserve and sustainably use the unique and globally threatened biodiversity, since this is not viewed as a national/binational priority.

4. The Proposed Alternative

4.1 The proposed alternative includes a series of conservation measures designed to promote the long-term conservation of biodiversity and the demonstration of sustainable use of biodiversity as alternative sources of livelihood for inhabitants of the Basin. These conservation measures in the proposed alternative are actions which are 'additional' to the baseline. These additional actions will complement existing and planned activities consistent with national development plans and priorities as set out in the BSP. In view of the understanding that biodiversity conservation, water quality and quantity, and land-use practices are intimately linked, especially in the TDPS which is an endorrheic system, there is a need for the BSP to be expanded to address the special concerns of the endangered and threatened biodiversity.

4.2 Specifically the additional activities are designed to reintroduce key native species into specific localities in the Basin, and to secure long term biodiversity protection in the form of strengthening the management of protected areas, creating participatory schemes for natural resource management by local communities, indigenous groups and other sectors of society. It will also promote the sustainable use of the regions biodiversity through pilot projects to demonstrate a range of alternative livelihoods to communities consistent with biodiversity conservation including the rearing of native species of birds, frogs, and alpaca and the sustainable harvesting of totora reeds for fodder and craft material and thola for wood.

4.3 These actions would involve a wide range of government, NGO, private sector and community stakeholders in all stages of the project execution and evaluation. Present land tenure systems operating as a consequence of Agricultural Reforms and Regulations in both countries means that unless these communities are involved throughout the process through consultation, and subsequently in the management of the biodiversity and biological resources, none of the ventures are likely to succeed.

4.4 Incorporation of these components into the BSP will ensure the conservation of globally unique biodiversity by integrating biodiversity protection into sectoral development plans and activities throughout the basin. In the long term this would ensure the restoration of these important biodiversity to sufficient stock levels allowing some of these species to be managed for sustainable harvests.

4.5 There is a need to make a distinction between biological resources and biodiversity. When a species is at critically low levels, biodiversity in itself is threatened; but as the species is restored over time and lends itself to sustainable use and harvest, it needs to be managed as a biological resource (or bio-resource). In the former situation, there would be a need for full-costs to be estimated. In this project, for example, the native fish are presently threatened and need to be restored and rehabilitated, and the full incremental costs of doing so are estimated. However, as the resource gets restored to stable levels and is amenable to sustainable harvest it would be necessary to put mechanisms in place which ensure that the fish do not get 'mined'/ degraded (again). The removal of any barriers which would jeopardize the long term management of the resource would need to be costed.

4.6 The main program and activities which constitute the proposed alternative include:

1. sustainable use of biodiversity within the Titicaca basin through demonstration projects
    - pilot programs and projects
    - strategy for promoting alternative sources of income

1. biodiversity conservation strengthened in the Titicaca Basin
    - Titicaca National Reserve
    - two new adjacent protected areas
    - re-introduction and recovery of key native species
    - reduction of the threat to aquatic biodiversity from water pollution

1. strengthening the technical and management capacity of government and non-government institutions to plan, implement and monitor biodiversity management and conservation programs in the TDPS

    - Biodiversity Management Plan
    - Biodiversity Information Campaign
    - strengthening of capacity for sustainable use of biodiversity in the TDPS system
    - strengthening of government and NGOs technical and managerial capabilities for the sustainable use of biodiversity
    - strengthening of technical and managerial capacities of the Autonomous Lake Authority (ALT)

The details for each of these program activities are in the Project document (Section B. 5).

4.7 As mentioned above, the overall threats to the biodiversity of the TDPS are summarized in Table 1. The Table also provides an overview as to how these threats will be addressed: through the baseline (as part of the BSP, and/or some other initiative) or the proposed alternative (as a GEF project).

4.8 The assurance that the projects and activities associated with the baseline are in the pipeline (or underway) is very important because unless the most important of these threats are tackled, any move to introduce the alternative strategy is not likely to have the desired outcome. Especially critical is that the abstraction of water from the lake does not exceed the recommendation of the BSP, as that could alter adversely the ecology of the lake. If that is so then the alternative recommendation for rehabilitating the fish stock would be counter-productive. Also the improved water management and improved irrigation associated with the baseline should reduce the pressure of overgrazing and improve the land use patterns, which in turn would reduce pressure on the protected area management. This should have positive effects on the terrestrial biodiversity, and the investments through the alternative strategy to improve management of these protected areas are more likely to succeed.

5. Scope of Analysis

5.1 Because the TDPS is an endorrheic system, it defines quite naturally the scope of analysis. The range of the various components of the project may extend over different parts of the TDPS, and hence national or binational territory, and the implications of these may need to be monitored closely. Also some components may need to be phased. For example, in terms of the restoration of endangered native fish in the lakes, it may be prudent to begin these activities at Lake Titicaca which is less prone to the increasing salinisation that has afflicted Lake Poopo and the Salar de Coipasa due to various anthropic activities. Any rehabilitation of native fish at these sites may be more tricky and uncertain. But even at Lake Titicaca, the problems of urban pollution and sewage at Puno need to be addressed as part of the baseline.

