

**CAMBODIA NATIONAL ENVIRONMENTAL ACTION PLAN  
1998-2002 – TEXT ONLY VERSION**

**MINISTRY OF ENVIRONMENT  
JANUARY 1998**

## **1. INTRODUCTION**

1.1 The Paris Peace Agreement of 1991 inaugurated a new era of peace for Cambodia, a country that had seen more than two decades of civil war. This agreement and the United Nations-sponsored election in 1993 paved the way to ensure political stability and development of the country's war-torn economy.

1.2 One major area of concentration for Cambodia in current peacetime efforts is to ensure sustainable use of its rich and diverse natural resources. Efforts in this area are strongly linked to the economic development and poverty alleviation goals of the Government. In 1994, the Government took an important step in addressing this issue through the creation of the Ministry of Environment (MoE). The Ministry was established to provide institutional leadership for conservation and environmental management. The MoE has since received a variety of financial and technical assistance from the international donor community to fulfill its mandate, including support from UNDP to prepare the "Cambodia: First State of the Environment Report 1994" which was published in 1995.

1.3 The preparation of this first Cambodia National Environmental Action Plan (NEAP) is another initiative by the MoE to develop and implement guidelines for policy makers, private sector interests, and the general public to assist these groups in integrating environmental concerns into national and local development policies, economic decision making, and investment planning. The NEAP was prepared through a participatory process involving a variety of government and non-government stakeholders. The process comprises the following three phases: (i) The first phase covers the identification of priority issues and the preparation of this action plan; (ii) the second involves organizing and holding a meeting of donors to mobilize financial and technical assistance for the implementation of priority policy reforms and investment programs identified during Phase I; and (iii) the third phase entails the preparation of these programs for implementation (see Annex 1).

1.4 Since government agencies and local NGOs in Cambodia have limited institutional capacity, the MoE decided in April of 1995 to limit the scope of the NEAP to six priority issues. These issues were chosen following consultations with other government agencies, selected local communities and NGOs, and the international development community. The criterion used to select these areas of concentration was the extent of their potential adverse impact on the national or a local economy, ecosystem integrity; and/or public health should these concerns go unaddressed. The six priority themes are as follows: (i) forest policy; (ii) fisheries and floodplain agriculture in the Tonle Sap region; (iii) coastal fisheries management; (iv) biodiversity and protected areas; (v) energy development and the environment; and (vi) urban waste management.

1.5 This Action Plan summarizes key issues related to the six thematic areas iterated above, and presents a pragmatic five-year program to improve environmental management in Cambodia. The first phase of the program (Years 1-2) focuses primarily on strengthening the policy and regulatory framework while the second phase (Years 3-5) would involve the implementation of investments needed to improve environmental management. It should be noted that the civil war and political instability in Cambodia since the late 1960s has precluded substantive work on natural resource assessment and monitoring. Thus, there is a considerable

lack of current information on many of Cambodia's natural resources; this in turn, limits the depth of analytical discussion in this document.

1.6 The NEAP is a strategic planning document and, as such, does not provide details, including economic analysis, on operationalizing specific programs. This will be done as part of Phase III of the NEAP process -- the detailed preparation of discrete interventions. The NEAP process in Cambodia is iterative; therefore, the priorities and strategies on environment and natural resource management outlined in this document are expected to be reviewed at least every five years as stipulated by the Law on Environmental Protection and Natural Resource Management (1996).

## 2. FOREST POLICY<sup>1</sup>

2.1 Cambodia's forests cover an area of about 11.2 million hectares, about 62 percent of the country's total land area (Department of Forestry, Pers. Comm.), and they are an important source of timber for domestic uses and export. Over the last 20 years Cambodia's forests have been degraded by war, wood harvesting, and the expansion of agriculture. In the future these forests will face greater degradation largely because of the high levels of illegal logging which disregards technical standards and forest reclamation for development. Therefore, without strong political will and the introduction of innovative forestry policies and management practices, Cambodia risks losing this valuable environmental and economic resource. Sustainable forest management will also require collaboration among the Government, the private sector, local communities, foreign investors and international organizations.

2.2 Official statistics cited by the World Bank indicate that the export of wood products in 1995, for example, amounted to \$185 million, but exports may be higher because of a major illegal export trade in logs. The Ministry of Economy and Finance reported that the total revenue for wood exports was 47.1 billion Riels (about US\$18.7 million) in 1995 and 27.5 billion Riels (about US\$10.5 million) in 1996. The forest sector is also a source of employment, particularly in harvesting and processing operations. The forests also provide a variety of non-timber products such as fuelwood, medicinal plants and wildlife. Wood is the principal source of fuel of the Cambodian population, and fuelwood is the largest use of wood harvested in Cambodia. Most fuelwood is collected by rural people in the accessible forest area (i.e. on the outskirts of forests and in the degraded or deciduous forests) or in woodlands. Out of a total of 6 million cubic meters of fuelwood extracted annually about 3 million cubic meters comes from forests.

### Status and Trends in the Forest Sector

2.3 Forest Area and Land Use. There are eight major forest types in Cambodia and the evergreen and deciduous forests are the most dominant types, covering 9.1 million ha (Annex 2a). Until the mid-1900s, forests covered 73 percent of Cambodia's total land area, about 13 million hectares (Department of Forestry, Pers. Comm.). Over the last 40 years, and especially during the last twenty years, many of these forests have been destroyed or damaged. Between 1973 and 1993 commercial logging, shifting cultivation, and wood harvesting for fuelwood and charcoal production resulted in a net loss of about 1.1 million hectares of dryland forests and 316,900 hectares of edaphic forest. This represents an annual loss of about 0.5 percent per year. Though significant, it is half of the average rate of forest degradation in other countries of the subregion during the same period. Because of the regional variations in forest distribution, the southern and central parts of the country, which have less significant forest cover, could face a shortage of wood and fuelwood if present trends should continue. The situation is less acute in

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<sup>1</sup> This chapter is largely a summary of the World Bank, UNDP, FAO report entitled "Forest Policy Assessment, Cambodia, (1996). Unlike the other thematic areas, the forest policy chapter was not prepared using the participatory process described in Annex 1. It is the output of consultations between Senior Cambodian Government officials and the World Bank, UNDP, FAO and other local and international stakeholders.

the western and northeastern areas, which are covered largely by evergreen and deciduous forests respectively (See Annex 2b for data on deforestation trends by province).

2.4 Other endangered forest types include edaphic forests such as mangroves along Cambodia's coast, which are being harvested to produce charcoal for export to Thailand and other southeast Asian countries. The inundated forest around the Tonle Sap lake is another endangered forest type. Deforestation has reportedly caused major changes in hydrologic conditions in the Tonle Sap and its associated river systems, but there are no data or detailed scientific analyses to substantiate these claims. The hydrologic role of the inundated forests, however, is well established and it is reasonable to expect that major changes in forest area could impact stream flows and aquatic life (see Chapter 3 for a detailed discussion of the Tonle Sap).

## Overview of Commercial Logging

2.5 Forest Potential and Allowable Cut. An allowable cut depends on the potential productivity of forests. The allowable cut in Cambodia is approximately 30 percent of total standing volume, of trees more than 60cm in diameter (as stipulated in Article 3 of the "Regulations on Forest Resources Exploitation). In reality, however, the potential of the forest to sustainably supply timber is both unknown and highly dependent on site conditions, species mix and harvest practices. Forest policy needs to ensure that forest management is sensitive to these variables in establishing cutting intensities and harvest cycles. In areas with abundance of old growth forest and under appropriate forest management practices, the MAFF could permit harvesting intensity exceeding the allowable cut. This allowable cut was established based on the estimated growth of 0.33 m<sup>3</sup>/hectare/year for the moist evergreen and deciduous forests of Cambodia. This growth rate is much lower than that of the equatorial evergreen forests of countries such as Indonesia and Malaysia, which are about 1.0 m<sup>3</sup>/hectare/year and 1.0-1.5 m<sup>3</sup>/hectare/year respectively, because of lower rainfall and other less-favorable growth factors in Cambodia.

2.6 Volume of Logs Harvested. Until the 1970s, logging activities focused on only 25 species with well-known qualities and ready markets. With political stability and a well-functioning public administration, harvesting removed an average of about 350,000 m<sup>3</sup> of logs annually and an additional volume of 1.8 million m<sup>3</sup> of fuelwood. The civil war and periods of political instability in the 1970s and 1980s significantly disrupted logging activities. As a result, the volume of logs extracted dropped between 1971 and 1980 to approximately 100,000 cubic meters/year and fuelwood use dropped to about 1.0 million cubic meters/year. There was a rebound in production to about 140,000 cubic meters of logs and about 2.4 million cubic meters of fuelwood from 1981 to 1990 as military activity shifted mainly to the western provinces, allowing a gradual increase in logging activities in central and eastern Cambodia.

2.7 Since 1991/92, the volume of logging has increased because it remains one of the major sources of income for many rural people and revenue at the disposal of the different factions and armies before the 1993 election. Intermittent efforts to control or ban logging have had little impact because continued civil insecurity allows illegal logging and export. Official statistics suggest that 1.5 million cubic meters of logs were extracted in 1995, but actual removals may be close to 2.3 million cubic meters.

2.8 Access and Security. The transportation infrastructure of Cambodia was largely destroyed during the war, with the heaviest damage in the north and east parts of the country. Until 1991, reconstruction was largely limited to the strategic highways between Kompong Som and Phnom Penh. Access to most forest areas in Cambodia is also difficult because of security problems. The Cambodian Mine Action Centre is conducting a new review of the location of mine fields, and its preliminary estimate indicates that 35 to 40 percent of the forests could be dangerous due to mines, fighting or areas uncontrolled by the diminishing insurgents in Anlong Veng. According to Handicap International, in the province of Battambang at least 10 mine accidents involving local people cutting wood at the forest margin are recorded every month.

2.9 Export of Wood Products. Cambodia has become a key regional exporter of wood with Thailand, Viet Nam, Japan, Taiwan, and Singapore as major importers. In 1989, Thailand imposed a national logging ban and canceled some 300 concessions, greatly increasing demand for Cambodian wood. Deforestation in Viet Nam, to a large extent the result of war, has dramatically reduced forest cover and has increased that country's dependence on Lao and Cambodian wood. Though only the export of processed wood products is permitted because of the December 1996 ban on log exports, illegal export of logs to neighboring countries -- Thailand, Viet Nam, Laos -- is believed to be taking place, either for local use or transshipment to a third country.

2.10 Forest Revenues. The export of wood products is a major source of revenue for the Government. In 1995, the country earned about \$185 million in export revenue. The sale of impounded illegal logs is another source of income for the Government. In 1995, the Government earned \$20 million from such sales (Ministry of Economy and Finance, Pers. Comm.). Although significant efforts are being made to control illegal logging, seizures probably account for a very small amount of all illegal felling. An Inter-Agency Commission is responsible for domestic and export sales of seized logs and the proceeds are transferred to the Treasury. Impounded logs are auctioned to Cambodian purchasers for domestic use. Logs seized in some remote areas are sold to foreign buyers. The ban placed at the end of December 1996 on long-period impoundment of seized logs could help to increase earnings to the government and reduce forest degradation and also gradually eliminate corruption in the forest sector.

2.11 Forest Protected Areas. Cambodia in 1993 established a National Protected Area System for the conservation of biodiversity. The 23 protected areas, classified as National Parks, Wildlife Sanctuaries, Protected Landscape and Multiple-Use Areas, cover representative ecosystems including evergreen, deciduous and edaphic forests and other fragile and critical habitats. They cover 3.3 million ha, or 18.23 percent of the country's total area, 2.8 million hectares of which is dryland forest. This total coverage makes Cambodia one of the countries in the world with the highest proportion of forest land for biodiversity conservation.

2.12 Many of the areas around the protected areas have already been allocated to logging concessionaires or are under active consideration. Because the protected areas have not been surveyed and boundaries clearly demarcated and because of the absence of effective management, it would not be surprising if there is an overlap between the forest concessions and the designated protected areas (see Chapter 5 for detailed discussions of the protected area system).

## **Key Issues in Forest Concession Management**

2.13 Forest concessions have been an established means of promoting forest-based development in Cambodia. In the last two years, Government has accelerated efforts to grant concession agreements to reduce the extent of illegal logging, speed the growth of value-added wood processing in Cambodia, and increase Government timber royalty revenues while maintaining the current log export ban. Through these efforts the Government has entered into agreements with about 20 firms, covering more than 6 million hectares of forests and including over 3 million hectares of well-stocked forests (See attached Map for designated concession areas). The rapid expansion of the Cambodian concession system has raised both environmental and fiscal concerns. This section of the report discusses issues associated with the country's forest concession agreements, royalty rates, policy and regulatory framework, and the management capacity of the Department of Forestry.

2.14 Forest Concession Agreement. There are two interlinked agreements between the Government and forest industries in Cambodia. First is the Investment Agreement under which a concessionaire agrees to make a specific investment in wood processing facilities and in return the Government would give it exclusive harvesting rights to a specified forest area. The second is the Forest Timber License under which the Government allocates a specific area to a concessionaire, specifying broad outlines of the concessionaire's rights to conduct forest operations and, very generally, the procedures for Government review and regulation of the forest enterprise.

2.15 Both the Investment Agreements and Forest Timber Licenses share similar features, though they are not identical. They all specify the value of the proposed investment, the broad category of processing facility (sawmill, plywood mill, etc.), the forest concession area, royalty rates, period of the agreement, deposit requirements, and area fees. They also require the concessionaire to operate the concession under sustainable yield management. The Forest Timber Licenses specify some of the technical details on the required forest management practices. The Forest Timber Licenses also specify that the concessionaire will furnish written Management and Working Plans and that the Government will issue a permit to enter coupe before harvesting may commence.

2.16 It appears that nearly all the forest areas with commercial potential have either been granted or are under consideration for grant to a concessionaire. Eleven concessions, totaling 2.2 million hectares, were established prior to 1994. Because reports differ on the exact status of some agreements, there is some uncertainty on the exact areas and number of recently granted concessions.

2.17 These concessions have been awarded to large scale commercial interests through a process which is non-transparent and with limited detailed surveys of the concession areas. They were mostly negotiated between prospective concessionaires and senior government policymakers. The criteria used to award concessions are not apparent, and details of agreements are generally not public nor are they fully available to all agencies responsible for resource management. Despite the magnitude of the concession areas and the investment commitments, only limited investigation and survey work are typically undertaken prior to granting a concession. Detailed ground surveys were not conducted prior to the completion of negotiation

of concession agreements, and for some concession agreements only cursory aerial surveys of forest areas took place during the negotiation process.

2.18 As these recent concession agreements are implemented, the issues of investment in wood processing and harvesting intensity must be addressed. The current concession policy of the Government seeks to explicitly tie forest harvesting with investment in wood processing. Implementation of these proposed investments is negligible to date, although some preliminary surveys and initial work have begun in some areas. Several concession holders are now in the process of preparing their forest management plans. Although Forest Timber Licenses state that harvesting must be carried out in a sustainable manner, the concessionaires clearly expect to cut at higher intensities. The wood volume required to justify the proposed processing investments are based on a harvesting intensity between 40-50 cubic meters/hectare, an intensity 4-5 times the volume initially proposed by the Department of Forestry.

2.19 Royalty Rates. Because of the ban on logging in Cambodia pending the approval of concession plans, royalties play only a limited role in shaping behavior in the forest sector. When log exports were permitted, concessionaires paid an estimated royalty of around \$41 per cubic meter. Under the proposed concessions and log export ban, royalties will likely average \$14 per cubic meter compared with a world market price equivalent to about \$74. These agreements specify royalty schedules that differentiate between logs intended for domestic processing and logs intended for export in unprocessed form. The lower rates for logs destined for domestic processing are indicative of the main thrust of the government's concession strategy: use subsidized raw material supplies to attract investment in value-added processing.

2.20 The royalty rates under present concession agreements understate the true economic value of the country's wood resources. By setting below-market royalty rates, the Government sought to promote investment in wood processing facilities and to capture multiplier benefits from the resulting employment and value-added processing. Additionally, royalties were set at low levels with the expectation that concessionaires would invest in social and physical infrastructure such as schools, roads and clinics in the areas under their control. However, low royalties aimed at promoting local investment in wood processing can contribute to overcapitalization, resulting in the development of an inefficient processing industry and unsustainable demands on the forest resource base. In addition, because of low royalty rates, the Government is losing an estimated \$100 million annually in forest revenue.

## **Policy and Regulatory Regime**

2.21 Cambodia's forest legislation (Forestry Decree, 1985) regulates the commercial uses of forest resources. It requires sustainable yield management and the protection of residual stands from logging damage. These and other guidelines, though they require updating, are generally credible and could contribute significantly to forest management if they were effectively implemented. The Law on Environmental Protection and Natural Resource Management passed in 1996 also seems to provide an additional tool to ensure sustainable forest management, as it requires the Ministry of Environment to conduct environmental assessment of proposed projects. This implicitly includes investments in the forest sector. The overriding problem with the current status of forestry seems to be the lack of political will to ensure effective enforcement of regulations. In fact, the Department of Forestry has been excluded from the process of awarding



concessions, which are typically approved by senior Government officials. In addition, the shortage of qualified Department of Forestry staff, equipment, and vehicles, which limits the Department's ability to assess timber stocks in proposed concession areas, monitor concessionaire performance and to sanction violations.

2.22 Trade Controls. In recent years the Government has made a number of attempts to use trade controls to indirectly affect forest use. In September 1992 a log export ban was imposed, but in October 1993 it was lifted to permit log exports until the end of 1993. In January 1994, the export of unfinished sawn timber was also banned, but the log export ban was suspended. In April 1994 a log export ban was reinstated, only to be suspended after June 1994. In April 1995, all logging was banned pending implementation of a new forest policy and the ban on log exports was reinstated. Limited log exports were permitted in late 1996 only to be prohibited again at the end of December 1996. Under the current log export ban and current concession policy, Government guarantees a supply of logs to favored mills (including parastatals). Despite enforcement attempts, log exports, mostly illegal, is believed to be significant.

2.23 Recent auctions of seized logs illustrate the economic risk of excluding foreign competition. In 1995 logs reserved for domestic mills were sold for about \$45 per cubic meter. When foreign bidders were allowed to bid, prices for the same quality logs were about \$95 per cubic meter. A similar difference can be seen between concession agreements made prior to the ban on log exports and the recent proposed concessions. When log exports were permitted, concessionaires paid an estimated average royalty of about \$41 per cubic meter. In addition, they paid an export tax of 10 percent on the FOB<sup>2</sup> value of logs, which averaged \$170 in 1994/95, thus providing total rent capture of about \$58 per cubic meter. This contrasts with a likely average of \$14 per cubic meter under the proposed concessions and the log export ban, resulting in a revenue loss of \$44 per cubic meter on every exportable log that is domestically processed.

### **Weak Institutional Capacity**

2.24 Significant areas of Cambodia, particularly along the Cambodia-Thailand border, remain beyond the effective control of the line agencies. Although former Khmer Rouge guerrillas have been integrated into the Government, the personnel of line agencies have not been able to visit those areas because of security concerns. Security issues are particularly critical in the forestry sector, as safety for government workers and concessionaires is an essential condition for sectoral development. The Department of Forestry is currently incapable of monitoring concession performance and of enforcing legislation and regulations. Staff mobility in the field is essentially nonexistent. This is the key weakness of the Government's forest policy and it would have major implications on any sectoral reforms.

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<sup>2</sup> FOB (free on board) is the price of an export commodity loaded on a ship or other conveyance that will carry it to foreign buyers.

## **Strategic Framework to Improve Forest Concession Management**

### ***Government's Strategy***

2.25 Timber and other forest products should continue to play an important role in economic development in Cambodia. However, to ensure sustainable use and management of the country's forest resources, the policy and regulatory framework for the sector needs to be updated and the management capacity of the Department of Forestry strengthened. The Department has already initiated an important part of the process of defining the Government's role in the forest sector by formulating a six-part strategy for sustainable development of forestry and wildlife. The strategy identifies six areas of concern and action, including improving and strengthening the institutional framework (i.e. legislative reforms and organizational responsibilities); human resource development; forest and wildlife management (including land classification and inventory); forest and wildlife utilization (including concession management and forest industries development); plantation establishment and reforestation; and strengthening international cooperation (including working with neighboring countries on forest law enforcement and with donor countries on a coordinated assistance strategy).

2.26 The Government in July 1996 established a Steering Committee on Forest Policy Reform co-chaired by the two Prime Ministers, with the Minister of Economy and Finance and the Minister of Agriculture, Forest and Fisheries as the co-Vice Chairpersons. Representative of other relevant Ministries are members of this committee. The Steering Committee which has a permanent secretariat in the Department of Forestry and Wildlife is responsible for:

- (a) coordinating all policy reform activities;
- (b) overseeing the recruitment of local and international staff for the forestry sector;
- (c) preparing a sectoral investment program; and
- (d) coordinating policy dialogue between the Government and international donors.

