

 : Master Plan Study/Feasibility Study/Investigation  
 : Detailed Design  
 : Construction

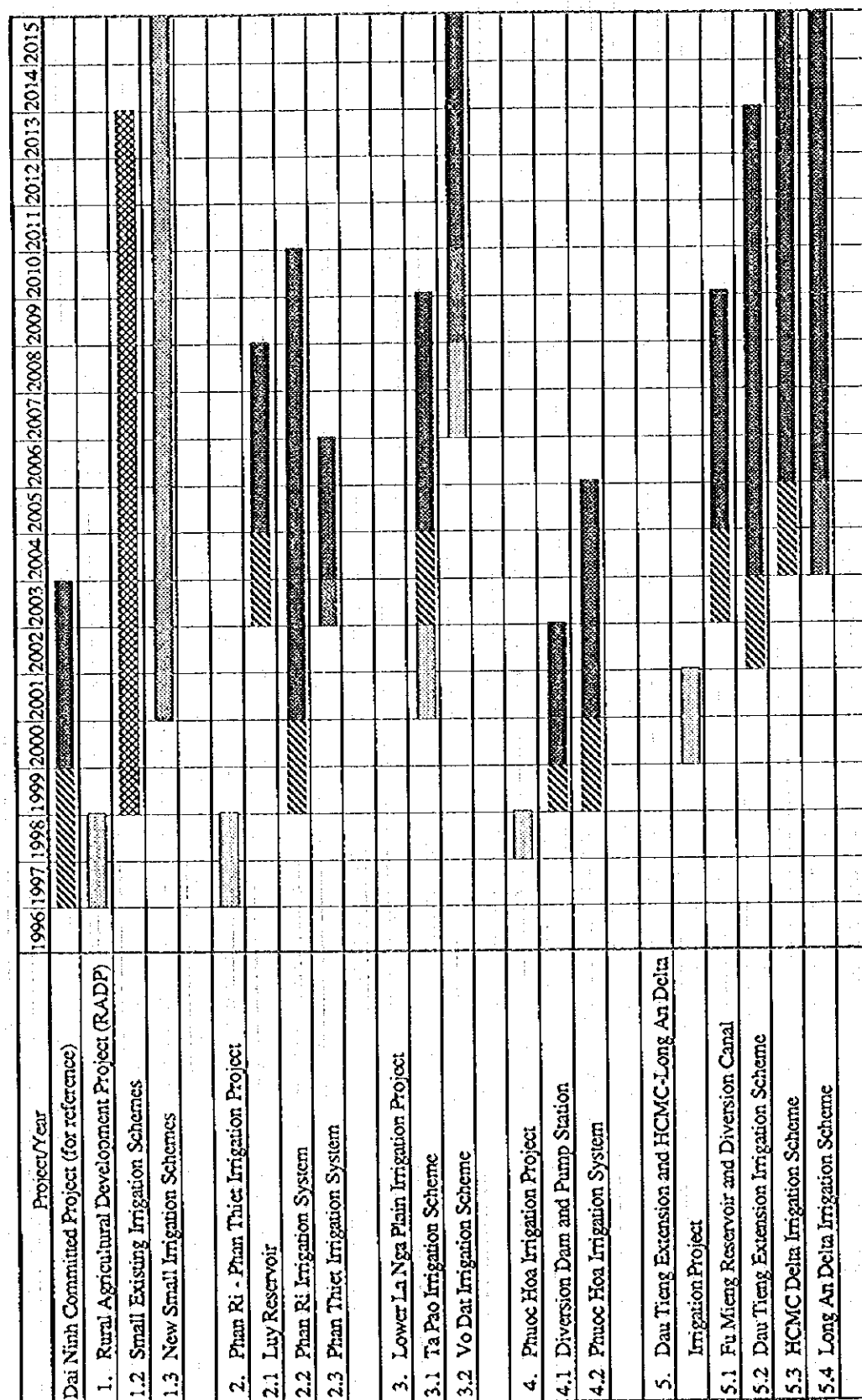
SOCIALIST REPUBLIC OF VIET NAM  
 MASTER PLAN STUDY ON DONG NAI RIVER  
 AND SURROUNDING BASINS  
 WATER RESOURCES DEVELOPMENT