6. Costs and the Incremental Cost Matrix

6.1 The full complement of programs in the BSP, UNEP-OAS and other related commitments by the two governments constitutes the baseline of necessary actions on which to build a conservation strategy. The additional activities targeted specifically to alleviate the threats on the unique but threatened biodiversity within the TDPS together with the baseline comprise the alternative strategy. The incremental cost matrix for TDPS is presented in Table 2, showing the main cost and benefit components associated with the baseline and alternative strategies.

6.2 With regard to the global benefit, shifting from the baseline to the alternative strategy will provide for enhanced biodiversity conservation in the TDPS, especially of the species which are currently threatened. The baseline domestic benefits will also benefit from the rehabilitation of biodiversity, and its subsequent sustainable use could be incorporated into the local livelihood strategies to further alleviate poverty in the region.

6.3 The baseline costs are estimated for the key programs which will be undertaken through the BSP (and the UNEP-OAS) study (Table 2). It is important that the flooding and irrigation program is underway first because this would have the overall effect of restoring the ecosystem of the TDPS basin. The observance of the recommended limit for the abstraction of water from the lake is critical to ensure also that the ecology of the lake is not disturbed. The total cost of the baseline course of action is estimated at $ 330.2 million and is being financed by a wide range of sources which are described in the project document.

6.4 The improved management and use of the hydrological resources is the same as that required under the baseline situation, as their compliance is crucial for success of the alternative strategy. The first 'additional' program of the alternative strategy focuses on strengthening biodiversity conservation in the Titicaca basin, both at the aquatic and terrestrial fronts, and is estimated to cost $ 1.1.9 million. The program will go beyond the general concerns that will be addressed through the hydrobiological and environment programs of the baseline to incorporate specific action for the endangered and threatened aquatic biodiversity at the TDPS. The improved management of specific Protected Areas in the TDPS is critical especially for terrestrial biodiversity. Again, this would only be effective if the baseline actions are in place. For example, the improved water management and improved irrigation associated with the baseline would improve the land-use practices and reduce the pressure of overgrazing. These measures should have positive effects on the terrestrial biodiversity and reduce pressure on protected areas, and the investments towards improved management of these protected areas, as defined under the alternative strategy, would be cost-effective.

6.5 The second program of the alternative strategy centers upon the sustainable use of biodiversity components, and is estimated to cost $ 760,500. These will be conducted through a series of pilot programs and projects to ensure that the harvest of any unique biodiversity does not exceed its regeneration potential. Properly executed, this would enable a strategy for alternative sources of income to be designed and introduced to the locals.

6.6 The pressures on biodiversity are exacerbated by weak institutional capacities at the local, regional and national levels which are presently either insufficient or conflicting. Capacity strengthening, the third program in the alternative would concentrate on these aspects, including biodiversity management plans and information campaigns. This program has to be innovative to deal with changes and challenges. For example, planned improvements in the transport systems and energy supply serving the water basin may further intensify the pressures on biodiversity and harvest of resources unless corrective and sustainable management programs and institutional capacities are firmly established from the outset. The total cost of this component is estimated at $ 929,820.

6.7 Costs for project management, implementation workshops, and the administration costs have been estimated to be $ 1.1 million . The total costs of the alternative strategy are estimated at $ 334.2 million.

6.8 All costs, both for the baseline and alternative strategy, are presented as total costs for each program.

7. Results

7.1 The total cost of the baseline strategy is $ 330.2 million compared to that of the alternative strategy of $ 334.2 million. The incremental costs to pursue the alternative strategy are $ 4.0 million.

7.2 The complementarity of the baseline and the alternative is of the essence. As mentioned above, the alternative strategy will include the actions of the baseline, but will be targeted to ensure that specific actions are taken to address the threats to the endangered and endemic biodiversity of the TDPS. However, unless the programs in the baseline are well executed, the alternative strategy will be ineffective. It is for this reason that the programs and costs of the baseline are also represented in the alternative option (Table 2).

7.3 The increment of $ 4.0 million represents just over 1% of the total costs, the remaining being the baseline costs. Despite the ‘small’ increment in terms of total project costs, it represents a strategic contribution, and it is important to ensure in that the defined aims are not simply lost. Any neglect or omission may undermine the long term management of critical biodiversity resources, and which could in turn have impacts on the wider project.

7.4 The GEF grant requested is for $ 3.11 million as the two governments have received co-financing for the project for $ 890,000.

