more, knowing that there are only limited opportunities for access. In contrast, under the existing system, so long as the visitor is willing to pay the minimum "hurdle" price ($65 peak season or $55 low season per day plus expenses), then the incentives are to keep costs low and number of visitors high - just the opposite of the countries goal of high value/low volume tourism. Third, a user fee results in the government capturing the rent associated with the excess of benefits over costs, rather than the private sector, whereas under a quota mechanism the higher price paid by tourists visiting the country would be captured by the private sector.

The only potential cost of a quota system would be that large tour operators might be able to drive small operators out of business, thereby reducing the opportunities for small businesses and creating a monopoly situation in the industry. This problem could be readily solved, however, by allocating tradable "rights" to the tour operators based on the number of visitor days that they currently are selling. Each operator would thus be guaranteed at least the current business that they are doing (and the profits they would obtain for that number of visitors would increase as the visitors begin to bid up the price). Any operator, however, could sell a certain number of visitor day rights (or sell all their rights) to other operators if they felt that they could earn more through the sale of the right than through the business itself.

The most desirable approach would likely be to maintain the existing fee charged by the RGOB, while setting limits to the total number of tourists visiting the country and allocating tradable rights to the existing tour operators. Operators would thus have to pay the government the current $65 peak season or $55 low season per visitor day fee, but then would be free to charge what the market would bear. Using this approach, the government could also seek to steer tourist visits to other parts of the country or to other seasons of the year through either regional quotas or limits on hotel construction in Paro and Thimphu. The government could expand the number of tourists (the quota) in future years either by allocating additional rights to the operators or auctioning off those rights to the highest bidders.

5.3 Non-Timber Forest Products

Bhutan could increase economic benefits gained from its natural forests through intensified efforts to develop non-timber forest products. With support from UNDP, a project is already underway to expand production and quality of production of lemon grass oil. Other plants have been identified as having high potential for commercial exploitation of essential oils or resins, including *Pinus roxburghii* (chirpine), *Cympopogon distans* (a separate lemon grass species), *Artemesia vulgaris, Gaultheria spp.* (Wintergreen), *Abies densa* (silver fir), *Aquilaria agallocha,* and various lichen species (La, 1996). The RGOB has developed a horticultural action plan as part of the process of developing the Eighth five-year plan to identify priorities for further development of NTFPS.

NTFP as a source for food security should also be assessed in terms of famine food for rural communities, where food from the forest become critical in times of crisis. Edible plant parts as in fruits, roots, bulb, stem, flower, etc. can be important source of essential nutrients in the diet regime of people living in close proximity to forest. In a study conducted in the West central Bhutan, forest plants contributed an average of 21% to the total household diet and 19% to the household income (Namgyel 1996). During difficult times, farmers venture out in the field in search of edible tuber; seeds for extraction of cooking oil; fruits and nuts for domestic consumption and sale; bamboo shoots, fern shoots, mushrooms, cane shoots, wild orchid flowers as a substitute for vegetables, etc.
It was proposed in May 25, 1988, to impose ban on the export of medicinal plants and establish cooperation between the DoF (now DoFS) and the NITM (now ITMS) for a mechanism of collection and cultivating medicinal plants. Various promotion schemes as in the waiving of forest royalty and sale tax on bamboo and canes to promote and encourage production of handicrafts for sale and domestic use and also to promote lac cultivation in a similar manner.

The lack of NTFP data makes it difficult in assessing the carrying capacity of particular important species found in a particular site. The acute shortage of information has a drastic impact on the management of these resources, which are considered critical for the mostly agrarian population in

the country. The lack of qualified manpower in this field further exacerbates the problem. Another constraint lies in the geographical landscape of the country, the steep and abrupt terrain limits trade only to areas where feasible and those connected with road network. Although, road network in certain portions of the country are well developed, the erratic climatic conditions pose yet another deterrent in trade of products within the country as well as outside the border to India.
Resin tapping, a lucrative industry is carried out in the five eastern districts. The present method of resin extraction includes the French Cup and Lip method and studies are underway in the prospect of adoption of the Rill method. Benefit accrues in the form of employment and revenue to buy subsistence goods at the village level.