2.27 Other measures the Government has taken include the submission of a draft forestry code to the National Assembly for approval; and a ban on log exports from insecure areas of the country. The Government has also undertaken diplomatic initiatives to secure assistance from neighboring countries in the control of illegal log shipments. The Minister of Agriculture and other senior Government officials have worked with counterparts from neighboring countries, particularly Thailand, to seek cooperation on the control of log movement and on the disposal of confiscated and impounded logs. While it is important for this work to continue, diplomatic initiatives can aid, but not substitute for, national capacity to regulate forest areas and control illegal activities. The currently limited international assistance to the sector stands in stark contrast to its significant development assistance needs. It seems that donors are awaiting clarification of policy framework for forest exploitation before venturing to provide assistance to the sector, and this puts emphasis on the need for Government to take the initiative in sectoral reform.

2.28 Forest Sector reforms which the Government needs to urgently address include:

- (a) creating transparent and predictable systems of governance for efficient and sustainable forest management;
- (b) Developing mechanisms for determining forest fees such as royalties that reflect the scarcity and true value of forest resources, encourage sustainable use and optimize economic benefits to the country; and
- (c) Establishing trade policies that promote efficient and sustainable use of forest resources.

## **Governance and Environmental Sustainability**

2.29 Allocation of Concessions. The Government should design and adopt a concession system that will maximize economic returns, encourage sustainable forestry practices, and minimize rent seeking. Concessions should no longer require that concessionaires invest in domestic wood processing industries, as de-linking concession awards and forest industries investment will foster the emergence of a log market. Allocation of future concessions should be through market-based practices that include prior area identification by government, advertisement, bidding and evaluation based on announced criteria. To this end a legal review of current concessions and criteria for establishing default should be commissioned.

2.30 Forest Management Guidelines. The Government must play a critical regulatory role within the concession system. Focus of regulation should move from trade control to enforcement in the forest. Government must issue guidelines for forest management plans, and monitor and enforce compliance. Guidelines for forest management plans must ensure sustainable harvesting and management practices. They must provide flexibility to address local conditions, but also must be easy to administer and interpret.

2.31 Technical responsibility for monitoring compliance with concession terms and conditions can be contracted to private sector firms with policy direction and supervision from government agencies. This would ensure effective monitoring and at the same time provide opportunities to transfer skills and knowledge to the staff of the Department of Forestry.

2.32 Community Forestry. Local people in forest areas depend on this resource for a variety of products. Therefore, they have an important role to play in sustainable management of Cambodia's forests. The involvement of local communities should include participation in the design and implementation of programs in forest protection, reforestation, community wood lots to provide firewood and timber, and agroforestry systems comprising local hardwood, fruit trees, and fuelwood in combination with annual crops.

2.33 Experience from several countries suggests that tenure security of forest land for local communities is a major incentive for sustaining local participation in forest management. One option for Cambodia to consider is to establish agreements between the Department of Forestry and local communities, giving people long-term access or user rights to public forest lands. The beneficiaries would in turn protect and manage the forest in a sustainable manner.

## **Economic Performance**

2.34 Royalties. Royalties, as noted earlier, are expected to average \$14 per cubic meter under the proposed concessions and log export ban. This would not capture the full economic value of a resource, and it will likely promote unsustainable management practices. A better approach would be to demand from concessionaires a fuller share of the rental value of the resource. Not only would this increase government revenue, but it would also promote sustainable management and compliance with forest management standards. Moreover, rather than relying on concessionaires to invest in local communities, when royalty rates are set higher the government can allocate earnings to social development needs. With higher royalty rates, government rent capture could be increased by an additional \$100 million annually with reduced environmental impacts.

2.35 Log Trade Policy. Experience from several developing and developed countries indicates that a free market system for log trading would typically help to allocate resources to the most economically efficient alternatives and to provide incentives for forest management and industrial development. Because of this, the Government should consider instituting a free market log trading system after sustainable forest management is established to ensure environmental protection. It should develop a plan that liberalizes the trade of certified logs from approved concessions under sustainable forest management. In addition to the immediate trade and foreign exchange impacts of liberalized log trade, relaxation of the log export ban could have domestic industrial and environmental benefits. While there seems to have been relatively little impact on illegal logging from the recent export ban, some efforts to synchronize improved forest management with relaxed trade are justified. It will be necessary to carefully assess trade reform options and, where possible, to institute trials or pilot operations before completely deregulating log trade.

2.36 A wide range of techniques can be utilized in the forest sector to extract a reasonable share of the economic rent from timber sales, including auctions, bidding, area sales, volumetric sales and sales based on appraised prices. The preferred choice of sales procedure varies depending on forest type and species composition, the availability of information on the stand, harvesting cycle and practice, and other aspects of the sales contract. Pending more detailed assessments, a \$74 per cubic meter estimate is probably a conservative estimate of average economic stumpage value and can serve as a reasonable target for rent recovery.

2.37 Forest concessions should be auctioned and minimum price appraisals set to ensure that royalties relate to economic rent value. An inter-agency review system should be established to monitor royalty levels and collection. Royalty terms and budgetary receipts should be announced publicly on a regular basis. In the short term, Government should maintain commitment to sustainable harvesting (i.e., at an allowable cut of 10 cubic meters per ha) and advise concessionaires that harvest management guidelines will be strictly enforced.

## **Proposed Program for Forest Policy Reform**

2.38 The proposed program for forest policy reform (Table 1) will help operationalize the strategy of ensuring environmental sustainability, optimum economic benefits, and improved governance in the forest sector.

Table 1. Proposed Program for Forest Policy Reform

Component	Objective(s)	Activities to be supported
<b>Phase I (Years 1-2)</b>		
Governance and Environmental Sustainability	Develop and implement regulatory reforms to ensure sustained yield forest management	<p>(i) Review of existing concession contracts by independent legal experts to ensure that they meet sustained management criteria.</p> <p>(ii) Develop and implement regulations for the review, monitoring, and enforcement of management plans.</p> <p>(iii) Define environmental impact assessment procedures for the forest sector.</p> <p>(iv) Investments in field capacity (training, infrastructure, mobility, communication).</p>
	Establish a framework for the allocation of land for specific uses that ensures environmental protection and minimizes illegal rent seeking opportunities	<p>(i) Develop and implement a transparent market-based system of allocating forest areas for timber concessions and other landuses.</p> <p>(ii) De-link the award of forest concessions from investment in forest industries.</p> <p>(iii) Evaluate and update, if necessary, existing contracts to ensure optimum environmental and economic benefits.</p>
	Ensure that budgetary allocation for forest management reflects potential economic returns and that forest revenues are allocated within the overall budgetary framework	<p>(i) Review and reform financial controls in the Ministry of Agriculture, Forest and Fisheries, including the Department of Forestry.</p> <p>(ii) Use public accountants for financial controls in the short-term.</p> <p>(iii) Develop and implement a forest revenue sharing system among the central government, provincial governments, and local communities to motivate effective collaboration from the major stakeholders in forest management.</p>
	Develop and implement guidelines and procedures for sustained forest management	<p>(i) Develop and implement a transparent and competitive system which will ensure that royalties and other forest fees capture the full economic value of a resource and promotes sustainable forest management and compliance with forest management standards.</p> <p>(ii) Establish an inter-agency review system to monitor royalty levels and collection performance.</p> <p>(iii) Pilot forest management guidelines, including resource assessment and inventory, and independent</p>

Component	Objective(s)	Activities to be supported
		monitoring of logging activities. <sup>3</sup>  (iv) Develop indicators for monitoring compliance with concession terms.
<b>Phase II (Years 3-5)</b>		
	Promote effective community involvement in local forest management	Design and implementation of community-based forest management activities, including agroforestry and woodlots.
	Develop and implement a training strategy for the forest sector.	In-country and overseas training programs for the staff of the Department of Forestry and of the Forestry Faculty of the Royal University of Agriculture.
Economic Performance	Promote the emergence of a log market to supply efficient domestic processors and the export market	Develop and implement a plan to liberalize the log trade, including a log export licensing system, after effective forest management regimes have been established.

<sup>3</sup> The UNDP/FAO-supported Forest Inventory Project could be reformulated to demonstrate the application of forest inventory techniques to forest management.

### **3. FISHERIES AND FLOODPLAIN AGRICULTURE IN THE TONLE SAP REGION**

3.1 The Tonle Sap (or Great Lake) is an important symbol of national identity for Cambodians. His Excellency Dr. Mok Mareth, Minister of Environment, has described the lake as the “heart and soul of the people of Cambodia.” From the days of the Great Angkor Kingdom (9-13 century) until today, natural resources from the Tonle Sap have supported large human settlements. Presently, about 3 million people in six provinces--Siem Reap, Battambang, Pursat, Kompong Chhnang, Banteay Meanchey, and Kompong Thom--depend on the Great Lake and its floodplain for their livelihood. This represents nearly 30 percent of Cambodia’s population, which was estimated at 10.25 million in 1995. Fishing and agriculture are the main economic activities in the Tonle Sap region.

3.2 The Tonle Sap lake and its floodplain extend from Sisophon in the northwestern part of the country to Kampong Chhnang in the southeast (see attached map). During the rainy season, when the lake is about 250 km long and 100 km wide, it is the largest freshwater lake in Asia. It shrinks to about 120 km in length and 35 km in width during the dry season. The Tonle Sap is surrounded by a floodplain 20-40 km wide; comprised mostly of flatland, this floodplain is inundated at various depths and is dominated by inundated forests and rice fields.

3.3 A unique hydrology distinguishes the Tonle Sap lake. The lake acts as a natural flood retention basin regulating flood water from the Mekong river. The Tonle Sap river joins the Mekong river at Phnom Penh; during the high flood season in June or early July, shortly after the onset of the rainy season, the current of the Tonle Sap river reverses and flows back into the Great Lake. This reversal of flow causes the surface area and depth of the lake to increase more than four-fold. The water surface expands from 250,000-300,000 ha during the dry season to 1.1-1.3 million ha in the rainy season. The average depth of the Tonle Sap lake increases from 1-2 m in the dry season to 8-10 m during the rainy season.

3.4 Because of the changes in the depth and surface area, the storage capacity of the Tonle Sap lake also varies seasonally. A water balance study by Carbonnel and Guiscafre (1963, cited in ORSTOM and BCEOM 1993) during the 1962-63 hydrological year reported that the storage capacity of the lake increased from  $1.3 \times 10^9$  cubic meters at the end of the dry season to  $72 \times 10^9$  cubic meters during the peak of the rainy season. This study also reported that flood flows from the Mekong river accounted for about 62 percent of the volume of water in the lake and the remaining 38 percent came from watersheds associated with the lake.

3.5 With its rich biodiversity, the Tonle Sap ecosystem plays an important role in the economic, social and cultural life of Cambodians. Because of the economic, social and cultural significance of the Tonle Sap’s rich biodiversity it has been included in the country’s protected areas system as a “protected Multiple Use Area.” In addition, the King of Cambodia, His

Majesty King Norodom Sihanouk, has proposed that the area should be designated as a "World Heritage site".<sup>4</sup>

## Overview of the Fisheries

3.6 The Tonle Sap lake, its floodplain, and the adjoining river systems support one of the most highly productive inland fisheries in the world. This lake reportedly has a potential fish production of 65 kg/ha/year (based on the dry season area of the lake); this is more than five times that of most tropical freshwater bodies, which average 12 kg/ha/year (FAO 1994)

3.7 The total recorded fish catch from artisanal and industrial inland fisheries throughout Cambodia has varied between 50,500 tons and 74,700 tons; the Tonle Sap fisheries account for about 53-68% of this catch (See Annex 3a). The value of the total inland catch is reportedly US\$44-58 million a year, about 5% of the country's annual GDP. The government receives substantial revenues from the Tonle Sap fisheries through fishing lot rental fees, the sale of harvesting permits, and fines. The Government's total revenue from both inland and marine fisheries in 1994 was approximately 7.1 billion Riel (US\$2.9 million), of which 4.8 billion Riel (US\$1.9 million) came from the leasing of fishing lots on the Tonle Sap lake, 240 million Riel (US\$120,000) from licensing of inland fisheries and 958 million Riel (US\$383,000) from licensing of marine boat operators (Department of Fisheries 1995). Total revenues to the Government from the above sources rose to 10 billion Riel (US\$4 million) in 1995 (Department of Fisheries 1995).

3.8 The fisheries also play an important role in the diet and socioeconomic life of Cambodians. Fish account for an average of about 75% of the animal protein intake of the population (MoE 1994; FAO 1992). About one million people depend directly on the lake's fisheries for their livelihood (Tana, unpublished). In the 170 floating villages on the Lake, for example, about 90% of the population is involved in fishing or related activities. These permanent villages are built on floatable structures and they migrate twice a year, as much as 7 km, depending on the expansion and contraction of the lake.

3.9 Fish Species. Several species of fish, occupying a variety of ecological niches -- including plankton feeders, detritus feeders, predators and opportunists -- can be found in the Tonle Sap lake and its associated riverine system. They include 215 recorded species and FAO (1994) reported that there are 19 principal commercial species (See Annex 3b) and another 36 species with some commercial significance. Fish in the Tonle Sap lake can be grouped into two broad ecological categories: white fish and black fish. White fish require waters of higher oxygen content and lower pH fluctuations than black fish. They breed largely in the main channel of the Mekong river, but migrate annually into the Tonle Sap lake with the rise of the Mekong floodwaters. White fish consist of several species from the families *Cyprinidae*, *Schilbeidae*, *Notopteridae*, *Pangasidae*, and *Channidae*. They are economically more important than the black fish.

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<sup>4</sup> World Heritage site refers to a site with unique monuments and/or natural features designated for protection under the Convention for the Protection of the World Cultural and Natural Heritage which was signed in Paris in 1972.



3.10 The black fish live in the floodplain year-round because they can survive during the dry season in small puddles of water with low oxygen concentrations. They are able to breath atmospheric oxygen using accessory respiratory components. Black fish comprise mostly species from the families *Claridae*, *Ophicephalidae*, *Bagridae*, and *Anabantidae*.

3.11 Categories of Fishing. There are three categories of fishing operations in the Tonle Sap fisheries: industrial, artisanal, and family fishing. Industrial fishing is based on “fishing lots” or concessions which are allocated through an auction system for exclusive exploitation over a two-year period. The larger lots (there are about 20 lots) are typically 15-20 km long and 5-10 km wide and can be auctioned for as much as US\$200,000 a year, while a smaller lot is valued at \$2,000-5,000 (Lieng et al. 1995). The fishing lots cover about 80% of the lake's shoreline. In 1994, 298 lots were auctioned, but this was reduced to 279 in 1995, reportedly to provide subsistence fishermen greater access to the fisheries. The lessees employ guards to discourage illegal fishing in their lots. The artisanal (medium-scale) and the family (subsistence) fishermen fish outside the lots using mainly motorized or non-motorized boats of up to 10 m in length.

## **Management of the Fisheries**

3.12 The Fisheries Law (Fiat on Fishery Management and Administration, 1987) is aimed at ensuring resource conservation and regulation of the exploitation of Cambodia's freshwater and marine fisheries resources. If effectively implemented, this law could make a significant contribution to the management of the Tonle Sap fisheries. The Fisheries Law includes provisions addressing access control, gear restrictions, closed seasons, and the designation of fish sanctuaries (or protected areas). There are two Council of Ministers sub-laws (issued in 1988 and 1989) which provide detailed procedures on regulating management activities, including auctioning of fishing lots and determining resource rents. In addition, Provincial Administrators in the Tonle Sap area have issued a “Circular” (a legal instrument issued by provinces) on the degradation of inundated forest, illegal fishing gear, and harvesting of wildlife.

3.13 Access control. The fishing lot system in the industrial fishery provides an effective mechanism to control access, but it has not been effectively used to manage catch because of the lack of reliable data. The Fisheries Law requires lot operators to record their catch in a log book, but this has not been effectively monitored. Moreover, because the base price for a lot and fishing permit fees for a particular year are determined from the previous year's harvest, these operators have a strong incentive to under-report fish catch.

3.14 Entry to the artisanal fishery requires a permit from the provincial office of the Department of Fisheries; the fee is based on the type of fishing activity, the size of the boat, and the type of gear to be used. The family fishermen are not required to obtain fishing permits.

3.15 Gear restrictions. The Fisheries Law specifies in detail the type of gear which can be used in each of the three segments of the Tonle Sap fisheries. Four types of gear--barrage traps, bamboo fence traps, bag nets for fish and bag nets for shrimp--have been specified in the law for industrial fishing. In the artisanal fishery, 23 gear types, comprising a variety of traps, nets and hooks (including long lines), are permitted; the family fishermen are allowed to use 21 different gear types, including harpoons, spears, traps, seines, single hook lines, and cast, gill and scooping nets. In addition to specifying gear types, the Fisheries Law outlines restrictions on

mesh sizes for nets and provides for a ban on the use of fish aggregating devices, brush parks, lights, electricity and explosives. However, enforcement of these restrictions appears to be inadequate.

3.16 Closed Season. The Fisheries Law establishes a closed season (June 1-September 30) for the industrial and artisanal fisheries. This period coincides with the monsoon season, when most fish species in the Tonle Sap lake migrate to the floodplains to spawn. Thus the ban on fishing is intended to minimize major disruptions in the migration and reproduction cycle of fish. Though this prohibition does not apply to the family fishermen, their catch during this period is relatively low because the expanded surface area of the lake makes the fishing gear they use less efficient.

3.17 Fish Sanctuaries. Eight sections of the Tonle Sap lake have been designated, under the Fisheries Law, as fish sanctuaries (or reserves). These sanctuaries incorporate deeper portions of the lake to protect concentrations of fish during the dry season when the lake's surface area decreases dramatically. Fishing is banned in the sanctuaries, but enforcement is apparently weak. In fact, the boundaries of the sanctuaries have not been marked to guide fishermen.

### **Major Issues Affecting the Fisheries**

3.18 Meeting future demand for fish. Meeting the demand for fish of Cambodia's rapidly growing population--a population growing at an estimated rate of 2.6-3% annually--could have major implications for the Tonle Sap and other fisheries in Cambodia. Fish accounts for about 75% of the animal protein intake of the population. At the current annual per capita consumption of 10.6 kg, which is about half of the minimum nutritional requirement, the demand for fish is expected to increase by about 30%, from 106,000 tons in 1995 to 137,000 tons by 2005 (or 3% per year). At a higher consumption, for example the minimum nutritional requirement of 21.5 kg/capita/year, the demand for fish would increase from 215,000 tons for 1995 to 277,000 tons during this same period (Annex 3c) (Ministry of Environment, no date).

3.19 Based on the current annual recorded fish catch of about 95,000 tons from both marine and inland water (the catch in 1994), the projected demand of 137,000 - 277,000 tons cannot be satisfied without risking a collapse of the inland and marine fisheries, especially as recorded catches are believed to be grossly underestimated. Though freshwater and brackish water aquaculture would continue to play an important role in narrowing the gap between demand and supply, pond production is not expected to exceed 10,000 tons/year by 2000. The average production from 1990-1994 was 7,338 tons. Experience in Thailand and several other countries suggests that coastal aquaculture could have adverse impacts on the marine environment, including the degradation of mangrove forests, unless effective environmental management measures are implemented.

3.20 Limited Resource Information. One of the major issues affecting the Tonle Sap fisheries is the lack of reliable data for resource management. The civil war, which began in the 1970s, disrupted data collection on the fisheries. There are very limited data on fish catch, trends in fishing effort, and on other biogeochemical interactions in the lake such as sedimentation, the degradation of the inundated forest, and the impacts of this degradation on fish stocks and other biodiversity.

3.21 There are questions about the reliability of most of the available data because of the type of data collection protocols used. It was not until 1994 that valid sampling schemes were instituted to estimate harvests by industrial and artisanal fishers. Using the new sampling procedures, Lieng et al. (1995) reported a harvest estimate in the Tonle Sap river of 18,411 tons, an estimate 71% greater than the figure of 10,755 tons reported by fishery staff using previous methodologies.

3.22 Some efforts are being made to improve and update data on the fisheries. The Department of Fisheries, with financial and technical assistance from DANIDA (under the Management of Freshwater Capture Fisheries of Cambodia Project),<sup>5</sup> began in 1994 to improve its capacity to collect and analyze data on fish stocks and on the socioeconomic aspects of the Tonle Sap fisheries.

3.23 Status of Fish Stocks. Because of the limited historic data on the Tonle Sap fisheries, it is difficult to determine trends in the status of fish stocks. Moreover, because records of catches had been reported by size (e.g. > 1 kg = Group 1 fish) or by nature (white fish or black fish), they cannot be analyzed to determine the status of individual fish species.

3.24 Analysis of data on catch per unit effort (CPUE) of catch per boat is another approach to determine the status of fish stocks. Available data suggest that catch per boat in the inland fisheries in Cambodia, including the Tonle Sap, had declined from 2.7 tons in 1982 to 1.4 tons by 1989 and apart from peaking at 3.7 tons in 1993, harvests have varied between 1.5 tons and 2.7 tons from 1990-1995 (see Annex 3d). However, these data do not provide conclusive evidence that over-fishing had occurred in the Tonle Sap or other inland fisheries. Some local fishery staff have suggested that the increase in the number of recorded boats is a result of increased registration of fishing boats with the Fisheries Department, as required by law, and not a result of substantial increase in new entry.