8. Positive Lessons from the TDPS Incremental Cost Assessment

8.1 This case study provides an excellent example of a situation which demonstrates that a well constructed root cause analysis helps towards good project design and subsequently the assessment of incremental costs. The need for the removal of these threats to achieve defined biodiversity benefits then allows a corresponding identification of those actions which would be conducted through the baseline (i.e. in national/domestic interests, and in line with the broad development goals) and those which are additional (would benefit the global community). This infomation would feed into the incremental cost matrix and allow for an assessment of the costs.

8.2 The case study also demonstrates a good example of the complementarity of the actions in the baseline and the alternative. Although the actions recommended under the proposed alternative are ‘additional’ to the baseline, the root cause analysis demonstrates that achievement of the baseline as critical towards achieving the objectives of the proposed alternative (e.g. the limit on the abstraction of water from the lake). Specifically, this requires a phasing of the actions

TABLE 1: BIODIVERSITY THREAT ANALYSIS AT LAKE TITICACA: AS ADDRESSED BY THE BASELINE AND/OR PROPOSED GEF ALTERNATIVE.

Threat type	Sphere of Influence	Threat	Baseline[1]		Alternative
			BSP	Other[2]	
Proximate	Aquatic biodiversity	• introduction of exotic fish • overfishing • overharvest of aquatic vegetation • water pollution • land-use practices • flooding • lack of irrigation water	x x x x x	x x x	x x x
	Terrestrial biodiversity	• land-use pattern • overgrazing	x x	x x	
Intermediate	Overall	• institutional weaknesses • poor enforcement of regulatory frameworks • sectoral approach to planning • poverty/livelihood strategies	x x x x	x x x x	x x x
Ultimate	Overall	• extensive structural changes			

		• economic crisis			

Notes:

[1] the baseline is being funded through several initiatives (see Project Document, Section E)

[2] other studies/plans e.g. UNEP-OAS diagnostic study currently underway.

- where both the baseline and alternative address the same threats, the emphasis is on different aspects.
- the table is compiled using information from the Project Document, the Binational Strategic Plan and the UNEP-OAS Executive Summary.

Table 2: Incremental Cost Matrix for TDPS

	Baseline (B) **(BSP)**	**Alternative (A)** **(BSP + biodiversity conservation measures)**	**Increment (A-B)**
Global Biodiversity Benefits	• no specific conservation measures to target endangered and threatened endemic species	• specific conservation measures to restore and rehabilitate endangered and threatened endemic species • promotion of sustainable use of biological diversity	• enhanced biodiversity conservation in TDPS
Domestic Benefits	• control and prevention of flooding • irrigation • hydrobiological management program • environmental program	• control and prevention of flooding • irrigation • hydrobiological management program • environmental program • sustainable harvest of biological resources associated with the rehabilitation of specific biodiversity	• improved levels of biologica stock to allow for sustainable use
Costs	• Flooding and irrigation components (S 324.3 million) • Hydrobiological management program ○ fisheries development ($ 5.2 million) ○ aquatic vegetation management studies	• Flooding and irrigation components (S 324.3 million) • Hydrobiological management program ○ fisheries development ($ 5.2 million) ○ aquatic vegetation management studies	

	($ 0.8 million) • Environmental program ○ control of soil erosion and soil conservation ○ control of water pollution ○ control of river sedimentation ○ component for the creation or protected areas (still being worked out)	($ 0.8 million) • Environmental program ○ control of soil erosion and soil conservation ○ control of water pollution ○ control of river sedimentation ○ component for the creation or protected areas (still being worked out) • Strengthening biodiversity conservation in Titicaca basin ○ Titicaca National Reserve ($ 122,500) ○ two adjacent protected areas ($ 314,200) ○ re-introduction and recovery of key native species ($ 437,800) ○ reduction of the threat to aquatic biodiversity from pollution ($ 316,119) • Sustainable use of biodiversity in Titicaca through demonstration projects ○ pilot programs & projects ($ 545,900) strategy for promoting alternative sources of income ($ 214,600) • Strengthening capacity of (locals) govt. and NGOs to plan, implement & monitor biodiversity management & conservation programs ○ Biodiversity Management Plan ($ 221,000) ○ Biodiversity Information Campaign ($ 184,900) ○ strengthening capacity of locals for sustainable use of biodiversity in TDPS ($ 85,000) ○ strengthening of govt and NGO technical and managerial capabilities for sustainable use of biodiversity ($ 377,800) ○ strengthening of technical and managerial capacities of ALT ($ 61,120) • Project management and evaluation ($ 974,795) • Pre-implementation workshop ($ 27,761)	

		• Administration costs ($ 116,505) ($ 334,200,000)	

Total costs	($ 330.2 million)		($ 4,000,000)
Co-finance	($ 0)	($ 890,000)	($ 890,000)
GEF contribution			($ 3,110,000)