Economic benefits from medicinal plants could also be increased in Bhutan; however, it will be difficult to expand this potential market while ensuring conservation and equitable sharing of benefits. Naturally grown medicinal plants with high potential for commercial exploitation include *Taxus baccata, Swertia chirata, Piper spp., Pseudo ginseng, Illicium anisatum, Cordecep sinensis, and Picrorhiza kurooa.* Bristol-Myers Squibb, for example, approached the National Institute of Traditional Medicine inquiring about the possibility of sourcing material *(Taxus baccata)* from Bhutan for production of Taxol. (The request was denied.). Substantial trade is now underway with two plants: *Swertia chirata* (a member of the Gentian family exported to India as a multi-purpose medicinal plant) and pepper or pipla *(Piper* spp.), sold for spice production (the fruits) and pan (the leaves). By one estimate, sales of pipla could expand to about $50,000 per year in Eastern Bhutan (Dorji, 1995).

The conservation risks associated with trade in medicinal plants are already well appreciated in Bhutan. Poaching of medicinal species -- including in some cases by Tibetans or Indians in the border regions -- is already a problem for a number of species. If markets are developed for additional species added pressure will be placed on the collection of wild populations and, for some species, this could threaten the populations with extinction. This has been a common outcome of active marketing of medicinal plants in other regions of the world. Major conservation problems exist for wild medicinal plants commercially marketed in Africa (Cunningham, 1993). In Southern India alone, 80 medicinal plants have been labeled threatened by IUCN (Tandon, 1996). And often, the pressure of commercial demand comes from larger markets in other countries. In Nepal, 60-70 percent of the medicinal herbs collected in the early 1980s were exported to India (85-200 tons annually between 1972 and 1980). Merely establishing cultivation of the species involved is not a sufficient solution to the problem (and, for many species, practical methods of cultivation are not yet known and may be difficult to achieve). Even if some people cultivate the species involved, the incentive for others to collect the species from the wild will still exist unless the cultivated product becomes so abundant that the price of the product drops to the point that benefits to wild collectors are too low.

The Institute of Traditional Medicine Services is, hoping to establish a two-tiered pricing scheme for medicinal plants -- it will pay a higher price to producers who can 'certify' that their material comes from cultivation. This policy should effectively reduce pressure on wild stocks (for those species suited to cultivation) so long as the ITMS is the primary purchaser of herbal products. Maintaining this exclusivity for species with clear market value, however, will be increasingly difficult as transportation infrastructure is further developed and as local communities establish more extensive trading relationships with others in Bhutan and in neighbouring countries.

Bhutan may want to establish 'pre-emptive' marketing policies for different categories of medicinal plants. The most restrictive category (Category I) would be for species that are relatively rare and which could easily be threatened by overharvesting. It would allow no commercial trade and ITMS would use material only from cultivated sources. Category II would allow commercial trade only if practical means of cultivation have been developed. Category III would allow commercial trade even if the species were only obtained from the wild so long as a management plan has been prepared by the Department of Forestry Services. For example, *Taxus* would probably fall in Category III -- with an effective management plan the species is sufficiently abundant that it would be difficult to threaten with extinction through controlled harvest.

Bhutan should also carefully examine the issue of benefit sharing with local communities and traditional healers for traditional medicines that enter into the commercial trade. Currently, benefit sharing takes place largely through employment opportunities and the involvement of traditional healers in the ITMS. The Institute can be viewed to be strengthening the capacity of these individuals to achieve their public health goals -- they are an integral part of the Institute, rather than a beneficiary of the Institute's work. While not all of the traditional healers in Bhutan may be directly involved in the institute, the ITMS nonetheless provides "implicit" benefit sharing to all of Bhutan's people (including other healers). By virtue of the fact that while it is using traditional knowledge it is repaying society by making the products of that knowledge more readily available across the country. So long as products are not being developed and sold for profit, this appears to be an effective arrangement.

However, if material is introduced into commercial markets then the issue of benefit sharing becomes more important. It clearly becomes an issue if a private entrepreneur wishes to sell traditional remedies or herbal plants that may have been used by many healers in the country. The issue would also be relevant if ITMS -- even as a non-profit institution - sells material for use outside Bhutan. In both these cases, the individuals whose knowledge of traditional medicines "created" the product that is being marketed would not all be receiving an equitable share of the benefits from that commercial use.

If traditional products are marketed, the RGOB thus may want to consider placing a small tax on the sale of products and using the funds raised in that fashion to provide benefits to the country's traditional healers, in particular those not directly involved in ITMS. Alternatively, since the initial revenues from a small tax on a new commercial product would be very small, a portion of the Bhutan Trust Fund for Environmental Conservation, say $ 10,000 per year, could be allocated to activities that support traditional healers throughout Bhutan. The revenues raised through a tax on sales of traditional medicines would go directly into the Trust Fund. A small board comprising of traditional healers from villages and those involved in ITMS could have oversight over the use of funds raised through either of these mechanisms.