JAPAN INTERNATIONAL COOPERATION AGENCY

Figure 4.2

Implementation Sequence of Master Plan Project for the Hydropower Sector





: Master Plan Study/Feasibility Study

: Design

: Construction

: Construction in parallel with Design

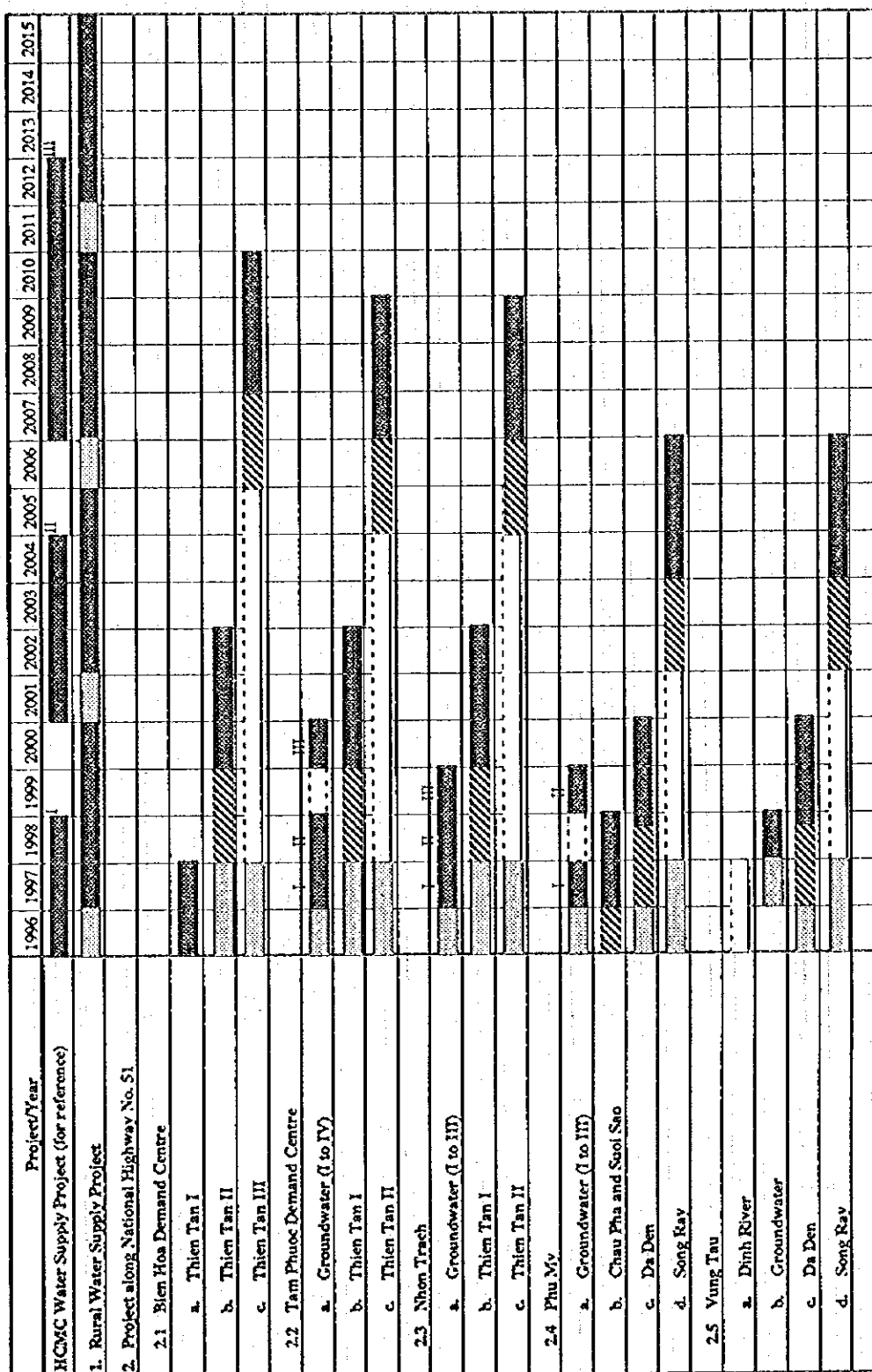
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AND SURROUNDING BASINS  
WATER RESOURCES DEVELOPMENT