3.25 There are also reports that the stocks of some commercially valuable fish species such as giant catfish (*Pangasionodon gigas*), pla thepa (*Pangasius sanitwongsei*), and pla esok (*Probarbus jullieni*) have collapsed, but there are no data to substantiate this claim. Nevertheless, as a precaution the government has placed a ban on the harvest of these species, though enforcement appears to be weak. Similarly, the capture and export of fries and fingerlings of aquaculture species, to Viet Nam in particular, is illegal but enforcement seems to be a problem.

3.26 A better determination of whether the maximum sustainable yield (MSY) has been reached or exceeded in the Tonle Sap fisheries would require information such as trends in CPUE for the different gear types being used in the fisheries, and information on the composition and length-frequency distribution of commercially important fish species. Studies are also necessary to determine the impacts hydroelectric dams under consideration on the Mekong or Tonle Sap river would have on the fisheries (including the commercially important white fish) and other biodiversity. While adverse ecological and social impacts are associated with

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<sup>5</sup> The objectives of the Management of Freshwater Capture Fisheries of Cambodia project (\$3.25 million) are to: (i) strengthen the Department of Fisheries through training of staff in fish stock assessment and in conducting socio-economic surveys; and (ii) establish a data collection system for freshwater capture fisheries of the Tonle Sap and the creation of a database (with ecological and socioeconomic data) for management planning.

hydropower dams, there are no data available in Cambodia to determine the extent of any impacts.

3.27 Weak Management Capacity. The Department of Fisheries in the Ministry of Agriculture, Forestry and Fisheries is responsible for the management of the Tonle Sap fisheries. It has a mandate to administer the Fisheries Law, but the lack of trained staff has limited the Department's ability to manage the fisheries effectively. Though the Department has a staff of more than 1,000 people (for both marine and inland fisheries), very few of them have experience in fisheries management. Moreover, morale among the staff is reportedly low because of low salaries, which average \$20 a month.

3.28 Budgetary constraints have also precluded effective management of the fisheries. Although the department generates substantial revenues for the government by auctioning fishing lots and selling fishing permits, none of these funds are earmarked for fisheries management activities. In 1994 for example, the department generated about US\$3 million in revenue, but it received a budgetary allocation of \$200,000 from the Ministry of Finance in 1995. About half of the budget was spent on surveillance and enforcement, but this was not enough to purchase needed boats and to cover most operational costs.

## **Land Use in the Floodplain**

3.29 The Tonle Sap lake covers nearly one-fifth of the Tonle Sap catchment area of about 1.4 million ha; the inundated forest covers another one-third (38.4%) of the area. The latter is a secondary forest and data from Carbonnel and Guiscafre (1963; cited in ORSTOM and BCEOM 1993) and from 1989 Landsat TM imagery indicate that a majority of this forest has been logged over at least once. The other major vegetation, covering nearly 20% of the area, is grassland and brushwood (See Annex 3e).

3.30 Agriculture, practiced on about 25% of the Tonle Sap area, is one of the main economic activities of the 3 million people living in the six provinces surrounding the lake. There were about 248,521 ha of paddy fields in 1989 and in 1991 they accounted for about 15% of the national rice output of 2.4 million tons. The Tonle Sap catchment area also includes 5,414 ha of upland crops (mungbeans, soybean, vegetables, etc.) (See Annex 3e).

## **Major Landuse Issues**

3.31 Lack of Reliable Data. The lack of adequate and reliable data for planning is one of the impediments to sustainable landuse management in the Tonle Sap area. A major effort is underway, through the FAO-supported Participatory Natural Resources Management Project,<sup>6</sup> to collect data on local resource use, trends in agricultural production, socioeconomic conditions, and environmental and health issues in selected communities in Siem Reap province.

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<sup>6</sup> The objective of the Participatory Natural Resources Management in the Tonle Sap Region Project, a \$2.8 million project, that began in 1995 are to: (i) prepare an integrated forest conservation and natural resources management plan for sustainable community-based development at selected pilot sites; and (ii) strengthen local capacity in integrated forest conservation and in sustainable forest-based income generating activities.

3.32 Deforestation of the Inundated Forest. The degradation of the inundated forest and watersheds associated with the Tonle Sap lake appears to be a major problem. It has been reported that deforestation has reduced the inundated forest in the Tonle Sap area from 1 million ha in the 1960s to 614,000 ha by 1992 (Thung 1994). Additionally, it has been reported by fishery staff and others, though not supported by reliable data, that the degradation of the inundated forest has contributed to a decline in species diversity and in fish populations in the Tonle Sap lake, as the floodplain is an important spawning, nursery and/or feeding ground for several fish species. Harvesting of trees for firewood or charcoal is one of the major causes of deforestation in this area. The largest consumers of firewood are the cottage industries, mostly brick manufacturing and fish smoking. A second major cause of deforestation is the reclamation of forest areas for the cultivation of rice, mungbeans and other crops.

3.33 Poor Soils. The soils in the floodplain of the Tonle Sap are generally poor in fertility. The three major soil types found in this area are: (i) young lacustrine alluvial soils (entisols); (ii) alluvial soils (ultisols); and (iii) acid sulphate soils (alumisols). The young lacustrine soils were formed from colluvial and alluvial outwash from acidic and basic rocks from the upland areas bordering the Tonle Sap lake, and from silt and clay deposits carried by the floods of the Mekong river. These soils can be found in about 1 million ha of the floodplain; they typically occur in low-lying areas of the floodplain with broad, flat depressions. These areas are flooded throughout the rainy season (water depth is 2-4 meters for 4-6 months) and most periods during the dry season. The most dominant natural vegetation on the young lacustrine soils is the inundated forest (FAO/IC 1994).

3.34 For agricultural purposes, one type of the young lacustrine alluvial soils, the finer-textured loamy sand lacustrine soil, is the best in the floodplain of the Tonle Sap. Though low in phosphate, it is usually high in organic matter and it has a neutral or slightly acid (pH 6-7) top soil. This soil type supports floating rice crops during the rainy season, and flood recession rice and upland crops (mungbean, soybean, vegetables, etc.) in the dry season. The reported yield for rainy season rice is 1.0-1.6 tons/ha/crop without fertilizer application. Farmers cultivating high-yielding IRRI varieties with added fertilizers and irrigation have reported higher yields of up to 3.3 tons/ha.

3.35 The alluvial soils (ultisols), the second major soil type, are derived primarily from ancient alluvial deposits and occur on the old alluvial terraces around the Tonle Sap lake. These soils are highly leached, have low base saturation, and they are in general, sandy, acidic, low in fertility, and very low in cation exchange capacity. They are also poor in texture and water retention; they tend to become compact after plowing or harrowing. Delvert (1961) has noted that this soil type is “mediocre for the cultivation of rice,” yet it is the most common soil for the cultivation of rainfed lowland rice in Cambodia. Rice yields from this soil are low, about 0.5-1.1 tons/ha under rainfed conditions, and the potential for higher yields is limited (up to about 1.5 tons/ha) mainly because of this soil’s low retention capacity for applied fertilizer.

3.36 Finally, the acid sulphate soils (alumisols) occur in limited areas of freshwater swamps around the Tonle Sap lake. They are heavy textured and very acidic alluvial clay soils that have developed under freshwater mangrove forest. Under these swampy conditions, high concentrations of sulphide and sulphate have accumulated, releasing soluble aluminum toxic to plants. Paddy rice is grown on these soils, but yields are reportedly poor (up to 1/2 ton/ha) and

the potential for increasing yields is low because it is very difficult, in general, to reclaim and manage acid sulphate soils.

3.37 Because most of the soils in the floodplains of the Tonle Sap are not very fertile, a limited number of farmers have begun using agrochemicals such as chemical fertilizers and pesticides to improve yields. These chemicals are applied mainly to high-valued dry season crops such as irrigated rice and cash crops. Though it does not appear to be a major problem at present, widespread use of agrochemical could have major adverse impacts on the Tonle Sap ecosystem. Some of the pesticides already in use have been banned in several countries. A Rapid Rural Appraisal (RRA) in 1995, for example, reported that some farmers were applying a mixture of DDT and Folidol (Methyl parathion) on mungbean crops (MDRN/MoE 1995; FAO 1995 a,b,c). Both DDT and methyl parathion are Class 1 or extremely hazardous chemicals and they are not biodegradable. Therefore, uncontrolled increased use of such chemicals would pose a major problem for biodiversity and public health, as they could poison people when they enter and accumulate in the food chain.

3.38 There is no legislation in Cambodia regulating the importation and use of toxic pesticides and other agrochemicals. It is expected that the proposed law on the management and use of pesticides and on other agricultural control standards (on veterinary drugs, quality of meat and farm products, etc.) that the Ministry of Agriculture is preparing will ensure a stricter control on the use of agrochemicals.

3.39 Availability of Water. Rainfall in the Tonle Sap area is distributed unevenly during the year; this is a major constraint in agriculture. The mean annual rainfall is 1200-1600 mm, but about 85% of the rainfall occurs during the rainy season of May through October. The intensity of the rains during the rainy season causes major floods, which often delay land preparation and cause poor seedling development in nursery beds. The rainy season is followed by a dry season characterized by a prolonged drought; as a result agriculture is successful only under irrigated conditions.

3.40 The alternate periods of flood and drought have resulted in major crop damage and reductions in yield. A scoping survey by MDRN/MoE (1995) in Kompong Thom Province, for example, reported that in 1993 and 1994 26,000 ha--more than 20% of the total rice cultivated area of 124,600 ha--were destroyed by flood.

## **Strategic Framework For Sustainable Management Of The Tonle Sap Area**

3.41 The Tonle Sap area, as noted earlier, has a unique biodiversity and plays a critical role in the socioeconomic and cultural life of the people of Cambodia. Because of the complex ecological linkages between the Tonle Sap, its floodplain, and associated watersheds, ensuring sustainable management of this area requires an integrated approach. An integrated management approach would require an effective mechanism for collaboration among the different government agencies responsible for economic development and conservation activities, and collaboration between these agencies and other stakeholder groups. In addition, reliable ecological and socioeconomic information is necessary to guide development in the agricultural and other sectors, conservation planning and implementation, and to provide a baseline for resource monitoring in the Tonle Sap ecosystem.

3.42 Inter-agency Collaboration. Integrated management of the Tonle Sap region would involve several agencies, including the Ministry of Agriculture, Forest and Fisheries; Ministry of Environment; The National Mekong Secretariat; Ministry of Finance; Ministry of Rural Development; Ministry of Industries, Mines and Energy; Ministry of Women's Affairs; Ministry of Tourism; Ministry of Public Works, universities and research institutions. An institutional mechanism is needed to facilitate interagency collaboration. The Government, with the assistance of international donors, has already taken steps to facilitate such a collaboration. The Cambodia National Mekong Commission (CNMC), an inter-ministerial body with representatives from several Ministries -- Public Works and Transport; Environment; Agriculture, Forestry and Fisheries; Industry, Mines and Energy; Foreign Affairs; Planning; and Rural Development -- is formulating a strategy for the development and management of water and related resources in the Tonle Sap region. The UNDP is providing financial and technical assistance for this initiative.<sup>7</sup>

3.43 The Inter-Ministerial Forum on the Tonle Sap under the auspices of the Ministry of Environment is another coordination mechanism for the discussion of issues affecting the Tonle Sap. A Tonle Sap Unit has been set up in the Ministry, with financial and technical support from UNESCO, to serve as a Secretariat to the forum. Other roles of this unit include:

- (a) assisting the MoE or other Ministries in the preparation of plans and programs for the sustainable development and management of the Tonle Sap;
- (b) assisting the Government with preparation of plans for the inscription of sections of the lake with historic, cultural, and biodiversity value as a World Heritage site and as a Ramsar site; and
- (c) promoting coordination among government agencies and the international development community on development and management of the Tonle Sap.

3.44 The above initiatives are important steps and they have already made significant progress in promoting interagency collaboration. This should evolve in the long-run into the formation of a single coordinating body with representation not only from the relevant government ministries, but also from universities and research institutions, provincial administration, resource users and other local stakeholders.

3.45 Such a body would have administrative and arbitration roles. Its administrative role would include reviewing and monitoring planned resource management and development activities to ensure that they are consistent with an integrated management framework for the Tonle Sap. Implementation of such activities would remain with existing agencies. The arbitration role would include initiating inquiries when the rights, obligations or interests of stakeholders appear to be causing substantial damage to the ecosystem, and helping to resolve resource use conflicts.

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<sup>7</sup> The UNDP-funded project, Natural Resource-based Development Strategy for the Tonle Sap Area, is aimed at strengthening the technical and managerial capacity of CNMC to coordinate development planning and management of water and related resources in the region.

3.46 The coordinating body should have a relatively small technical secretariat to provide administrative support and to communicate with existing agencies to assemble and analyze technical information required by the commission for decision-making.

3.47 Resource Management Information. Integrated management of the Tonle Sap ecosystem would require reliable data on biogeochemical (environmental) interactions and resource use patterns; these data are presently lacking. Priority should be given to improving the database on water quality, particularly sedimentation; the interactions between fish species and other aquatic organisms; interactions between fish species and the floodplains; and the potential economic and socioeconomic impacts of dams and other major development on the Tonle Sap lake, Tonle Sap river, and the Mekong river. In addition, fisheries-related data required for management planning--the age and growth rates of key fish species, total catch and species composition, and trends in fishing effort and CPUE -- should be collected. Data on socioeconomic aspects of the fisheries, including the differentiated roles of women and men, should also be gathered.

3.48 To be cost-effective and consistent with the integrated approach being proposed, the agencies involved in the management of the Tonle Sap should share research and resource monitoring facilities. It is therefore proposed that a Tonle Sap Ecosystem Research and Monitoring Center be established to support collaborative research and management. The Center would also facilitate the exchange of information and personnel among institutions within and outside Cambodia.

### **Strategy to Improve Fisheries Management**

3.49 Supply and Demand. The rapid rate of population growth in Cambodia will increase the demand for fish, and is expected to substantially increase harvesting pressure on the Tonle Sap fisheries. Based on officially reported catch/production data (which may underestimate actual catch) for the inland and marine fisheries and aquaculture, it appears from projections that demand for fish will outstrip supply (See Annex 3e). Therefore, to prevent over-harvesting of the fisheries the Department of Fisheries (DoF) must involve fishermen and other stakeholders in management planning and implementation, strengthen the management capacity of the DoF, and provide alternative non-fishing income generating opportunities in local communities.

3.50 Co-management of the Fisheries. The DoF has primary responsibility for the management of the Tonle Sap fisheries, but its effectiveness has been undermined by weak institutional capacity, including budgetary constraints and a limited technical staff. Effective management will require greater involvement of fishermen and other local stakeholder groups in management activities. This is particularly important in the small-scale fisheries (family and artisanal fisheries) where fishers land their catch at several hundred points, making it unrealistic for the DoF to monitor. A co-management approach would also encourage local support for management activities because it provides the stakeholders with a better understanding of why certain actions have to be implemented and invites their input into decisions affecting the fisheries.

3.51 To facilitate co-management, the DoF should build on local institutions and the existing lot system for the industrial fishery. The Department, in consultation with local communities, should delineate areas for exclusive use by small-scale fishers. The DoF and local communities



would collaborate to regulate total catch through gear restrictions. Harvest quotas and access control are also desirable management tools in fisheries; however, they cannot be realistically enforced in the small-scale fisheries of the Tonle Sap because they involve several thousand fishers and several hundred catch landing ports.

3.52 Implementation of a harvest quota system is more realistic in the industrial fishery because it involves less than 300 fishing lot operators. An allowable catch could be specified for each lot and the capacity of the DoF to monitor catch could be strengthened. To ensure that the prices paid for the lots correspond to the value of the potential catch, the present system of pricing lots based on size should also take the allowable catch into consideration. Such a change would also generate additional resource rents for the government to support management activities.

3.53 Capacity Building for the Department of Fisheries. Effective fisheries management would require capacity building for the DoF. Priority should be given to providing overseas training opportunities in fisheries research and management for the staff of DoF at institutions such as the Asian Institute of Technology. The Department also needs equipment such as boats and vehicles for surveillance and enforcement. The infrastructure the DoF would require for fisheries research would be provided through the proposed Tonle Sap Ecosystem Research and Monitoring Center (see para. 3.48).

3.54 Alternative Livelihood. Strengthening management of the fisheries is critical to the conservation of the Tonle Sap ecosystem. However, because management alone is inadequate, additional measures are necessary to slow the rate of growth of harvesting pressure. Alternative livelihood activities would also provide much-needed income for local fishing households during the off-season (June-September). Such activities include the development of programs such as fish processing, aquaculture and cottage industries to provide alternative non-fishing employment in local communities. Aquaculture, for example, has a long history in Cambodia, dating back to the 10th century. Current production is nearly 9,000 tons of fish annually and this can be significantly increased if more people have access to land, training in production techniques, and affordable credit. Both indigenous and exotic fish species are cultured (Annex 3f).

3.55 Aquaculture promotion in Cambodia should emphasize indigenous fish species and precautions should be taken to preclude the introduction of exotic species because they could dramatically (and adversely) alter the species composition in the Tonle Sap lake and other water bodies. For example, the introduction of Nile perch (*Lates niloticus*) into Lake Victoria in East Africa for sport fishing resulted in the extinction of a majority of the lake's endemic cichlid (*Haplocromis spp.* and *Hemichromis spp.*) and tilapia species. Crocodile farming is another economic activity that is becoming increasingly important as a source of income in Cambodia.

3.56 Policy and Regulatory framework. The changes proposed above to improve the management of the Tonle Sap fisheries would require a review and update of the policy and regulatory framework, including the Fisheries Law. Priority issues that should be covered in such a review include equitable access to the fishery by all categories of operators, particularly subsistence fishers; updating restricted and permitted fishing gear; inclusion of potential allowable catch in a fishing lot as one of the criteria of setting the base price for lots; and

earmarking revenues from the auction of fishing lots and other fees for fisheries management activities.

3.57 Regional Cooperation. The Tonle Sap lake, as noted earlier, is linked to the Mekong river via the Tonle Sap river. Therefore, the aquatic biota depend on the flow regimes in the Mekong river. The life cycle of some commercially important migratory fish species, for example, illustrates the close ecological relationship between the Tonle Sap lake and the Mekong river. Fishes from the families *cyprinidae*, *siluridae*, and *pangasiidae* spend different times of the year at various sections of the Mekong river, using the river to provide rearing habitat and a passage corridor to spawning grounds. Some fish species from the family *pangasiidae*, for example, spawn in sections of the Mekong river on the Cambodia-Lao border and their fry are carried passively downstream to the Tonle Sap lake as the flow regimes in the river change. Thus, the construction of a hydro-power dam, for example, on the main river channel would have devastating impacts on the Tonle Sap fisheries and local communities.

3.58 Because the Tonle Sap lake and the Mekong river, an international river, are physically and ecologically linked, management of the lake alone would not ensure sustainability. Therefore, Cambodia needs to ensure that the use of the river by other riparian countries - Viet Nam, Laos, and Thailand, will not have adverse impacts on the ecology of the Tonle Sap. The Mekong River Commission (China and Myanmar are riparian countries but not members of the commission) provides a framework for Cambodia to work with the other riparian countries to minimize any adverse ecological changes that may result from development on the Mekong river or its tributaries.

3.59 The Mekong River Commission, which was established in April 1995, replaced the Committee for the Coordination of Investigations of the Lower Mekong Basin set up in September 1957. The Commission's role is to facilitate cooperation and coordination among the riparian countries on sustainable development, utilization, management and conservation of the water and related resources in the Mekong river basin, including irrigation, hydro-power, navigation, flood control, fisheries, timber floating, recreation and tourism (Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin signed by Cambodia, Laos, Thailand and Viet Nam on April 5, 1995). The Commission's current focus is to prepare, with assistance from donors, a basin development plan, rules for water utilization and inter-basin diversion, and human resource development.

## **Strategy for Sustainable Landuse**

3.60 Given the Government of Cambodia's goal of achieving food self-sufficiency for a rapidly growing population, agriculture in the floodplains of the Tonle Sap will likely expand. The challenge for the policymakers is to take into consideration the trade-off between agricultural development and the conservation of biodiversity to ensure an optimum and sustainable combination of landuse practices. To achieve sustainable landuse in the Tonle Sap area, priority should be given to the protection of critical habitats, improvements in production systems, land tenure security, development of alternatives to fuelwood, and providing an adequate legal framework to regulate the use of agrochemicals.

3.61 Protection of Critical Habitats. The Tonle Sap area has a rich biological diversity, including many species of fish and water birds that should be protected. The eight fish sanctuaries and other important spawning areas in the lake must be clearly demarcated, and the capacity of the DoF to enforce the prohibition of fishing in these areas must be strengthened. In addition, priority should be given to the implementation of conservation efforts in Boeng Chhma and associated river systems. This 28,000 ha area in Kampong Thom and Siem Reap provinces has been identified as a critical habitat for the protection of biodiversity, including globally endangered water birds. It comprises an open lake, pools, river and creeks, freshwater swamps and floodplain.

