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JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

THE SOCIALIST REPUBLIC OF VIET NAM  
MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT

THE MASTER PLAN STUDY  
ON  
DONG NAI RIVER AND SURROUNDING BASINS  
WATER RESOURCES DEVELOPMENT

FINAL REPORT

VOLUME V

APPENDIX IV NATURAL ENVIRONMENT

AUGUST 1996

NIPPON KOEI CO., LTD., TOKYO JAPAN

This Report consists of

Volume I	Executive Summary	
Volume II	Main Report	
Volume III	Appendix I	Socio-economy and Institution
Volume IV	Appendix II	Topography and Geology
	Appendix III	Meteorology and Hydrology
Volume V	Appendix IV	Natural Environment
Volume VI	Appendix V	Hydropower Generation
Volume VII	Appendix VI	Agricultural Development and Irrigation
Volume VIII	Appendix VII	Domestic and Industrial Water Supply
Volume IX	Appendix VIII	Flood Mitigation and Urban Drainage
	Appendix IX	Salinity Intrusion
Volume X	Appendix X	Formulation of Master Plan
Volume XI	Data Book	



The cost estimate was based on the December 1995 price level and expressed in US\$ according to the exchange rate of US\$ 1.00 = Vietnamese Dong 11,014 = Japanese Yen 101.53 as of December 15, 1995.

## LIST OF ABBREVIATIONS

AFS	Agriculture and Forestry Service (PC)
CBMMA	Committee for Ethnic Minorities and Mountainous Areas
DCWSSS	Design Company for Water Supply and Sanitation System (HCMC-PC)
EA	Environment Assessment (Multi-lateral Lending Agencies)
ECSP	Evaluation Commission for State Projects
EIA	Environmental Impact Assessment
ENCO	Ho Chi Minh City Environmental Committee
EVN	<i>General Company of Electricity of Viet Nam (Abolished and renamed in November 1995 as Vietnamese Power Corporation)</i>
FIPI	Forest Inventory and Planning Institute (MOARD)
GCOP	Governmental Committee on Organization and Personnel
GDLA	General Department of Land Administration
GDMH	General Department of Meteorology & Hydrology
GOV	Government of Viet Nam
GSO	General Statistical Office
HCMC	Ho Chi Minh City
HEC	Ho Chi Minh Environment Committee (HCMC)
HIDC	Hydraulic Investigation and Design Company (MOARD)
HPC	Ho Chi Minh People's Committee (HCMC)
HSDC (or SDC)	Ho Chi Minh Sewerage and Drainage Company (HCMC)
HWSC (or WSC)	Ho Chi Minh Water Supply Company (HCMC)
IDD	Irrigation and Drainage Department (MOARD)
IEE	Initial Environmental Examination
IBR	Institute for Economic Research (HCMC-PC)
IHPH	Institute of Hygiene and Public Health (MOPH)
IM	Institute of Mines (MOID)
INVESCO	Investment Company for the Development of Water Sector (HCMC-PC/TUPWS)
IOE	Institute of Energy (MOID)
IURP	Institute of Urban and Rural Planning (HCMC-PC/Construction Service)
IWRE	Institute of Water Resources Economics (MOARD)
IWRP	Institute of Water Resources Planning (MOARD)
IWRR	Institute of Water Resources Research (MOARD)
JICA	Japan International Cooperation Agency (Japan)

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IURP	Institute of Urban and Rural Planning (HCMC-PC/Construction Service)
IWRE	Institute of Water Resources Economics (MOARD)
IWRP	Institute of Water Resources Planning (MOARD)
IWRR	Institute of Water Resources Research (MOARD)
JICA	Japan International Cooperation Agency (Japan)

<b>MOAFI</b>	<i>Ministry of Agriculture and Food Industry (Abolished and integrated into the new MOARD)</i>
<b>MOAP</b>	Ministry of Aquatic Products
<b>MOARD (New)</b>	Ministry of Agriculture and Rural Development (Created in October 1995 by the merger of the former Ministry of Water Resources, Ministry of Agriculture and Food Industry and Ministry of Forestry )
<b>MOC</b>	Ministry of Construction
<b>MOCI</b>	Ministry of Culture and Information
<b>MOD</b>	Ministry of Defence
<b>MOE</b>	<i>Ministry of Energy (Abolished and integrated into the new MOID)</i>
<b>MOET</b>	Ministry of Education and Training
<b>MOFI</b>	Ministry of Finance
<b>MOFO</b>	<i>Ministry of Forestry (Abolished and integrated into the new MOARD)</i>
<b>MOFA</b>	Ministry of Foreign Affairs
<b>MOHI</b>	<i>Ministry of Heavy Industry (Abolished and integrated into the new MOID)</i>
<b>MOID(New)</b>	Ministry of Industry (Created in November 1995 by the merger of the former Ministries of Heavy Industry, Light Industry and Energy)
<b>MOJ</b>	Ministry of Justice
<b>MOIT</b>	Ministry of Interior
<b>MOLI</b>	<i>Ministry of Light Industry (Abolished and integrated into the new MOID)</i>
<b>MOLWISA</b>	Ministry of Labour, War Invalids and Social Affairs
<b>MOPH</b>	Ministry of Public Health
<b>MOPI (New)</b>	Ministry of Planning and Investment (Formed from a merger of the former SPC and SCCI)
<b>MOSTE</b>	Ministry of Science, Technology and Environment
<b>MOTC</b>	Ministry of Transport and Communications
<b>MOT</b>	Ministry of Trade
<b>MOWR</b>	<i>Ministry of Water Resources (Abolished and integrated into the new MOARD)</i>
<b>MPAC</b>	Ministrial Project Appraisal Committee
<b>NEA</b>	National Environment Agency
<b>NGO</b>	Non-Governmental Organization
<b>NIAPP</b>	National Institute for Agricultural Planning and Projection
<b>NPAC</b>	National Project Appraisal Committee
<b>OECC</b>	Overseas Environmental Cooperation Centre
<b>OECF</b>	Overseas Economic Cooperation Fund (Japan)
<b>PC</b>	People's Committee (executive arm of the People's Council)



PCC	Power Construction Company (VPC)
PIDC	Power Investigation and Design Company (VPC)
PPC	Provincial People's Committee (City People's Committee = CPC)
SBV	State Bank of Viet Nam
SCCI	<i>State Committee for Cooperation and Investment (Abolished and integrated into the new MOPI)</i>
SFEZ (or SFEA)	Southern Focal Economic Zone (or Southern Focal Economic Area)
SIWRP	Sub-Institute of Water Resources Planning (MOARD-IWRP)
SIWRR	Southern Institute of Water Resources Research (MOARD)
SPC	<i>State Planning Committee (Abolished and integrated into the new MOPI)</i>
SRV	Socialist Republic of Viet Nam
UNDP	United Nations Development Programme
UNICEF	United Nations International Children's Education Fund
UNIDO	United Nations Industrial Development Agency
VPC (New)	Vietnam Power Corporation (the former General Company of Electricity of Viet Nam = EVN)
WASECO	Water and Sewerage Construction Company (MOC)
WB	World Bank
WHO	World Health Organization
WPMI (IWRPM)	Water Planning and Management Institute (MOARD)
WRD(or WRS)	Water Resources Department or Water Resource Service (PC)
WSC	Water Supply Company (under Construction Services of the PC)

Note: Abbreviations in *Italics* are no more existent (already abolished and integrated in November 1995).

## Measurements

### Length

mm	=	millimeter
cm	=	centimeter
m	=	meter
km	=	kilometer
ft	=	foot
yd	=	yard

### Area

cm <sup>2</sup>	=	square centimeter
m <sup>2</sup>	=	square meter
ha	=	hectare
km <sup>2</sup>	=	square kilometer

### Volume

cm <sup>3</sup>	=	cubic centimeter
l	=	litre
kl	=	kilolitre
m <sup>3</sup>	=	cubic meter

### Weight

g	=	gram
kg	=	kilogram
ton	=	metric ton

### Time

s	=	second
min	=	minute
h	=	hour
d	=	day
y	=	year

### Electric Measurements

V	=	Volt
A	=	Ampere
Hz	=	Hertz (cycle)
W	=	Watt
kW	=	kilowatt
MW	=	Megawatt
GW	=	Gigawatt

### Other Measures

%	=	percent
PS	=	horsepower
°	=	degree
10 <sup>3</sup>	=	thousand
10 <sup>6</sup>	=	million
10 <sup>9</sup>	=	billion

### Derived Measures

m <sup>3</sup> /s	=	cubic meter per second
kWh	=	Kilowatt hour
MWh	=	Megawatt hour
GWh	=	Gigawatt hour
kVA	=	kilovolt ampere

### Currencies

US\$	=	US Dollar
VND	=	Vietnamese Dong

**Volume V**

**Appendix IV**

**NATURAL ENVIRONMENT**



**APPENDIX IV**  
**Natural Environment**

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## ATTACHMENT

- A. List of Agencies and Persons Contacted Relating to Environmental Aspects of Dong Nai Basin Master Plan Study
- B. Review of Environmental Impact Assessment Registration in Viet Nam as Related to Dong Nai Basin Master Plan and Other Water Resource Projects
- C. Preliminary Evaluation of Effects of Dong Nai No. 8 on Nam Cat Tien National Park
- D. Socio-economic Profile for the Dak Plao Community

## REFERENCES



## NATURAL ENVIRONMENT AND RELATED ASPECTS

### 1. INTRODUCTION

The general objectives of this Appendix relating to the natural environment and related aspects are fourfold:

- a) To provide a basic indication of the existing environmental situation in the Study Area,
- b) To highlight the key environmental conservation and resource management issues associated with water resource development of the Dong Nai and surrounding river basins, and
- c) To preliminarily indicate some of the potential critical environmental impacts and issues which could be associated with individual water resource development projects under consideration.
- d) To carry out Initial Environmental Examination (IEE) for the projects, which are identified to cause significant negative impacts to the surrounding environment out of the selected master plan projects.

## 2. AVAILABILITY OF DATA

The UNDP report (VIE 93/G81) entitled "Strengthening National Capacities to Integrate Environment into Investment Planning and Public Policy Making in Viet Nam" states that "existing information on natural resources and environment is limited, fragmented, often conflicting and frequently unreliable" (UNDP, 1994). This is also a valid statement in respect of environmental related data pertaining to the Study Area. Data are of varying quantity and quality and appear to be related to specific topics of interest to the authorities directly concerned; research or natural resource administrative agencies, for example. Also much of the data is selectively held by agencies located in Ho Chi Minh City with limited baseline data relating to natural resources available at the provincial or district levels.

Furthermore, rapidly changing situations and fragmentation in respect of legalities and responsibilities for administering, controlling exploitation, protecting the natural resource base and implementing environmental controls result in additional constraints on the availability and reliability of data. There are, however among leading natural resource administrative agencies, a rapidly expanding awareness of environmental issues and the needs for related data improving the reliability of this data base (e.g. water, quality data monitoring data and its use in targeting or prosecuting illegal discharges).

Visits were made to the main agencies involved in environmental and natural resources administration for the Study Area and these included discussions on the availability of environmental data (refer to Attachment A).

Many of the actual EIA reports prepared to date relating to Southern Viet Nam have been for industrial projects and are documented in Vietnamese (EPC, pers comm.). Similarly, most of the existing environmental data base (e.g. forestry use data, reports, maps. ect.) are also in Vietnamese. Several environmental reports of direct relevance to water resources development in the Study Area have been prepared, but remain available with the parties directly concerned with report preparation or responsible for project implementation including, as examples only:

- a) Draft Report for Environmental Improvement Programme for Ho Chi Minh City (October 1994); an ADB funded project for HCM City Environmental Committee (ENCO),
- b) EIA (Post Evaluation Study) for Tri An reservoir being prepared for the then Ministry of Energy by the Environmental Protection Centre (EPC) to be completed in the year 1995,
- c) Background Environmental Status Reports for Selected Provinces in Southern Viet Nam including Dong Nai Provincial Environment Committees as prepared by EPC,
- d) Report on Environmental Monitoring Network for Ho Chi Minh City prepared by EPC in 1993/1994 and recently transferred to Ho Chi Minh City ENCO,

- e) Hydrobiological survey data (1992-1993) of the lower Dong Nai River basin (from Tri An Reservoir to Coastal Mangrove Areas including sampling at more than 400 sites for water quality, flora, fauna, benthos, fish ... ) prepared by Sub-Institute of Ecology and Biological Resources (SIEBR), and
- f) EIA report for Ham Thuan-Da Mi Reservoir Project prepared by Hanoi-based experts for JICA and the then Ministry of Energy.

National environmental regulations have only recently been approved (October, 1994), but these do not include provisions requiring the "public availability" of EIA Reports and related data.

### **3. SCOPE OF FINAL REPORT**

Water resources development projects, particularly dam and reservoir and irrigation projects, are recognised as having potential substantial environmental effects not only in respect of their directly affected project areas but also at the regional and sometimes national levels. This is particularly so in the case of a "master plan for basin development" such as this study. With the main rivers directly involved in the Study Area having their confluences in the vicinity of Ho Chi Minh City and discharging through the downstream delta system, the importance of environmental factors associated with extensive water resources development in these catchments is obvious. Furthermore substantial agroforestry, intensive agricultural and industrial development is ongoing or planned for the catchment areas included in the Study Area (e.g. Dong Nai province ranks third highest after Ho Chi Minh City and Hanoi in terms of investment proposed for industrial development in Viet Nam).

The main catchments involved in the Study Area and the respective provincial administration units are shown in Figure 3.1. The Study Area includes the entire areas of six (6) provinces and Ho Chi Minh City and parts of Lam Dong, Long An and Dac Lac provinces as listed in Table 3.1.

The environmental ecosystems involved in the Study Area range from high density urban areas in Ho Chi Minh City, through coastal mangroves to extensive areas of irrigated and upland rice cultivation, agroforestry plantation, rubber and coffee plantations, lowland river and swamps to undisturbed mountain evergreen forests included in national parks and nature and forest reserves.

This Final Report focuses on the main land use, environmental situations, potential issues and general impacts associated with the water resource sector and proposed development in the context of:

- a) Land Use and Forest Cover and Resources,
- b) Flora, Fauna and Biodiversity Values,
- c) Environmental Planning, Resources Management and Conservation Issues
  - Protected Areas and Management
  - Deforestation, Erosion and Sedimentation
  - Water Related Diseases
  - Reservoir and Watershed Management Issues,
- c) Environmental Legislation and Requirements, and
- e) Impacts and Water Resources Development on Natural and Social Environments.