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Figure 4.3

Implementation Sequence of Master Plan  
Projects for Irrigation Sector





Master Plan Study/Feasibility Study/Investigation

Detailed Design

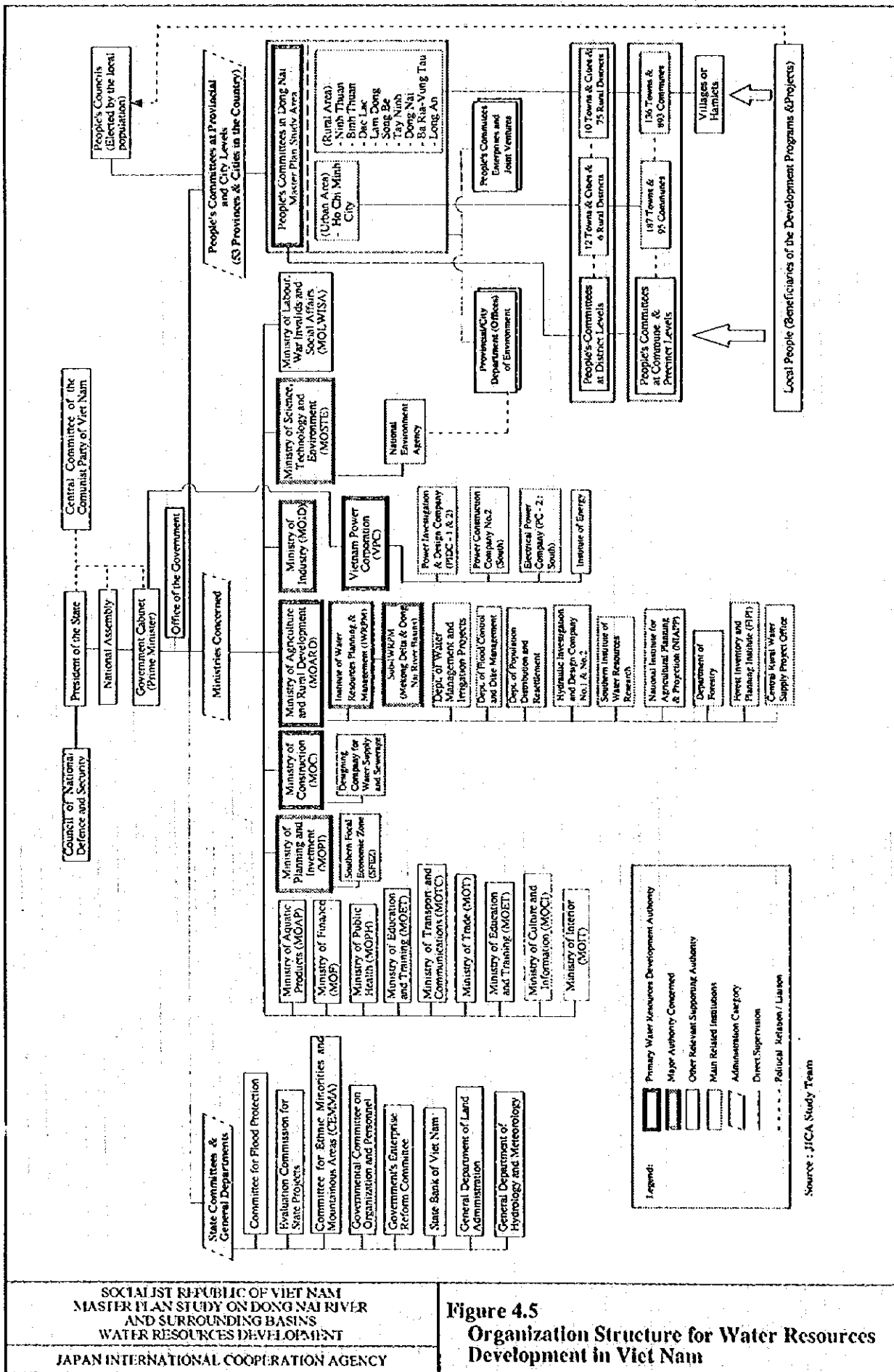
Construction

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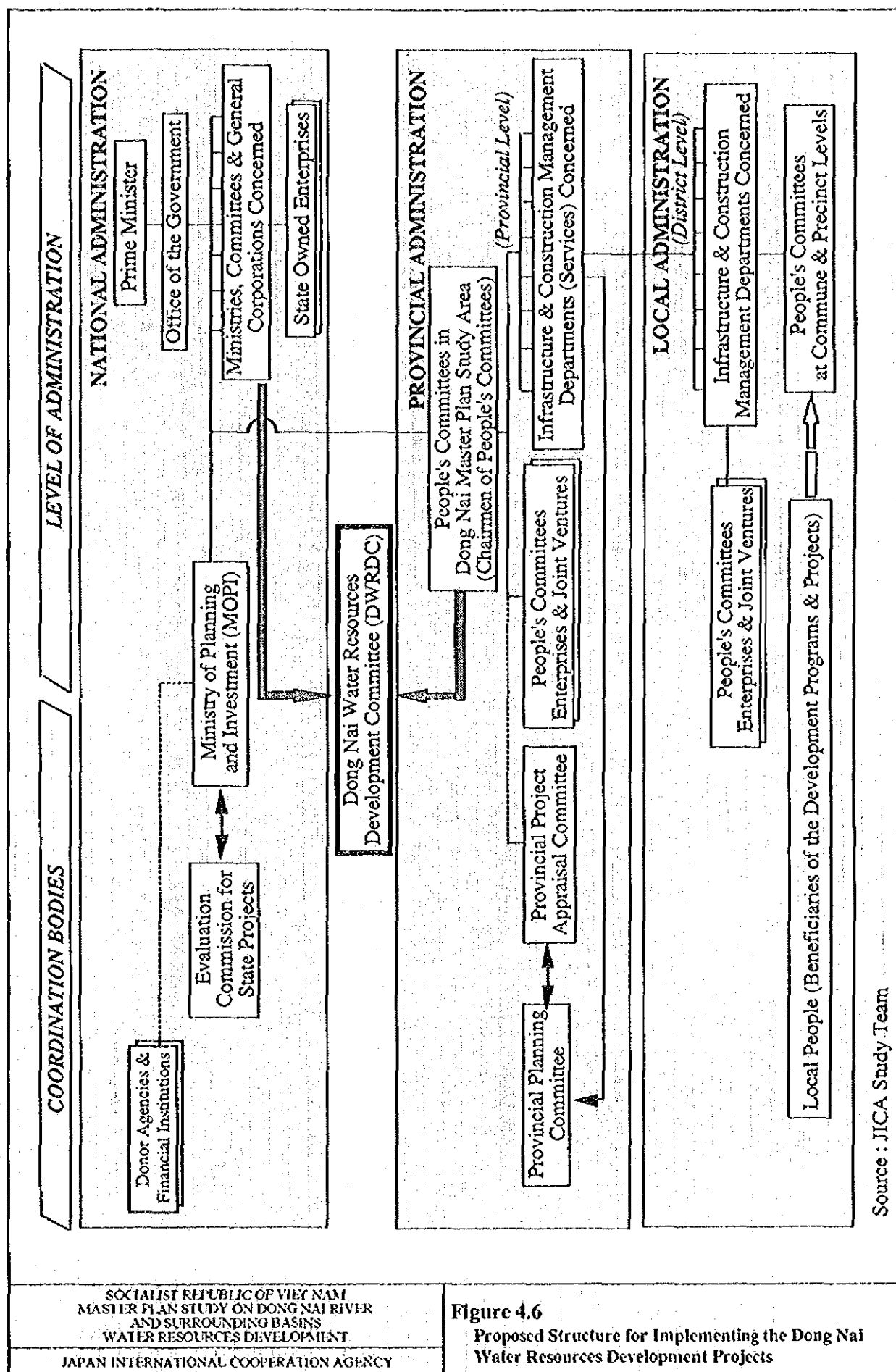
Figure 4.4  
Implementation Sequence of Master Plan  
Projects of the Water Supply Sector