3.62 Improvements in the Production System. Increasing agricultural productivity in the floodplains of the Tonle Sap should focus less on expanding areas under cultivation and more on improving production systems. Improvements should build upon traditional systems rather than replacing them because these systems, though relatively low in productivity, have proved to be sustainable. For centuries, the ancient Khmer and modern-day Cambodians have developed an effective symbiotic relationship with the environment. They built irrigation and water control structures and harnessed the silt-laden flood waters of the Tonle Sap lake, the Mekong river and other water bodies to develop various rice-based farming systems. This indigenous knowledge and experience should be enhanced to meet the current challenges facing agriculture.

3.63 Rehabilitation of water control structures would play an important role in ensuring year-round availability of water. This could be achieved by rehabilitating and/or modifying existing flood control and irrigation structures and by constructing small-scale irrigation systems. The beneficiaries of these systems should have greater involvement in the operation and maintenance to ensure efficient management. As irrigation systems, depending on the scale, could impact the hydrology and biodiversity of the Tonle Sap and public health, it is important that the environmental and social tradeoffs are carefully considered at the planning stage.

3.64 The emphasis on increased production should not be at the expense of indigenous crop varieties, which have important agronomic advantages and are preferred by most local consumers. In the case of rice, for example, IRRI had identified and catalogued at least 2,600 native rice varieties by 1995; each variety has its own unique characteristics--a different maturation period; varying degrees of tolerance to flooding, drought, or pest; and different cooking qualities. Each of these cultivated varieties has adapted to the particular hydrometeorological and soil conditions in the Tonle Sap area and the rest of the country. These varieties can be classified as rainfed rice, deep water floating rice, dry season recession rice, dry season irrigated lowland rice, and rainfed upland rice.

3.65 It is important that Cambodia rebuilds its collections of seeds, including those of local rice and other crop varieties which were destroyed during the civil war, to conserve genetic diversity. However, this would not necessarily require the country to develop seed or gene banks in the short term; this could be done in collaboration with regional and international institutions such as the International Plant Genetic Resources Institute (IPGRI) based in Rome, Italy. The IPGRI already has a collection of different rice varieties from Cambodia dating back to the beginning of this century.

3.66 Finally, on-farm research will play a crucial role in agricultural development in Cambodia. In the Tonle Sap area, research should focus primarily on soil fertility improvement (using plants and animal manure) and pest management. Indigenous species should be investigated for possible wider application as green manure and/or biocide. For example, Litzenberger and Ho Tong Lip (1961) have drawn attention to the potential of *Chromolaena odorata* (also known as *Eupatorium odorata*) to improve crop yields in Cambodia; Tichit (1981) reported significant increases in yields for rice grown in degraded sandy soils using *Chromolaena* as green manure and biocide.

3.67 Tenure Security. Experience in several countries suggests that security of tenure is critical to encourage farmers to invest in sustainable agricultural practices. However, most farmers in Cambodia have no legal recognized title to land they cultivate; this has reportedly led to land disputes and has also created an unstable environment for land improvements. Improved titling of agricultural lands will require clarifying and strengthening the Land Law and improving the capacity (skilled staff, equipment, database, etc.) of the national and provincial land titling offices.

3.68 Agrochemicals. The use of agrochemicals in agriculture is likely to increase substantially. This will require strengthening the Agricultural Materials Law by including national standards to regulate the importation or manufacture, sale, or application of agrochemical inputs such as fertilizers, pesticides and herbicides. In addition, the government should ban the importation and/or use of Class I (extremely hazardous) pesticides in agriculture to prevent an ecological disaster in the Tonle Sap area or other ecologically sensitive sites.

3.69 Woodfuel. Harvesting of trees for fuelwood, as noted earlier, is one of the major threats to the inundated forest in the Tonle Sap area. The biggest users of this fuelwood are the small-scale brick-making operations. Therefore, a shift away from wood burning, brick-making kilns in the Tonle Sap area (and in the rest of Cambodia) is vital if the inundated forest (as well as other forests) is to be protected. Cambodia should begin piloting energy efficient brick technologies such as the one that uses a non-fired process. (This technology is currently used in China, Germany, Russia, and Italy.) The non-fired process uses only chemical glue and hydraulic pressure to produce bricks that are of higher quality than the conventional kiln-fired bricks.

3.70 Another critical measure needed to protect forests is the reduction of household fuelwood consumption; this would require the introduction of culturally appropriate energy efficient cooking stoves and kilns. The widespread use of other energy sources--electricity and natural gas, for example--in rural areas does not appear to be feasible at present. These sources are available mostly in a few urban areas and are too expensive for most rural people.

3.71 Finally, the establishment of woodlot and other reforestation programs should be given high priority not only within the floodplains of the Tonle Sap but also in the adjoining upland areas. The supply of wood from such programs would significantly reduce harvesting pressure on the inundated forests.

### **Proposed Program To Support Sustainable Ecosystem Management**

3.72 This section presents a proposed program, based on the strategies outlined in the previous chapter, to support sustainable management of the Tonle Sap ecosystem (Tables 2 A, B, C). The program covers capacity building for integrated ecosystem management, fisheries management, and landuse management.

**Table 2. Proposed Program to Support Sustainable Management of the Tonle Sap Area**

**A. Integrated Ecosystem Management**

<b>Component</b>	<b>Objective(s)</b>	<b>Activities to be Supported</b>
<b>Phase I (Years 1-2)</b>		
Institutional Coordination	Enhance the existing institutional mechanisms for coordination of management activities	<p>(i) Multi-stakeholder consultations on the evolution of the two main coordination mechanisms into a single coordination mechanism for the sustainable management of the Tonle Sap and the preparation of relevant legislation.</p> <p>(ii) Outline in detail the roles, responsibilities and organizational structure of the single coordinating mechanism.</p> <p>(iii) Designation of a technical support unit for the coordinating body.</p>
<b>Phase II (Years 3-5)</b>		
Ecosystem Research and Monitoring Center	Set up a center associated with the coordinating body to direct collaborative research and resource monitoring activities related to the management of the Tonle Sap ecosystem	<p>(i) In-country and overseas technical training for selected staff of participating institutions</p> <p>(ii) Provision of physical facilities and equipment for ecosystem research and monitoring.</p> <p><u>Priorities:</u></p> <p>(a) fish stock assessment, and socioeconomic (including gender aspects) survey of communities dependent on natural resources in the Tonle Sap;</p> <p>(b) hydrology and sedimentation studies on the Tonle Sap lake and associated watersheds;</p> <p>(c) development of baseline data on key ecological and socioeconomic indicators for resource monitoring and planning.</p> <p>(iii) Establishment of a network (for the exchange of information, staff, etc.) between the Center and relevant institutions within and outside Cambodia.</p>
Integrated Management Framework	Prepare an evolving long-term integrated management framework, using data generated by the Center and from other sources, as guide for resource users and managers	<p>(i) Zoning (and demarcation) of the catchment area into protected, agricultural, archaeological/ cultural sites, eco-tourist sites, etc. using aerial photographs, satellite imagery, ground surveys, etc.</p> <p>(ii) Preparation of a long-term integrated management framework which outlines priority activities, sequencing of implementation, etc. for approval by the coordinating body for the management of the Tonle Sap. Implementation of the activities outlined in framework would remain with existing agencies.</p>

## B. Fisheries Management

Component	Objective(s)	Activities to be supported
<b>Phase I (Years 1-2)</b>		
Policy and Regulatory Framework	Review and update the policy and regulatory framework for fisheries management	<p>Review and prepare options for updating the policies and regulations for action by the Government on:</p> <p>(a) pricing fishing lots, basing it not only on size, but also on potential allowable catch</p> <p>(b) access control, resource allocation among different fishers, gear and harvest restrictions on small-scale and large-scale fishermen</p> <p>(c) earmarking of a proportion of revenues from the auction of fishing lots, permits etc. for fisheries management</p>
<b>Phase II (Years 3-5)</b>		
Fisheries Management	<p>Strengthen fisheries management by:</p> <p>(i) promoting co-management by DoF, fishing communities etc. in collaboration with other participating agencies in the Ecosystem Research and Monitoring Center</p> <p>(ii) implementing alternative livelihood programs in selected fishing communities</p> <p>(iii) strengthening surveillance and enforcement</p>	<p>(i) Develop and implement mechanisms for co-management of the fisheries by DoF, local communities and other stakeholders.</p> <p>(ii) Public information campaigns on sustainable resource management and the responsibilities of stakeholders.</p> <p>(iii) Implementation of pilot projects by community groups in the provinces around the Tonle Sap lake, including women's organizations, to provide alternative livelihood for local people as a way to reduce fishing pressure and to provide off-season employment in fishing communities. The pilot projects would include fish processing, aquaculture, etc.</p> <p>(iv) Provision of training and equipment to DoF and local government units to strengthen surveillance and enforcement in collaboration with local communities.</p>

## C. Landuse Management

Component	Objective(s)	Activities to be supported
<b>Phase I (Years 1-2)</b>		
Regulatory framework	Enhance the regulatory framework on agriculture land tenure and on agrochemicals	<p>(i) Assistance to MAFF to prepare for enactment regulations on agricultural land tenure security.</p> <p>(ii) Implementation of parcellary surveys and issuance of tenure instruments in pilot areas by national and provincial land titling offices.</p> <p>(iii) Provide technical assistance to MAFF and MoE to prepare national standards and implementation mechanisms for the importation or manufacture, sale and use of agrochemicals.</p>
<b>Phase II (Years 3-5)</b>		
Agricultural Productivity Improvement	Promote sustainable improvements in agricultural productivity in the Tonle Sap area.	<p>(i) On-farm research to improve the productivity of local crop varieties, including the use of green manure and biocide.</p> <p>(ii) Rehabilitation of selected water control structures.</p> <p>(iii) Collection and storage in seedbanks of unique local crop varieties.</p>
Conservation of critical habitats	Protection of Boeng Chhma and associated river systems, protection of critical watersheds, and conservation of the inundated forests	<p>(i) Capacity building for MoE and local communities to protect Boeng Chhma.</p> <p>(ii) Public Information Campaign on the need to protect critical habitats, and the responsibilities of stakeholders.</p> <p>(iii) Rehabilitation and/or conservation of degraded inundated forest areas and watersheds by local communities with assistance from MAFF, MoE, etc.</p> <p>(iv) Establishment of woodlot and other reforestation programs both in the floodplain and in upland areas.</p> <p>(v) Support to MIME to develop and promote in selected communities more efficient, affordable, and culturally appropriate energy for household use, brick manufacturing and other cottage industries.</p>



## 4. COASTAL FISHERIES MANAGEMENT

4.1 Cambodia's 435 km coastline is shared by the provinces of Koh Kong, Kompong Som, Kampot and Kep City. Only about 5% of the country's population lives in these provinces; most of the people live inland, in the lower Mekong basin. Cambodia has an Exclusive Economic Zone (EEZ) (the EEZ is the area from the shore to 200 nautical miles offshore) covering 55,600 sq. km (World Resources Institute 1994). The EEZ is an important fishing ground, though the participation of Cambodian fishers is limited because of the population's preference for freshwater fish. Most of the boats fishing Cambodia's EEZ are reportedly of Thai or Vietnamese origin. The marine fishery accounts for 30,000 tons of fish annually (Department of Fisheries 1996). The actual catch may be higher because this figure does not include the harvests of foreign fish fleet that land their catch outside Cambodia, illegal commercial boats, and subsistence fishers.

4.2 The marine fishery comprised mainly subsistence and artisanal fishers until 1960 when trawlers were introduced. Since that time, the number of motorized boats with 11-30 horsepower (Hp) grew to more than 1,800 by 1993. In addition, there may be about 200 foreign-owned vessels of 30-425 Hp fishing in Cambodia's EEZ. In Kompong Som Province alone, 174 vessels were registered in 1995 (Department of Fisheries, Pers. Comm. 1996).

4.3 Cambodia's coastal zone supports diverse habitats and species significant to biodiversity conservation, including mangrove forests, coral reefs, and seagrass beds. The mangrove forests are estimated to cover a total area of 85,100 ha (Department of Forestry, Pers. Comm.). The coast of Koh Kong and its offshore islands, for example, reportedly have 63,000 ha of mangrove forest, the largest undisturbed area in Cambodia. The mangrove forests along the coast typically occur in four major zones, from the shoreline to the landward edge: *Avicennia-Sonneratia*; *Rhizophora*; *Bruguiera-Kandelia-Ceriops*; and *Lumnitzera-Xylocarpus-Bruguiera* (Asian Wetland Bureau 1994).

4.4 Other forests are found along the coast, most notably the lowland evergreen forest that grows along the catchment and deltas of several rivers. This forest is dominated by *Dipterocarpus costata*, *Anisoptera oblonga*, *Shorea hypochra*, *Heritiera javanica*, *Dipterocarpus alatus*, and *Irvingia oliviera*. These evergreen forests are reportedly the most extensive and least disturbed in southeast Asia and they play a critical role in the protection of soils and the regulation of the flow of water and nutrients to the intertidal zone. Other important habitats in Cambodia's EEZ are coral reefs and seagrass beds. Fauna significant to biodiversity conservation reportedly found in the coastal and marine area include marine mammals such as the dugong (*Dugong dugon*) and marine dolphin (*Delphinus spp*), and three species of marine turtles (*Chelonia mydas*, *Lepidochelys olivacea*, and *Eretmochelys imbricata*) (Ministry of Environment, no date).

### Key Issues Facing Coastal Fisheries

4.5 Limited data on fish stocks. There is very limited information on the status of fish stocks in Cambodia, information required for developing a management program for the fishery. The most extensive research on fish populations was conducted jointly by USSR and Cambodian

scientists in four scientific expeditions supported by the Scientific Research Institute for Oceanography and Fisheries of the then USSR from August 1983 to May 1986. This study reported more than 400 fish and crustacean species from 94 families in the EEZ. It also identified mackerel, scad, anchovy, sardine, tuna and pomfret as the most commercially important pelagic fish; threadfin bream, croaker big-eyes, lizard hairtail fish, flat fish, snapper, barracuda, grouper, shark and conger eel were identified as the most commercially important demersal fish (Csavas et al. 1994; Tana 1994).

4.6 The USSR/Cambodian study also reported that fishers could be “allowed to catch per year for sustainable management” 20,000 tons of fish. This presumably refers to the Maximum Sustainable Yield (MSY). However, an analysis of the trends in total fish catch from 1980 to 1994 and trends in the number of boats does not yield reliable information on whether both inshore and offshore harvests are close to or exceed the estimated MSY. The catch statistics indicate that total annual harvests have grown substantially, from 1,200 tons in 1980 to 39,900 tons by 1990. However, catches began to decline after 1990, dropping to 30,000 tons by 1994 (See Annex 4a) (Department of Fisheries, 1996). It seems these dramatic changes relate primarily to reported harvests rather than to changes in actual harvests. Also, the data do not include the harvests of foreign vessels, subsistence, and illegal fishers.

4.7 Similarly, there have been dramatic changes in the number of fishing boats. The number of registered unmotorized boats less than 5 tons increased from 553 in 1983 to a peak of 2,449 boats in 1988 before declining to 882 in 1993. These changes may reflect a shift towards motorboats. In the 11-30 Hp motorboat category, the number more than doubled from 446 boats in 1983 to 1,377 in 1993. Vessels with more than 30 Hp increased from 408 in 1983 to a peak of 844 boats in 1990, before dipping to 436 in 1993 (Annex 4b) (Tana 1994, Department of Fisheries 1996). It is not clear if these changes reflect a major shift in fishing pressure (or effort) or a change in degree of enforcement of the requirement that boat operators should request fishing permits from the Department of Fisheries.

4.8 Degradation of critical habitats. Mangrove forests play a critical role in the survival of some fish species and other marine organisms. They are one of the most productive ecosystems in the world, providing essential nutrients (including detritus, planktonic and benthic organisms, and leaf litter) for marine organisms in the intertidal zone. Mangrove forests also serve as spawning or nursery grounds for several commercially important fish species. Because of this importance, over-exploitation of mangroves can have adverse impacts on the fishery. Presently, over-exploitation of mangroves in Cambodia appears to be localized, but this could potentially become a major problem in the coastal areas if action is not taken. Harvesting of mangrove forests for charcoal-making is one of the major causes of degradation. About 100,000 tons of mangrove trees were reportedly harvested in 1992 to produce 24,000 tons of charcoal, 90% of which was exported to Thailand and other southeast Asian countries (Department of Fisheries, Pers. Comm.).

4.9 Mangrove areas are also threatened by brackish water shrimp aquaculture, which converts mangrove areas into agricultural land. There are already indications that the expansion of shrimp aquaculture has expanded into mangrove forest areas, particularly in Koh Kong Province. In 1994, about 238 ha of mangrove areas had been converted to intensive shrimp farms, 177 ha of ponds were under construction, and 425 ha of ponds had been approved by DoF

for construction (Department of Fisheries, Pers. Comm. 1996). This trend has accelerated because of growing interest in Cambodia's relatively pristine mangrove areas shown by foreign investors, particularly those from Thailand where inappropriate shrimp culture practices have degraded many of the areas suitable for shrimp farming.

4.10 Other habitats critical to the marine fishery resource that could be threatened by human activities include coral reefs and seagrass beds. The main potential threat to these and other habitats important to coastal/marine biodiversity is offshore oil and gas development. Cambodia reportedly may have a potential of 1.5-3.5 trillion cubic feet of gas and 30-180 million barrels of oil, mostly offshore (Ministry of Environment, no date). Contaminants associated with the oil and gas industry include production water that contains heavy metals, elemental sulfur and sulfides, and organic compounds; oil spills; and sanitary and domestic waste from the drilling platform (see Annex 5 for a detailed discussion on Energy and Environment).

4.11 Weak management capacity. The DoF, under the Ministry of Agriculture, Forest and Fisheries, is responsible for the management of the marine fishery, but the effectiveness of management has been limited. Its responsibilities include issuing fishing permits to domestic and foreign boat operators, enforcement of gear restrictions aimed at controlling harvests, and protecting marine ecosystems that are critical to the sustainability of the fishery. The Fisheries Law (Ministry of Agriculture and Cooperatives' fourth Proclamation, 1987) specifies in detail 40 different types of commercial gear permitted in the marine fishery. These gear include trawl, purse and other seine nets; gillnets; traps; and hook and line (including long line). The Ministry has placed a ban on motor-pulled trawls in water less than 20 m deep and this is intended to prevent over-fishing, particularly during periods of relatively large concentrations of fish, such as the breeding seasons. The use of dynamite as a fishing gear is also prohibited to prevent damage to coral reefs and other underwater habitats.

4.12 The DoF is also responsible for conducting ecological and socioeconomic research to provide information for marine fishery management plan development and implementation. An Oceanographic Institute was established in Sihanoukville in the 1960s, but was closed during the Khmer Rouge era.

4.13 The inability of the DoF to undertake its responsibilities effectively is due to lack of adequate staff with training in fisheries management. In the provincial office of the DoF in Kompong Som, for example, only two persons out of a total staff of 55 have some training in fisheries management. In addition, budgetary constraints further weaken the capacity of the DoF's surveillance and enforcement activities. The enforcement unit based in Sihanoukville, for example, has three boats, the largest of which is 20 m in length with a maximum speed of about 8 knots. These vessels are old and not well equipped for enforcement operations on the high seas. Though the DoF generates substantial income for the national treasury, its budgetary allocation is insufficient to meet operational requirements. In 1995, for example, the DoF generated \$4 million in revenues, including \$300,000 from the sale of fishing permits, fines and other fees from the three coastal provinces, but its total budget for both marine and inland operations was only \$200,000.

## Strategic Framework For Sustainable Fishery Management

4.14 The EEZ of Cambodia is less exploited than the EEZs of its neighbors, Thailand and Viet Nam. Therefore it will continue to be an important source of fish and employment for coastal fishing communities in the country. To prevent a collapse of the marine fishery, Cambodia has to implement strategies to ensure sustainable management of the offshore and inshore fisheries, to protect critical coastal/marine habitats, and to strengthen the capacity of the DoF and other government agencies to ensure effective conservation of the coastal ecosystem.

4.15 Offshore Fishery. Because Cambodia's EEZ is relatively small (55,600 sq km) compared with Viet Nam (722,100 sq km) or Thailand (85,800 sq km), it may be prudent for the country not to develop its own industrial fishing fleet because this may lead to excess harvesting capacity and, eventually, a collapse of the fishery. Such a situation has already occurred in several countries in the region, including Thailand, where overcapitalization resulted in over-fishing of its EEZ. To stay profitable, some of the Thai industrial vessel operators have reportedly been poaching or colluding with local people to illegally secure fishing rights in Cambodia's EEZ.