Detailed descriptions and statistical data relating to the natural resources and their use are not provided due to difficulties in assembling a comprehensive data base from a variety of sources (i.e. three to four agencies are involved in some cases such as the Forestry Sector). Rather an overview of the resources and their current use and management issues relating to water resources planning and development are proposed. The final two Sections relate to environmental assessment and BIA requirements in the context of the main dam/reservoir projects proposed as the master plan projects of this study.

#### 4. LAND USE, FOREST COVER AND RESOURCES

Substantial changes in land use have occurred in Southern Viet Nam in recent years through the SVR Government's policy of decentralisation of agricultural production and marketing decisions to individual households. Since the year 1989 (i.e. following "Doi Moi"), land has been redistributed to individual families on a contract basis (i.e. 15-year tenure) with further progression to private land holdings proposed in recent changes in land policy.

Promotion of the VAC system based on garden (Vuon); pond (Ao) and animal husbandry (Chan nuoi) as the key basis for individual farm development has been beneficial in terms of both self-sufficiency and productivity increases, particularly in those resettlement programmes involving ethnic minorities.

The above reforms have resulted in significant increases in the extent of cultivated land in the past 10 to 15 years, particularly in Tay Ninh, Song Be and Dong Nai provinces. Present land use in the Study Area is indicated in Tables 3.1 and 4.1.

The actual extent of forestry land altered to other land use purposes in recent years is difficult to ascertain, but this is preliminarily indicated by the loss to deforestation. It is indicated that approximately 30 % of the forest cover of the Study Area was lost in the 1943 to 1991 period including over 240,000 ha or 11 % of the remaining forest cover in the 1973 to 1991 period (refer to Table 4.2). This is possibly an underestimate given the most recent interpretation of land use based on 1993 land use imagery (refer to Table 4.1). Likewise recent reports indicate further substantial losses to forest cover in areas such as Tay Ninh where it is estimated that "of the remaining 41 % (i.e. 41,000 ha); 24,000 ha is in deplorable condition" including only 4,000 ha of the Dau Tieng reservoir's 12,000 ha of (watershed) Protection Forest (Viet Nam News, 1994).

Extensive community and district forestry plantations have been developed by the various agencies of the Ministry of Agriculture and Rural development (then Ministry of Forestry) and the People's Committees at various administrative levels. Communal agroforestry programmes are widespread throughout the lower and middle reaches of the Dong Nai River basin with excellent examples of mixed use of *Eucalyptus camadulensis* and *Acacia magnium* plantations including integrated use for pulpwood, firewood (thinnings and refuse), poles and charcoal, being evident in the immediate surroundings of the Dong Nai River and around of Tri An reservoir.

Basic land use mapping at a scale of 1:250,000 as interpreted from 1993 Landsat Imagery by the Integrated Resources Mapping Centre (IRMC) has been obtained for the Study Area. This will be supplemented with more detailed land use mapping at 1:100,000 in selected areas covering potential damsites, reservoir areas and irrigation development areas. Further



descriptions, analyses and comments relating to deforestation and watershed management are outlined in subsequent Chapter 6.

## 5. FLORA, FAUNA AND BIODIVERSITY VALUES

### 5.1 Perspective

Historically, Viet Nam was considered to have eight (8) agro-ecological zones including the Northern Mountains, Northern Midlands, Red River Delta, North Central Highlands/Plateau, Eastern Nam Bo (or North East of Mekong) and Mekong Delta. Extensive parts of the upper catchment consisting of upper midland, highland and steep river valleys in the Study Area remain undisturbed, particularly in the Dong Nai and Be river catchments. These are, to a large extent, areas under the control of the Ministry of Agriculture and Rural Development, and include Production, Protection and Special Use Forests as noted below.

Over 40 % of Vietnamese recorded 7,000 floral species are endemics (i.e. occurring only in Viet Nam) with further new endemic species considered likely also to occur, particularly in wetland ecosystems since these have not been fully sampled. The country's fauna is also diverse with over 270 mammals, 800 birds, 180 reptiles, 80 amphibians, 2,500 fish and invertebrates (i.e. 2,000+ being marine species) and 5,500 insects having been identified. Considerable scientific interests exist in the country's flora and fauna particularly as a result of recent discoveries of new mammals (i.e. a small bovine (cattle like) animal (*Vu Quang ox-Pseudoryx spp.*) and a species of Giant Barking deer (*Muntiacus spp.*) in the highlands of central Viet Nam/Laos border area).

Habitat losses due to deforestation and uncontrolled exploitation of the country's fauna for subsistence by ethnic minorities and for sale locally as meat as well as exotic collection species, for delicacy purposes and for traditional medicine uses (e.g. tiger bones, bear paws ... ) have resulted in serious depletion of the nation's faunal resources. Some 350 endangered animals and plant species have been included in Viet Nam's Red Book including 28 % of its endemic mammals, 10 % of its birds and 21 % of its amphibians and reptiles according to the Biodiversity Action Plan for Viet Nam (BAP, 1994).

A considerable number of flora and fauna species including rare and endangered species are indicated to occur in the Study Area. Preliminary estimates of the number of animal species possibly associated with the Study Area and undisturbed project areas are included in Table 5.1. Similarly, a preliminary list of the main mammals considered likely to occur in the Study Area, mainly its undisturbed forests, is presented in Table 5.2.

More detailed research and field surveys relating to specific ecosystem types and/or project areas are required to confirm the actual flora, fauna and biodiversity associated with specific ecosystems and project affected areas. Such tasks would be undertaken during the preparation of individual project EIA's as required by the SRV Government and major lending agencies.

## 5.2 Flora Resources Status and Use in the Study Area

As with other parts of Viet Nam, vegetation in the Study Area is diverse but residual areas rich in diversity and continuity are diminishing rapidly. This applies throughout the Study Area but particularly to the highland areas of the upper Dong Nai and Be river catchments. With over 7,000 plants and 1,400 species of epiphytes, fungi and periphytes identified, the potential exists for hundreds of flora species to occur in undisturbed areas such as the inaccessible riverine ecosystems upstream of Dong Nai No. 6 Project and in the Can Dong Project area. Systematic inventories of such sites have not been completed, but data are available for projects such as Ham Thuan-Da Mi and for parts of the Cat Tien area.

Intrusions into remote areas for shifting cultivation, logging and exploitation of high quality woods (e.g. *Azelia spp.* and *Sindora spp.*), minor forest products (e.g. rattan, resins and natural fruit) and medicinal plants, are common in areas inhabited by minority ethnic groups (i.e. hilltribes such as Nung and Cho-ro in Dong Nai province, Xtieng in Song Be province and Lat and E-de in Dac Lac province).

Recent reports relating to required programmes for protecting the country's biodiversity indicate a serious lack of scientific data relating to wetland ecosystems; a diversity of which is associated with the rivers, reservoirs and estuaries in the Study Area. Of particular importance to these wetland ecosystems are the following:

- a) Determination of Protection Area status and requirements including buffer zones and preparation of detailed management plans and operational budgets for key inland wetland areas recently nominated for preservation (e.g. Cat Tien and Bien Lac) by IUCN/WWF (BAP, 1994).
- b) Planning and management including controls on clearing for aquaculture development of undisturbed mangrove forests of the Dong Nai/Vam Co delta areas and of the coastal lagoon ecosystems between Phan Thiet and Vung Tau and expansion of mangrove reclamation/revegetation projects in areas degraded through prawn aquaculture development.
- c) Long term ecological changes likely to occur due to alterations to regime, storage and diversion for irrigation and domestic/industry supply purpose and increasing pollution assimilation loads resulting from due to urban and industrial expansion in the Vung Tau-HCMC-Bien Hoa economic development triangle.

### 5.3 Forest Land Status and Use in the Study Area

The forestry organisation with the most concern relating to water resources development planning in the Study Area is the Forest Inventory and Planning Institute Sub-Institute II (FIPI-II) based in Ho Cho Minh City. The FIPI-II is directly responsible for inventorying and preparing management plans for all forest lands in the Southern 19 provinces from Ninh Thuan /Lam Dong through to the Mekong Delta. This includes most of the Study Area except for the Southwest quarter of Dac Lac province which is administered by the Forest Inventory Master Brigade III covering the Southern Central Highlands and Coastal Areas and based in Qui Nhon (Binh Ding province).

Many of the proposed dam/reservoir projects are located within or in proximity to MOARD administered lands. The current status of all forest lands in the Study Area and their respective management objectives and plans are key issues affecting water resource project development priorities, potential environmental impacts and watershed protection. It is also noted that several important Special Use Forests (SUF) for national parks, nature reserves and scenic and cultural sites are located in vicinity vegetation of ongoing and proposed dam/reservoir projects within the Study Area. Some of these reserves are of significance to wildlife and biodiversity protection and conservation interests at the national level. A request for detailed data on the location, extent, purposes and status of management plans for all three types of forest lands within the Study Area has been initiated and more complete documentation relating to these aspects is given as part of discussions on the master plan projects.

The following preliminary information is presented to indicate the present situation, further requirements for analysis and potential resources allocation/environmental issues associated with the proposed projects currently under consideration for inclusion in the Master Plan for water resources development. These data and opinions will be refined in subsequent analysis and reports in the context of particular projects and basin development planning requirements (e.g. watershed protection and management).

Documented land use for forest cover as given in Table 4.2 does not represent all forest land administered by MOARD which, in summary, includes:

- a) Production Forests - including MOARD, provincial, district and communal enterprise managed forest, administered settlement programmes (e.g. under the Fixed Cultivation and Sedentarization Programme involving ethnic minority groups) and non-forested land (i.e. wastelands including categories such as barren land, and bush grass lands which account for almost 25 % of the land areas (refere to Table 4.2) in the Study Area,
- b) Protection Forests - including those surrounding reservoirs; with management plans having already been prepared for the Da Nhim, Tri An, Dau Tieng and Thac Mo projects

within the Study Area; some of which are being degraded (e.g. Dau Tieng area) by illegal deforestation activities, and

- c) Special Use Forests - including national parks, nature reserves and scenic and cultural sites of which there are more than 15 in the Study Area with a total area exceeding 250,000 ha and additional areas including Wetland Reserves now proposed (refer to Tables 5.3 and 5.4, respectively).

The location of all Special Use Forest areas relative to the projects being considered in this master plan study is mapped as part of Initial Environmental Examination for the master plan projects. Discussions with FIPI-II representatives indicate that basic management plans for the key Special Use Forest such as Cat Tien National Park, Bu Gia Map, Lo Go Mat and Duc Linh/Thanh Linh/Bien Lac Nature Reserves and the Da Lat Scenic Site have been prepared. Confirmation of the status and objectives of the management plans for key reserves which could be directly or indirectly affected by water resources development projects was sought from FIPI-II for environmental assessment of the individual projects.

#### 5.4 Wildlife Habitat and Resources in the Study Area

The Study Area has a diversity of wildlife habitats ranging from undisturbed midland and upland primary forests to extensive grass and herbaceous scrub (barren areas) including some excellent inland and coastal wetlands. It is probable that virtually the complete range of main mammals as listed in Table 5.2 occurs somewhere in the Study Area, except possibly the endangered species Kouprey (*Bos sauveli*).

Of particular importance in respect of the wildlife habitat and resources relating to proposed water resources developments in the various basins are the following aspects:

- a) Projects in the lower and middle reaches such as Dong Nai No. 6 and 8 projects particularly and to a lesser extent Ta Pao/La Nga No. 3 and Phuoc Hoa projects would cause further losses in the limited extent of lowland riverine habitat remaining in the Study Area; this aspect requires confirmation.
- b) Dong Nai No. 6 project and probably Dong Nai No. 5 project as well as Ta Pao/La Nga No. 3 with diversions to irrigation could have adverse effects in wetland habitats located downstream (i.e. riverbased swamps) of the Cat Tien and Bien Lac areas which are important in respect of endangered species such as freshwater crocodile and rare birds such as cranes, storks and ducks known to inhabit and use these areas for breeding purposes and as winter refuges for migratory waterfowl and other bird species.

- c) Upstream projects such as Dong Nai No. 1, 2, 3 and 4, Can Dong, Luy and Da Den would all cause losses in undisturbed forest habitat and have localised effects on selected species such as primates, mouse deer, smaller cats and civets and otters, both through actual habitat losses and barrier effects of the reservoirs on local movement through home ranges of such species.
- d) Most proposed reservoir areas are relatively small except for Fu Mieng (70 km<sup>2</sup>), Dong Nai No. 6 (77km<sup>2</sup>) and Dong Nai No. 8 (120km<sup>2</sup>), so their potential effects on larger endangered or rare species such as Elephant, Tiger, Panther, Clouded leopard and Sun bears are likely to be minimal but this needs to be confirmed in field surveys of EIAs for individual projects.
- e) There is some risk that selected local populations of rare or endangered species could occur in areas to be inundated by certain projects and this would relate to species such as Douc langur, Francois langur, Small clawed otter, Pygmy loris and smaller mammals and reptiles including Golden river tortoises.

Additional and more specific comments relating to the distribution of wildlife habitat and resources relevant to particular areas and projects, potential effects on rare or endangered species and possible mitigating actions are included in the Initial Environmental Examination of the proposed master plan projects.

### **5.5 Aquatic Ecology and Fisheries in the Study Area**

Based on discussions with representatives of the EPC, SIEBR and the Ministry of Fishery's-Research Institute for Aquaculture No. 2 (RIA2), there is indicated to be substantial site specific data available (in Vietnamese) relating to river and reservoir aquatic ecology and fisheries. This apparently includes occasional field surveys of hydrobiological aspects including water quality, plankton and benthos as well as those for crustaceans and fish resources. But virtually no long term or consistent location/technique type sampling of aquatic resources or collecting of water quality monitoring data has undertaken at any river or reservoir sites in the Study Area.

In conjunction with water resources developments, it is indicated that baseline surveys of water quality, aquatic flora, plankton, benthos and fish resources have been completed for Tri An and Dau Tieng reservoirs and for the existing riverine systems at Ham Thuan dams site (La Nga River) and Cat Tien wetlands (Dong Nai River). There appears to be major data gaps in respect of the riverine and reservoir fisheries located at higher elevations in the upper Dong Nai River catchment such as in the Dong Nai No. 4 project area (EL 360 m) and further upstream

including Da Nhim and Ankroet reservoirs and in the smaller coastal catchments such as Luy, Quao/Koi Ty, Dinh, Ray and Xoai rivers.

Basically, the river fish species are similar to those of the lower Mekong system with species distribution and productivity being controlled by river elevation and hence water temperature, flood regime and water quality. As elsewhere in Southeast Asia the main riverine and estuarine fish species would be dominated by the Cyprinids (Carp); Bagridae and Siluridae (Catfishes) and the universal predators Snakehead (*Ophiocephalus spp.*) in the river sections and Seabass (*Lates calicifer*) in the estuarine zones. Analyses of data available on fish distribution in the lower/central Mekong River basin indicate Cyprinids to account for 35 to 45 % of species present (pers. data source).