**Figure 4.5**  
**Organization Structure for Water Resources Development in Viet Nam**





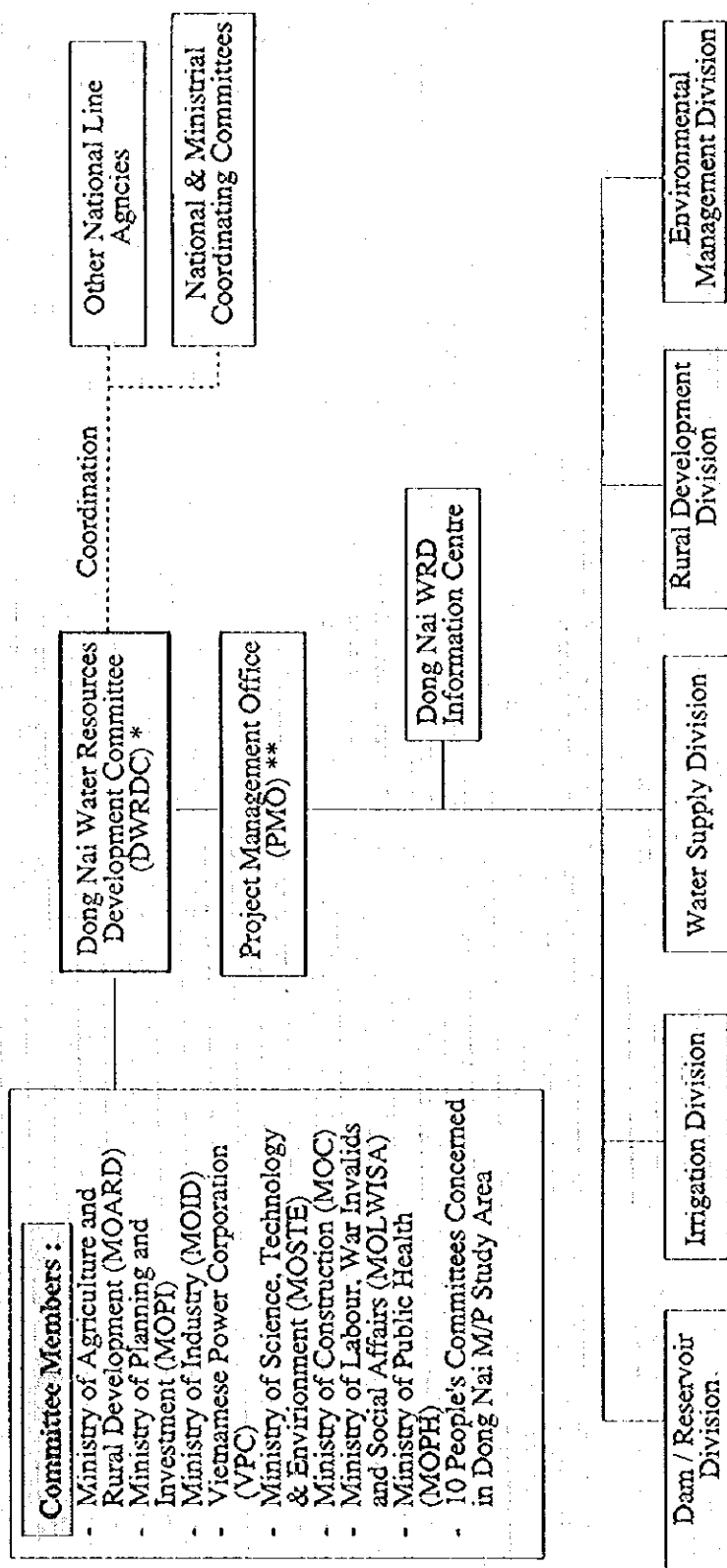
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AND SURROUNDING BASINS  
WATER RESOURCES DEVELOPMENT