5.4. Bioprospecting

"Biodiversity prospecting" (or "bioprospecting") refers to the research, collection and the utilization of biological material and other related resources, for purposes of applying the knowledge derived there from for scientific and /or for commercial applications. In a developing country like Bhutan, which is rich in biodiversity and where traditional local knowledge and practices regarding this biodiversity prevails, bioprospecting can be promoted as a sustainable environmental activity as it provides both economical and ethical incentives for biodiversity conservation.

Bioprospecting fits in fully with the Royal government's sustainable development policy, particularly the "middle path" approach efforts, which supports the integration of conservation and economic development. Bioprospecting is particularly important for sustainable development as it represents economic opportunities that are not resource extraction intensive and also helps attach a more precise value to preserving biodiversity that is otherwise difficult to quantify.

5.4.1 Potential Benefits of Bioprospecting in Bhutan

As the population of Bhutan is mostly rural based, bioprospecting can be very important to the local communities who are the stewards of the nations biodiversity. Bioprospecting has the potential of providing benefits to the local communities by establishing monetary value to the traditional cultural practices and knowledge associated with the natural environment. It can thus create incentives for indigenous people to conserve biodiversity and provides an opportunity to catalogue and revive traditional people's knowledge and practices. Bioprospecting also has the potential of increasing the development of the urban population particularly the private sector in Bhutan by providing investment opportunities with potentially high returns. Bioprospecting may also accelerate the development of scientific biodiversity knowledge and provide access to cutting edge technologies,

which would be important aspects to Bhutan, given that we are in an era where globalization and technological advancement are inherent.

The potential benefits of bioprospecting program can include sustainable technology transfer (particularly in the field of Biotechnology), training and education programs, reaping of the monetary gains of natural product development, intellectual property rights protection and the protection of indigenous rights and knowledge. Also through the proper usage of the income created from conserved biodiversity increased local and national capacity to effectively oversee and co-ordinate the conservation and sustainable utilization of biodiversity could be established.

Bioprospecting can become a useful strategy for achieving the natural resource goals as emphasized by the RGoB with regards to long-term sustainability, self-reliance, national sovereignty, and promotion of national happiness. However this can be accomplished only if the RGoB is supported in its initiatives by the local communities in partnership with the private sector, including international organizations involved in research and development.

5.4.2 Precautionary Measures to be considered

Bioprospecting is a complex undertaking as it involves many stakeholders. Moreover developing countries normally deal with potential partners from developed countries. It is therefore essential and of paramount importance that adequate national capacity to deal with the complexities of bioprospecting is built within Bhutan, which currently does not exist. Building national capacity in bioprospecting is essential to ensure that Bhutan benefits from opening it's biodiversity resources to the world while averting being exploited in its future bioprospecting ventures.

Experiences from other countries that have established and initiated bioprospecting agreements have shown that bioprospecting can provide greater up-front benefits by adopting the following approaches. (a) High up-font payments that cover more than just the cost of collecting materials, such as the cost of establishing the basic scientific infrastructure for identifying, locating and recollecting species and monitoring their population size; (b) Enhancement of technological for extraction and isolation of active chemicals and preparation of samples. (c) Establishment of the capacity for basic screening of compounds for potential utility as drugs or industrial products; and to (d) Training of scientist in chemical analysis, drug discovery, and taxonomy (Reid et al, 1995)

5.4.3 Preconditions for an Effective Bioprospecting Program: Actions to be undertaken

The preconditions for an effective bioprospecting program in any country are (1) the presence of basic biological/scientific knowledge about the resource; (2) presence of effective laws regulating access to biodiversity and the human and scientific capacity to enforce the laws. These preconditions are not yet met in Bhutan but are in the process of being addressed. Thus investment in these areas would establish the basic groundwork in case the RGoB ventures into commercial bioprospecting in the near future.

5.4.3.1. Biological/Scientific Knowledge

Like any commodity the trade in genetic or biochemical resources will contribute most to development if the country "adds value" to the raw material. Even so, most countries still are involved almost exclusively in the trade in raw materials- often simply sending plant samples to firms without even performing the basic chemical extractions within the country. Countries have an opportunity to multiply the benefits they obtain from biodiversity, if they choose-as part of a broader technological development plan- to build technological capacity related to biochemistry, biotechnology, agriculture or pharmaceuticals.

Bhutan should explore the merits of establishing the capacity to add value to biodiversity. Bhutan can also explore the opportunities to establish joint ventures with institutions in other countries like India, Costa Rica or possible even developed countries like the United States- that would enable Bhutanese scientists to work directly with the partner institutions.