Similarly, the above indicated species tend to dominate the bigger fish species found in Southeast Asian reservoirs. A comparative list of fish species for various rivers, river sectors and estuarine zones and reservoirs needs to be prepared when all the relevant data are available from the EIA's for the reservoir and various industrial projects and other research projects. A preliminary list of the main freshwater and estuarine species is included in Table 5.5 as an interim indication only.

## 5.6 Aquatic Resources Industries and Development

Development of aquatic resources and associated production requires careful assessment; particularly in the context of river basin water resources planning and management. River-based fisheries are seasonally and locally oriented with little hard data available. Circumstantial evidence from Viet Nam and elsewhere in Southeast Asia indicates evidence of detrimental effects of dam projects on several Cyprinid and Catfish species utilising flood plains for breeding, particularly in downstream sectors.

Replacement and increased fisheries resources in man-made reservoirs can be substantial but require detailed planning and management inputs as mitigating measures for specific dam/reservoir projects. These plans need to be based on ecological assessments during and immediately following the impoundment of reservoirs to determine and implement effective reservoir fisheries development programmes. These programmes should include hatchery development, stocking programmes, sampling and extension services for open water capture and cage-culture fishery development and setting up of fishermen's co-operatives for development loans and marketing. Reservoir fisheries must be integrated into local, district and regional development plans both for water resources and economic expansion.

To date in the Dong Nai River and surrounding river basins, water quality monitoring has focussed on Ho Chi Minh City in the context of urban and industrial wastewater disposal and associated pollution problems. The water quality monitoring parameters and the sampling locations will need to be extended in the long term to provide additional ecological related data relating to waters used for natural fisheries or aquaculture production. This is particularly so for the estuary/coastal zone aquaculture downstream of or located within the Vung Tau/Ho Chi Minh City/Bien Hoa economic triangle zone.

Presently, riverine and reservoir fishery industries are only adversely affected locally by water pollution, with the main locations including:

- a) Ho Chi Minh City and the immediate downstream estuarine zone due to urban and industrial wastewaters, and
- b) Tri An reservoir in the immediate proximity of the highway bridge due to a high concentration of cage culture (i.e. eutrophication due to excessive use of fertilizers) and indiscriminate waste disposal (i.e. deoxygenated wastewater from the sugarmill and garbage from local communities).

Aquaculture is now the dominant source of fish and crustacean production (i.e. prawns and crabs) in the freshwater and estuarine waters of the Study Area. Grass, Silver, Bighead and Common Carp species are all raised using cage culture in Tri An and Dau Tieng reservoirs. Tiger prawns (*Penaeus monodon*), White/Banana prawns (*P.indicus*) and some Seabass are raised in ponds in the estuarine zones. Most of these ponds are located southeast from Nha Be to Vung Tau in former mangrove areas converted to aquaculture ponds and are supplied from a modern prawn hatchery located near Vung Tau.

The main problems relating to fish resources and production in the Study Area relate to the following:

- a) Over-exploitation of all natural open water fisheries by both subsistence and commercial fishermen,
- b) Loss of main natural breeding habitat for Giant freshwater prawn (*Macrobrachium rosenbergii*) through barrier effects of Tri An reservoir on the lower Dong Nai River,
- c) Unnecessary destruction of mangrove forests for prawn culture by poorly financed and non-professional enterprises (i.e. prawn and seabass culture requires sophisticated aquaculture management),
- d) Deterioration of reservoir cage culture productivity associated with water quality problems and disease (e.g. eutrophication due to poor management and chemical stratification in the Tri An reservoir), and



- e) Acid water and salinity intrusion problems associated with large scale changes in land and water use (i.e. irrigation development) in the East Vam Co River and West Vam Co River systems.

Preliminary comments relating to inputs on fisheries are outlined in subsequent Sections 8.2 and 8.3 and Table 8.1, and suggestions relating to reservoir fisheries management requirements are indicated in Section 8.5.

## **6. KEY ENVIRONMENTAL PLANNING, RESOURCE MANAGEMENT AND CONSERVATION ISSUES**

### **6.1 Perspective**

There are several inter-related environmental planning, resource management and conservation issues which are of direct concern to water resources planning and development in the Study Area. Of particular importance at the early planning and prioritising of projects are the issues relating to:

- a) Potential conflicts between projects and established or proposed Protected Areas or biodiversity/conservation reserves,
- b) Deforestation and associated erosion and sedimentation problems; particularly in the context of catchment (watershed) management for protecting reservoir and water supply sources for industrial, municipal and domestic (IMD) purposes,
- c) Water quality degradation, management and monitoring; particularly in relation to factors such as urban and industrial discharges and drainage; contamination of supply sources including groundwater in urban/industrial zones; salinity intrusions and pollution assimilative capacities requirements including those of the estuarine zones, and
- d) General public health situations throughout the Study Area but most particularly in respect of water-related diseases such as malaria and waterborne gastro-intestinal infections.

For basin-wide planning and development of water resources the linkages with and needs for multiple-objective resource planning administration and management are most important. For example, controls for shifting cultivation, agroforestry development, legitimate logging of production forests and agricultural based sedentarization programmes are all integral components of watershed management requirements. Most of the recent reports focussing on environmental legislation and management by aid agencies (e.g. WB, UNDP, and SIDA) and NGO's (e.g. IUCN, WWF) indicate that coordinated and integrated approaches to environmental and resource management are lacking at all administrative levels in Viet Nam. Institutional strengthening in this respect is required for the efficient planning development and management of the Study Area's water resources.

With a present population exceeding 11.6 million and with an average population density of 230 plus per km<sup>2</sup>, the Study Area faces environmental management problems directly resulting from population pressure on its natural resource base and increasing urbanisation and intensification of industrial development, particularly in the Vung Tau/Ho Chi Minh City/Bien Hoa "economic zone". This is reflected in continued deforestation, decreasing fish stocks and productivity, water quality degradation and over-exploitation of wildlife despite SRV laws,

decrees, regulations and ministry policies and guidelines invoking controls and prevention of such activities. Again considerable institutional strengthening of all natural resource and environmental protection agencies at the appropriate levels and in specific areas of conservation interest is required.

This Chapter preliminarily outlines some of the environmental planning, resource management and conservation issues in the Study Area.

## 6.2 Protected Areas and Management

As of the year 1992, there were 87 Protected Areas (PA) or Special Use Forests (SUF) covering about 3 % of Viet Nam's land area or about 993,000 ha. Recent assistance to the SRV Ministry of Agriculture and Rural Development by conservation-oriented NGO's, particularly the IUCN, has recommended expansion and consolidation of Protected Areas into a more representative system covering Viet Nam's natural resource base and diversity and to include at least 2 million ha covering approximately 6 % of the country. There is considerable international interest in the environmental and conservation situation in Viet Nam by NGO's such as IUCN and World Wildlife Fund (WWF) and major aid and lending agencies such as World Bank (WB), Asian Development Bank (ADB), UNDP, UNEP and bilateral assistance agencies (e.g. Overseas Environmental Cooperation Centre (OECC); SIDA and AIDAB).

A preliminary list of the Protected Areas located within the Study Area including general comment relating to specific proposed projects is presented in Table 8.1.

The most important factors evident at this time relating to Special Use Forest or Protected Areas and their management and water resource developments recommended as "priority projects" include:

- a) The middle and upper parts of the Dong Nai River and Be River catchments have residual forested areas including designated Protected Areas which are key components of the country's representative ecosystems and biodiversity.
- b) Specific designated Protected Areas such as the Nam Bai/Bat Tien/Bai Cat Tien National Park are considered internationally significant (e.g. as proposed Man and the Biosphere (MAB) Reserves) and could be critical habitat for preservation of some water-related endangered fauna in Viet Nam (e.g. freshwater crocodile, otters, selected birds (White-winged duck, cranes and stork) and tortoises).
- c) There is considerable overlap of areas designated for Protected Areas for different purposes (e.g. Bien Lac and Cat Tien swamps are designated as both "wetland reserves"

and "forest reserves"), but these allocations will be sorted out during rationalisation of the revised Special Use Forest or Protected Area system by the Forest Inventory and Planning Institute (FIPI) and the Ministry of Agriculture and Regional Development in conjunction with their international NGO advisers on wildlife and conservation issues.

- d) There is a lack of a consolidated data base relating Protected Areas and their overall significance to Viet Nam and to the Dong Nai, Be/Saigon, Vam Co and coastal river basins, with information being largely specific to particular areas of varying reliability and of very limited extent relating to areas to be affected by priority projects for reservoir and irrigation development.
- e) Previously constructed reservoirs such as Da Nhim, Tri An and Dau Tieng are included in the Biodiversity Action Plan's proposed Wetland Reserve programme.

Wetland ecosystems in Viet Nam contain at least 30 genera of flora due to the presence of the Mekong Delta and inland riverine swamps and are indicated as having a greater biodiversity than those of other Southeast Asia ecosystems (e.g. Thailand (24 genera) and Philippines (19 genera)). Of particular ecological and economic value are the *Melaleuca leucadendron* or "tram" forests (acid coastal and Mekong Delta swamps); coastal mangroves (*Rhizophora, asclata* or "duoc"; *Avicennia alba* or "nam quan" and *A.intermedia* or "nam den") and the tidal zone river fringing plant *Nipa fruticans* or "dua nuoc". Likewise there are several rare or endangered wildlife species associated with these wetlands.

A comprehensive system of Wetland Reserves has been proposed to the then Ministry of Forestry by the IUCN. This includes 10 wetlands including two lowland reservoirs (Tri An and Dau Tieng) and two highland reservoirs, Da Nhim (Don Duong Lake) and Ankroet (Dan Kia Lake), in the Da Lat area (refer to Table 5.4).

Additional data relating to the fauna and flora of existing and proposed Protected Areas, the Study Area in general and the priority project areas were sought from the FIPI. This is used to delineate and assess any conflicts between existing and proposed Protection Areas and master plan projects for water resource development in the Study Area.

### 6.3 Deforestation, Erosion and Sedimentation

Deforestation in Viet Nam between the year 1943 and 1991 resulted in a reduction of forested area from 67 to 29 %. A similar loss from 69 to 29 % is indicated to have occurred in the Study Area (refer to Table 4.2). More significantly from the biodiversity sustainability viewpoint are the losses in moist (evergreen) forests with the remaining area indicated to be

20 % or less. Similarly losses in lowland riverine habitats in the Study Area have been serious and detrimental to regional ecology and wildlife resources.

Deforestation has resulted from several activities including:

- a) Removal of forest cover for agricultural land development based on irrigation (lowland area); shifting cultivation (highland area) and the tree crops at varying elevations (e.g. rubber, cashews, coffee, tea),
- b) Logging, both legal and illegal with some controls, puts into law and regulation in the year 1989, remaining ineffective against continued cutting for firewood and fuelwood as well as against taking of selected valuable species (e.g. rosewood) and local timber production.
- c) Destruction of forests by spraying of defoliants, broadscale clearing and burning during the Viet Nam war (1968-1975) including substantial areas in parts of Tay Ninh, Song Be and western Dac Lac provinces close to the Cambodian border, and
- d) Fires particularly in the peat swamp area between the East Vam Co and West Vam Co rivers and in the pine forests in the Dalat area.

Data analysis for the Tropical Forest Action Plan (TFAP) indicated an annual breakdown of the deforestation for the northeast of Mekong zone (most of the Study Area) as follows (TFAP, 1991):

- Shifting cultivation	- 3,000 ha (5 %)
- Firewood and charcoal	- 32,000 ha (54 %)
- Logging/timber production	- 13,000 ha (22 %)
- Fire damage	- 11,000 ha (19 %)
Total	- 59,000 ha.

The dominance of deforestation for fuel (firewood and charcoal) in the Study Area is further shown in Table 6.1 which indicates the northeast of Mekong zone being responsible for 15 % of Viet Nam's firewood and 40 % of its charcoal consumption. Since a large component of this is for urban areas, particularly Ho Chi Minh City, forests areas of Song Be, Tay Ninh and Dong Nai province are in effect being deforested for supply of fuel to urban areas. The above figures reflect an untenable situation in terms of forest resource sustainability on a long term basis for the Study Area.

Deforestation is also directly linked to erosion problem and indirectly to sedimentation transport in local rivers which are of direct concern to proposed reservoir projects. Erosion rates from upland rice growing areas for Viet Nam have been estimated as follows:

- 100-150 tonnes/ha/year for land slopes of 5-6 %
- 250-300 tonnes/ha/year for land slopes of 15-20 %
- 350 tonnes/ha/year for land slopes >30 %.

Most of the uplands in the Study Area considered susceptible to erosion have been designated as Class 1 or least susceptible to erosion (289 km<sup>2</sup>) out of a total area of 48,500 km<sup>2</sup> or about 0.6 % of the area. Only about 114 km<sup>2</sup> or 0.2 % of the Study Area land is classified as being Class 3 or 4 in terms of susceptibility to erosion.

There are indicated problems of excessive erosion and sedimentation in the Dau Tieng reservoir catchment, which are associated with deforestation of both natural and afforested areas which are parts of declared Protection Forests. The extent and implications of this situation require confirmation; particularly if it is a result of post-project intrusion for cutting of firewood due to access provided by the reservoir project itself.

No comprehensive assessment of sediment transport is available for the various sectors of the rivers which would be involved in water resources developments for the Master Plan. Further analysis of the implication of deforestation and resultant erosion and sedimentation in respect of the main sectors of the catchments involved in the recommended projects for the Master Plan is discussed as part of their Initial Environmental Examination.

#### **6.4 Reservoir and Watershed Management Issues**

The issue of watershed reservoir management in the Study Area is integrally linked and is complicated by the fact that many of the boundaries between provinces follow the main rivers. For example the Dong Nai River is the boundary between Dong Nai and Dac Lac and Song Be provinces in vicinity of the Dong Nai No. 3, 4, 5 and 6 projects (refer to Figure 3.1). Responsibility for management of key resources such as forestry is on a provincial basis, so a comprehensive watershed management plan could require the cooperation of three or four Provincial Forestry Departments and 10 to 12 District People's Committees. Likewise the controls on non-forestry land use in any reservoir's catchment area could be divided among a similar number (or more) of provincial or district authorities and state enterprises.

Due to the above situation, controls on deforestation and remedial measures for controlling erosion and sedimentation would need to be planned and implemented involving numerous agencies. Consequently, the planning, programming and budgeting for watershed management programmes would need to be completed and to be included as an integral part of project planning, programming and budgeting. This would probably require an annual allocation from

project revenue from electricity generation in order to effectively implement watershed management requirements over the long term.