4.16 Instead of developing a domestic industrial fleet, Cambodia should implement a policy of selling fishing rights in its EEZ, on a sustainable basis, to foreign fleet. Such an arrangement could also contribute to reducing the projected fish supply shortfall in Cambodia if the Government requires vessel operators to land a proportion of their catch in Cambodia for local consumption. Some countries require foreign boats to land 10% of their catch and all by-catch for domestic consumption. The success of such a policy, however, would depend on Cambodia's capacity for surveillance and enforcement. Cambodia should monitor foreign fishing vessel operations by placing observers on board and conducting random boarding of boats to check compliance with fishery regulations.

4.17 Near-shore Fishery. Based on available information on population densities in the coastal provinces, the number of subsistence and artisanal fishing boats, and the potential for the creation of non-fishing employment in these provinces, it is less likely that over-fishing would occur in the nearshore fishery. The population in the three coastal provinces, as noted earlier, is only 5% of the total national population. These provinces have a strong potential for industrial development, making increases in the number of fishing boats seem less likely. Nevertheless, it is important that mechanisms are developed for co-management of the fishery by the DoF, local fishers and other stakeholders, focusing primarily on ensuring compliance with management regulations such as gear restrictions, closed seasons, and the protection of critical habitats.

4.18 Protection of critical habitats. Coastal marine habitats critical to the sustainability of Cambodia's fishery--mangrove forests, coral reefs and seagrass beds--may be under threat in the near future. One approach to protect these habitats is to include the most critical sites in Cambodia's protected areas system. Although some mangrove forest areas are represented in the system, for example in the Preah Sihanouk, Peam Krasop, and Dong Peng, marine ecosystems are not covered in the legal boundaries of these parks. To address this gap, the Government should extend the boundaries of the coastal protected areas to include critical marine and other ecosystems. The Government should ensure effective management of these protected areas.

4.19 Reducing harvesting pressure on mangrove forest outside protected areas will require the development of management programs with local communities to ensure sustainable use, including reforestation programs. These management programs should also outline a landuse plan for mangrove areas, including a land use plan for shrimp farming.

4.20 The contamination of the coastal/marine ecosystem, particularly from offshore oil and gas development, is another major threat which requires proactive measures by the Government. The Government should require prospective investors in the oil and gas sector to include in their investment proposal an environmental impact assessment and an outline of a long-term environmental monitoring program. Such a program would enable both the firm and the Government to track the impacts of exploitation operations on the environment. The Government should also establish and monitor environmental quality standards for the oil and gas sector.

4.21 Strengthening Management Capacity. Effective management of the marine fishery will require strengthening the institutional capacity of the Department of Fisheries in two key areas: marine fishery research and management; and surveillance and enforcement. The limited technical skills of the staff of DoF in marine fishery research and management should be enhanced through in-country and external training programs. To provide reliable information for management planning, an ecological survey should be undertaken to collect relevant data, such as the status of fish species, level of harvest, and data on socio-economic aspects of the marine fishery. Cambodia may not be able to purchase its own research vessel in the short-term, but the Government should seek collaboration with international institutions as it did successfully with the then USSR in the 1980s. Such collaboration would also provide training opportunities for Cambodian fishery managers.

4.22 With regards to surveillance and enforcement, the provincial offices of DoF should be strengthened by providing training and motivation to the staff and equipment such as patrol boats. As the Cambodian Navy is involved in protecting the territorial integrity of the country, it would be advantageous for the DoF to improve coordination with the Navy and other government agencies on surveillance and enforcement of fishery regulations. Regional Cooperation must be another important element of Cambodia's strategy to improve surveillance and enforcement. Cambodia would need cooperation from Thailand and Viet Nam to minimize illegal encroachment of fishing boats from these countries into its EEZ. Cooperation with these and other countries is also necessary in the management of highly migratory fish species.

### **Proposed Program To Improve Management Of The Marine Fishery**

4.23 Based on the strategies presented in the previous chapter, this section outlines a proposed program to improve marine fishery management in Cambodia (Table 3). The program covers policy and regulatory issues associated with access to the fishery by domestic and foreign boats, protection of critical habitats, and capacity building for management of the marine fishery.

**Table 3. Proposed Program To Improve Management Of The Marine Fishery**

<b>Component</b>	<b>Objective</b>	<b>Activities to be Supported</b>
<b>Phase I (Years 1-2)</b>		
Policy and Regulatory Framework	Review and update regulators on the entry into the fishery by domestic and commercial boat operators and on fish harvests	<p>(i) Develop guidelines for approval by the Government on entry into the fishery by foreign vessels, including licensing system, permit fee structure, and contribution of foreign fleet to domestic fish supply.</p> <p>(ii) Review and update the Fisheries Law, especially elements dealing with access control and harvest restrictions, including permitted gear.</p> <p>(iii) Develop the policy and legal framework to facilitate community participation in coastal resource planning and management.</p>
<b>Phase II (Years 3-5)</b>		
Protection of Critical Habitats	Protect critical marine and coastal areas within the protected areas system	<p>(i) Baseline surveys to identify critical coastal/marine habitats not included in the protected areas system.</p> <p>(ii) Survey and demarcate the boundaries of existing coastal parks to include critical habitats; preparation and implementation of management plans for three priority parks.</p> <p>(iii) Mangrove reforestation.</p> <p>(iv) Preparation and implementation of management plan (including landuse) for mangrove areas.</p> <p>(v) Implementation of an environmental monitoring program by the Ministry of Environment to track the impact of oil and gas development in the EEZ.</p>
Capacity Building for Fishery Management	Strengthen the capacity of the Department of Fisheries and local communities to develop and implement management plans	<p>(i) In-country and external training for the staff in fishery research and management, surveillance and enforcement, and in socioeconomic surveys.</p> <p>(ii) Implementation of ecological and socioeconomic surveys to develop baseline information for fishery management.</p> <p>(iii) Provision of patrol boats and other equipment for the provincial offices of DoF.</p> <p>(iv) Develop mechanisms for earmarking a portion of revenues from permit fees, fines, etc. to support specific fishery management activities.</p> <p>(v) Development and implementation of mechanisms for co-management of the inshore fisheries by DoF and local stakeholders.</p>
Diversification of Economic Opportunities	Reduce dependence of fishery resource exploitation and diversify income sources of local communities	<p>(i) Promotion of coastal and marine aquaculture on a sustainable basis.</p> <p>(ii) Development of fish handling and processing facilities.</p>

## 5. BIODIVERSITY AND PROTECTED AREAS

5.1 Cambodia's diverse topography and hydrology accounts for its rich biological diversity. The country's topography is dominated in the east by the western slope of the Annamite mountain chain and in the southwest by the isolated highlands of the Elephant and Cardamom mountains. Forests are the most dominant vegetation, covering 62% of Cambodia's total land. Wetlands cover 30% of the country's land area, as Cambodia lies within the plains and valley of the Mekong and Chao Phraya rivers. The Mekong River and the Tonle Sap (Great Lake), one of the largest floodplain lakes in the world, dominate the country's hydrology. Other important wetland areas are found around Stung Treng and the coastal estuaries of the Stung Kaoh Pao and Stung Kep.

5.2 These forest, wetland and other habitats support many species of flora and fauna, including 212 species of mammals, 720 bird species, 240 reptile species and more than 2,300 species of vascular plants (UNDP 1994; Ashwell 1994b). Tana (1994) reports that 435 marine fish species have been identified in the waters of Cambodia. While other estimates of the country's flora and fauna are much lower, the significance of its biodiversity is not disputed (WCMC 1994; Dinerstein and Wikramanayake 1993). The World Conservation Monitoring Centre estimates that 15,000 different species of plants, at least one third of which are endemic, exist in Cambodia. While Cambodia's fauna may be less diverse than its neighbors, its diversity of flora is generally believed to be greater. At lower altitudes the country's flora is typical of the Indo-Chinese floristic region. At higher altitudes the flora is typical of the Indo-Malay region. Cambodia appears to be one of the world's richest countries in terms of diversity of plant families, with representatives of nearly 54% of all families of seed plants. UNDP and IUCN have described some 2,300 species of vascular plants.

### Biodiversity and Endemism

5.3 Most of the data on Cambodia's biodiversity are outdated because ecological and other data collection activities in the country were disrupted during the civil war. Nevertheless, the limited available data suggest that Cambodia is biologically rich and diverse and harbors several species of fauna of global conservation significance (see Annex 5a).

5.4 Forest Ecosystem. Cambodia's tropical rainforests, together with those of Viet Nam and Laos, have the greatest biological richness in Indochina (Braatz 1992). The rainforest vegetation is comprised of species from the families *Dipterocarpaceae*, *Leguminosae*, *Lythraceae*, *Fagaceae*, and to a limited extent, *Pinaceae* and *Podocarpaceae*.

5.5 Despite its rich tropical diversity, the level of endemism in Cambodia is low compared with many countries in Asia. The country's more well-known endemic species include kouprey (*Bos Sauvelii*), a bovine which is also the country's national animal. It is a rare wild ox endemic to Cambodia, although its range extends to limited areas in Laos, Viet Nam, and Thailand. Another recently described endemic bovine is "Khting sipu" (*Pseudonovibos spiralis*), the horns of which were discovered in northeast Cambodia.

5.6 Wetland Ecosystem. The Tonle Sap is the most important wetland area in Cambodia. It is one of the largest floodplain lakes and one of the most productive inland fisheries in the world. The lake has a unique hydrological relationship with the Mekong River, to which it connects via the Tonle Sap river. During the monsoon season (June-October), the Tonle Sap river regulates flood water from the Mekong. As the flow of the Mekong River increases, the flow of the Tonle Sap river reverses from a downstream direction backwards into Tonle Sap. As noted earlier (para. 3.3), this reversal expands the surface area of the lake more than four-fold, from about 250,000-300,000 ha to 1.1-1.3 million ha. The lake's depth also increases, from 1-2 m to 8-10 m (Asian Wetlands Bureau 1995).

5.7 The flood plain of the Tonle Sap forms a 20-30 km ring around the lake, covering a 614,000 ha area (Asian Wetland Bureau 1994). About 70% of the area comprises inundated forest, which reportedly supports at least 115 species of plants, mostly medium-size trees such as *Barringtonia acutangula* and *Cynometra sp*, undergrowth vegetation such as *Hymenocardia wallichii*, *Croton caudatus*, and several species of lianas (FAO 1994).

5.8 The Tonle Sap and its floodplain support a rich diversity of other flora and fauna adapted to the wide seasonal fluctuations in water depth, temperature, pH, dissolved oxygen and other environmental parameters. About 850 species of fish have been recorded in the lake and the lower Mekong River, including globally endangered species such as giant catfish (*Pangasianodon gigas*), trey trasak (*Probarbus jullieni*), and large carp (*Catlocarpio siamensis*) (FAO 1994b). This ecosystem is also an important wintering and breeding ground for water birds, including globally rare or endangered species (see Annex 5b).

5.9 Marine and Coastal Ecosystem. Cambodia's coastline of 435 km and its Exclusive Economic Zone (EEZ) of 55,600 sq. km are relatively small compared with neighboring countries. Thailand has a coastline 3,219 km long and an EEZ of 85,800 sq. km, and Viet Nam's coastline is 3,444 km long with an EEZ of 722,100 sq. km. Nevertheless, Cambodia's marine waters reportedly have a high biological productivity and they support diverse habitats, including coral reefs and seagrass beds. These marine habitats support 435 species of fish from 97 families and globally endangered marine mammals such as dugong (*Dugong dugon*) and marine dolphin (*Delphinus sp.*) (Tana 1994).

5.10 Coastal wetlands are another important habitat on the coast of Cambodia, and they are dominated by mangrove forests that cover an area of 85,100 sq. km. There are 74 species of mangroves in Cambodia (Tana, unpublished). These relatively pristine mangrove forests occur in four major species zonations, from the shoreline to the landward edge: (i) *Avecennia-Sonneratia*, (ii) *Rhizophora*, (iii) *Bruguiera-Kandelia-Ceriops*, and (iv) *Lumnitzera-Xylocarpus-Bruguiera* (Asian Wetlands Bureau 1994).

5.11 Coral reefs, an important habitat for fish and other aquatic organisms, occur around islands off the coast of Cambodia, including at Koh Rong, Koh Rong Sanlem, Koh Thas, Koh Russey, Koh Takiev, Koh Ses islands, Koh Tang, Koh Pring, and Koh Chlarm islands. Twenty-four species of hard coral and fourteen species of soft coral and sea fans have been identified in Cambodia. Some of the coral reef, for example, around the island of Polowaii, are in poor condition -- probably due to sedimentation, but the causes are not clear.



5.12 Seagrass beds occur in sheltered estuaries in Cambodia, in the area between the Vietnamese island of Phu Quoc and the Kompot Bay in Cambodia. Seagrass species in this area believed to include *Enhalus acoroides*, *Cymodocea seradata*, *Syringodium isoetifolium*, and *Halodule pinifolia*. (Tana, unpublished). The seagrass beds provide important habitat for aquatic life, including the marine mammal, *Dugong dugon*, which has been classified by IUCN as globally “vulnerable”.

## **Status And Trends In Ecosystem Degradation**

5.13 The extent of habitat degradation in Cambodia is reportedly low, as, unlike most countries in Indochina, large-scale development has not yet occurred. Though development activities in the country were interrupted during the decades of civil and regional conflicts, the trend has begun to change since the war ended in the early 1990s. Demand for natural resources by the rapidly growing population has now begun to increase substantially. The Government's success at attracting some foreign investment has also placed additional pressures on the country's renewable natural resources, particularly on forests and wetlands.

5.14 Status of Forests. Cambodia's forest cover is currently estimated at 11.2 million ha, 62% of the country's total land area. There are eight major forest types in the country, with evergreen and deciduous forests the most dominant. These two forest types cover an area totaling 9.1 million ha, nearly half of the country's total land area (see Annex 2a).

5.15 Deforestation is a problem in Cambodia, and it is expected to worsen because of increased commercial logging, shifting cultivation, rapid population growth and related development activities. However, the rate of deforestation in Cambodia to date appears to be significantly less than in most Asian countries, where losses of up to 70% of the original forest cover have been reported (Braatz 1992). Data collected in the 1960s and in 1992 suggest that the annual deforestation rate in Cambodia is less than 1%. In the 1960s, Cambodia had a forest cover of 13.2 million ha (73% of the total land area), but an assessment in 1992, using Landsat satellite imagery, indicated that the coverage had dropped to 11.2 million ha (62% of land area) (Thung 1994; Ashwell 1994b). There are variations in deforestation rates among the Provinces. While forests in Kandal and Takeo Provinces appear to have been completely denuded, those in Battambang, Kompong Thom, Pursat, Siem Reap, Koh Kong, and Mondulhiri Provinces seem to be relatively intact (see Annex 2b). Though more recent data are not available, it is believed that deforestation rates have accelerated in the last five years.

5.16 Causes of deforestation. One of the major causes of deforestation in Cambodia is logging. Large-scale concessions, totaling over 6 million ha, have been granted to more than 20 firms. Much of this logging takes place in a relatively unplanned and unregulated manner, and considerable illegal logging is also believed to occur. These large-scale logging efforts, both legal and illegal, have reportedly caused significant degradation of forest biodiversity. Logging roads have facilitated an influx of shifting cultivators in some parts of the country, causing further degradation (see Chapter 2 for detailed discussions on forest policy).

5.17 The Pol Pot regime's agricultural policies (1976-1974) also contributed significantly to deforestation. This regime's “rice first” policy led to the conversion of about 1.5 million ha or primary forest to cropland. Regional and civil conflicts have also had major adverse impacts on forests in Cambodia. There are reports that during the Viet Nam war in the 1960s and 1970s,

large forest areas in the eastern part of Cambodia suffered extensive damage from bombing and spraying of chemical defoliants, such as agent orange, by the United States military. In addition, mining activities, forest fires and intensive fuelwood cutting by the largely poor and rapidly growing population have contributed significantly to deforestation and biodiversity loss in Cambodia.

## **Status of Wetlands**

5.18 Inland Wetlands. The people of Cambodia have historically had strong economic and cultural ties to wetlands. About 95% of the country's population, estimated at 9.63 million in 1993, live within the inland wetland areas of Cambodia, and wetlands provide the people with a variety of products, including fish, firewood, and medicinal plants. They are also important areas for rice cultivation and for navigation. Increased human pressure has led to the degradation of some wetland areas in Cambodia, though there are no reliable data on the extent of habitat destruction and conversion because of the absence of recent studies.

5.19 The main human activities responsible for the degradation of wetlands in Cambodia include drainage for agriculture, over-fishing, and over-exploitation of the inundated forest for fuelwood. The proliferation of exotic species, for example *Mimosa pigra* (a weed) in the Tonle Sap area, has created pressure on endemic biodiversity. The growing use of agrochemicals (fertilizers, pesticides, herbicides, etc.) is widely believed to be having adverse impacts on the lake's ecosystem, but there exist no data on the scale of this problem and its impact on biodiversity.

5.20 It has also been suggested that a major threat to the flora and fauna of the Tonle Sap in particular is a significant increase in sedimentation. The current data are insufficient to assess the extent of sedimentation rate increases and the impact on the Tonle Sap ecosystem. The suggestion that this lake could silt up by the year 2000, however, is not conclusively supported by available data. Studies by Carbonnel and Guiscafre (1963) and Orstom and BCEOM (1993) indicated that at current rates of sedimentation it would take between 600 and 1,500 years for the Tonle Sap to fill with silt. Still, there are strong indications that localized sedimentation could become a major problem. The western shore of the Tonle Sap, for example, is reportedly facing serious siltation problems as a result of gem mining near Pailin, which has led to increased flows of sediments into the lake via the Battambang river. Similarly, points at the confluence of the Mekong and the Tonle Sap rivers (known as Chakdamuck) and at the entrance to the Great Lake (known as Snoc Trou) have silted up to levels that are affecting the reverse flow of the Tonle Sap river during the dry season. (see Chapter 3 for detailed discussion of the Tonle Sap.)

5.21 Coastal Wetlands. Much of Cambodia's mangrove forest and other coastal wetland areas has suffered relatively little degradation largely because of limited human pressure. Only 5% of the population lives on the coast, and very little industrial or other development activities have been undertaken in the coastal areas. An emerging problem in the coastal areas is the conversion of mangrove areas into brackish water shrimp ponds. This conversion is occurring mostly in Koh Kong, where investments and strong shrimp demand from Thailand have resulted in the tripling of the area of shrimp ponds in a single year, from 100 ha in 1992 to 273 ha by 1993 (Asia Wetland Bureau 1994). This trend will accelerate if management measures are not taken, as water quality problems in the Gulf of Thailand and the near absence of pristine mangrove areas

in Thailand are major constraints in the rapidly expanding Thai shrimp farming sector. Another major cause of mangrove forest degradation in Cambodia is over-exploitation for charcoal production, much of which is exported to Thailand and other countries in Indo-China.

## **Wildlife Trade**

5.22 Trade in wildlife and associated products is increasingly becoming a major threat to some species of animals and, to a lesser extent, plants in Cambodia. Of particular concern to conservationists is the illegal export trade, which is growing despite a Government ban on hunting for commercial purposes. Much of the wildlife is exported to Thailand via Laos, and to China via Viet Nam. Several species of mammals, birds and reptiles, including globally and regionally endangered species, are harvested for food and/or medical markets (See Annex 5c). The combination of relatively high prices for wildlife and limited capacity for controls on wildlife exploitation have made this trade attractive to many local people. A live tiger, for example, is reportedly being sold for US\$500 - \$2,500. These prices are similar to those paid in neighboring countries where controls are tighter. Cambodia has not been able to fully participate in international efforts to control the illegal trade in wildlife because it is not a member of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).<sup>8</sup> There are no data on the scale of the wildlife trade and its impacts on the country's flora and fauna.

## **Protected Areas**

5.23 Present Status. The traditional approach to biodiversity conservation is to establish protected areas such as national parks and wildlife sanctuaries. Cambodia became the first country in southeast Asia to establish a national park in 1925, when the 10,800 ha forest around the Angkor Temple complex was declared a protected area. By 1969, the country had established a total of six national parks and wildlife sanctuaries covering nearly 2.2 million ha, 12.15% of the country's total land area. The civil war disrupted management activities in these parks, but the country renewed its efforts toward conservation of biodiversity by establishing protected areas after the war ended. On November 1, 1993, His Majesty King Norodom Sihanouk issued a Royal Decree (or Kret) designating 23 areas, covering a total of about 3.3 million ha (18.23% of total land area), as national parks, wildlife sanctuaries, protected landscapes, or Multiple Use Areas (see attached Map). The four categories of protected areas in Cambodia reflect the different characteristics and management objectives for these areas and they correspond to international classifications such as those of IUCN (see Annex 5d).

5.24 The "new" protected areas include areas designated in the 1960s and additional sites selected to ensure that the diversity of habitats in Cambodia is represented (See Annex 5e). The location of one of the protected areas, Virachey National Park (332,500 ha) in northeastern Cambodia, provides an opportunity for the creation of a trans-frontier reserve with the proposed Dong Amphan National Park (122,100 ha) in Lao P.D.R. and the Mom Ray National Park (101,400 ha) in Viet Nam. As of yet, however, these areas have not been fully surveyed, their boundaries have not been demarcated, and there has been no conservation management in the parks. Some steps have already been taken to manage the following parks - Preah Sihanouk,

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<sup>8</sup> Convention on International Trade in Endangered Species of Wild Fauna and Flora.