Whether a country ends up only trading raw material or developing a value added capacity, the core scientific knowledge needed is the same: What species are present? Where they are located? What is the status of their population? What is their ecological role? How they are used by traditional cultures? How do they interact with predators and pest? For a country like Bhutan, developing this core information is no small undertaking. Specific approaches for building this knowledge base and the human capacity associated with it (are discussed in Chapter 4.1), as part of the needed actions since this need crosscuts many of the potential economic opportunities associated with biodiversity.

Preliminary actions taken since BAP I regarding scientific knowledge

As an output of the BAP I document, indicating that the presence of basic knowledge on the country's biodiversity is a prerequisite for an effective bioprospecting program. Also given the importance of establishing a core information base for the sustainable use and management of biological diversity in the nation, the WWF-Bhutan Program provided financial assistance to the RGoB to develop a project proposal to address this issue. The NBC in collaboration with other stakeholders developed a project proposal called the "Bhutan Integrated Biodiversity Information Systems (BIBIS) project" to be implemented in the 9th Five Year Plan. The project which is awaiting donor funding will assist in documenting and creating inventories of all the biological resources in Bhutan and the information is to be presented through an integrated web based system called BIBIS. This inventory and information link will play a key role as the scientific/biological knowledge base for implementing Bioprospecting in Bhutan.

The needs for human capacity development and technological requirements for implementing bioprospecting in the country will be addressed during the 9th Five Year period of the RGoB.

5.4.3.2 Effective Bioprospecting Laws and Regulations

As discussed in Chapter 4, Bhutan may want to allow access for biodiversity research by foreign scientists as part of a broader effort to build its human capacity and scientific knowledge related to biodiversity. However, until Bhutan has built the capacity for negotiating equitable contracts and enforcing access legislation and has increased the information base regarding its biodiversity, the best policy may be to continue to disallow certain forms of commercial bioprospecting. It is difficult, however, to draw an unambiguous line between types of commercial bioprospecting that should be allowed and those that should not. For example, a no-commercial-bioprospecting policy would presumably seek to prevent a local entrepreneur from making extracts of biodiversity and selling them to a pharmaceutical company. But should it also prevent a local entrepreneur from making extracts and selling those as essential oils? Would this latter case be "commercial bioprospecting," or "development of a non-timber forest product"? And if the latter case is allowed because it better fits the NTFP model, should the government seek to prevent the local entrepreneur from growing the species in India where the conditions may be better for production?

Technological advances will make it increasingly difficult for Bhutan to draw this line identifying acceptable commercial uses of biodiversity. For example, consider the different ways that one extract from a plant in Bhutan might be used for commercial purposes. The extract might be found to contain a valuable oil, creating a new "non-timber forest product" for Bhutan. Alternatively, it might be the source of a new fragrance of value to the perfume industry. This industry does not patent the chemical (it instead synthesizes a different compound that produces the same fragrance) but firms are willing to pay for exploration of new biodiversity-based fragrances. (INBio in Costa Rica has had contracts with the perfume industry, for example.) Alternatively, the same sample might contain a chemical that could be used as a pharmaceutical product. Pharmaceutical companies do patent the chemical involved, although the final drug often is synthesized and typically is somewhat different in structure from the original chemical. Finally, the sample, might show activity as a pesticide, leading genetic engineers to search for the gene that produced the chemical involved, patent the gene, and introduce it into a new crop.

A no-commercial-bioprospecting policy is thus too broad to protect the nation's economic interests. Instead, Bhutan should consider establishing a policy with criteria for access that would prevent specific types of biodiversity uses. For example, Bhutan may choose to prevent: a) patenting of a chemical or gene obtained from the country; and b) shifting of the source of production of a material produced by a Bhutanese species to another geographical location.

Thus, in the examples given above, Bhutan would want to avoid export of material that would lead to the new drug and the genetically engineered crop. It would also want to ensure that if a new essential oil was developed from a species endemic to Bhutan that the producer couldn't establish a plantation in India thereby cutting Bhutan out of the benefits. On the other hand, the country would allow research to develop a new fragrance or the production of a new essential oil so long as the production was based in Bhutan.