Provisions under the policies of the Ministry of Agriculture and Rural Development relating to Protection Forests and leasing of Production Forest for private establishment, maintenance and scheduled harvesting would also need to be considered in the preparation of watershed management plans for any individual or a series of reservoir projects. Similarly, some proportion of any watershed management budget should be allocated for the "protection roles" of Special Use Forests such as National Parks and Nature Reserves included in any specific watershed management plan.

With the progress being made in Viet Nam in respect of assigning Forestry Department controlled land to individuals on a long term lease basis (i.e. 10 to 15 ha/household), there should be good opportunities for implementing effective watershed management programmes in the long term. The opportunity for reforestation of natural forest areas as an integral part of watershed management plans should also be possible if properly planned and negotiated with Forestry Department through the Forestry Inventory and Planning Institute (FIPI). Subsequent Section 8.5 is a preliminary assessment of the reservoir and watershed management issues in the context of Dong Nai River basin developments. Further details and recommendations relating to reservoir and watershed management for the reservoir catchments of the master plan projects requiring specific protection or mitigating measures are also included as part of Initial Environmental Examination.

## **6.5 Water Related Diseases and Associated Issues**

### **6.5.1 Perspective**

The situation in respect of responsibilities and data for various aspects of public health at the provincial and district levels is difficult to obtain and summarise. Based on discussions with the senior officials of the Institute of Hygiene and Public Health (IHPH) in Ho Chi Minh City (HCMC) who are responsible for the southern provinces, the general situation is as follows:

- a) The IHPH in HCMC is responsible for water related hygiene and public health programmes including monitoring and statistical data collection for 27 provinces including all of the Study Area.
- b) The Sub-Institute of Malaria undertakes epidemiology and vector control programmes relating to malaria, and the Pasteur Institute undertakes research and epidemiology studies relating to other communicable diseases.

- c) Malaria problems are particularly severe in the provinces of Song Be and Long An and to a lesser extent in the mountain areas bordering Cambodia due to lack of vector control programmes in these areas in recent years.
- d) Plague, which is not a water related disease but which has rats as the intermediate hosts, is a problem disease in Bien Hoa due to poor waste disposal and sanitation practices.
- e) Water-borne gastrointestinal diseases such as diarrhea, dysentery, typhoid, etc. are common throughout the region being associated with poor sanitation, both at the community and the personal levels.
- f) Malaria and dengue haemorrhagic fever (DHF) are widespread, and local epidemics relate mainly to seasonal and ecological conditions (i.e. availability of suitable mosquito breeding habitat).
- g) Other water related tropical diseases such as Japanese B encephalitis occurrences in the Study Area relate primarily to cases imported from outside the Study Area.

Assistance to the Public Health sector in Viet Nam since the year 1985 has largely been initiated through UNICEF and WHO with the assistance of SIDA, and has focused on:

- a) Expanded Immunisation Programme (EIP) for infants with effective coverage now exceeding 90 %,
- b) Maternal and Child Health Programme (MCP) focusing on controls on diarrhoeal disease (CDD), malnutrition and acute respiration infection (ARI),
- c) Improvements to community water supply systems, and
- d) Population and family planning programmes.

The six main diseases causing hospitalisation in the Study Area in descending order of frequency are malaria; diarrhoea/gastro-intestinal infection; acute respiration infection, dengue haemorrhagic fever (DHF), eye infection and tuberculosis. Local morbidity rates are of the order of 4,300/100,000 population with non-hospitalised infection rates being much higher. Most of these diseases are either directly or indirectly related to water availability or supply, sanitation and/or hygiene factors at the community, family and personal levels.

Most of the country's malaria problems in recent years have occurred in southern Viet Nam and are related to a number of factors including increasing resistance of the *Plasmodium falciparum* parasite to chloroquine, reduced mosquito vector control programmes and complications due to factors such as land clearing and resettlement projects and persons returning from infected areas such as Cambodia. A 2 to 3 times increase in confirmed and severe cases of malaria occurred nationwide in the 1985 to 1989 period with a 3:1 ratio of *P.*



*falciparum* to *P. vivax* infections. The total number of deaths in the year 1989 from malaria was reported as 3,439 but the actual figure was probably higher due to non-reporting of malarial induced deaths in remote areas (World Bank 1994).

Data relating to the incidence and occurrence of various other water-related diseases are not readily available (in English). Specific requests for data relevant to respective projects can be made through the IBPH.

#### 6.5.2 Implication to Basin Planning and Development

A number of the factors in respect of water-borne and water-related diseases and their implications to water resource development in the Study Area are evident. These include:

- a) Need to include medico-ecological baseline surveys as part of any EIAs required for major dam/reservoir, irrigation, drainage improvement and urban development projects included in the Master Plan,
- b) Need to integrate community water supply and sanitation considerations in respect of all water development proposals, particularly those involving increases in intensity of land use (e.g. irrigation or industrial estate development); resettlement/urban expansion programmes and those causing a alternation to regime and the availability of water downstream.
- c) Need to integrate medico-ecological screening and disease prevention and control programmes as part of all dam/reservoir projects involving major construction workers forces and camps (e.g. possible importation of worker from outside the project area into areas where malaria is endemic).
- d) Need to provide the ways and means (i.e. realistic programmes and budgets) for monitoring of medico-ecological aspects associated with major water resource development projects such as those involving dams/reservoirs, irrigation and drainage components.

## 7. ENVIRONMENTAL LEGISLATION AND REQUIREMENTS

Within the Study Area, the following provincial level authorities have issued environmental regulations and standards relating to air emissions from various sources (e.g. group of industries and vehicles); ambient air quality and noise levels and wastewater discharges:

- Ho Chi Minh City, (15 May 1993)
- Dong Nai province
- Tay Ninh province
- Ba Ria-Vung Tau province.

The "Regulations on Environmental Pollution Control in Ho Chi Minh City" are available in English and the "Permissible Limits for Trade Effluents" from these regulations are included in their Appendix IX. Copies of similar regulations from other authorities are in Vietnamese and have not yet been obtained, translated or reviewed but are understood to be similar to those for HCM City.

National environmental legislation entitled "Law on Environmental Protection" consisting of some 55 Articles was passed by the SRV National Assembly during its 9th session (6 to 30 December, 1993). A copy of this Environmental Law is available and has been reviewed. The national basic "Implementing Regulations for Environmental Law (Decree No 175/CP)" were passed by the National Assembly on 18 October, 1994. A copy of these regulations has been obtained during Phase II and the following items are included (VIR, 1994):

- a) Guidelines outlining the types of projects requiring Environmental Impact Assessment Reports (EIAR) to be prepared, submitted and approved prior to project implementation,
- b) Guidelines as to the contents to be included in Preliminary EIARs and Detailed EIARs,
- c) Air emission and noise standards relating to all new vehicles,
- d) Rules applicable to the importation of second hand industrial plants, or parts thereof,
- e) Definition of industries which are required to contribute (i.e. taxes) for operation of an "Environmental Protection" fund, and
- f) Provisions for devising and implementing pollution control (environmental) standards applicable to specific areas and/or groups of industries.

Of particular interest to the Dong Nai Master Plan Study are the regulations and guidelines relating to EIAR requirements. A summary of the MOSTE guidelines in general and in the particular context of the Dong Nai Basin Master Plan is included as Attachment B.

## **8. IMPACTS OF WATER RESOURCE DEVELOPMENT ON NATURAL AND SOCIAL ENVIRONMENTS**

### **8.1 Perspective**

Only basic assessments of the potential environmental effects and main issues associated with specific dam and reservoir projects are possible at this stage. Ideally a subjective evaluation of the extent or magnitude of potential adverse and beneficial effects of each project should be prepared for comparing the various projects included in the Master Plan, although only limited information is presently available on the social effects of the projects.

The project features and basic indicated implications of the main projects or groups of projects are presented below and summarised in Table 8.1. These preliminary data and comments are intended to highlight potential issues which could be associated with the main dam/reservoir projects likely to be included in the master plan projects.

The main environmental issues of the proposed developments as outlined in this Section include:

- Downstream Effects of Proposed Developments (Section 8.2);
- Conflicts between Protected Areas and Proposed Projects (Section 8.3);
- Groundwater Resources and Environmental Issues (Section 8.4); and
- Reservoir and Watershed Management (Section 8.5).

### **8.2 Downstream Effects of Proposed Developments in the Dong Nai River Basin**

The potential downstream effects of proposed developments are of environmental concern; particularly since these are integrally linked with planned urban and industrial expansion in the Ho Chi Minh-Vung Tau-Bien Hoa economic triangle. Also the potential effects on the estuarine area downstream of the above area could occur downstream of major irrigation projects proposed for the coastal plains in the Phan Rang, Phan Ri and Phan Thiet areas. Dams for re-regulation and possible interbasin diversion of water for irrigation located on the Be River downstream of Thac Mo could also have downstream environmental effects in the Ho Chi Minh City area, particularly relating to surface water quality.

The water balance and water quality management throughout the Ho Chi Minh City area is complicated by the extensive network of drainage canals and the influence of tidal dispersion combined with river and industrial and urban waste effluent disposal. High rainfall intensities during the monsoon season and poor urban drainage result in localised flooding in the Ho Chi

Minh City area, but these would benefit from reduced flooding due to expanded reservoir developments upstream in the Dong Nai and Be river systems. Intensive field investigations and computer modelling of the salinity intrusion and flooding in the context of existing situations and the changes in regimes of the Dong Nai, Saigon and Vam Co river systems associated with main development scenarios are an integral part of the Master Plan Study. The potential environmental effects, particularly those relating to water quality, estuarine ecology and commercial fishing/aquaculture, are dependent on the results of these hydraulic and hydrological investigations. These are discussed in Appendix VIII, Flood Mitigation and Urban Drainage, and Appendix IX, Salinity Intrusion.

At this stage, the following general comments relating to the downstream effects of proposed water resource development on the water environments of Ho Chi Minh City area and the estuarine/coastal zone can be suggested for the respective zones.

#### 8.2.1 Dong Nai River Zone-Tri An Reservoir to the Confluence with the Saigon River (Nha Be)

- a) Upstream salinity intrusion of levels of 0.25 g/l should be maintained downstream of the Hoa An/Bin An urban water supply intakes.
- b) Strict controls on liquid waste treatment and monitoring must be put into effect in the existing Bien Hoa and developing Long Binh industrial zones at Bien Hoa and in the Thuan An, An Binh, Tan Thuan and Cat Lai industrial zones of Ho Chi Minh City. Monitoring should include selected cross-river profiles upstream of Bien Hoa and in the vicinity of the Ho Chi Minh City water supply intakes at Hoa An in the Dong Nai River.
- c) Further investigation of the use of package treatment plants for combined waste streams from specific industrial estates as recommended in the Ho Chi Minh City-Environmental Improvement Planning Study should be made and decisions undertaken by appropriate People's Committees and ministries, as a matter of priority.
- d) Gradual improvements in water quality at water intakes should occur and existing problems associated with high organic content and algae should decrease since higher water levels and dry season discharge quantities are increased in Tri An reservoir and in the Dong Nai River due to further re-regulation by upstream reservoir projects. This is evident from the improvements in water quality, particularly salinity, in the lower Dong Nai since the operation of the Tri An reservoir is related to salinity intrusion investigations as part of this Study.

- c) A land use management plan for lands in the immediate vicinity of the Dong Nai River from Tri An to Bien Hoa including controls on mining of riverbed and riverbank sand, gravel and clay should be implemented by the People's Committees for Dong Nai province and Bien Hoa City.

#### 8.2.2 Saigon River-Phuoc Hoa to the Confluence with the Dong Nai River (Nha Be)

- a) Recommendations relating to further assessment of polluting small scale industry and implementing of required waste disposal treatment at these and in newer industrial estates as well as monitoring of industrial areas as outlined in the Ho Chi Minh City Environmental Improvement Report should be put into effect, as a matter of priority.
- b) Dry season downstream releases to the Saigon River upstream of Ho Chi Minh City should be the priority water demand for releases from Dau Tieng and diversions from the Fu Mieng or Phuoc Hoa schemes and should include water quality demands (i.e. pollution assimilation requirements) as well as urban and industrial supply, salinity intrusion repulse and irrigation requirements.
- c) Improvements to the sewerage and drainage system for the central part of Ho Chi Minh City as recommended in the Environmental Improvement Planning Report are essential to water quality management in the lower sector of the Saigon River and downstream of Nha Be.
- d) The potential downstream effects of diversions from the Be River to the Saigon River and further to the East Vam Co River catchment areas for irrigation purposes (e.g. to Phuoc Hoa and to Dau Tieng and Hoc Mon/Bac Binh Chan) include:
  - Further deterioration of basic water quality of surface waters through the Ho Chi Minh City area due to contamination of return flows from agrochemicals and salt or acid sulphate leaching from saturated soils depending on local conditions, and
  - Possible conflicts in the long term for water allocation as the demands associated with Ho Chi Minh City change with increased urban and industrial development.

#### 8.2.3 East Vam Co and West Vam Co River Systems

Since these catchment areas are characterised by acid sulphate soils, further expansion of drainage and irrigation based on diversion from the Saigon River could result in long term degradation in water quality in the southwest sector of Ho Chi Minh City's poorly drained areas.

#### 8.2.4 Estuarine and Coastal Zone of the Ho Chi Minh-Vung Tau Area

- a) Water quality problems already exist in the Thi Via inlet and the coastal zone from Ba Ria to Vung Tau due to poor drainage and industrial waste effluent disposal which adversely affect water used for brackish water fish and shrimp ponds. Planned and controlled waste disposal programmes for the existing and proposed industrial development zones between Long Tanh and Vung Tau (i.e. Go Dau/Phuoc Thai; Phu My/Ba Ria, My Xuan, Go Gang/Cay Khi, Long Son and Ben Dinh) should be priority for the Dong Nai and Ba Ria/Vung Tau Provincial People's Committees and the Government of Viet Nam agencies involved in promoting and developing industrial estates.
- b) Increasing the base river level and daily inflows of freshwater in the Dong Nai/Saigon/Vam Co delta systems during the dry season through upstream reservoirs would have minimal effects on the estuary area's aquatic ecology since these areas are already adapted to change (e.g. in response to Tri An Reservoir impoundment) and already are degraded due to factors such as industrial expansion and associated poor waste disposal and heavy shipping traffic.
- c) Dredging of ship canals along the Soa Rap/Dong Nai and Long Tau/Mui Nai could have temporary effects on water quality in the coastal zone depending on the dredging and disposal techniques involved. Use of cutter suction dredges and contained disposal based on land reclamation or offshore disposal at sea are suggested as the most environmentally acceptable for any dredging programmes.