Kirirom, Bokor and Kep. Efforts to improve management of the Botum Sakor National park, the Phnom Kulen national park and the wildlife sanctuaries are at the planning stages.

5.25 Because no major ecological and socioeconomic surveys were conducted before designating parts of the country as protected areas, there are not data to determine the international, national or local biodiversity conservation significance of the designated areas. In addition, as noted earlier, the government has allocated millions of hectares of forest lands to logging concessionaires. There is, however, no data to determine whether there is an overlap between some protected areas and forest concessions.

5.26 Angkor Protected Landscape. The Angkor protected landscape is particularly important among the 23 sites designated as protected areas in Cambodia because of its archaeological and biodiversity conservation significance. This area was the metropolitan center for the ancient Angkor kingdom (8-13 th centuries) and it was inscribed as a World Heritage Site in December 1992 because of its unique architectural, artistic, and cultural value. The unique features of Angkor includes:

- (a) architecturally unique and extensive temples decorated with narrative reliefs that were constructed in honor of the gods of the ancient Angkor kingdoms. The most internationally renowned temple complex is the Angkor Wat which was built around the mid-12th century. The central temple of Angkor Wat is about 55 m high and the entire complex is fortified with a wall and a 5.5 km long moat; and
- (b) complex hydrological systems -- canals and reservoirs -- for irrigation and water supply to the ancient metropolis. The largest reservoir was 8 km x 2.2. km with a storage capacity of about 70 million cubic meters of water.

5.27 Because of its importance, the Government designated sections of the Angkor landscape, including the temples and surrounding forest, as the Angkor Archaeological Park in 1925, the first national park in South East Asia. Preservation work at Angkor began in the early 1900s by Conservation d'Angkor, a Government agency, with assistance from the Ecole Française d'Extrême-Orient and it focused on the restoration of physical structures and documentation. This effort was disrupted in the early 1970s following the outbreak of war.

5.28 The present challenges facing the Angkor protected landscape include the dilapidation of many temples, illegal removal of statues and other items for sale to collectors, expansion of agriculture into buffer areas around the temples; and expansion of urban areas. Since the late 1980s UNESCO has spearheaded efforts to mobilize financial and technical assistance from the international community to assist the Government to establish a legal and administrative framework to restore and protect the temples and the surrounding natural habitat. Despite significant progress, more efforts are needed to restore and protect the temple complex, ensure sustainable use of natural resources, and regulate tourism and urban development.

5.29 Gaps in the Designated Protected Areas. Cambodia's protected areas are representative of the three major biomes in the country: forests, freshwater wetlands, and coastal habitats. At the ecosystem level, there are three important gaps in the system: (i) marine ecosystems (coral reefs, sea grass beds, etc.); (ii) lowland evergreen rainforest (i.e. below 500 ft); and (iii) riverine ecosystems, particularly freshwater swamp forests.

5.30 The marine protected areas in Cambodia currently consist of one protected area, Preah Sihanouk (Ream) National Park (comprising of lowland coastal evergreen forest, mangroves, rear mangrove formations of *Melaleuca* sp and islands); one wildlife sanctuary at Peam Krasop (comprising of coastal protected areas with tidal flats, mangroves, *Melaleuca* forest and watershed areas); and an officially proposed site for Ramsar protection on the Kaoh Kapik islands (comprising of coastal wetlands with mangroves, sand and mud flats, alluvial islands, *Melaleuca* and beach strand vegetation). Marine habitats are not well surveyed, but are clearly threatened by intensive shrimp farming, burning of mangroves, and fuelwood and timber cutting. Information is needed to delineate breeding grounds; nursery, nesting, and courtship areas; migratory pathways; and other appropriate zones for protection. If Preah Sihanouk is extended to include marine waters, proper management of the current protected areas should be sufficient to sustain representative marine ecosystems.

5.31 Because a high percentage of Cambodia's total land area already falls under the designated protected areas, care should be taken in recommending additional sites to fill the ecosystem gaps. It is important that conservationists seek a balance between protected areas and the other land requirements of present and future generations. The following sites are recommended for priority consideration for any future expansion. Biodiversity assessment would be required to determine the size and boundaries of the protected areas:

- (a) Lowland evergreen forest. The area north and east of the Mekong river (105°45'E, 12°35'N) in the Districts of Prek Prasap and Sambo (in Kratie Province); Santok and Sandan Districts (in Kompong Thom Province); and Stung Treng District (in Kompong Cham Province). Recent aerial surveys suggest that this area may be one of the most pristine lowland rainforests in southeast Asia (Ashwell, pers. comm. 1995).
- (b) Riverine system. A potential site known as Mekong Leour is the riverine system and associated flood forests and islands along the upper reaches of the Mekong river in Kratie and Stung Treng Province. This wetland area is a proposed Ramsar<sup>9</sup> Site. It comprises sandy and rocky islands with unique tree communities and shrubs such as *Barringtonia* sp., *Engenia* sp. *Acacia* sp. and *Morindopsis* sp. The area is also an important habit for several globally rare or endangered fauna such as irrawaddy dolphin (*Orcaella brevirostris*) and birds such as river stern (*Sterna aurantia*), small pratinole (*Glaerola lactea*) oriental darter (*Arhinga melanogaster*) and great stone plore (*Esacus recurrirostris*).

5.32 Presat Tuyoy is another potential site. It is a 70,000 ha area between Tonle Bassac and the Mekong River (in Kandal and Prey Veng Provinces) and its main habitats include swamp, inundated forest, open lake and river, and flooded pasture. These habitats support a variety of flora and fauna, including waterbirds.

5.33 The only protected area in Cambodia with an international designation is the Angkor temple complex and its surrounding forest. This area was inscribed as a World Heritage site in December 1992. The Government is presently taking steps to have the Tonle Sap lake and its

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<sup>9</sup> A site designated under the Convention on Wetlands of International Importance Especially as Waterfowl Habitat.

floodplains designated as a World Heritage site. In addition, three other wetland areas are being proposed as Ramsar sites: Boeng Chhma and its associated river system; Kaoh Kapik and associated islets; and a section of the Mekong river (See Annex 5f). With respect to other international conventions, Cambodia ratified the Convention on Biological Diversity on February 9, 1995 and it is presently preparing documentation needed to submit its application to join CITES.

## **Protected Areas Management**

5.34 Legal Regime. Cambodia's protected areas system was established under the Royal Decree on the Creation and Designation of Protected Areas in November 1993. This was followed in 1996 by the enactment of the Law on Environmental Protection and Natural Resource Management which reaffirmed the Ministry's mandate on protected areas and other aspects of environmental management in the country. Other instruments (Sub-Decree, Regulations or Prakas, etc.) are now needed to cover the operational aspects of protected areas management, including the process of designation and gazettelement, and the preparation and implementation of management plans. Environmental impact assessment regulations will also be important for biodiversity conservation in Cambodia.

5.35 Organizational Arrangements. The MoE, under the Royal Decree establishing a protected areas system, is responsible for the management of protected areas. The Department of Nature Protection and Conservation (DNPC) of the Ministry is specifically responsible for managing protected areas. DNPC has a staff of 60 persons in Phnom Penh and 10-15 persons each in the Preah Sihanouk National Park, Kirirom National Park and Bokor National Park.

5.36 The Ministry of Agriculture, Forestry, and Fisheries (MAFF) has the legal mandate for forest management outside protected areas, including inundated forests, mangroves, primary and secondary forest, and wildlife. The Wildlife Protection Office (WPO) in the Department of Forestry, MAFF is responsible for the conservation of wildlife. The Department of Fisheries in this Ministry is responsible for the management of wetlands, inundated forests and all aquatic biodiversity. The complementary roles and responsibilities of the MoE (in the Department of Nature Protection and Conservation) and the MAFF for biodiversity conservation are clearly defined in the sub-decree on Protected Areas Management.

5.37 Institutional Capacity. The MoE lacks adequate institutional capacity to effectively manage protected areas because of its limited human resource capacity and budgetary constraints. Very few DNPC staff have training or experience in protected areas management. Moreover, low salaries (the average salary is US\$20-30 per month) and the absence of a structured career profile have created motivational problems among the staff. Management capacity, experience in field work, and training in environmental policy, legislation, economics and planning are all largely lacking in the Ministry.

5.38 Inadequate budgetary allocation from the Government continues to be a major constraint facing the MoE. In 1995, for example, the Ministry received a budget of 1.1 billion Riels (about US\$446,000) out of its original request of 3 billion Riels (US\$1.2 million). This budget covered staff salaries, with very little left to procure needed materials, to pay for operational expenses, and to make investments. Investments in equipment, offices and tourist facilities in the gazetted National Parks cannot be made on the Ministry budget. The international donor community has

provided limited assistance to the MoE for protected areas management. The largest support of US\$83,000 was provided by UNDP and was intended for IUCN and the MoE to prepare a Biodiversity Prospectus, completed in 1996, which outlines opportunities and priorities for the conservation of biodiversity

5.39 The MAFF also suffers from resource and capacity constraints. The Wildlife Protection Office, for example, has a staff of about 30 persons in Phnom Penh with little training in conservation management. Throughout the MAFF, capacity for wildlife and natural resources research, conservation and management is constrained by inadequate technical staff and limited budget.

5.40 Biodiversity Information. There is very little information on the status of biodiversity within and outside protected areas in Cambodia. Most of the available data were collected prior to the 1960s, before the civil war disrupted ecological and socioeconomic survey work on all sectors. Limited on-going post-war surveys have generated some preliminary data on habitat classifications and distribution, species populations and distribution, and on the types and levels of threats to biodiversity in Cambodia.

5.41 Updated surveys will be important for design and management of the protected areas system, and for establishing a baseline and monitoring biodiversity. On-going survey work, mostly supported by international organizations, includes: (i) the survey of wetlands and large waterbirds by the Asian Wetlands Bureau; (ii) crane surveys by the International Crane Foundation; and (iii) an aerial survey of large herbivores in eastern Cambodia and a habitat survey of the Preah Sihanouk National Park by the MoE and IUCN.

5.42 Security Issues. Historical and current security problems have significantly affected conservation activities in Cambodia. During the Viet Nam war, bombing, shelling and chemical defoliation along Cambodia's eastern borders reportedly destroyed large tracts of forest and wildlife habitat. During the period of Khmer Rouge rule, 1975-79, some 1.5 million ha of primary forests were converted to rice fields. In the early 1980s forests were cleared as security precautions in areas believed to harbor opposition forces. Also during these times of hardship, an impoverished population, many of whom were armed, relied heavily on wildlife and forest resources for subsistence and livelihoods. This loss of habitat and over-exploitation of wildlife is believed to have cost Cambodia considerable loss of biodiversity.

5.43 Security is currently a serious issue in large areas where the Khmer Rouge remain active and where land mines have been planted. A number of the protected areas, such as Preah Vihear, Kulen-Promtep, Roniem Duan Sam, Samlaut and Phnom Samkos, lie in military security zones or in areas occupied by the Khmer Rouge. In these and other parts of the country, the greatest threat to both people and wildlife is anti-personnel mines. About 6-9 million land mines have reportedly been planted throughout the country, and an estimated 100 persons are killed or maimed daily by mines (World Bank 1994). In addition, illegal logging operations often take place under armed guard. Ironically, the security situation has in some ways served to protect natural habitats since 1980. While it has not been possible to establish conservation programs in zones of insecurity, it has not been possible to undertake large-scale development in these areas either--with the significant exception of illegal logging activities.

## **Strategic Framework To Enhance Protected Areas Management**

5.44 Enhancing protected areas management in Cambodia will require significant improvements in the following priority areas: (i) legal framework, (ii) human resources, (iii) financial resource mobilization, and (iv) management planning and implementation

5.45 Improving the Legal Regime. The Royal Decree establishing the protected areas system is an important first step towards protected areas management and biodiversity conservation in Cambodia. The proposed Law on Environmental Protection and Natural Resource Management, under consideration in the National Assembly, would further advance biodiversity conservation because it would clarify the mandate of the MoE regarding protected areas and other aspects of environmental management. It is important that Sub-Decrees and Regulations (i.e. Prakas) are developed and enacted by the Council of Ministers or issued by the MoE to cover the operational aspects of protected areas management, including park gazettelement and management planning and implementation.

5.46 Human Resources Development. Training for conservation planners, administrators, field staff and local communities is essential for effective management of protected areas and biodiversity conservation in Cambodia. The MoE should establish a training unit to assess the specific training needs of its staff and to prepare short-term and long-term programs to address them. In the short-term (i.e. within the next five years), the Ministry should use a combination of in-country training supplemented with overseas courses to build capacity. The advantage of such a training strategy is that the trainees could remain on the job (part-time) and in the field. In addition, it would ensure that most of the training is undertaken within a context relevant to biodiversity conservation in Cambodia.

5.47 The combination of in-country and external training could be achieved through a "twinning" arrangement between the MoE and an overseas university or institution. The Ministry should involve the personnel of other Government agencies involved in biodiversity conservation in its training activities. For example, the staff of the Customs Service, which is responsible for controlling the illegal international trade in wildlife, and the DoF, which is in charge of the conservation of forest wildlife outside protected areas, should participate in the training program.

5.48 Financial Resource Mobilization. The Government's budgetary allocation for protected areas and biodiversity is inadequate, covering mostly staff salaries. It is therefore important that additional resources are mobilized for the MoE. Such resources could be generated by an environmental trust fund or endowment,<sup>10</sup> which would provide funding over the long-term to cover operating expenses, including supplementing the low salaries of selected staff of the Ministry. A environmental trust fund or endowment would be appropriate for Cambodia because the interest it generates would provide a relatively small, but critical annual cash flow for a country where absorptive capacity is presently limited. There is also the potential to fund conservation activities in Cambodia over the long-term through user charges. The country could, for example, develop low impact nature tourism and a portion of the fees collected from tourists

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<sup>10</sup> A trust fund is a grant which has specific conditions on how the interest generated from the principal should be used. An endowment is a grant which may not have such conditions (Braatz 1992).



and park visitors would be earmarked for conservation activities. Also, a portion of revenues from the forest sector could be earmarked for biodiversity conservation activities.

5.49 Biodiversity Conservation and Management Planning. Current information on biodiversity in Cambodia is scarce. Baseline data and monitoring systems are needed to identify conservation priorities and effectiveness and ecological, geographic and sociological surveys are needed to plan protected area management strategies and evaluate their feasibility. Implementation of some critical conservation measures, however, should not be postponed until national surveys and data bases are completed. Strategic research to help design management plans in the priority areas described below should be the highest priority, so that urgent actions are not delayed by lengthy studies.

5.50 Implementation of Protected Areas Management. Because of budget constraints and limited technical staff, the Preah Sihanouk National Park is the only one of the 23 protected areas designated in 1993 in which the MoE has been implementing management planning activities. IUCN, with funding from UNDP and AUSAID, is providing some financial and technical support to the MoE to conduct ecological surveys in the Preah Sihanouk National Park. Additional technical assistance for protected areas management is being provided by WWF, with USAID funding, for the Virachey National Park and by the European Commission for the Bokor National Park. The Ministry urgently needs international financial and technical support to effectively manage the protected areas system. However, because of the Ministry's limited institutional capacity and internal security problems, management activities should first focus primarily on the following priority protected areas: Preah Sihanouk National Park, Virachey National Park, and Bokor National Park; Kirirom National Park, Angkor protected landscape; Tonle Sap Multiple use area, and the three proposed Ramsar sites--Mekong Leour (the floodplain of the Mekong river, from Kratie to the Laos border), Boeung Chhma, and Koah Kapik.

5.51 Experience in several countries suggests that national agencies alone cannot effectively conserve biodiversity in protected areas, and this also seems to be the case in Cambodia. It is therefore important that the MoE develops a participatory management planning and implementation process (for both government and non-government stakeholders) and simultaneously builds the capacity of its staff and the communities living adjacent to protected areas to facilitate local participation. To sustain their interest in participation, it is also important that these communities benefit directly from park activities. In addition, experience in many developing countries suggests that conservation efforts would be undermined if poverty alleviation in the local community is not addressed as an integral part of protected areas management. Such benefits might include providing employment for some of the local people in adjacent communities; permitting the people to harvest, on a sustainable basis, some products from the parks; and earmarking a proportion of revenues from user fees to support alternative livelihood programs and other community development activities.

### **Proposed Program To Improve Protected Areas Management And Biodiversity Conservation**

5.52 In this section, a proposed short-term program to improve protected areas management in Cambodia, based on the strategies outlined in this chapter, is presented below (Table 4). In the long term, all the nation's protected areas must be gazetted and demarcated, and subject to conservation management plans that have been developed in consultation with local populations.

Some of the nation's parks have significant potential for environmentally friendly eco-tourism that could generate employment and significant revenues if developed appropriately.

5.53 Biodiversity conservation can be further advanced, in many cases, through the designation of two or more reserves which are contiguous across an international boundary as a trans-frontier reserve. Such a reserve is particularly necessary to protect animals whose ranges extend beyond national borders and require large expanse of habitat. A number of the protected areas designated under the Royal Decree in Cambodia have potential, in the long-term, for the formation of trans-frontier reserves. This is particularly the case along Cambodia's borders with Viet Nam and Lao P.D.R., where similar high quality habitats exist across the border. Unfortunately, severe habitat degradation and intensive logging on Thailand's side of the border preclude the inclusion of Thailand in a trans-frontier reserve system.

5.54 The best candidate for a trans-frontier reserve in Cambodia is the Virachey National Park (332,500 ha) which adjoins Dong Amphan (a proposed Park of 122,100 ha) in Laos, and Mom Ray (a 101,400 ha protected area) in Viet Nam. The resulting tripartite international park would conserve over half a million hectares of some of the most important montane, sub-montane, and lowland forests remaining in continental southeast Asia.

**Table 4. Proposed Action Program For Protected Areas And Biodiversity Conservation**

<b>Component</b>	<b>Objective (s)</b>	<b>Activities to be supported</b>
<b>Phase I (Years 1-2)</b>		
Legislation	Preparation and enactment of relevant legislation on the operational aspects of protected areas management	Assistance to the MoE in preparing Sub-decrees and/or regulations on the process designating national parks, park gazettelement, and management planning and implementation.
<b>Phase II (Years 3-5)</b>		
Human resource development	Provide training for the staff of the MoE and other agencies involved in biodiversity conservation within and outside protected areas and local communities	(i) Establishment of a training unit within MoE to manage the implementation of training activities. (ii) Implementation of an in-country/external practical training program developed by the unit for park administrators, conservation planners, field staff, and customs officials responsible for controlling the illegal wildlife trade through a twinning arrangement with a overseas university/institution. (iii) Training for local organizations to participate in co-management of conservation areas.
Financial resource mobilization	Establish an environmental trust fund or endowment to support protected areas management and biodiversity conservation	Development and implementation of operational procedures for an environmental trust fund or endowment.
Protected areas management planning and implementation	Prepare and implement management plans through a participatory process for the following eight priority areas: (i) Preah Sihanouk national park; (ii) Virachey national park; (iii) Bokor national park; (iv) Lomphat wildlife sanctuary; (v) Angkor protected landscape; (vi) Kirirom national park (vii) Tonle Sap Multiple Use Area; and the proposed Ramsar sites; (viii) Mekong leour (ix) Boeung Chhma; (x) Koah Kapik;	(i) Development of a participatory management planning and implementation process. (ii) Ecological surveys using satellite imagery, aerial photographs etc. to prepare maps for each project site. (iii) Ground survey to identify and document habitat types and major flora and fauna; their extent/or numbers; threats; type of management required; and opportunities for low impact nature tourism. (iv) Socioeconomic survey to identify communities adjacent to the protected areas/Ramsar sites/World Heritage sites; surveys to determine the socioeconomic conditions in those communities, resource use patterns, source of employment, and community institutions. (v) Delineation as protected areas of areas identified through surveys as having international, national, or local biodiversity and cultural conservation significance. (vi) development of infrastructure for conservation activities, including communication equipment. (vii) preparation and implementation of a management plan for each site. (viii) Implementation of pilot livelihood projects to provide alternative sources of income for the communities as a way to reduce harvesting pressure on biodiversity. (viii) Implementation of a public information and education campaign, focusing primarily on adjacent communities and park visitors. (ix) Provision of infrastructure for park administration and for low impact nature tourism where applicable. (x) Data management system for monitoring and evaluation of conservation activities.

## **6. ENERGY DEVELOPMENT AND THE ENVIRONMENT**

6.1 Cambodia, a country with a population of 9.63 million people (in 1993), depends primarily on fuelwood for its domestic energy needs and on petroleum product imports for its commercial energy requirements. The Ministry of Industry, Mines and Energy (MIME) estimated that in 1994 biomass accounted for 86% of total energy use, with fuelwood 82.8%, charcoal 1.6% and agricultural residues 1.8%. Commercial fuels, such as oil, gas and electricity, provided the remaining 14% of energy consumed.