In addition to this criteria of setting the terms for the type of access that the country desires to allow, several other elements of access legislation, national environmental law or formal government policy will form an important part of the country's efforts to regulate access and ensure the equitable sharing of benefits of the use of biodiversity.

a) ***Focal point contact.*** The Ministry, Commission, or Agency with final responsibility for reaching a decision and issuing or disallowing a collecting permit (or a permit enabling transfer of biological samples) should be clearly identified for users both within Bhutan and internationally. Any such focal point would need to consult broadly with potentially affected Ministries, and deal with all of Bhutan's biodiversity.

b) ***Scope of restriction.*** Bhutan should determine whether restrictions on commercial bioprospecting apply only to non-Bhutanese "prospectors" or to citizens as well. In other words, should a private business that makes extracts of local species and then sells those extracts to pharmaceutical companies be allowed to be established in Bhutan? Under a strict no-commercial-bioprospecting policy, both local entrepreneurs and foreign researchers would have to apply for permits.

c) ***Activities requiring permits.*** To protect against material being used in a manner that would lead to new patents on chemicals or genes or the loss of material to producers outside of Bhutan, the country should consider establishing a requirement for an export permit. Anyone -- Bhutanese citizen or foreign national -- must obtain this before exporting any biological material or material derived from biological material. Existing commodities exported from Bhutan (such as agricultural or timber products, resins, oils, etc.) would be exempt from this permit requirement and exemptions could be granted for other commodities in the future.

The permitting procedure would have two basic purposes. First, it would ensure that the material exported could be used only for the stated purpose and any use of the material for developing other products would not be allowed without obtaining permission from the RGOB. Standard language could also state that the material could not be used as the basis for establishing populations of the species outside of Bhutan (e.g., through tissue culture or planting cuttings or seeds) without consent of RGOB. Second, the permit requirement would enable the authority responsible to prevent those activities clearly directed at commercial exploration for new chemicals or genes that could potentially be subject to patent. The permit process should be simple and efficient -- since most applications are likely to involve activities related to the development of NTFPs, that the RGOB may want to encourage. But it would provide the basis for preventing activities that held the potential of commercial exploitation before Bhutan is in a position to ensure that it gains an equitable share of the benefits.

d) ***Benefit sharing with local communities.*** Either through the permit process described above or through other mechanisms, Bhutan's policy should specify that the prior informed consent of local communities (or individuals such as traditional healers) must be obtained before using information from them for either collecting biodiversity or developing potential products. The policy

should also specify the mechanism for ensuring equitable sharing of potential benefits from the use of that knowledge.

Preliminary Actions Taken regarding bioprospecting laws and regulations.
A project proposal to address these needs has been developed by the NBC called the "biodiversity prospecting management" in Bhutan. In order to develop the national biodiversity prospecting management project proposal for Bhutan, as well as to increase the awareness of biodiversity prospecting among the concerned institutions of the RGoB, the NBC along with the Nature Conservation Division (NCD) and the Planning and Policy Division (PPD) of the MoA, organized a multi-stakeholder bioprospecting workshop/training in Bhutan in May 2001. As bioprospecting is a relatively new field of study in Bhutan, external technical assistance was sought from the World Foundation for Environment and Development (WFED), an institution renowned for their work and with leading global experience in the field of biodiversity management.

To ensure the development of effective policy and legal framework for Bhutan, the activities of the biodiversity prospecting management project is to be carried out in two phases. The first phase is for the development of the policy and the legal frameworks and the institutional capacities that are essential and necessary for sustainable implementation of bioprospecting management activities in the nation. As bioprospecting is a new venture to be undertaken by the RGOB, there is a great need for specialized training in the fields relevant to bioprospecting, in particular in biotechnology and its applications accordingly. On successful completion of Phase one, and in order for the RGOB to evaluate and assess the effectiveness of the developed bioprospecting rules, regulations and laws and the potential usefulness of our rich biodiversity, a pilot biodiversity-prospecting project will be formulated and initiated for implementation, during the course of the 9th Five Year Plan period.

With the support of external assistance and donor funding the bioprospecting management project will be ready for implementation in the 9th Five Year Plan period of the RGOB.

5.5 Carbon Storage

Bhutan is in a somewhat paradoxical situation with regards to its potential to capture greater economic value from the carbon content of its forests. Despite the fact that Bhutan is heavily forested and those forests play an important role in sequestering carbon from release in the atmosphere, any mechanism established for financial transfers to pay for carbon offsets -- either through Clean Development Mechanism (CDM) or carbon trading -- will hinge on the principle of incremental costs. Funds through CDM, for example, would be available to pay for additional storage of carbon beyond what is already in the country's economic interests. In Bhutan's case, loss of forest cover would be extremely damaging to the country's economy (due to the extensive erosion, degradation of hydropower potential, and loss of locally important biodiversity that would result). It is difficult to make a case that funds from CDM or carbon trading should help to pay for the cost of protecting the forest.