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**Figure 4.6**

**Proposed Structure for Implementing the Dong Nai Water Resources Development Projects**





Legend : ——— Direct Supervision or Relationship  
 ..... Cooperative or Coordinative Linkage

Notes : \* DWRDC consists of 18 members from the government agencies, corporation and people's committees concerned. The Council is headed by a representative of the MOARD.

\*\* Project Management Office (PMO) consists mainly of representatives of MOARD, MOPI, MOID, VPC, MOC and other development agencies.

Source : JICA Study Team

Figure 4.7  
 Structure of Project Management System  
 for the Dong Nai WRD Projects



# **Attachment-1**

## **Dong Nai Mixed Integer Programming Model**







## Attachment-1 Dong Nai Mixed Integer Programming Model

### Objective function

$$\begin{aligned}
 & \text{Max} \{ BP, \sum_t \sum_i GE_{it}, && \text{for } t = 1 \text{ to } 12 \text{ and } i=1 \text{ to } 5 \\
 & + BI_j \sum_i I_i && \text{to select one of six irrigation benefit patterns} \\
 & && \text{for } i=6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16 \\
 & && \text{and } 17 \\
 & + 365 \times BM \sum_i HCM_i && \text{for } i=18 \text{ and } 19 \\
 & - \sum_i CD_i (H_i) && \text{for } i=1, 2, 3, 5 \text{ and } 8 \\
 & - \sum_i CT_i (P_i) && \text{for } i=1, 2, 3 \text{ and } 5 \\
 & - \sum_i CPI_i (PI_i) && \text{for } i=5 \text{ or } 6, 8 \text{ and } 12 \\
 & - \sum_i CI_i (I_i) && \text{for } i=6, 7, 8, 9, 10, 11, 13, 14, 16 \text{ and } 17 \\
 & - \sum_i CM_i (HCM_i) && \text{for } i=18 \text{ and } 19
 \end{aligned}$$

### Conditions for each project

1. Dam
  - a. Site 1 is committed; that is, the scale optimization is sought, even if the project itself is determined to be constructed by the year 2015.
  - b. Site 2, 3, 5 and 8 are planned. Among them, Site 8 is for irrigation.
  - c. Site 4 and 7 are existing.
2. Irrigation
  - a. Site 12 and 15 are existing.
  - b. Other irrigation sites are planned.
  - c. The diversion canal to Site 14, DQ<sub>12</sub>, (West Canal) is to be extended, whilst the portion between Sites 7 and 12 (East Canal) is completed.
  - d. There are two mutually exclusive alternatives for the trans-basin diversion from the Be River to the Saigon River; DQ<sub>5</sub> and DQ<sub>6</sub>.



- e. Irrigation water for the Phan Thiet area is to be supplied from the Dong Nai River through PQ<sub>1</sub> and DQ<sub>8</sub>.

### 3. Water Supply

- a. Site 18 requires to draw water not only for the supply to Ho Chi Minh City but also for the supply to Bien Hoa and Economic Triangle Zone.
- b. Site 19 is the intake for the water supply to Ho Chi Minh City.