6.2 An estimated 88% of energy use in Cambodia is domestic. Biomass is the primary fuel for domestic needs, particularly in rural areas where 80% of the population lives. Electricity is only used for domestic purposes in urban households. Biomass is also the primary energy source for small industries, such as brick making, palm sugar refining, brewing, fish smoking, bakeries, and tobacco steaming. While it is anticipated that commercial energy use will increase with urbanization and industrialization, the amount of biomass energy use is still expected to rise as the population grows.

6.3 Petroleum products are largely imported. In 1995, the country imported 220,013 tons of diesel, 145,983 tons of gasoline, and 51,203 tons of fuel oil. Imports could be significantly higher since some imports may not necessarily pass through customs, the source of these data. Thirty-five percent of this imported petroleum was used in electricity generating plants. These plants, including relatively small independent diesel or oil-fired generators, are mostly operated by the Electricité du Cambodge.

6.4 Power-generating facilities in Cambodia suffered extensive damage or neglect during the civil war, severely curtailing electricity generation. Phnom Penh, which has more than 90% of the country's installed capacity for electricity generation, is supplied by six power stations with a total capacity of 80 MW, but only about 48.0 MW is operational, which is not enough to meet the demand of consumers in Phnom Penh connected to the distribution system. The aging generators at these stations are in poor condition because of inadequate maintenance and lack of spare parts. As a result, power outages are so frequent that economic activities and the provision of essential services such as telecommunications and water treatment have been adversely impacted. Many consumers have installed their own diesel generating units. These generators are estimated to exceed 100 MW (Ministry of Industry, Mines and Energy, 1995).

6.5 The Government's strategy is to ensure a reliable supply of electricity in the short-term and to rehabilitate and expand existing power stations and electricity distribution systems throughout the country. It hopes to finance these investments with loans and grants from multilateral and bilateral sources, and from the private sector under a Build-Operate-Transfer (BOT) arrangement. The Government has obtained a total of US\$244.8 million in commitments and pledges for rehabilitation and expansion work between 1993-1998 from private investors and multilateral agencies, including a US\$40 million loan from the World Bank (Ministry of Industry, Mines and Energy 1995).

6.6 In the long-term, the Government of Cambodia's primary focus is to revitalize the country's economy, which was devastated during the civil war. Its goal is to achieve and maintain an annual growth in GDP of 7-8%. At this rate of economic growth, the demand for electricity for industrial and household purposes is expected to rise significantly, but total electricity supply, based on planned (but not fully funded) rehabilitation and expansion work, may not be able to keep pace with demand. Preliminary estimates by the Ministry of Industry, Mines and Energy (1995) indicates that the total demand for electricity is expected to rise from 28.7 MW (against a supply of 26.9 MW) in 1994 to 144 MW by 2000, with a projected supply of 142.1 MW for that year, but further analysis is needed to confirm these projections. Cambodia's capacity to meet any growing demand for electricity will depend largely on the success of the energy sector reforms and the country's ability to attract private investment.

6.7 In addition to short-term measures to rehabilitate and expand existing power plants, the Government is pursuing a long-term strategy to develop Cambodia's hydroelectric power and oil and gas potential. The strategy is aimed at:

- (a) providing an adequate and reliable supply of energy throughout the country (both urban and rural areas);
- (b) supplying energy at competitive prices to facilitate foreign investment in Cambodia. For the country to be competitive with its neighbors, it must be more efficient and provide electricity at a rate significantly less than the present rate of US\$0.14 - \$0.21 per Kwh; and
- (c) reducing imports of petroleum products and exporting excess energy to Thailand and other neighboring countries.

## **Biomass Management**

6.8 Fuelwood consumption is estimated to be 0.6 cubic meters per capita per year. Some 50% of this is believed to be extracted from forest areas, with the remaining portion collected from homesteads and public areas. The pattern of fuelwood use differs somewhat by region. Fuelwood use is higher in forest-rich provinces, while more agricultural residues, such as rice straw, husks and cow dung, are used in forest-poor provinces. Socioeconomic as well as geographic differences exist in patterns of fuelwood use. For example, poorer families near forests collect their own fuelwood, and those farther away collect non-commercial fuelwood such as tree branches, rice husks, and palm leaves from public places. Wealthier families use commercially purchased woodfuel or charcoal.

6.9 Development of the commercial energy sector will not inevitably or quickly lead to a decline in woodfuel consumption in Cambodia. The constraints on a transition from fuelwood to electricity are both spatial and financial. Spatial issues arise particularly in rural areas and in poor informal or peri-urban areas that are simply not connected to the power grid; however, in some areas the grid can be quickly expanded. Financial issues manifest where housing structures are unsafe to be wired for electricity, where the appliances that utilize electricity are unaffordable, and where the relative immobility of electrical appliances make them unattractive purchases for those without tenured living arrangements.

6.10 The use of biomass as an energy source in Cambodia will therefore continue and likely increase. The 1995 draft energy policy from the MIME states a commitment to address issues regarding the use of fuelwood and other biomass. As yet, however, the Department of Forestry, to whom responsibility for fuelwood has been delegated, has no formal policy or strategy on this issue.

## **Hydropower Development**

6.11 Existing hydropower facilities. The Ochum power station, a 1 MW unit, is the only hydropower station operating in Cambodia. The station was built in 1993, with funding from the Cambodian Royal government, to provide electricity for the northeastern Province of Ratanakiri. The country also has a 10 MW station near Kirirom that was built in 1968 to supply part of Phnom Penh's electricity needs via a 120-km high voltage (110 kw) transmission line, but the power station was damaged during the civil war and ceased to operate in 1970. There is also a partially completed 18 MW hydropower station at Prek Thnot. Construction work on this facility was disrupted in 1970 by the war.

6.12 Potential hydropower sites. The Mekong river (and its tributaries) flows through six countries--China, Myanmar, Viet Nam, Lao P.D.R., Thailand, and Cambodia -- and is estimated to have a total hydropower potential of about 58,000 MW (Ministry of Industry, Mines and Energy, Pers. Comm. 1997). Within Cambodia's borders, the MIME estimates that the hydropotential is about 10,000 MW -- 50% on the Mekong mainstream, 40% on the tributaries of the Mekong river and 10% outside the Mekong basin, in the south western coastal part of the country. About 40 sites have already been identified for hydropower development in Cambodia and it is believed that the Government is seeking international assistance (private, multilateral and bilateral funds) to develop the energy potential at the following sites -- Sambor, Stung Treng, and Khone Falls (see Annex 6 for details on some of the potential sites identified by MIME for the short-, medium- and long-term). Under the agreement signed by Cambodia and the other riparian countries (excluding China and Myanmar) establishing the Mekong River Commission in April 1995, Cambodia would have to consult these countries on any plans to develop hydro power on the Mekong river.

## **Oil and Gas Development**

6.13 Potential sites. Cambodia reportedly has offshore and onshore oil and gas deposits in commercial quantities. A total of eight potential oil bearing basins have been identified in the country: the Khmer trough and the Pattani trough (offshore sites); the Siam basin and the Mekong Delta Basin (covering both offshore and on-shore areas); and Chung Basin, Khorat Basin and the Preah Basin (onshore sites). For these exploration blocks, no bidding has been conducted for test drilling. The government has, however, signed a contract for a land seismic survey covering 1,500 km exclusively on "roads and highways" and a second contract for an aerial survey of the Tonle Sap and Mekong Basins.

6.14 Since the civil war ended in 1991, initial work in the oil and gas sector has focused on exploration. Three international oil firms completed drill stem tests in 1994 and the initial results indicated that it is less likely that commercial quantities of oil or gas may be found within 200 km of Cambodia's coast.

## Major Environmental Concerns in Energy Development

6.15 Some Impacts of Fuelwood and Biomass Use. The collection and use of fuelwood and other biomass energy sources have two important environmental implications: the degradation and loss of forest area as a consequence of collection, and indoor pollution resulting from biomass burning for cooking purposes.

6.16 The extent of forest loss that may be attributed to fuelwood use is unclear. On the whole, it appears that fuelwood collection contributes only marginally to Cambodia's deforestation. Fuelwood collection tends to occur in degraded areas, making it difficult to assess whether or not it is an important factor in degradation. In specific areas, however, fuelwood collection is clearly causing degradation. The most striking examples of localized degradation are in the flooded forest areas of the Tonle Sap, where relatively large populations have put significant pressure on limited and vulnerable forest resources, and in areas surrounding Phnom Penh, where the growing urban population has demanded ever increasing supplies of fuelwood and charcoal.

6.17 In the past, tree plantations have alienated rural populations and have been unsuccessful if forest access for the local community was not taken into account. In some areas, such as Siem Reap, studies suggest that fuelwood plantations would be uneconomic and that timber or commercial trees should be planted. Nevertheless, as a large part of fuelwood appears to be gathered from homesteads, villages and non-forest areas, the promotion of community and agroforestry, such as fuelwood and multi-purpose tree plantations at the family and commons level, could help ease localized pressure on forest resources. Improvements in charcoal kiln efficiency could also help ease pressures on forest resources. Public education programs and the recognition and enforcement of forest resource laws could also have an impact, as the issue of fuelwood management is not widely appreciated in Cambodia.

6.18 An additional hazard of fuelwood collection is the presence of land mines in the forest. Some 50 percent of Cambodia's land mines are believed to be planted in the forests, and 30 percent of recorded land mine victims were collecting fuelwood at the time they were injured.

6.19 Indoor air pollution from cooking with biomass fuels seriously affects health, particularly the health of women and children. It has been estimated that the concentration of some pollutants emitted during cooking with biomass is 10-100 times that considered safe by the World Health Organization. The most common method of cooking in Cambodia is the use of three stones or termite hill blocks over an open fire. This allows only limited control of fuel burning rates, and presents significant fire hazards from sparks and significant health hazards from emissions. Other types of stoves, such as mud stoves, ceramic stove and metal stoves are also used with biomass fuel, but these are more efficient and somewhat less polluting. Kerosene and gas stoves are common only in the urban areas.

6.20 Fuel substitution and improved stoves and chimneys could help alleviate indoor air pollution. Fuels such as kerosene are far less polluting than biomass, but they are prohibitively expensive for the poor and require infrastructure networks for their delivery. Improved stoves, however, are both efficient and economical. The improved Thai stove, for example, has been used in Cambodia since the mid-1980s and is both inexpensive (about US\$1) and highly efficient in fuel use. Improved stoves also reduce safety hazards and provide economic opportunities for stove production, maintenance and sales.

6.21 Some Potential Impacts of Hydroelectric Dams. The construction and operation of hydroelectric dams can cause irreversible environmental changes, therefore careful assessment is necessary to determine the environmental and social trade-offs. When a decision is made to construct a dam, it is important to develop preventive and/or mitigation measures at the planning stage to minimize the environmental and social impacts. The type of preventive and mitigation measures depend on the location and size of a dam, the choice of technical design, the size and distribution of human settlements, and the characteristics of biodiversity in areas to be flooded after a dam is constructed.

6.22 There seems to be no specific plans in Cambodia at present, to build a hydropower dam on the Mekong river. If a dam is constructed, the Mekong river or the Tonle Sap river would result in changes in the hydrology and limnology, and this could have significant impacts on the volume and quality of water, characteristics of aquatic biota, and sedimentation dynamics of the river. Perhaps the greatest socioeconomic loss would be the fisheries of the Tonle Sap, one of the most productive freshwater fisheries in the world. About 50,000-60,000 tons of fish, 70-80% of total national fish catch, are harvested from the lake annually and fish is important in the diet of Cambodians, providing up to 75% of the animal protein intake. Several thousands of people are employed by the fisheries in harvesting, processing, and marketing.

6.23 A dam on the Mekong River or the Tonle Sap River on the fisheries will likely have several specific impacts on the fisheries, including:

- (a) permanent inundation of spawning areas, including the floodplain, would be particularly devastating for many commercially important fish species such as *cyprinids* and *pangasius*, which have narrow depth ranges for spawning;
- (b) the loss of littoral areas (shallow areas of a lake), typically used by fish to escape predation, following the creation of a reservoir would adversely affect the population of fish, particularly of juveniles. In addition, the inundation of wetlands and swamps that are important nursery grounds would have a similar effect on fish populations; and
- (c) disruption of the migration of most commercially important fish to upstream spawning and nursery grounds, will lead to a collapse of fish populations. For example, *pangasius* spawns in the upstream portions of the Mekong river, close to the Cambodia-Lao border. Its fry are then carried passively downstream to the Tonle Sap as the seasonal flow of the river and depth of the lake change (Hill and Hill 1994).

6.24 A dam will also have major implications for floodplain agriculture. The creation of a reservoir associated with a dam will result in the displacement of communities in the inundated zone and the loss of production on floodplain agricultural lands. The changes in the hydrology of the Mekong river could also have significant public health impacts, including a major increase in the incidence of water-borne diseases such as schistosomiasis (bilharzia), onchocerciasis (river blindness), and encephalitis if they are endemic to the area. Changes in the hydrology of the Mekong river will also affect river transportation, which is very important for the movement of people and goods -- including agricultural produce -- because of the dilapidated state of the country's road network



6.25 Some Potential Impacts of Oil and Gas Development (Onshore operations). The development of Cambodia's onshore and offshore oil and gas potential, assuming commercial quantities exist, raises environmental concerns that, depending on the scale of operation, could have devastating effects on some sectors of the country's economy. The sector most vulnerable to impacts from onshore and offshore operations is tourism, which is also the fastest growing segment of Cambodia's economy. Tourism is growing rapidly because international visitors are attracted to the country by its unique archaeological and cultural sites, such as the Angkor temple complex; its unspoiled beaches; and its relatively pristine natural habitats. However, the impact associated with onshore drilling operations and ancillary support services in the oil and gas sector could cause significant damage to the country's archaeological and cultural assets, agricultural lands, and sensitive ecosystems, including important fishing grounds. These impacts include:

- (a) extensive surface disturbances from seismic operations and drilling of oil and gas wells;
- (b) air emissions associated with combustion gases from diesel-powered generators and pumps, oil evaporation during transfer and loading, flaring or venting of waste gas, and oil well blowout or refinery fire. These emissions often contain toxic gases such as sulfur dioxide, nitrogen oxides, unburned hydrocarbons, and carbon monoxide; and
- (c) major oil spills, especially those resulting from oil well blowout, ruptured pipelines or storage tanks.

6.26 Agriculture could also suffer major losses from oil and gas drilling operations. Farmlands are vulnerable to onshore operations because a major oil spill would contaminate soils and water, precluding the cultivation of crops. One area where oil contamination would have a devastating socioeconomic impact is the Tonle Sap basin. This area accounts for about 50% of the national rice crop and 75% of the country's inland fish harvests. It is therefore commendable the Government has not permitted oil and gas prospecting to occur in the area. It is, however, not clear if this is a temporary or a permanent measure to protect the Tonle Sap ecosystem.

6.27 Offshore oil and gas development could have similar impacts on air quality as onshore operations. In addition, offshore oil and gas development could contaminate the ocean and coastal areas in a variety of ways. Although no specific analysis on the possible environmental impacts of oil and gas development in Cambodia has been undertaken, some of the major contaminants often associated with this sector include:

- (a) production water which is typically more saline than seawater and often contains heavy metals, elemental sulfur and sulfides, and organic compounds;
- (b) an oil spill at transfer or loading points, pipeline failure, tanker spill, or a well blowout or on the Mekong river, which is widely used for the transportation of petroleum products could result in localized or extensive contamination, depending on the size of a spill;

- (c) sanitary and domestic wastes from the drilling platform, including waste from the accommodation of the work crew; and
- (d) oil tanker washing.

6.28 Oil contamination could have major effects on the marine/coastal biodiversity and the fisheries:

- (a) the seabed could also be contaminated by drilling mud and solid wastes, all of which may contain toxic residues, including heavy metals. Such a contamination would destroy aquatic organisms that live on the sea bottom (i.e. benthic organisms);
- (b) the destruction of important habitats for aquatic flora and fauna by an oil spill. Cambodia's waters include coral reefs and mangrove forests, and endangered species such as dugong (*Dugong dugon*) and marine dolphin (*Delphinus sp*); and
- (c) a possible collapse of the marine fisheries, the most productive fishery in the Gulf of Thailand, if a major oil spill contaminates important spawning and nursery areas for fish and other aquatic organisms.

## Legal and Institutional Issues

6.29 The Government of Cambodia, as noted earlier, has taken the initial step of developing the country's oil and gas potential by issuing licenses to three international firms for offshore oil exploration. It is also seeking international assistance to tap the country's hydroelectric power potential. The challenge for the Government is to ensure that the environmental and social trade-offs associated with hydropower and oil and gas development are thoroughly assessed and that measures will be implemented to prevent or minimize any major adverse ecological and social impacts. Unfortunately, the Government and the private sector in Cambodia, at present, cannot meet this challenge because of inadequate regulatory framework and weak institutional capacity.

6.30 Regulatory Limitations. Petroleum Regulation (September 28, 1991) provides the regulatory framework for oil and gas operations in Cambodia and two key provisions of this regulation relate to the environment. In section 25(d), a contractor is required to "Protect the natural environment, avoid causing loss or damage to life of men, animals, natural property, forest, fishery and archaeological [sites] subject to concerning Rules." In section 29(c), after production operations are completed a firm is required, at its own cost, to "restore the area used for petroleum operations to its original condition, unless otherwise instructed by the Ministry of Industry." In addition, in the existing petroleum licensing agreement, a firm is required to "adopt all measures necessary to avoid or minimize pollution of soil, air, or water," and the firms are required to submit environmental protection procedures and plans for review and approval by MIME.

6.31 These provisions are an important step in ensuring environmental protection in the oil and gas industry. However, implementing regulations are needed to ensure effective enforcement. For example, additional regulations are required to:

- (a) stipulate emission/effluent standards;
- (b) hold firms financially liable for environmental damage;
- (c) link oil and gas exploration or production license of a firm to its record of compliance with environmental quality and safety standards;
- (d) control hazardous waste management; and
- (e) to deal with emergencies such as an oil spill or a fire.

The MIME is preparing a Law on Petroleum Exploration and Development and this is expected to enhance the environmental protection requirements, including requiring firms to conduct environmental and social impacts assessment before conducting petroleum operations. Compliance with environmental obligations will be made a pre-condition for a firm's ability to produce and/or export oil and gas from Cambodia. The recently passed Environmental Protection and Natural Resource Management Law (1996) further enhances the regulatory regime for general pollution control, but because of the limited capacity of the relevant government agencies responsible for implementation, it is too early to determine the actual impacts of this law.

6.32 Weak Institutional Capacity. The MIME, is responsible for the development and implementation of policies and legislation for the energy sector. Because of its limited in-house capacity in environmental management planning and implementation, the Ministry has not been able to adequately address the environmental aspects of energy development in Cambodia. A similar constraint is faced by the MoE, which is responsible for the formulation of environmental policies, standards, and guidelines. The effectiveness of both Ministries has also been adversely affected by inadequate number of staff with training and experience in environmental management. Their limited budgetary allocations are also a major problem because they cover staff salaries, with relatively little left to purchase needed equipment or to pay for operational expenses. Therefore, both agencies lack the capacity to monitor and enforce environmental provisions, including operational standards in petroleum agreements and the prohibition on mineral exploitation and the use of explosives in protected areas.

### **Strategic Framework To Improve Environmental Management**

6.33 As noted earlier, management of biomass resources and the development of hydroelectric power and oil and gas potential in Cambodia are part of the Government's strategy to reduce the country's dependence on imported oil and to meet the expected increases in future energy demand. It is important that the country develop energy policy for both biomass and hydrocarbons that will deal with both supply and demand management. It is also necessary that steps are outlined in the energy policy to ensure that environmental and social impacts associated with such developments are adequately addressed before investment decisions are made. Building the capacity of the Government to make such an assessment would involve improving the environmental aspect of the present legal framework, and strengthening the capacity of the MIME and the MoE in environmental management. Steps are already being taken under the World Bank-supported Phnom Penh Power Rehabilitation Project to establish an Environmental

Unit within EDC, whose role will include the development and implementation of a strategy to minimize any of the adverse environmental impacts that may result from existing power stations.

6.34 Improving the Legal Regime. The Petroleum Regulation provides some safeguards against some of the adverse environmental and social impacts associated with oil and gas development. It requires firms to take necessary precautions to avoid contamination of natural habitats and, to the extent possible, to restore drilling sites to their original habitat when exploitation is completed. This regulation, and others such as the Royal Decree on Protected Areas and the Law on Environmental Protection and Natural Resource Management, however, cannot be effectively enforced without additional Sub-Decrees or Prakas (Regulations) which would define environmental quality standards, environmental assessment and monitoring requirements and procedures, and the protection of cultural or ecologically sensitive sites.