#### 8.2.5 Estuarine and Coastal Zones-Vung Tau-Phan Rang

The estuarine zones of the smaller coastal river systems along the coast from Vung Tau to Phan Rang are intensively developed as local fishing ports and for salt production and aquaculture ponds. The extent of mangroves in these areas has been substantially reduced in the past 10 to 15 years for fish and prawn pond culture and for salt production. The potential downstream effects on these smaller estuarine zones would focus on the Phan Rang, Phan Ri and Phan Thiet areas due to irrigation development in these catchments. In general, these long term effects would include:

- a) Long term alterations to the aquatic ecology of the upstream parts of the estuarine zones due to changes in hydrologic and salinity intrusion regimes; this has already occurred at Phan Rang and will occur at Phan Ri due to the downstream releases from the Da Nhim and Dai Ninh projects, respectively, depending on long term irrigation developments,

- b) Possible adverse effects on estuarine ecology, particularly the bottom fauna such as bivalves and shrimps, due to long term changes in basic hydrology and water salinity (i.e. reduced extent of habitat), loss of mangrove forests and possible accumulation of agrochemical residues in sediments,
- c) Alterations to local natural populations of these species such as freshwater prawns (*Macrobrachium spp.*) and fish (Goby or *Oxyeleotris marmoratus*) using the estuarine zones for breeding/nursing habitats, and
- d) Possible improvements for local fishing fleets due to increased water levels during the dry season when access to and within the estuaries is limited due to low water levels.

### 8.3 Conflicts between Protected Areas and Proposed Projects

#### 8.3.1 Protected Area Legislation and Status

Based on information received from the Forest Protection Department (FPD) of then Ministry of Forests (MOF) in Hanoi, it is indicated that there are a number of potential direct and indirect conflicts between existing, proposed or expanded Protected Areas and major hydropower or irrigation projects proposed for the Dong Nai Basin Master Plan. The rationalisation of land allocation and responsibility for land use and development is ongoing at the provincial, district and community levels throughout Viet Nam. Many degraded and barren lands have been reallocated to the Ministry of Agriculture and Rural Development for restoration through afforestation and agroforestry under the "Doi Moi" policy. Forest related legislation passed in recent years provides for protection of forests through:

- a) Regulations protecting specific rare or endangered plant and animal species,
- b) Regulations relating to allocation and use in specific categories of forest including;
  - i. Environment Protection Forest; to be used mainly for protecting water and soil resources, combating erosion and limiting natural disasters,
  - ii. Conservation Forests (Protected Areas); to be used for conserving nature, representative ecological units and significant cultural relics and landscapes and tentatively to be categorised as;
    - National Parks
    - Nature Conservation Areas
    - Cultural and Social Forest Areas

- Scientific/Laboratory Forests

and which include requirements that:

- National Parks and Nature Conservation Areas be strictly managed and protected, and
  - Activities which damage Conservation Forests be prohibited, and
- iii. Production Forests to be used mainly for producing timber and other wood products, special forest plants (e.g. rattan/cane) and fauna (e.g. deer) on a sustainable basis.

There are several ongoing programmes supported by international donors (e.g. Conservation NGOs and bilateral aid) assisting the Forest Protection Department in inventorying and planning for long term management of Conservation Forests or Protected Areas, training of rangers, public environmental awareness programmes and preparation of regulations for flora and fauna protection. Recently, the Government of The Netherlands (GTN) has provided \$US 5 million assistance towards such a programme including funds for training rangers, associated infrastructure development and research for Cat Tien National Park and Cat Loc Rhinoceros Sanctuary (i.e. Nature Conservation Area) located in the central portion of the Dong Nai River basin.

### 8.3.2 Main Conflicts between Protected Areas and Proposed Projects

There are indicated thirteen (13) Protected Areas in the Study Area as shown in Figure 8.1. Of them, the main Protected Areas which could be affected by projects proposed in the Dong Nai Basin Master Plan include:

- a) Dong Nai No. 5 and Dong Nai No. 6, which would flood those parts of the Cat Loc Rhinoceros' Sanctuary adjoining the Dong Nai River, with this Protected Area likely to become the northern part of Cat Tien National Park when it is officially declared under new Conservation Forests legislation (i.e. approval of the "Management Plan" for the combined area under preparation as part of the GTN assistance programme to the FPD).
- b) Dong Nai No. 8 reservoir which would flood out the south east corner of Cat Tien National Park including lands designated for a habitat restoration project, and the residual components of the lowland riverine ecosystem between Tri An reservoir and Cat Tien National Park. More detailed comments on the effects of Dong Nai No. 8 project on Cat Tien National Park are outlined in Attachment C.



- c) La Nga No. 3 reservoir which could flood parts of the expanded Bien Lac/Nui Ong National Park as currently proposed and possible indirect effects of water diversion for irrigation or local flood control works on the seasonal flooding regime of the Bien Lac wetlands which is of importance to its ecological integrity. The exact location of the 40,000 ha expanded Park relative to La Nga No. 3 project works is being confirmed.
- d) Possible changes to the hydrological regime and water quality of the Phan Rang Wetland Reserve, the majority of which is indicated to be already extensively and adversely affected by destruction of its mangrove ecosystems for salt production and brackish water aquaculture ponds.

### 8.3.3 Dong Nai No. 5, 6 and 8 Projects

A major consideration in resolving the apparent conflicts outlined in respect of the Cat Tien/Cat Loc Protected Areas and the Dong Nai No. 5, 6, and 8 projects is the high profile and ecological importance both nationally and internationally. The only remaining known population of Javan Rhinoceros in Thailand, Laos and Indochina is inhabited in the Cat Loc area, and Cat Tien is perceived as a National Park of international significance due to its diversity of wildlife and plants and its wetland ecosystems. Consequently, proposals to construct these projects can be expected to be publicly criticised by conservation interest groups from both within and outside Viet Nam.

The situation is presently complicated by the uncertainty as to the long term classification of the Protected Area (e.g. National Park or World Heritage Area) and what activities will be permitted and prohibited in such a Protected Area. PIDC2 as the agency responsible for feasibility study investigations is presently seeking confirmation and clarification from the MOARD relating to the "environmental acceptability" of Dong Nai No. 5 and 6 projects and has commissioned an independent EIA study for the Dong Nai No. 8 project.

In the meantime, it is suggested that priority formulating the Master Plan should probably be given to Dong Nai No. 3 and 4 projects in place of Dong Nai No. 5 and 6 projects and that due consideration should be given to lowering the full supply level at Dong Nai No. 8 project to minimise effects on the southeast sector of the existing Nam Cat Tien National Park (ie. from 120 to 110 m). A preliminary analysis of the mitigating actions for Dong Nai No. 8 relating to the Nam Cat Tien National Park is outlined in Attachment C.

#### 8.3.4 La Nga Project

The conflict situations indicated above relating to the La Nga No. 3 project and its potential effects on the proposed Bien Lac/Nui Ong National Park are uncertain at this stage. This depends on obtaining detailed data relating to this Protected Areas' boundaries, but no detailed field investigations for a Management Plan for the proposed Bien Lac/Nui Ong have been undertaken to date. However it is indicated that alterations to the regime through construction and operation of the La Nga No. 3 reservoir and irrigation projects and any flood control works would have some effects on the Bien Lac wetland. Assessment of the nature of these works and discussions with Binh Thuan Province's Forest Protection Department are necessary to finalise impacts, potential mitigating actions and conclusions to be documented for the indicated conflict between the proposed La Nga No. 3 scheme and the Bien Lac/Nui Ong National Park.

#### 8.3.5 Phan Rang Irrigation Project-Northern Plain

There are no apparent land use conflicts between the proposed Phan Rang Irrigation Project and the coastal lagoon wetlands of the Phan Rang Nature Reserve. Return drainage from the northern part of the irrigation scheme would enter this lagoon. Since water quality is the critical factor, this must be considered in the context of the present situation where much of the mangrove forest habitat is originally present and is used by wetland birds, amphibians and reptiles. This present situation has been destroyed by development of salt production and nursery areas for fish and prawns. Consequently, potential problems such as nutrient (e.g. soluble ammonia or phosphates) and pesticide residue levels have to be considered in the context of reduced extent of habitats and population of estuarine animals, birds and fish/prawns. At this stage, potential environmental impacts associated with the Phan Rang Irrigation Project should not affect the ranking for priority and implementation of this project.

### 8.4 Groundwater Resources and Environmental Issues

In rural areas the main source of water for domestic use remains rivers and streams (i.e. about 45 %) with shallow hand dug wells being used for drinking water on an individual and communal basis. Urban residents make use of shallow wells (i.e. less than 20 m deep) in the northern sectors of Ho Chi Minh City. The main environmental problems associated with local groundwater resources are limited to:

- a) Highly localised contamination due to lack of protection measures to prevent runoff and infiltration to hand dug shallow wells from nearby septic tanks, particularly if these are not operating effectively or due to overflows from tanks during the wet season, and
- b) Seasonal contamination of upper horizon groundwaters by infiltration of polluted local surface runoff; mainly due to locally poor effluent and solid waste disposal practices as well as inadequate drainage systems.

There is no evidence to date (based on documents reviewed and discussions with the SIWRP Water Quality Laboratory personnel) of agrochemical residue contamination of local groundwater resources.

The groundwater resources of the Ho Chi Minh City and other areas of the Dong Nai/Saigon River delta areas are located in Quaternary deposits (i.e. old upper deltaic deposits). Consequently with the high seasonal rainfall regime, recharge rates for both upper (< 40 m deep) and mid-depth (40 to 180 m deep) aquifers are characterised by full annual recharge. Likewise improved water quality in the lower Dong Nai and Saigon rivers due to upstream regulation via Tri An reservoir is an important factor in maintaining water quality during the dry season when horizontal/gradient recharge may occur to a minor extent in vicinity of these rivers and associated canals, where wells are often located.

Localised contamination due to use of surface waters for effluent disposal in the older industrial zones of the Ho Chi Minh City such as Thu Duc and Tan Binh with effluents with heavy pollution loads is a possible concern and requires more intensive monitoring to confirm that these are not problem areas (HCMCEC, 1995). Similarly, the use of interception wells to monitor and retrieve any contaminated leaching from land fill or urban waste disposal sites needs to be an integral part of such schemes for Ho Chi Minh City, Bien Hoa and other developing urban areas.

With the annual recharge of local aquifers plus the fact that underlying aquifer deposits are primarily deltaic sands and gravels, ground level subsidence due to groundwater withdrawal is not currently, or likely to be, an environmental problem. In effect with proper management of its groundwater resources, the main urban/industrial development zone (i.e. Ho Chi Minh City/Bien Hoa) has good long term potentials for the combined use of surface water and groundwater supply to meet projected demands.

## 8.5 Reservoir and Watershed Management

### 8.5.1 Current Situation

The current situation relating to responsibilities for reservoir and watershed management in respect of individual river basins is uncertain. Institutional responsibilities for watershed management are designated under the current MOARD policy to the Forest Protection Department (FDP) at the Provincial level and with jurisdiction limited to the particular province, district or commune through the respective People's Committees involved. The situation is similar with responsibilities for reservoir areas and associated lands. For example in the case of Tri An Reservoir, this is allocated to the three respective districts with lands inundated (i.e. Vin Anh, Tan Phu and Thong Nhat districts). These districts, although having responsibilities for allocation and management of reservoir shorelands areas flooded by the reservoir and local fisheries operations, have no knowledge or access to data about management of reservoir water levels. This responsibility rests entirely with the hydroelectric power producer, PC No. 2. Likewise, there is virtually no suitable institutional framework for overseeing water resource management responsibilities in the case of multi-project basin developments such as required with further developments in the Be and Dong Nai River basins (e.g. management of downstream releases for water quality control).

The general distribution of provinces and districts with responsibilities for natural resource allocation and administration associated with the main existing and proposed reservoir and watersheds in the Study Area is listed in Table 8.2.

In summary, the situation in respect of the four main watershed units in the Study Area is:

- a) The Dong Nai River above Tri An reservoir has the potential for 12 to 15 projects which would involve four provinces and at least twelve districts.
- b) The La Nga River above Tri An reservoir has the potential for five projects which would involve two provinces and five districts.
- c) The Be River above Ho Chi Minh City has the potential for four projects which would involve two provinces, two cities (TP: Thanh Pho) and seven to eight districts.
- d) The Saigon River above Ho Chi Minh City has the potential for three projects which would involve two provinces and five districts.

It is indicated that in general four to five communes would be involved within each district and that the more institutionally complicated projects such as Dong Nai No. 6 would have a reservoir affecting three provinces, three or four districts and 15 to 20 communes. In respect of watershed management, the Dong Nai No. 3 project could involve three provinces, up to

eight districts and thus 30 to 40 communes. The situation becomes further complicated where other forest administrative units such as Protected Areas or State Enterprise Forests are involved (e.g. in the central part of the Dong Nai River basin). Thus the institutional complexities of implementing effective reservoir and watershed management for a specific river basin or project are substantial and require due consideration in all river basin or project planning, including recommendations for institutional strengthening measures to overcome such complexities.

#### 8.5.2 Reservoir Management and Monitoring

As noted above, presently the responsibilities for reservoir management in respect of water releases are vested with the hydroelectric power or irrigation headworks operating authority. Use of the reservoir, its drawdown zone and its shoreland is vested with the province, district and communes directly involved. The indicated designated responsibility for aspects such as water quality monitoring of reservoir waters or those downstream is vested with the "Ministry of Agriculture and Rural Development" and the provincial "Offices of Science, Technology and Environment" according to Article 5 (2) and 6 (2), respectively of the "Guidance for Implementation of the Law on Environmental Protection" (1995). However, it is yet to be determined whether these organisations assume those responsibilities in their respective "Regulations for Environmental Protection" as in the case of Dong Nai province for Tri An reservoir and where the expertise and budgets for such monitoring are to be sourced.

The importance of the needs for reservoir management and monitoring is evident by recent problems in respect of cage culture operations at Tri An reservoir. The over concentration of floating fish cages and fishing villages at the Highway 20 bridge location, indiscriminate fertiliser use, fish feeding and solid waste disposal into the reservoir combined with drawdown to minimum level requirements (i.e. levels unsuitable for cage culture operations) have resulted in extensive losses through fish disease and die off. The reasons for low oxygen levels characteristic of low reservoir levels at this location are unknown to district authorities promoting and permitting expansion of cage culture and are generally not understood by those fish farmers engaged in these practices. This is an example of development not being integrally planned on the basis of proper water quality and reservoir operational investigations prior to promoting cage culture activities at such locations.