#### Constraints

##### Site 1 (Dai Ninh)

$$\begin{aligned}\frac{S_{1,t+1}}{k_1} - \frac{S_{1,t}}{k_1} &= Q_{1,t} - R_{1,t} - PQ_{1,t} \\ GE_{1,t} &= 9.8 \times \eta \times PQ_{1,t} \times (HC_1 + HV_{1,t}) \times \frac{k_1}{3,600} \\ PQ_{1,t}/PF_1 &\leq P_1 \\ P_1 &\leq PQMAX_1 \\ S_{1,t} + DV_1 &\leq V_1 \\ V_1 &\leq VMAX_1 \\ S_{1,t} &= f(HV_{1,t}) \\ HV_{1,t} &\leq H_1 \\ H_1 &\leq HMAX_1\end{aligned}$$

##### Site 2 (Dong Nai No. 3)

$$\begin{aligned}\frac{S_{2,t+1}}{k_1} - \frac{S_{2,t}}{k_1} &= Q_{2,t} - Q_{1,t} + R_{1,t} - PQ_{2,t} - R_{2,t} \\ GE_{2,t} &= 9.8 \times \eta \times PQ_{2,t} \times (HC_2 + HV_{2,t}) \times \frac{k_1}{3,600} \\ PQ_{2,t}/PF_2 &\leq P_2 \\ P_2 &\leq PQMAX_2 \cdot y_2 \\ S_{2,t} + DV_2 \cdot y_2 &\leq V_2 \\ V_2 &\leq VMAX_2 \cdot y_2 \\ S_{2,t} &= f(HV_{2,t} \cdot y_2) \\ HV_{2,t} &\leq H_2 \\ H_2 &\leq HMAX_2 \cdot y_2\end{aligned}$$



Site 3 (Dong Nai No. 4)

$$\begin{aligned}\frac{S_{3,t+1}}{k_t} - \frac{S_{3,t}}{k_t} &= Q_{3,t} - Q_{2,t} + R_{2,t} + PQ_{2,t} - PQ_{3,t} - R_{3,t} \\ GE_{3,t} &= 9.8 \times \eta \times PQ_{3,t} \times (HC_3 + HV_{3,t}) \times \frac{k_t}{3,600} \\ PQ_{3,t}/PF_3 &\leq P_3 \\ P_3 &\leq PQMAX_3 \cdot y_3 \\ S_{3,t} + DV_3 \cdot y_3 &\leq V_3 \\ V_3 &\leq VMAX_3 \cdot y_3 \\ S_{3,t} &= f(HV_{3,t} \cdot y_3) \\ HV_{3,t} &\leq H_3 \\ H_3 &\leq HMAX_3 \cdot y_3\end{aligned}$$

Site 4 (Tri An)

$$\begin{aligned}\frac{S_{4,t+1}}{k_t} - \frac{S_{4,t}}{k_t} &= Q_{4,t} - Q_{3,t} - Q_{11,t} + R_{3,t} + PQ_{3,t} + R_{11,t} + IR_{11,t} \times \\ &\quad RETURN_t - PQ_{4,t} - R_{4,t} \\ GE_{4,t} &= 9.8 \times \eta \times PQ_{4,t} \times (HC_4 + HV_{4,t}) \times \frac{k_t}{3,600} \\ PQ_{4,t}/PF_4 &\leq PQMAX_4 \\ S_{4,t} + DV_4 &\leq VMAX_4 \\ S_{4,t} &= f(HV_{4,t}) \\ HV_{4,t} &\leq HMAX_4\end{aligned}$$

Site 5 (Fu Mieng)

$$\begin{aligned}\frac{S_{5,t+1}}{k_t} - \frac{S_{5,t}}{k_t} &= Q_{5,t} - R_{5,t} - PQ_{5,t} - DQ_{5,t} \\ GE_{5,t} &= 9.8 \times \eta \times PQ_{5,t} \times (HC_5 + HV_{5,t}) \times \frac{k_t}{3,600} \\ PQ_{5,t}/PF_5 &\leq P_5 \\ P_5 &\leq PQMAX_5 \cdot y_5 \\ S_{5,t} + DV_5 \cdot y_5 &\leq V_5 \\ V_5 &\leq VMAX_5 \cdot y_5 \\ S_{5,t} &= f(HV_{5,t} \cdot y_5) \\ HV_{5,t} &\leq H_5 \\ H_5 &\leq HMAX_5 \cdot y_5 \\ DQ_{5,t} &\leq PI_5 \\ PI_5 &\leq DMAX_5 \cdot \chi_5 \\ \chi_5 &\leq y_5\end{aligned}$$



$$PI_5 = 60 \cdot u_1 + 70 \cdot u_2 + 80 \cdot u_3 + 90 \cdot u_4 + 100 \cdot u_5$$