Even so, opportunities do exist to take advantage of these sources of funding the two of which are:

5.5.1. Fuel-Wood offsets.

CDM funds could be used to help pay for the cost of hydropower developments that will lessen pressure on fuelwood supplies in areas that are facing fuelwood shortages. So long as fuelwood is not overharvested, it does not represent a net addition of carbon into the atmosphere. But where it is overharvested, leading to forest loss, then a case can be made that substitution of hydropower for fuelwood as an energy source will help prevent net additions of carbon into the atmosphere. Given current fuelwood consumption of 1,200,000 m^3 and assuming that roughly one third of that consumption is now in areas facing fuelwood scarcity and that hydro development could reduce that demand by two thirds, the net carbon contribution would be the carbon equivalent of about 266,650 m^3 of wood yielding a net value of 26,600 tons of carbon. Damage costs per ton of carbon released into the atmosphere are usually taken to be about $20 per ton, however, alternative

carbon offset projects involving fuel conversion yield carbon savings at a value of $5 per ton. A rough estimate of the market value of the carbon offset associated with reduced fuelwood consumption based on the above assumptions and a price of $5 to $ 10 per ton offset would thus be about $125,000 to $250,000 per year.

5.5.2. Reforestation.

CDM funds could be used to pay for reforestation in areas where the forest has been degraded. Successful reforestation efforts have been undertaken in the area surrounding Thimphu and Wangdi, for example. CDM could be used to support such reforestation efforts, so long as a strong case could be made that reforestation of a particular region was not simply displacing pressure to other forests that would then be cleared more quickly.

Bhutan recently rejected a proposal for a $20 million AU project from the FACE Foundation of the Netherlands out of concern over the potential loss of sovereignty implied in the project. Based on the lessons learned through the negotiation with the FACE foundation, and through consultation with other countries like Costa Rica that are actively implementing AIJ projects, the RGOB may wish to develop a set of criteria to help guide its future considerations of carbon offset proposals or to identify specific proposals it wishes to make to donors.

For any revegetation project to be considered as a target for CDM funding, the donor will need long-term assurance that the carbon will remain sequestered. These criteria can be met in a manner that does not undermine the country's sovereignty over its resources. In effect, the country financing the CDM project is paying for a long-term lease on land in Bhutan, just as the country might allow a long-term lease for a mining operation by a private company. In neither case is the sovereignty of the country placed in question -- a particular right to the land has simply been purchased for a specified period of time.

The donor would also need assurance that the restoration of a forest won't simply lead to the loss of an adjacent forest. This issue of carbon "leakage" can be difficult to address. As a rule of thumb, however, unless the proposed project has the effect of stopping the pressures that led to the original loss of the forest, then the result of the project is likely to be leakage. Thus, if the forest was degraded due to expansion of agricultural land, then revegetation of the forest will simply shift the pressure of expanding agriculture elsewhere. On the other hand, revegetation of the hills surrounding Thimphu was achieved in part by fencing cattle out while the forest was being established. Once the forest was re-established, the cattle could be allowed back into the forest without difficulty. There is thus less reason to expect that revegetation of this forest would lead to carbon leakage to other areas.

5.6.Ecosystem Services

The maintenance of natural ecosystems in Bhutan provides economic benefits that fall into three general categories: market and non-market values associated with particular species (NTFP's, bioprospecting, genetic resources), aesthetic values that draw ecotourists to see the diversity of species or particularly charismatic species, and values associated with ecosystem services. Ecosystem service values have traditionally been least well appreciated by policymakers world-wide -- probably because of the difficulty in capturing their full economic value -- but they are likely to prove to be one of the most important sources of economic revenue associated with the maintenance of natural ecosystems in Bhutan.

Some examples of services provided by ecosystems are air filtration, water purification, maintenance of soil fertility, pollination of crops, flood control, erosion control, maintenance of stream discharge rates, protection of coastlines and so forth. Many of the services that an ecosystem provides are altered when changes are made to its species composition or structure, as for example when a forest is replaced with cropland or pasture. Sometimes the effects on ecosystem services are intentional -- for example, filling a wetland to reduce the threat of disease transmission by mosquitoes. Other times, the effects are inadvertent - by filling that same wetland the next flood runoff may be exacerbated, destroying downstream settlements.