An ongoing "Study of the Environmental Impacts of Tri An Reservoir (1993-95)" is being completed by the Environment Protection Centre (EPC) of Ho Chi Minh City as part of a "National Research Project" funded by MOSTE. However, no comprehensive continuous programme for environmental monitoring of any of the existing reservoirs in the Study Area has been proposed or planned to date.

There is an apparent need in view of the lack of water quality and other aquatic environment related data for existing reservoirs and the planned long term development of several other reservoir projects for a "status and ongoing monitoring programme" covering the ecological range of reservoirs in the Study Area. In this respect, the following basic investigations and monitoring are recommended:

- a) Lowland Reservoirs - Tri An as a "Stabilised Reservoir" and Thac Mo as a "Reservoir Under Stabilisation":
  - Ongoing water quality and limnological (ie. lake ecology parameters) as recommended in the Tri An Environmental Study by EPC, and
  - Setting up a baseline water quality and limnological at four nominated sites in Thac Mo reservoir on a quarterly bases (4 times/year), and
- b) Upland Reservoirs - Da Nhim as "Stabilised Reservoir" and Ham Thuan as "Reservoir Under Stabilisation" (midland elevation heavily forested) followed by Dai Ninh as "Reservoir Under Stabilisation" (highland elevation limited forest cover):
  - Setting up a water quality and sedimentation inflow measurement programme for Da Nhim based on quarterly basis (but including measurements of inflow under maximum runoff conditions and minimum reservoir levels), and
  - Setting up a water quality limnological and sediment inflow monitoring programme for Ham Thuan-Da Mi based on sites nominated in the project's EIA Report.

### 8.5.3 Institutional Requirements for Reservoir Management Committees

The complexities associated with divided responsibilities for reservoir management involving the operating authority and provincial, district and local authorities are outlined above. This will become further complicated since additionally vested interests occur in the future such as water demands for satisfying downstream urban and industrial requirements for water supply, retardation of salinity intrusion and maintenance of pollution assimilative capacities. Consequently, it is essential that effective "ways and means" of establishing and authorising powers for Reservoir Management Committees be duly considered. As a preliminary indication, the following general make-up of a Reservoir Management Committee for each major reservoir is suggested:

**Chairman:** Director of Ministry of Agriculture and Rural Development appointed to the province with greatest area of reservoir,

**Vice Chairman:** Deputy Director of Authority responsible for operation of the reservoir, and

**Representatives:**

- Senior Water Resource Engineers from all provinces and districts directly affected by the reservoir,
- Senior Environmental Officers from provincial/city or district Offices of Science, Technology and Environment or Environmental Committees (e.g. Ho Chi Minh City) affected by the reservoir or with downstream urban water supply intakes,
- Senior Fisheries Officers from provinces or districts directly affected by the reservoir or nominated representative from Reservoir Fisheries Sub-committee as noted below, and
- Senior Department officers of Land Management and/or Forest Protection Department of the provinces affected by the reservoir.

The main responsibilities of the Reservoir Management Committee would include:

- a) Planning and controlling land use on lands adjacent to the reservoir and of the drawdown zone,
- b) Planning and implementing effective water quality and ecological baseline assessments of the reservoir including its fisheries potentials and management requirements,
- c) Planning, initiating and arranging financial responsibilities for a comprehensive water quality monitoring programme including major inflowing rivers and river sectors downstream as appropriate to satisfy regional environmental protection objectives,
- d) Planning and programming (including periodic reviews) of reservoir operation criteria as required to meet project objectives and to accommodate any changing needs for downstream water use and new demands for urban/industrial supply and environmental mitigation (e.g. salinity intrusion, pollution assimilation, groundwater recharge etc.), and
- e) Developing and implementing public relations campaigns relating to reservoir management needs (e.g. shorelands erosion control programmes).

#### 8.5.4 Reservoir Fisheries Management Sub-Committee

All of the potential reservoir projects proposed in this Study would be subject to substantial annual fluctuations in levels due to their primary functions as hydropower or irrigation water supply sources. In general, planning for, development of and management of reservoir fisheries require technical inputs beyond the expertise readily available at the provincial and district levels. Consequently it is suggested that a Fisheries Management Sub-committee be operated for each reservoir, once a decision is made to proceed with the related project. A fisheries development and management programme would be a priority, would be based on reservoir ecology and operating regime and would include development components relating to the following:

- Open water capture fisheries,
- Reservoir stocking and hatchery requirements and plans,
- Aquaculture potentials, constraints and zonings for activities (e.g. cages),
- Fisheries development extension services and credit requirements and programmes,
- Fish landings and marketing, and
- Fisheries productivity, yield and economic benefits monitoring programme.

The composition of the Fisheries Management Sub-committee for a particular reservoir is suggested as follows:

**Chairman:** Director of Fisheries for province with greatest area of reservoir or as appointed by the Reservoir Management Committee,

**Vice Chairman:** As elected by the Sub-committee or appointed by the Reservoir Management Committee,

**Representatives:**

- Senior provincial or district Fisheries Department Officers with areas affected by the reservoirs,
- Representative from any existing Fisheries State Enterprise involved in fisheries development and extension in the provinces affected by the reservoir, and
- Technical representatives, as appropriate, from the Aquaculture Research Institute (ARI) No. 2; ARI No. 2 Sub-centre for Freshwater Fish Production (Cai Be) and/or Institute of Fishery Economics and Planning.



The make-up of the individual reservoir's Fisheries Management Sub-committee should be investigated and recommendations made in the EIA prepared for the individual reservoir projects.

#### 8.5.5 Institutional Strengthening for Reservoir Fisheries Management

It is indicated that ARI No. 2 in the Ho Chi Minh City and its Cai Be Research Station in the Mekong delta have limited experience in reservoir fisheries although they have extensive research capabilities relating to aquaculture of freshwater fisheries and prawns. With the number and extent of reservoirs to increase substantially in the next 15 to 20 years and limited knowledge about the ecology and fisheries production from existing reservoirs, there is an apparent need to plan and implement a more comprehensive approach to reservoir fisheries planning, development, controls, management and monitoring by the Ministry of Fisheries. In this respect the setting-up of a centralised reservoir fisheries research and sub-centre at Tri An Reservoir is preliminarily recommended as an institutional strengthening requirement for Southern Viet Nam in general and for the Study Area in particular. This aspect needs to be discussed in more detail with the ARI No. 2 and Ministry of Fisheries planning staff to determine its acceptability and priority.

#### 8.5.6 Background Situation on Watershed Management

Planning and implementing watershed management on a basin wide scale has not been undertaken to date in Viet Nam. Pilot projects based on small catchments in the highland areas have been initiated under the UNDP/FAO sponsored "Restoration and Conservation of Watersheds Programme" (VIE/93/G26). Other projects such as those related to development assistance to ethnic minorities in the highlands are being sponsored by the UNDP, FAO and World Bank and also include watershed management components. Specific reforestation and erosion control projects under provincial and district authorities relating to "barren lands" have been undertaken in the watersheds of the Dau Tieng and Tri An reservoirs and in selected areas of Lam Dong province.

Substantial research and practical experience have been completed for suitable tree species for reforestation in the Study Area and are ongoing at locations such as Bau Bang in Song Be province and Thong Nhat in Dong Nai province, respectively. Background research and pilot projects relating to aspects such as participatory rural appraisals; village-based agroforestry planning; community managed extension and training and integrated agriculture/forestry models for selected areas have recently been completed under the UNDP/FAO Project of Technical

Support to the World Food Programme (WFP) Project 4304 (i.e. UNDP/FAO Project VIE/92/022). This includes preparation of suitable extension materials for implementation of broadscale community based projects presently under negotiation with the Government of Viet Nam; one of these is proposed for Binh Thuan province located in the Study Area.

Based on discussions with Ministry of Agriculture and Rural Development personnel and UNDP/FAO Forestry Consultants, the main factors relating to planning and implementing effective watershed management programmes include:

- a) Recognition of the "Doi Moi" policy and its implications in respect of the needs for any land allocation and land use changes required for a specific watershed management project to be planned and programmed through People's Committee at the district and commune levels.
- b) Need to accept that high costs for project planning and programming will occur due to the involvement of several districts and numerous communes which will need to be consulted and negotiated with through participatory planning in order to implement appropriate agroforestry or community based reforestation programmes (i.e. land management is essentially put into effect by the district and commune administrations).
- c) Scope for implementing reforestation projects covering extensive areas may be restricted due to past or ongoing provincial and district policies of reallocating "State Forest Enterprise" forestry areas to "new economic zones" for community development under local administration or by new private companies or joint ventures.
- d) Due recognition will need to be made of ongoing programmes in certain areas, many of which could be compatible with watershed management objectives (e.g. "Barren Lands and Regreening Project" in highland areas; joint venture plantation forest projects by State Forest Enterprises and agroforestry projects sponsored by bilateral aid or NGO agencies in cooperation with the GOV agencies).
- e) Critical areas requiring watershed protection should be identified as early as possible; in effect during the preparation of the required BIA for individual reservoir projects based on the MOSTE Guidelines for Environmental Impact Assessment.

#### 8.5.7 Classification of Lands for Watershed Management

Several land classification systems have been developed for tropical environments, and these need to be reviewed in the context of Southern Viet Nam's topography, soils, land use and runoff patterns. Mapping of the Study Area's catchments on a watershed classification system has not been prepared. However general land use maps have been prepared at a scale of

1:250,000 based on 1993 Satellite Imagery as outlined in Chapter 4. This is of limited value in assessing watershed management requirements except for general distribution of erosion risks based on land use categories such as upland crops, barren lands, shifting cultivation and upland tree crops such as tea and coffee. Topographic and soil maps of land use at scale of 1:100,000 using similar land use categories have been prepared by the individual provinces as described in Chapter 4.

Allocation of land for use by individuals or enterprises is based on "prescribed land use" as determined by provincial and district authorities and is approved by the People's Committees. In practice this is somewhat dependent on the following:

- a) Historic jurisdictional authority over particular land units by the various ministries such as agriculture and forestry; with political and economic factors affecting any classification such as the lands inherent environmental attributes (i.e. intended use by the controlling authority is implied in classification for land use).
- b) Barren land is generally so classified if its actual use does not meet its jurisdictional allocation and reflects a difference between historical use or, capability and/or its present use. For example barren land includes:
  - Mountain slopes degraded through shifting cultivation or logging,
  - Hilly regions with bush and scrub vegetation, pasture or high grasses, including defoliated areas,
  - Rocky outcrop or mountains, and
  - All other lands controlled by the various MOARD departments and agencies with less than 10 % crown cover.

Re-assessment and refinement of land classification in the context of forestry and agricultural suitability and watershed management criteria such as slope, soil cover depth, erodability and rainfall intensity regime are required to produce maps for watershed management planning and programmes for the Study Area. This requirement should be included in the Terms of Reference for Feasibility Studies for individual proposed master plan projects in the context of their respective watershed protection requirements. Alternatively, watershed management plans should be prepared for each of the Don Nai and La Nga River above Tri An reservoir, the Be River, the Saigon River and the Vam Co River systems.

## 9. INITIAL ENVIRONMENTAL EXAMINATION

### 9.1 Objectives and Procedure for IEE

#### 9.1.1 Objectives

The Initial Environmental Examination (IEE) is a preliminary environmental impact assessment. The IEE conducted at an early stage of project development, however, is an effective tool to identify possible environmental and social effects and to guide further project development planning. The original formulation criteria or make-up of any project may be modified, if significant negative impact is predicted by the IEE.

An initial screening for IEE requirement has been carried out for the proposed master plan projects which are expected to cause negative impacts to the surrounding area. The main objectives of this screening for IEE are:

- To identify possible environmental impacts in implementing the proposed master plan projects based on available data/information and limited field reconnaissance, and
- To make judgments as to needs for an environmental impact assessment (EIA) and what the critical issues for the project could be.

#### 9.1.2 Procedure

A total of 14 projects, except for "Strengthening of the Organization on Water-rated Institution, which is a non-structural measure, are proposed as the master plan projects for economic development as discussed in Appendix X; three hydropower projects, ten irrigation projects and one water supply project, and are grouped into ten projects by taking into consideration the geographical distribution of irrigation projects. These ten projects are classified in three categories related to IEE requirements:

- those requiring an IEE,
- those not requiring an IEE, and
- those not completely formulated to permit completion of an IEE.

All the proposed projects have been subjected to screening to classify them into these three categories and to indicate the extent of the likely main impacts. Judgment on whether or not the IEE is required depends on the type of project, scale of development, activities involved in projects and environmental site conditions. As a result of the screening, a total of nine projects

excluding a water supply project have been selected for the IEE as summarized in Table 9.1. Three hydropower projects, Dong Nai No. 6, Dong Nai No. 8 and Can Don, which are already subject to feasibility study and EIA by the various Viet Nam Government agencies, are also included in Table 9.1 to show the relative advantages of hydropower master plan projects, Dong Nai No. 3 and 4, in terms of environmental impacts. On the other hand, water supply project between Bien Hoa and Vung Tau is categorized as the one not completely formulated to permit completion of an IEE, however, estimated environmental impacts of the water pipeline are briefly discussed in Sub-section 9.2.2.

For each of projects selected by the screening, the IEE is carried out by screening and using an environmental and social impact matrix, which, in effect, provides a checklist of environmental and social effects. Classification of environmental elements, based on the JICA Environmental Survey Guidelines and the Government Decree No. 175/CP of October 18, 1994, is as follows:

<u>Class</u>	<u>Elements</u>
A. Natural Environment	<ul style="list-style-type: none"> <li>- Topography</li> <li>- Soil erosion</li> <li>- Groundwater</li> <li>- Hydrological situation</li> <li>- Coastal zone</li> <li>- Flora &amp; fauna</li> </ul>
B. Social Environment	<ul style="list-style-type: none"> <li>- Population distribution and resettlement</li> <li>- Economic activities</li> <li>- Traffic &amp; public facilities</li> <li>- Split of communities</li> <li>- Water rights and fishing rights</li> <li>- Sanitary condition</li> <li>- Landscape</li> <li>- Natural and cultural assets</li> </ul>
C. Public Pollution	<ul style="list-style-type: none"> <li>- Air pollution</li> <li>- Water pollution</li> <li>- Soil contamination</li> <li>- Noise &amp; vibration</li> </ul>

Activities of each project/programme are divided into three stages; pre-construction stage, construction stage, and operation and maintenance stage. The general procedure of the IEE in Viet Nam is illustrated in Figure 9.1, together with the procedure of Environmental Impact Assessment (EIA) required for further evaluation of certain projects in subsequent phases.