- (a) Regulations on Sectoral Environmental Impact Assessment (EIA)/Review, Monitoring and Implementation. Prospective investors should be required by law to include an EIA as part of an investment proposal on energy development they submit to the Cambodia Development Council (CDC) for approval. The project proposals should also outline a long-term environmental monitoring program that a firm would set up to track the impacts of its operations on the environment. Data from such a program would be submitted periodically to MIME and MoE. The two Ministries would review for the CDC, the EIAs and other environmental requirements associated with a proposed investment, such as oil spill contingency planning.
- (b) Regulations on Environmental Quality Standards. Regulations are needed to define environmental quality standards for the energy sector (and other economic activities that could have major adverse impacts on the environment). These standards should be limited to a relatively few key indicators which the Government can monitor in a cost-effective way. The validity of a firm's operating license should be linked to its environmental record.
- (c) Regulations on the Protection of Sites of Ecological and/or Cultural Importance. It is important that the Government enact legislation on the protection of conservation areas and other ecologically sensitive sites, as well as archeological and cultural sites, from damage by hydroelectric development or oil and gas exploration.
- (d) Regulations on Storage, Transportation and Marketing of Petroleum Products. Regulations on storage, including underground storage, and handling of petroleum products are needed to prevent or minimize adverse environmental impact.

6.35 Institutional Strengthening. The first step toward enhancing the capacity of the MoE and MIME is to clarify their respective roles regarding environmental management in the energy sector. It seems that the comparative advantage of the MIME is in environmental impact assessment and environmental management planning. The MoE would play a complementary role of reviewing and monitoring environmental impact assessment and taking the lead in

environmental quality (land, air, and water) monitoring in collaboration with MIME. Capacity building efforts, including training of staff and provision of equipment, should therefore aim at enhancing the different, but complementing roles of both Ministries. In addition, the role of the Department of Forestry in fuelwood management requires clarification, as responsibility has been delegated for the management of fuelwood but remains undefined.

### **Proposed Program to Enhance Environmental Management**

6.36 A proposed program to strengthen both the legal framework and the institutional capacity of the MIME and MoE is outlined in Table 5.

**Table 5. Proposed Program to Enhance Environmental Management in the Energy Sector**

<b>Component</b>	<b>Objective(s)</b>	<b>Activities to be supported</b>
<b>Phase I (Years 1-2)</b>		
Policy and Legal Framework	Enhance the policy legal framework to ensure that the environmental impacts of developing Cambodia's energy potential are prevented or minimized	<p>(i) Preparation of a national energy policy to address supply and demand, management and environmental and social issues. Preparation of standards on key environmental (land, air, water) quality monitoring parameters.</p> <p>(ii) Preparation of environmental and safety standards for energy sector industries</p> <p>(iii) Preparation of guidelines for prospective investors on sectoral environmental impact assessment, in-house environmental monitoring programs, and on oil spills/fire contingency planning.</p> <p>(iv) Preparation of legislation or regulations on the above standards and guidelines for approval by the Council of Ministers or Minister responsible for MIME.</p>
<b>Phase II (Years 3-5)</b>		
Biomass Management	Ensure sustainable use of biomass	<p>(i) Support sustainable utilization of designated forest areas for fuelwood.</p> <p>(ii) Implementation of community woodlot and agroforestry systems.</p> <p>(iii) Development and promotion of more efficient, affordable, and culturally appropriate energy for household and cottage industries.</p>
Capacity building (MoE)	Capacity building for the MoE in planning, reviewing and monitoring EIAs.	<p>(i) In-country and overseas practical training for the staff of MoE in environmental (land, water, air) quality monitoring.</p> <p>(ii) Preparation and implementation of protocols to monitor key environmental quality standards and safety standards in collaboration with MIME</p>

Component	Objective(s)	Activities to be supported
		<p>(iii) Establishment of a laboratory.</p> <p>(iv) Installation of a database system to store, manage and report relevant data such as ecologically sensitive sites in potential energy development areas, trends in key environmental quality parameters, etc. (This system would be linked to a similar one to be installed in MIME.)</p>
Capacity Building (MIME)	Capacity building for the MIME in sectoral EIA planning and implementation	<p>(i) In-country and overseas training for the staff of MIME in sectoral EIA; environmental management planning (including oil spill contingency planning, for the Mekong river, which is widely used for the transportation of petroleum products and later for coastal waters); environmental and safety monitoring, (including dam safety), and hazardous waste handling.</p> <p>(ii) Preparation of oil spill contingency plans</p> <p>(iii) Installation of a database system to store, manage, and report data on profile of energy industries (including environmental risks); records of firms' compliance with environmental and safety standards etc. (This system would be linked to a similar one proposed for MoE.)</p>

## 7. URBAN WASTE MANAGEMENT

7.1 Municipal waste disposal is one of the major environmental challenges facing cities in Cambodia, though the scale of the problem is relatively small compared with cities in most neighboring countries. Major cities in Cambodia have been experiencing a rapid increase in the volume of solid waste (mainly organic matter from residential, construction, and commercial sources), and “special waste” (toxic waste from small- and large-scale industries and from hospital and pharmaceutical facilities) since the civil war ended in 1991. The disposal of wastewater, including sewerage, is another emerging problem.

7.2 Phnom Penh, Siem Reap, and Sihanoukville are three cities with the potential for population increases of 40-50% by 2000 (Annex 6a) and significant economic activity, particularly in the industrial and tourism sectors. This expectation could worsen the problem of waste disposal in Phnom Penh, where the quantity of solid waste generated is projected to triple, from 464 tons/day in 1996 to 1,409 tons/per day, by 2010 because of significant increases in the city’s population and in the number of industries. Solid waste generated in Siem Reap and Sihanoukville is expected to remain relatively low, 47 tons and 43 tons respectively (Annex 6b).

### Key Issues Affecting Waste Management

#### Disposal of Solid Waste

7.3 Disposal Method. Solid waste generated in major cities in Cambodia comprise mostly of organic matter from residential, commercial and industrial sources, and from medical facilities. According to a waste survey in 1992, organic matter constitutes nearly 90% of the solid waste in Phnom Penh. Much of the solid waste is disposed of into open landfills; solid waste is also illegally dumped into vacant lots, swamps, waterways, and drainage canals, creating major public health and environmental problems.

7.4 One of the major risks associated with open dumps is the spread of disease pathogens and chemical contaminants. These dumps are accessible to waste pickers and to domestic animals that feed on garbage and they can spread disease pathogens and chemical contaminants to humans through the food chain. A second public health problem is air quality near the open dumps, which is adversely affected by burning and/or biodegradation of waste. People working or living close to the dumps, mostly the poor, are more susceptible to respiratory illness because of smoke generated from burning waste. In addition, gases associated with biodegradation within an open dump include benzene and vinyl chloride, both of which may be carcinogenic. The environmental impact of disposing solid waste in open and inappropriately sited dumps also include the contamination of soils, surface and groundwater by contaminated seepage and microorganisms from the dump site. As noted above, air quality in the vicinity of open dumps is typically poor because of pollution from the burning of waste and from dust generated from the dumping of garbage. There are no data on the extent of the public health and environmental impacts of the disposal of solid waste in open dumps in Cambodia.



7.5 Institutional Capacity. Until it was privatized in January 1996, the Waste Management Division of the Municipal Public Works and Transport Department was responsible for the collection and disposal of solid waste in Phnom Penh. The municipal government has granted a 50-year franchise to the Phnom Penh Clearing (PPC), a private firm, to collect solid waste. PPC pays \$24,000 a year to the city government (the rate is expected to increase 10% every five years). The firm provides vehicles and other equipment to three sub-franchisees which are directly responsible for the collection and disposal of waste. The sub-franchisees are also responsible for collecting user fees; they are assisted by neighborhood leaders, who receive a 10% commission on the fees collected. The role of the city government under the privatization scheme is to monitor the operations of the PPC and its sub-franchisees and to provide guidelines on user fees.

7.6 The privatization scheme has led to some improvements in solid waste collection in Phnom Penh. It is estimated that PPC (and its sub-franchisees) or Env (a private firm which took over after PPC collapsed) collect nearly 70% of the waste generated in the city; areas not covered because of insufficient hauling trucks continue to have piles of solid waste in creeks and vacant areas. The privatized approach also seems to be cost-effective for the city, but, perhaps, not for the firms. The two private firms have ceased operations, PPC in 1995 and Env in 1997 because of their operations were reportedly not profitable. While no data on the cost of waste disposal and collection in Phnom Penh and other cities exist, in many developing countries it constitutes about 30-60% of municipal revenues (World Bank 1991). Solid waste collection and disposal in Siem Reap and Sihanoukville continues to be the responsibility of the municipal governments.

## **Disposal of Special Waste**

7.7 Cambodia lacks the capacity to properly dispose of special waste such as hazardous industrial waste and medical wastes such as pathological wastes, syringes and bandages. These wastes are disposed of in open landfills and in public areas that are accessible to domestic animals, posing a major health risk to humans. Through the food chain, these animals could transfer pathogenic microorganisms and hazardous chemicals to humans.

7.8 The disposal of hazardous industrial waste is not a major public health or environmental problem nationwide. The problem is localized, mostly in Phnom Penh, because of the limited number of industries in other parts of Cambodia. Cambodia has about 200 large-scale industries and 4,000 small-scale or cottage industries, involved mostly in food processing (45% of the firms), textile manufacturing (25%), chemical industry (15%), and light industry (5%), and most of them are located in Phnom Penh.

7.9 The industrial sector, particularly the oil and gas and manufacturing sub-sectors, is expected to grow rapidly because it has been targeted by the Government to stimulate economic growth through industrialization. The Government provides generous incentives, including tax relief, to attract foreign investment and plans to develop a 1,100 ha. industrial estate in Stung Hav district of Sihanoukville, a major seaport. Rapid industrial growth would result in the generation of significantly more industrial waste, worsening the problem of waste disposal in a country that lacks appropriate waste treatment infrastructure.

## **Disposal of Wastewater**

7.10 In Cambodia, municipal wastewater disposal is primarily through a network of sewerage/drainage pipes (underground pipes and canals) that drain into retention basins known as Boengs. The wastewater in the retention basins is later pumped out into rivers and lakes. In Phnom Penh, for example, there is a network of sewerage/drainage pipes and nine pumping stations (only six stations are currently operational) covering the six main catchment areas: Boeng Trabek, Boeng Salang, Khmero Russian Hospital area, Daun Penh, New Front of Bassac, and Tuol Kork area.

7.11 There are several problems associated with the operation of the sewerage/drainage system in Phnom Penh and the other cities. Many of the pipes are dysfunctional because of lack of maintenance; many of them are clogged because of illegally dumped garbage and infrequent removal of silt. In addition, many of the pumping stations are not operational because of aging equipment, lack of spare parts, and an unreliable supply of electricity. The breakdown of the drainage system has increased the risk of flooding during the rainy season and overflows of wastewater into adjacent residential areas.

7.12 Institutional Capacity. The Ministry of Public Works and Transport and City Hall are responsible for the operation and maintenance of the drainage and sewerage infrastructure in Phnom Penh and other parts of Cambodia. However, inadequate technical capability and lack of equipment and spare parts have reduced the effectiveness of the Ministry.

## **Strategic Framework to Improve Waste Management**

7.13 The collection and disposal of solid waste and wastewater in major cities in Cambodia will continue to be a major problem confronting municipal governments because of the expected increase in urban population and growth in the industrial and tourism sectors. To avoid the major adverse public health and environmental impacts associated with inappropriate waste disposal, the Government should develop strategies to improve waste management, giving priority to Phnom Penh, Siem Reap and Sihanoukville--the three main potential economic growth centers. The framework aimed at improving waste management, outlined below, covers policy and regulatory issues, investments needed (including emergency civil works), and capacity building for government agencies involved in municipal waste management.

## **Policy and Regulatory Framework**

7.14 A review and update of the policy and regulatory framework will be an important first step in improving municipal waste management in Cambodia. Specific attention should be given to strengthening regulations on environmental and sanitation standards for residential and commercial waste disposal, and on pre-treatment of industrial and other special waste before disposal. In addition, the Government should develop policies and regulations to guide the privatization of waste collection and disposal. Apart from franchising, which is being implemented in Phnom Penh, other privatization arrangements the Government should consider include contracting, concessions and open competition.<sup>11</sup> Policies and regulations on the tariff

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<sup>11</sup> Contracting: The Government pays contractor (private firm) to provide solid waste management services for a fixed period of time.

structure should also be developed to ensure effective cost recovery, taking into account the socioeconomic status of different segments of urban populations.

## **Solid Waste Disposal**

7.15 Landfills. Improvements in solid waste management will require investments to upgrade existing open landfills to ensure that they meet adequate environmental and public health standards. It would also require the construction of sanitary landfills with at least a 10-year capacity to eventually replace the open landfills. Priority should be given to the construction of a sanitary landfill in Phnom Penh. The projected quantity of solid waste generated per day by Year 2010 in Siem Reap and Sihanoukville is relatively small (Annex 6b) and problems associated with waste disposal do not seem to be as urgent as in Phnom Penh. The advantages of a sanitary landfill include the collection and treatment of leachate to minimize the risk of soil and water contamination, and venting of gases that are produced by biodegradation of solid waste to reduce air pollution. Topographical, soil and geophysical surveys, and community consultations are necessary to ensure that suitable sites are selected. It is also important that public awareness programs are implemented to increase people's awareness of appropriate methods of solid waste disposal.

7.16 Composting and Recycling. There is the potential for wider use of compost in agriculture in Cambodia. Some farmers growing high-valued crops are already using 20-30 tons/ha of compost that they derive from their livestock and crop residues. However, because of the limited supply of animal manure, the price of compost in Cambodia is high, about \$48 per ton compared with \$5-12 per ton in Viet Nam (World Bank Mission Estimates, Infrastructure Rehabilitation Project, July 1996). To provide high-quality and affordable compost from municipal waste, a pilot low-cost compost facility should be established at the site selected for a sanitary landfill in Phnom Penh. Such a pilot facility would serve as a model for replication in other cities in Cambodia.

7.17 Recycling of waste at disposal sites, though desirable, does not appear to be feasible at present in Cambodia because there is very little waste with recycle value in the garbage that arrives at the dumps. Prior to collection, waste pickers collect recyclable material, mostly bottles (glass or plastic) and aluminum cans, and these are sold to local cottage industries.

7.18 Special Waste. The construction of a pilot medical waste disposal facility in Phnom Penh and training for medical staff will be important steps in ensuring proper handling of toxic medical waste in Cambodia. Proper disposal of waste would help minimize the risk of exposing people to the adverse public health and environmental hazards associated with inappropriate disposal of medical waste.

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Franchise: A private firm purchases a permit or license from the Government to provide exclusive services within a specific area. The revenues from user fees go to the firm.

Concession: The Government allows a private firm to process solid waste for profit -- for example, processing solid waste into compost. The Government typically guarantees the flow of waste to ensure optimum use of the processing facility.

Open Competition: The Government permits firms to provide solid waste management services, but unlike the franchise, no firm has monopoly over a particular area. The firms generate revenues from user fees, but there are no price regulations.

7.19 Appropriate treatment and disposal of hazardous industrial waste also requires significant improvement. Though the volume of toxic industrial waste being generated by industries in Cambodia is relatively small, it is important that the country build its capacity for waste management before the expected rapid expansion in the industrial sector occurs. Individual firms, depending on the types of waste generated, should be required to have on-site pre-treatment capability. In the case of firms located in an industrial park, such as the one planned for Sihanoukville, it would be more cost-effective for them to operate common waste treatment facilities. Therefore, provision for such treatment facilities should be incorporated into the design for this and future industrial parks at the planning stage. The Government should also establish environmental standards for industrial waste disposal. To ensure effective enforcement of these standards, the relevant government agencies, including the MoE and the MIME, should be strengthened to enable them to monitor environmental quality and enforce environmental quality standards.

7.20 Capacity Building for the Municipal Government. The Government has begun privatizing solid waste collection and disposal, beginning with Phnom Penh. Therefore no major capacity building efforts for municipal governments are anticipated except for strengthening municipal agencies in their oversight role. Institutional strengthening of municipal agencies would include training for technical staff and provision of equipment to ensure effective monitoring of the performance of private firms and operation of a tariff structure.

## **Wastewater**

7.21 Flood control and drainage. To improve wastewater management, the Government should give special attention to emergency infrastructure work to rehabilitate and upgrade the drainage network. Priority should be given to the following drainage infrastructure in the municipality of Phnom Penh, where the dilapidated drainage system has resulted in floods in many parts of the city during the rainy season: the Boeng Trabek main drainage canal and pumping station; Tuol Sen waterway and its projections; Boeng Salang retention basin, drainage channels, sluice gate and pumping station; Boeng Tumpun retention basin, pumping station and Mean Chhey channel; Tuol Kork retention basin, channel network, and pumping station; and the drainage channel for Mao Tse Toung boulevard.

7.22 Because of inadequate information on the drainage network and on options for rehabilitation and upgrading in Siem Reap and Sihanoukville, technical assistance should be provided to prepare a program to rehabilitate the drainage system in both cities.

7.23 Institutional Strengthening. As part of measures to improve the drainage system in the municipality of Phnom Penh, the technical skills of the staff of the Municipal Public Works and Transport Department should be upgraded through training. The Department's workshop should be rehabilitated, and adequate equipment and spare parts should be provided to ensure effective operation and maintenance of the drainage system.

7.24 Sewerage. Sewerage treatment and disposal is inadequate in Phnom Penh, Siem Reap, and Sihanoukville, but there is very little detailed information on the capacity of existing facilities, on the patterns of sewerage disposal by the population, and other factors significant to the development of a program for implementation. Therefore, technical assistance should be provided to help the Government identify priority issues and priority investments to upgrade

sewerage treatment and disposal in these cities. Such assistance should also help in the development of a program to raise public awareness on appropriate sewerage disposal methods.

### **Program To Enhance Solid Waste And Wastewater Management**

7.25 Based on the strategies outlined above, the following table (Table 6) outlined a proposed program, to improve waste management in major cities in Cambodia. The program focuses specifically on Phnom Penh, Siem Reap, and Sihanoukville.

**Table 6. Proposed Program to Improve Solid and Wastewater Management in Phnom Penh, Siem Reap, and Sihanoukville**

Component	Objective(s)	Activities to be Supported
<b>Phase I (Years 1-2)</b>		
Policy and regulatory framework	Develop an effective policy and regulatory framework on environmental and sanitation standards for waste disposal and for privatization of waste collection and disposal	<p>(i) Prepare for enactment by the Government environmental and sanitation standards for residential and commercial waste, special waste (including industrial and hospital waste), and industrial parks.</p> <p>(ii) Prepare a framework for the privatization of waste collection and disposal in major cities, including clarifying the roles of the Government and the private sector, and preparing guidelines on the structure of tariffs.</p>
<b>Phase II (Years 3-5)</b>		
Solid waste disposal	Improve the disposal of residential and commercial solid waste to minimize adverse public health and environmental impacts	<p>(i) Upgrade existing open dumps in Phnom Penh to reduce the risk of adverse public health and environmental impacts.</p> <p>(ii) Undertake topographic, soil and geophysical surveys, and community consultations to identify a potential site in Phnom Penh for a sanitary landfill.</p> <p>(iii) Construction of a sanitary landfill, with at least a 10-year capacity, which also has a pilot low-cost composting facility in Phnom Penh.</p> <p>(iv) Construction of a medical waste treatment facility in Phnom Penh.</p> <p>(v) Training for municipal staff in solid waste management and hospital staff in medical waste management.</p> <p>(vi) Public information campaign on appropriate waste disposal in Phnom Penh, Siem Reap, and Sihanoukville.</p>
Flood control and wastewater	(i) Undertake emergency works to rehabilitate the	(i) Rehabilitation/redesign of the following flood control and drainage systems in Phnom

Component	Objective(s)	Activities to be Supported
management	<p>drainage network in Phnom Penh</p> <p>(ii) Prepare a program to identify priority drainage works for Siem Reap and Sihanoukville</p> <p>(iii) Prepare a framework which outlines priority issues and actions to upgrade sewerage treatment and disposal in Phnom Penh, Siem Reap, and Sihanoukville</p>	<p>Penh:</p> <p>(a) Boeng Trabek: Main drainage canal and pumping station</p> <p>(b) Tuol Sen waterway and its projections</p> <p>(c) Boeng Salang: Sluice gate, pumping station, retention basin, and drainage channels</p> <p>(d) Boeng Tumpun: Retention basin, pumping station and Steung Mean Chhey channel</p> <p>(e) Tuol Kork: Retention basin, drainage network, and pumping station</p> <p>(f) Mao Tse Toung Boulevard drainage channel.</p> <p>(ii) Capacity building for the Municipal Drainage and Sewer Department, including staff training, and rehabilitation of mechanical and maintenance workshops.</p> <p>(iii) Technical assistance to identify priority drainage works for Siem Reap and Sihanoukville.</p> <p>(iv) Technical assistance to prepare a framework identifying priority actions for improving sewerage treatment and disposal in Phnom Penh, Siem Reap and Sihanoukville, including civil works and public awareness programs. The framework on sewerage would be integrated into other drainage-related activities to ensure complementarity.</p>

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