The maintenance of forest cover in Bhutan provides two particularly critical ecosystem services for the country: a) protection from erosion; and, b) maintenance of water discharge patterns. Without extensive forest cover, the steep slopes and highly erodable soils in much of the country would be subject to extensive landslides, slumps, and surface erosion. This would have both local and regional impacts. Locally, it would create water quality problems, threaten settlements and agricultural lands with landslides, and reduce the potential economic benefits from hydropower development either by shortening the effective life of reservoirs or increasing the maintenance costs of run-of-the-river hydro developments. Regionally, the added sediment load would accelerate the build-up of natural levies in low-lying areas in Bangladesh and India, raising the risk of massive devastation when natural levies break flooding low-lying areas.

Forest cover also evens out the discharge pattern of Bhutan's rivers. During wet periods, forests retain more moisture, lessening peak discharge rates and increasing discharge during periods with lower rainfall. A more uniform discharge rate provides substantial economic benefits for hydro development, since the pattern of power generation then more closely matches baseload power needs. And, because peak discharge rates are lessened when forest cover is maintained, the risk of devastating downstream floods is reduced. This again has regional implications-protection of forest cover in Bhutan diminishes flood threats in India and Bangladesh.

As critical as ecosystem services may be to the sustainable development of a region, they are not something that can be commercialized in themselves for expanded economic returns. Countries typically experience an economic cost when a service is lost, but the benefits provided by ecosystem services do not show up on a nation's economic ledger as revenues. For example, if the mangroves protecting a coastline from erosion are destroyed, the country has to pay to build an artificial barrier to protect the coast from erosion. The mangroves thus provide an economic benefit at least equal to the cost of the replacement of that service, but that benefit doesn't show up as revenue in the budget of the forest manager responsible for protecting the mangroves.

How then are countries to pay the costs associated with protecting these important ecosystem services? The answer is straightforward -- the cost of maintaining the services should be built into the price paid for the ultimate product of the service. If mangroves are protecting a coastline from erosion, then a tax should be placed on the value of the property protected and the revenue should be used to maintain the mangroves. If a wetland is helping to clean a town's sewage, then a fine should be placed on water use with the revenues used to help maintain the wetland. And, if the presence of forested watersheds increases the economic returns from downstream hydro development, then the cost of protecting those watersheds (or the opportunity cost of that forest if that value is greater) should be built into the price of electricity produced by the power plant. In effect, the opportunity cost of alternative uses of a forested watershed is as much a cost of development of a hydropower plant as the concrete and labour required for construction. And the cost of maintaining that forest cover is as much an operations and maintenance cost as the cost of replacing worn-out equipment.

Costa Rica is perhaps the first country to build the cost of maintaining ecosystem services directly into the costs of the final product. Costa Rica depends on hydroelectricity for 99 percent of its electricity needs and a large portion of the water "fuelling" that hydropower production-estimated to be 50 to 80 percent -- flows from the country's protected areas (GCR, 1992). In 1995, the country placed a small tax on users of water and electricity in the country. The revenue generated from that tax is then returned to the conservation areas. These revenues, combined with a small endowment and the revenues from Park entrance fees, will be able to cover 80 percent of the operating costs of the protected areas.

This same approach could be applied to planned hydro development in Bhutan. By way of example, consider the pre-feasibility study for the Kholong Chhu hydroproject. Development of this project is not planned for the Eighth Five-Year Plan, so this example is strictly hypothetical.) The hydro project would have an installed capacity of 290 MW and the continuity of its power production would rely heavily on the maintenance of the integrity of the upstream catchment area

(an estimated 1,134 square km, or about 2.5 percent of Bhutan's land area). The pre-feasibility study states, for example:

"Significant upstream catchment changes are not presently planned or expected, as no major population changes or infrastructure developments are anticipated for this area. However, it appears that the major change in the upstream catchment which could potentially have an impact on the project would be road construction and associated logging activities. This might affect the project hydrology in that the timing and magnitude of low and high flows and floods could change thus altering the project design parameters and operation characteristics. Likewise, extremely heavy logging, vegetation clearing or earth moving activities could cause a greater sediment load and inflow to the project." (IBRD, 1993; p. 6-7)

The economic evaluation of a project like this hinges on the cost of construction, the cost of operation and maintenance, and the price that the electricity will be sold. Electricity can be produced through Bhutan's hydropower projects at a much lower cost than the current market price in India. Market prices for energy in India in 1993 were 10.5 cents/kWh (peak), 7 cents/kWh (firm), and 3.5 cents/kWh (seasonal) -- these form the "ceiling" price for electricity sales from Bhutan. So long as Bhutan can cover the capital, financing, and operation and maintenance (O&M) costs at prices lower than these, then it stands to make a profit. (The pre-feasibility study estimated the unit cost of supply to be 2.34cents/kWh; the 1993 tariff for domestic sales in Bhutan was 1.3cents/kWh.) Typically, the actual electricity costs are set through negotiation with India at a level between the cost of production and the "ceiling" price (and because India has financed past hydro development, it has additional leverage on keeping the costs low).