The screening process identifies environmental elements that are likely to be seriously affected by activities of any project for commenting on in the IEE. According to the questionnaire/interview surveys submitted to and completed by the authorities concerned and information/data collected regarding the project construction works as well as present and probable future conditions of environment, the important environmental impacts are examined and evaluated for specific projects. For such impacts, mitigation measures are also preliminarily indicated in the IEEs for the Master Plan, as presented in subsequent Section 9.2.

Results of the screening for IEE requirement of the projects selected are presented in Table 9.2 in the form of the environmental impact matrix, as noted above.

### 9.1.3 General Suggestions Relating to Social Issues and Environmental Impact Assessment (EIA)

Only a preliminary screening of the possible environmental impact of the individual projects is given in the previous Section. The IEEs presented in subsequent Section 9.2 are limited in scope and it is indicated that a full environmental study (EIA = Environmental Impact Assessment which is beyond the scope of the present study) will be carried out in the next stage of project planning, the feasibility study programme of each project.

Changes resulting from projects can be both positive or negative-temporary or permanent-effects on environmental resources and social situations in project areas. Implementation of the development projects proposed in the Dong Nai Master Plan Study may modify the social and natural environments as reviewed in the Initial Environmental Examinations (IEEs).

In general, unless special measures are adopted, ethnic minority groups are often likely to be disadvantaged rather than helped by development projects. Consequently, projects need to be properly evaluated and designed so as to prevent or to mitigate negative effects to those groups.

It is therefore necessary to prepare a separate plan for ethnic minorities, tailored to their specific needs and local situations. Special action is required by the ethnic minorities groups in particular who are vulnerable to dislocation and impoverishment in conditions of rapid socio-economic change. To lower the risk of impoverishment and environmental degradation, special measures are to be provided and the advancement of these groups included in project objectives and plans. This is also now a requirement of the major lending agencies associated with water

resource development such as the World Bank, Asian Development Bank and bilateral agencies including JICA.

Such special action should take place at latest during the final formulation of development plans (at feasibility study stage) so that the needs of ethnic minorities can be taken into account in preparing the project proposal.

It is also appropriate to consider some of the past resettlement experiences in general including Viet Nam, in order not to repeat the same difficulties. In case of the resettlement issues in reservoir projects in Southeast Asia, the following problems are pointed out:

- a) Poor implementation of the resettlement plan due to its incompleteness and lack of reality, given the land capability and traditional skills of relocatees.
- b) Unit prices for compensation decided by the government not being equal to or sufficient relating to the market prices, so relocatees are disadvantaged.
- c) Delays in payment of compensation and insufficient support during relocation.
- d) Allocated lands are not being sufficient for livelihood of the resettlers; as a consequence, lack of land to cultivate and being in the need of relocating to another area or encroaching into forest for collecting and hunting.
- e) Lack of planning for the allocation of land use rights between the new immigrants and the local residents (host communities).
- f) Provision of job opportunity to the resettled people remains as one of the most difficult problems associated with implementing resettlement programmes for development project; where there is no job opportunity to them, they have to either relocate or they become transient labourers or welfare dependents.
- g) Insufficient financial support from the central government to solve the above and other compensation and resettlement problems associated with implementing resettlement programmes for major development projects.

To move toward the active participation of ethnic minorities in ways which enhance social and environmental conditions, the final development plan for projects affecting ethnic minority groups (together with EIA) should include the following:

- Baseline data of affected area and population,
- Development policy and legal framework relating to ethnic minorities,
- Participatory planning involving the affected people,
- Detailed development plans (infrastructure, public health, or other services),

- Organizational capacity for implementation of and action plan for developments for local communities, and
- Cost estimate, financing plan and implementation schedule for the development action plan of ethnic minorities.

The area of land to be allocated to each settler will vary with land capability, the crops to be grown, traditional and other economic activities and the family income target. In general, there is a tendency to over-estimate the fertility of the soils of lands to be used for settlement. The size of holding provided should be workable within the labour available within the family and the community and sufficient to produce an adequate income, without imposing a strain on its capacity for sustained production.

The above general comments are of special significance to some of the projects proposed in the Master Plan such as Dong Nai No. 3 and Song Luy reservoir, since they are located in areas where ethnic minority groups are present. Additional comments relating to specific social issues for the Master Plan projects are included in the summary of IEE for the master plan projects included in subsequent Section 9.2.

## **9.2 Initial Environmental Examination for the Master Plan Projects**

### **9.2.1 Introduction**

This Initial Environmental Examination (IEE) provides preliminary consideration of the main projects recommended in the Master Plan Study. It does not include IEE for those projects such as Dai Ninh, Ham Thuan-Da Mi, Dong Nai No. 6 and Dong Nai No. 8 reservoir projects and Hoc Mon/North Binh Chanh and Phuoc Hoa for which EIAs have recently been completed or are in progress. This IEE focuses on those projects or groups of projects which are considered likely to proceed to feasibility and design studies next. It is to be noted that all projects considered during this Master Plan Study are of such a nature and size that full EIAs would need to be completed to satisfy both Viet Nam's National Environment Agency (NEA) and international or bilateral lending agencies.

The projects and scope of coverage in the IEEs included in this Section are as follows:

- a) Dong Nai No. 3 and 4 projects as it is recommended they be constructed jointly and as examples of new main stream projects with hydropower generation as the main purpose,



- b) Fu Mieng project as a multipurpose project involving transbasin diversion of water and having external implications relating to downstream water quality management in the HCMC area,
- c) Song Luy reservoir and Phan Thiet/Phan Ri plains irrigation schemes as a combined reservoir and irrigation project involving integrated use of water diverted for hydropower (i.e. Dai Ninh No. 2 project) and local catchment water (i.e. Song Quao, Song Luy and Ca Giay reservoirs),
- d) Five (5) groups of irrigation projects (refer to Table 9.1) included in the Master Plan which are to be planned and implemented between the year 1996 and 2015, and
- e) Bien Hoa-Vung Tau Water Supply Pipeline Project; as the main urban and industrial water supply scheme for the Ho Chi Minh/Bien Hoa/Vung Tau economic development zone (for reference).

General and comparative comments relating to the environmental implications of other projects such as the Dong Nai River mainstream reservoir schemes are also included.

The scope and extent of the IEBs presented vary according to the information readily available but do provide a basis for framing Terms of Reference for the EIAs which would be required for each of the projects examined. It must be emphasised that these analyses are preliminary, that not all project implications may have been foreseen, and that there is a high probability that both the scope of the project and as a result, its environmental and social impacts will be altered during the feasibility studies for individual projects.

#### 9.2.2 Initial Environmental Examination (IEE) for Dong Nai No. 3 and Dong Nai No. 4 Hydropower Projects

##### (1) Project Objectives and Scope

The Dong Nai No. 3 and Dong Nai No. 4 are separate projects proposed under cascade development of the upper Dong Nai River. In particular, storage and re-regulated flows from Dong Nai No. 3 substantially enhance the power generation outputs from Dong Nai No. 4 project. Also, the access to the project for construction may be from a common regional centre, Dak Nong in Dak Lac Province; an undeveloped area so secondary local benefits would occur from improved roads associated with project development.

The basic objectives and scope of Dong Nai No. 3 and 4 projects include:

- a) Construction and operation of a 180 MW hydro project at Dong Nai No. 3 based on a 2,428 km<sup>2</sup> catchment area excluding all of the Dong Nai catchment above Dai Ninh project,
- b) Construction and operation of a 240 MW hydro project at Dong Nai No. 4 based on a 2,597 km<sup>2</sup> catchment area and re-regulated flows from Dong Nai No. 3 project, and
- c) Additional firm power generation benefits at Tri An project downstream and for dry season flows in Dong Nai River sections through Cat Tien National Park and below Tri An reservoir, including Hoa An water supply intake for the HCMC-Bien Hoa-Vung Tau economic development zone.

(2) Summary of Project Description

Dong Nai No. 3 Project

Dong Nai No. 3 project would have the following features:

- a) A 84 m high rockfill dam across a narrow section of the Dong Nai River approximately 3 km east of the nearest village with an excavated spillway on the right bank,
- b) A 180 MW underground power station on the left bank with an estimated annual output of some 490 GWh, and
- c) A 40 km<sup>2</sup> reservoir based on a Full Supply Level of 570 m and a Minimum Operating Level of 540m and an active storage volume of some 900 million m<sup>3</sup>.

Dong Nai No. 4 Project

The proposed Dong Nai No. 4 project would be located about 8 km southwest of the village of Quang Khe which is accessible to National Highway 14 approximately 15 km southwest at Dak Nong. The main features of Dong Nai No. 4 project include:

- a) A 102 m high rockfill dam across a gorge section of the Dong Nai River and utilising the additional 155 m of head across a horseshoe bend in the river downstream by constructing a 4.9 km long headrace tunnel and a left bank excavated spillway,
- b) A 240 MW underground power station on the left bank with an estimated output of some 600 GWh based on regulated flows from Dong Nai No. 3 project, and
- c) An 6 km<sup>2</sup> reservoir based on a Full Supply Level of 440 m and a Minimum Operating Level of 430 m and a active storage volume of some 50 million m<sup>3</sup>.

## Maps and Diagrams of Projects

The location map of the projects is shown in Figure 9.2, and for the detail layout, refer to Appendix V.

### (3) Existing Environmental Situation

#### Project Area

Dong Nai No. 3 and 4 projects are located in a relatively inaccessible middle section of the Dong Nai River. Vehicular access is limited to tracks passable in the dry season only and which have been constructed for military or logging purposes. River gradients are steep being characterised by rock outcrops, and numerous sections of rapids. No major waterfalls exist on the main river but do occur seasonally on some small tributary streams.

Estimates of average monthly discharge at the individual damsites were made over a 30-year period using a combination of historic flow from data upstream and downstream, rainfall and appropriate hydrological estimating procedures as outlined in Appendix III.

The proposed reservoir areas of the Dong Nai No. 3 and 4 projects are virtually undisturbed and would involve flooding of riverine fringe forests with relatively high wildlife habitat values and adjacent areas which are bamboo forests in the case of Dong Nai No. 3 and bamboo (left bank) and evergreen (right bank) in the case of Dong Nai No. 4 project. All these ecosystems are widely distributed in Central Viet Nam with equivalent habitats both upstream and downstream along the Dong Nai River, including in Cat Tien Natural Park located some 20 km downstream of Dong Nai No. 4 project (refer to Figure 8.1).

The general distribution of wildlife in the project area would be similar to equivalent habitats in Cat Tien National Park and probably the upper La Nga (Ham Thuan project) areas. However, it is indicated through discussions with local communities that the Javan Rhinoceros areas do not exist in the proposed reservoir areas. The indicated species of the main groups of animals are presented in Table 5.2 plus the following preliminary comments:

- a) Riverine forest habitats would be most important with probably good populations of primates (gibbons and macaque), otter and birds such as hornbills and kingfishers which are of interest conservation groups.
- b) The presence of big and small cats is probable, although local residents indicated that Tiger has not been seen or has not taken livestock in recent years.
- c) There is a low probability of species of conservation interest such as Gaur, or Crocodile and birds such as White-winged duck or Storks occurring in the areas affected by the proposed reservoirs.

- d) Some species of conservation interest such Asian elephant, Malayan sun bear, Dhole (wild dog) and small cats. Flying squirrels, pheasants and pythons are like to occur in the areas affected by the reservoirs.
- e) Exploitation of wildlife in the areas is limited due to difficulties with access but provision of good roads associated with development either dam/reservoir project would alter this situation adversely, requiring wildlife protection measures to control illegal hunting and gathering.

It is indicated from the aquatic ecology studies for the Ham Thuan-Da Mi Hydropower Project that the species diversity of zoo benthos both in the rivers and streams of the mountaneous region is limited with aquatic insects forming the main biomass. This is probaly also applicable to the Dong Nai No. 3 and 4 project areas, but species numbers and diversity could be less due to the torrential nature of the water courses in these areas.

There are only limited communities located in and near the ares affected by the project and the nearest villages to the damsite/reservoir in each case are of the order of 4 to 8 km away. The villages indicated to be immediately upstream of the Dong Nai No. 3 damsite (ie B'Koi-Da and B'Koi Dang 1 and 2) have been relocated to ridge sites in the B'sre area above proposed reservoir level. Continued use of these areas and the groups involved and their customary rights to the areas in the reservoir area need to be confirmed. Likewise the traditional use and rights of the Dak Plao community in the upper reservoir area need to be investigated and documented. Human use of the area is limited at present to opportunities for exploitation of forest, fruits and leaves, bamboo, rattan, wildlife (hunting and trapping) and fish. No local communities are entirely dependent on the forests of the proposed reservoir areas for their subsistence or income.

#### Regional Environment

The above description of the natural features of the project area for Dong Nai No. 3 and 4 also applies to main river valleys at the regional scale. Away from the Dong Nai River, encroachment into undisturbed forests from both directions towards the Dong Nai River as well as, re-occupation of old shifting cultivation upland areas in both Dac Lac and Lam Dong Provinces is occuring rapidly. It is indicated that commercial based and government induced development of coffee planting is expanding rapidly into zones accessible by main highways and district access roads. Shifting cultivation is evident in the tributary catchment upland zones located some 2.5 to 4.0 km from both damsites. In the case of Dong Nai No. 4, this farming is located in areas where access has been provided by logging tracks.

A chain of small lakes is located in the right bank tributary entering the Dong Nai immediately downstream of the Dong Nai No. 3 dam. The aquatic ecology of these has been disrupted by clearing of lands for coffee plantations but they should be investigated during any EIA field

surveys for the Dong Nai No. 3 and 4 projects. Similarly, the geological origins and land status of the topographically complex (maturely dissected) areas on either side of the Dong Nai No. 3 reservoir need to be determined, and their susceptibility to erosion investigated in order to protect the reservoir (i.e. erosion is already evident in areas developed along the ridges).

The Dong Nai No. 4 project reservoir is located mainly within the main river valley, but is more accessible with a relatively good access road to Quang Khe located 6 to 8 km east of the damsite. The direct catchment of the Dong Nai No. 4 project below Dong Nai No. 3 dam is 169 km<sup>2</sup> and logging tracks lie within 2 km, so a watershed management programme is definitely required to protect this area from erosion associated with agriculture development for the coffee and shifting cultivation.

The Mnong and other ethnic minorities residing in the nearby communities of Dak Plao and B'sre are traditional groups undertaking shifting cultivation for upland rice and most recently coffee as the main cash crop. Discussions with district Peoples' Committees indicate long term plans for the following:

- a) Upgrading of the link road (Route 724) between Dinh Trang Thuong (Lam Dong) and Dak Nong (Dac Lac province).
- b) Programmes to control shifting cultivation by minority groups by consolidation into communities, assistance with crop diversification, mainly coffee but also other cash crops, and provision of health and education facilities and services.
- c) Reforestation through community agroforestry projects under the "Doi Moi" policy and barren lands rehabilitation programme.