In the pre-feasibility study, capital expenditures for the project were estimated to be $215 million with operation and maintenance costs (O&M estimated to be about $2 million per year for the 25-year life of the plant. The capital expenditure for the site, however, does not include the opportunity cost of other uses of the catchment area (e.g., for timber harvesting) and the O&M costs do not include the cost of protecting and sustainably managing the forests in the catchment area. In the future, the RGOB may want to include both of these costs in the economic evaluation of specific hydroprojects. A substantial fraction of these costs could logically be covered as part of the O&M costs for various hydropower developments.

For an initial approximation of the value of this service, the RGOB could consider the costs of maintaining the forest cover to be equal to the FSD's budget. The annual FSD budget for the 8th Five-Year Plan is projected to be about $6 million. Since the catchment of this planned project covers about 2.5 percent of the country, a rough allocation of the Forest Services Budget to the O&M costs for the project would be 2.5 percent of $6 million, or $150,000 per year -- an increase of only 7.5 percent in the O&M costs for the project. The net effect would be to slightly increase the O&M costs of the project thereby increasing the unit cost of electricity supply. Through negotiations with the power purchaser the effect would be to slightly raise the minimum cost and slightly raise the final negotiated price. Bhutan would then obtain greater revenues from electricity sales, and some of those revenues could then be channeled back to support the protected areas and to support forest management.

In principle, to the extent that Bhutan protects more forest cover than is justified from its own economic self-interest, but which serves to lessen flood damage in Bangladesh or India, those countries should contribute to the cost of forest protection. In practice, capturing these economic benefits is likely to be difficult. First, the same issue of incremental cost arises here that bedevils the Joint Implementation issues. Protecting natural forest is largely justified in Bhutan simply because the costs of logging or converting the forest exceed the benefits that would be gained. Second, the actual link between forest cover in the Himalayas and flood risks in the lowland area is poorly understood. It would be in the interest of all three countries -- Bhutan, India, and Bangladesh -- to expand research on this issue. At the outset, it may be more appropriate to pursue the goal of support from India for research in Bhutan. Eventually, however, Bhutan may wish to consider seeking watershed protection grants from India, or building additional watershed protection costs into the electricity tariff charged to India and Bangladesh. In effect, India and

Bangladesh would pay an additional "tax" on electricity which would help to justify (and pay for the management of) the maintenance of forest cover in Bhutan, since the loss of that forest cover would have serious economic consequences for India and Bangladesh.

Annex1: Bibliography

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Annex 2: Protected Species

SCHEDULE I

Sl.No.	Common Name	Scientific Name
1.	Asian Elephant	Elaphus maximus
2.	Clouded Leopard	Neofelis nebulosa
3.	Golden langur	Presbytis geei
4.	Musk deer	Moschus chrysogaster
5.	Pangolin	Manis crassicaudata
6.	Pigmy Hog	Sus sylvanicus
7.	Snow Leopard	Panthera uncia
8.	Takin	Budorcas taxicolor
9.	Tiger	Panthera tigris
10.	Wild Buffalo	Bubalus bubalis
11.	Black-Necked Crane	Grus nigricollis
12.	Monal Pheasant	Lophophorus impejenus
13.	Peacock Pheasant	Polyplectron bicalcaratum
14.	Raven	Corvus corax
15.	Rufous-Necked Hornbill	Aceros nepalensis
16.	Golden Masheer	Tor tor
17.	Spotted Deer	Axis axis
18.	Gaur	Bos gaurus
19.	Leopard	Panthera pardus
20.	Leopard Cat	Felis bengalensis
21.	Himalayan Black Bear	Selenarctos thibetanus
22.	Red Panda	Ailurus fulgens
23.	Serow	Capricornis sumatraensis

SCHEDULE – I

S.No.	Local Name	Common Name	Botanical Name
1.	Agar/agaru	Eagle wood/ Indian Aloe wood	Aquilaria malaccensis
2.	Yartsa-guenboop	Chinese caterpillar	Cordyceps sinensis
3.	Pang-gen metog		Gentiana crassuloides
4.	Snow down Lily		Llyodia yunnanensis
5.	Tsher-ngeon	Blue poppy	Meconopsis grandis
6.	Kirang-shing	Yew	Taxus baccata
7.	Bhreeng-gee ra dza	Ginseng	Panax pseudo-ginseng