A brief socioeconomic profile of the Dak Plao community which could be directly affected by the Dong Nai No. 3 project is included as Attachment D. A more comprehensive evaluation and documentation of the regions environmental and social setting and the interrelationship with the project areas are needed in the EIA.

#### (4) Critical Environmental Issues of the Projects

##### Alteration to Regime and Downstream Effects

Both independently and combined, the Dong Nai No. 3 and 4 projects would have important effects on the zones immediately downstream of the dams. However, these impacts would be reduced substantially due to:

- a) Inflows 1.0 km downstream of the Dong Nai No. 3 damsite from the 672 km<sup>2</sup> catchment of the Dak R' Mang (right bank),

- b) Inflows 2.0 km downstream of the Dong Nai No. 4 damsite from the 420 km<sup>2</sup> Dak Sa Klong catchment (right bank), and
- c) Inflows downstream of the Dak R' Tih (right bank catchment area of 718 km<sup>2</sup>) and Da Siat (left bank catchment area of 115 km<sup>2</sup>) below the Dong Nai No. 4 power station outlet.

These inflowing tributaries located between and immediately downstream of the Dong Nai No. 3 and 4 projects would effectively mitigate any problems associated with reduced flows and water quality during periods when these power stations are not operating (due to maintenance, etc). Replenishment of water quality to ecologically acceptable levels would occur downstream of Dong Nai No. 3 and 4 projects during flood flows from dam spills and floods from the above indicated tributaries.

A detailed evaluation of effects on downstream regime and water quality is required in the EIA based on simulated inflows and power station releases, tributary flows and flooding. However, it can be safely stated that changes to regime and water quality associated with the Dong Nai No. 3 and 4 projects would not adversely affect Cat Tien National Park or riverine forests and their uses (very limited) in the areas above Cat Tien National Park.

#### Aquatic Ecology Aspects

##### a) Reservoir Water Quality

The water quality of the Dong Nai No. 3 and 4 reservoirs would be entirely dependent on the extent to which clearing of vegetation is undertaken. With relatively small reservoir areas (i.e. 40 km<sup>2</sup> for Dong Nai No. 3 and 6 km<sup>2</sup> for Dong Nai No. 4), it may be possible to log and extract forest products from the majority of the reservoir areas based on use of altimeters and GPS equipment. Rafting of bamboo for recovery after reservoir filling may also need to be considered due to topography constraints in both the reservoir areas.

Predictions of Dissolved Oxygen (DO) levels in the reservoirs should be undertaken for the EIA study based on forest inventory/biomass surveys and assumptions regarding the effective extent of clearing. Without clearing, water quality problems could occur due to the relatively dense vegetation cover and the fluctuating nature of both Dong Nai No. 3 and 4 reservoirs.

##### b) Reservoir Ecology

The reservoir ecology likely to occur in the Dong Nai No. 3 and 4 reservoirs would be similar to that for the Ham Thuan (25 km<sup>2</sup> in an area with similar vegetation). Thus, monitoring of water quality, primary productivity and basic ecological parameter during impoundment and stabilisation of Ham Thuan and Da Mi reservoirs is important for future development in the Dong Nai River basin. Extrapolation of aquatic ecology from other reservoir projects located either in southern Viet Nam (e.g. Thac Mo) and the north (e.g. Hoa Binh) should be

undertaken with caution. More detailed analysis of the aquatic ecology is required in the EIA study.

c) Fisheries Potentials

The annual productivity rates and potential yields for reservoir fisheries could be limited due to several factors including:

- Relatively narrow deep reservoirs characterised by drawdowns of 25 to 30 m, seasonally within one year,
- Low primary productivity due to limited nutrients present in river inflows and cooler water temperatures in the reservoirs,
- Potential thermal or chemical stratification during the winter season due to ambient temperatures and decaying biomass from seasonally exposed drawdown zones, and
- Diminished species diversity of fish due to relatively few river species being naturally adaptable to reservoir conditions and effects of the dams on fish migration for breeding purposes in the Dong Nai and tributaries of the project area and upstream.

Comprehensive surveys of aquatic resources including zoobenthos and fisheries of tributary streams are essential inputs to the EIA. There is no scope for mitigating measures such as fish passage facilities. Only with a reservoir fisheries management program based on a local hatchery for producing suitable species for stocking of the reservoirs and controls on open water fisheries the fisheries potentials of the Dong Nai No. 3 and 4 reservoirs could be realised.

Terrestrial Ecology

a) Vegetation and Forestry Projects

The exact status of the lands within and around the proposed reservoir is uncertain, but these are indicated to be "forestry lands". The vegetation cover is mainly disturbed forests except in the inaccessible tributary and main river valleys where undisturbed riverine gallery forests remain. It is indicated that:

- Over 30 % of the Dong Nai No. 3 and 4 projects' catchment area remains as forest and 80 % of the inter-project catchment area of 169 km<sup>2</sup> above the Dong Nai No. 4 dam site remains as forest.
- Some losses in biodiversity would occur particularly in the riverine vegetation where rarer plants such as orchids, medicinal plants, mosses and so on occur.

- Shifting cultivation and land clearing for agricultural development in both Dai Linh and Dak Nong districts are reducing the extent of forest cover and also promoting additional immigration for shifting cultivation and planting of cash crops, particularly coffee.
- Reforestation and watershed management programmes for the Dong Nai No. 3 and 4 projects downstream of the Dai Ninh project would need to involve forestry authorities from three provinces and four districts.

In addition to detailed mapping of the forest cover in the reservoir areas, catchment area maps (e.g. 1:100,000) delineating land use, land status, general forest cover and forestry and land development projects (either ongoing or proposed) in the catchment should be included in the EIA study.

#### b) Habitat and Wildlife

The reservoirs would adversely affect local wildlife habitat and populations to a varying extent, but the main impacts would focus on:

- Loss of some 46 km<sup>2</sup> of mainly bamboo forests and minor quantities of evergreen and riverine (gallery) forests with associated losses to wildlife such as gibbons, otters, squirrels, small cats and fruit bats which would dominate the losses of mammals and bird species such as kingfishers,
- Habitat losses and disruptions through the reservoir's barrier effects to wide ranging species such as elephant, wild dog and the bigger cats, if they still occur in the area,
- Unknown effects on and losses of smaller ground-based mammals, reptiles and amphibians which have small and specific habitats significant on a local area, if not sub-regional scale,
- Further (but probably acceptable) decreases in the continuous upland forest habitat and wildlife populations, provided all Dong Nai mainstream projects (i.e. cascade type reservoir developments) are not put into effect, and
- A potential for project induced effects on wildlife through improved access and new communities resulting in increased exploitation has to be recognised, and appropriate controls included in project development and watershed management programmes during feasibility studies.



## Socioeconomic and Resettlement Aspects

### a) Socioeconomic Situation

The areas directly affected and surrounding the Dong Nai No. 3 and 4 projects remain relatively undeveloped, but rapid changes are occurring within a 2 to 3 km along roads and in old areas of shifting cultivation. Use of these areas was originally limited to occasional hunting or gathering by ethnic minority groups using the forests. Opening-up of the areas to logging activities followed by immigration for development has occurred since the year 1980. The main migrants in this period were Kinh who came as state enterprise employees (i.e. forest or farm estates) and who has created some new communities based on allocation of lands as private farms. Most recently, post 1990, some ethnic minority groups such as Hmong and Tay have moved into selected areas to practice shifting cultivation and to exploit local forests for minor forest products such as rattan, fruit, leaves (la rung) and bamboo and its shoots and wildlife products.

The main access route into the projects is via the old Route 724 (to become National Highway No. 8) from Dac Nong and logging roads taking off from this road. It is probable that continued immigration from outside by ethnic minorities will continue into the catchment areas of the Dong Nai No. 3 and 4 projects.

The main communities in the vicinity of the Dong Nai No. 3 and 4 projects are as follows:

- Dong Nai No. 3 - B'sre (90 to 100 families) east of the damsite and Dak Plao (225 families) near the top end of the reservoir with B'sre well above proposed reservoir FSL of 570 m and Dak Plao, probably located on an island, requiring a causeway to access it. This aspect as well as the extent to which Route 724 south from the Dong Nai River to Dinh Trang Tuong would be flooded needs to be verified by topographical survey. Also the seasonal occupation and use of areas in the Dong Nai main valley upstream of the damsite need to be confirmed. A socioeconomic profile for the Dak Plao Community is summarized in Attachment D.
- Dong Nai No. 4 - Quang Khe consisting of 250 to 260 families plus several outlying hamlets to the north along Route 724 and to the east toward the damsite is all located above the proposed reservoir levels.

Mitigation measures provided in respect of habitat and wildlife should include project funding of acquiring replacement habitat or provisions for wildlife protection either within the project area or Cat Tien National Park (e.g. northern section in Lam Dong province which is important for special conservation programmes such as that for the Javan rhinoceros). Other mitigation measures should include consideration of wildlife access to water, river crossings problems,

habitat preservation and wildlife protection as integral parts of watershed management programme for the Dong Nai No. 3 and 4 projects. Extensive inputs to the habitat and wildlife inventory, assessment and mitigation measures will be required during the preparation of the EIA for the project.

The main potential socioeconomic effects of the Dong Nai No. 3 and 4 projects would be indirect and would include:

- Economic expansion of the two districts centres nearest the project; Di Linh to the south in Lam Dong province and Dak Nong to the north in Dac Lac province.
- Upgrading of Route 724, eventually to be National Highway No. 8 linking Dak Nong and Di Linh as well as associated effects particularly relating to;
  - i. Improved access for existing communities to local and regional markets,
  - ii. Localised benefits to existing or new business located along this road (i.e. 80 km), and
  - iii. Secondary benefits to local communities for access to schools, health facilities and services and so on located in district centres of Dac Nong and Di Linh.
- Adverse effects on land and forest resources due to further pressure for land development and forest area exploitation and in-migration due to employment opportunities.
- Opportunities to consolidate regional and area development plans due to improved infrastructure, communications and diversification of the local economy.

b) Resettlement Requirements

Compensation and resettlement requirement as presently indicated for the Dong Nai No. 3 or 4 projects are considered to be acceptable. Other minor ones including those associated with access road improvements are also acceptable as part of the projects. The situation could alter however between now and project construction due to ongoing influx of people to the general area. A "land freeze" on permanent occupation and allocation of land in the reservoir and their immediate tributary catchment within 3 to 4 km of the reservoir margins should be considered by the provincial, district and community People's Committees involved.

The extent of compensation and resettlement requirements for the Dong Nai No. 3 and 4 projects is uncertain as indicated above. It is possible that Dac Nong's Dak Plao community of 225 households may need to be relocated for the Dong Nai No. 3 project. No communities

presently exist in the southern sector of the proposed Dong Nai No. 3 reservoir in Di Linh district.

The EIA Report for Dong Nai No. 4 project prepared by the Environmental Centre of FIPI states that no families are located in the Dong Nai No. 4 reservoir area, but this aspect should be reconfirmed during Feasibility Study.

Up to 6 km of Route 724 located between Dinh Trung Thuong and the Dong Nai River in Bao Loc district may need to be wholly or partially part relocated.

c) **Public Health Aspects**

There are no obvious public health risks associated with the proposed Dong Nai No. 3 and 4 projects due to the deep reservoir's, steep drawdown zones involved and the absence of local communities. Malaria is endemic to the area and represents a risk in terms of construction camp operations. Preventative and therapeutic measures as well as monitoring of the malaria situation in local communities need to be included as part of the EIA Report's mitigation considerations and any overall project related public health action programme.

Erosion Control and Watershed Management

The catchment areas of the Dong Nai No. 3 and 4 reservoirs have maturely dissected topography and zones susceptible to erosion, particularly in the immediate vicinity of the Dong Nai No. 3 reservoir. Consequently, the EIA Report should include an assessment and mapping of erosion hazards and preparation of a basic watershed management strategy (i.e. action plan) including cost estimates. These costs should be included as part of the project's economic analyses during the Feasibility Study phase.

(5) **Mitigation Measures and Residual Effects**

The main mitigation measures required for the Dong Nai No. 3 and 4 projects can be summarised as follows:

- a) Clearing of the reservoirs to the greatest extent practical to enhance water quality and to minimize any problems associated with water use downstream,
- b) Undertaking new detailed large-scale topographic mapping of the reservoir areas not only for storage volume calculations but also for determining the extent of relocation required for Dak Plao and Route 724 in the upper reservoir of Dong Nai No. 3 project,
- c) Preparing and implementing a reservoir fisheries management programme based on field surveys and monitoring of upland reservoirs, particularly Ham Thuan, Da Nhim and Dai Ninh,

- d) Up-to-date detailed mapping of forest type and status and local forestry projects are required at the Feasibility/EIA Study phase as a basis for developing a watershed management strategy and programme including erosion controls near the reservoirs,
- e) An inventory and assessment of ecology including habitat and wildlife assessments are needed to make recommended actions regarding:
  - Possible funding of replacement habitats or specific conservation mitigation actions, and
  - Habitat preservation and wildlife protection and management in the project area including the riverine zone between Dong Nai No. 4 damsite and its power station,
- f) Area and regional development action plans should be formulated to facilitate project implementation, to provide for involvement of local communities and to minimise adverse socioeconomic effects such as uncontrolled in-migration and associated land clearing and development along project access roads, and
- g) A public health monitoring and a disease prevention and control plan focussing on malaria problems should be included as part of the development action plan in the projects area.

(6) Conclusion and Recommendations

The Dong Nai No. 3 and 4 projects, although located in relatively remote areas, could be constructed and operated in an environmentally acceptable way. The main environmental adverse effects would relate to further losses in riverine habitat of the Dong Nai River system. This could be acceptable, provided the extent of losses of the habitat type does not extend completely along the Dong Nai River through cascade type dam and reservoir development. It is considered that socioeconomic benefits would accrue in the long term relating to local, district and regional development, provided in-migration for land development in the catchment is controlled.

The exact elevation of the Dak Plao community and its associated hamlets as well as traditional lands used by the minority groups (Mnong) and the project effect on this community require special attention (including an anthropological survey) at an early stage so that a comprehensive Resettlement or Indigenous Peoples Action Plan can be prepared to comply with any multilateral lending agency's requirements (e.g. World Bank or ADB). In effect, investigation covering both Dong Nai No. 3 and 4 projects and the ethnic minority communities would be advisable to avoid criticism of the project effects on these communities.