#### Site 6 (Phuoc Hoa)

$$Q_{6,t} - Q_{5,t} + R_{5,t} + PQ_{5,t} = IR_{6,t} + R_{6,t} + DQ_{6,t}$$

$$IR_{6,t} = \text{UNIT}_{6,t} \cdot I_6$$

$$I_6 \leq \text{IMAX}_6 \cdot y_6$$

$$DQ_{6,t} \leq PI_6$$

$$PI_6 \leq \text{DMAX}_6 \cdot \chi_6$$

$$\chi_6 \leq y_6$$

$$\chi_5 + \chi_6 \leq 1$$

$$\text{MAND}_6 \cdot y_6 \leq R_{6,t}$$

$$PI_6 = 40 \cdot v_1 + 55 \cdot v_2 + 60 \cdot v_3 + 70 \cdot v_4 + 80 \cdot v_5$$

$$u_1 + u_2 + u_3 + u_4 + u_5 + v_1 + v_2 + v_3 + v_4 + v_5 \leq 1$$

#### Site 7 (Dau Tieng)

$$\frac{S_{7,t+1}}{k_t} - \frac{S_{7,t}}{k_t} = Q_{7,t} + DQ_{5,t} + DQ_{6,t} - DQ_{7,t} - R_{7,t} - IR_{7,t}$$

$$S_{7,t} + DV_7 \leq \text{VMAX}_7$$

$$DQ_{7,t} \leq \text{DMAX}_7$$

$$IR_{7,t} = \text{UNIT}_{7,t} \times I_7$$

$$I_7 \leq \text{IMAX}_7 \cdot y_7$$

$$\text{MAND}_7 \leq R_{7,t}$$

#### Site 8 (Phan Ri)

$$\frac{S_{8,t+1}}{k_t} - \frac{S_{8,t}}{k_t} = PQ_{1,t} + Q_{8,t} - DQ_{8,t} - R_{8,t} - IR_{8,t}$$

$$IR_{8,t} = \text{UNIT}_{8,t} \cdot I_8$$

$$I_8 \leq \text{IMAX}_8 \cdot y_8$$

$$S_{8,t} + DV_8 \cdot y_8 \leq V_8$$

$$V_8 \leq \text{VMAX}_8 \cdot y_8$$

$$DQ_{8,t} \leq PI_8$$

$$PI_8 \leq \text{DMAX}_8 \cdot \chi_8$$

$$\chi_8 \leq y_8$$

$$\text{SAMIN}_8 \cdot y_8 \leq R_{8,t}$$



Site 9 (Phan Thiet)

$$\begin{aligned}IR_{9,t} + R_{9,t} &= Q_{9,t} + DQ_{9,t} \\IR_{9,t} &= UNIT_{9,t} \cdot I_9 \\I_9 &\leq IMAX_9 \cdot y_9 \\SAMIN_9 \cdot y_9 &\leq R_{9,t}\end{aligned}$$

Site 10 (Ta Pao)

$$\begin{aligned}Q_{10,t} &= IR_{10,t} + R_{10,t} \\IR_{10,t} &= UNIT_{10,t} \cdot I_{10} \\I_{10} &\leq IMAX_{10} \cdot y_{10}\end{aligned}$$

Site 11 (Vo Dat)

$$\begin{aligned}Q_{11,t} - Q_{10,t} + R_{10,t} + IR_{10,t} \times RETURN_t &= IR_{11,t} + R_{11,t} \\IR_{11,t} &= UNIT_{11,t} \cdot I_{11} \\I_{11} &\leq IMAX_{11} \cdot y_{11}\end{aligned}$$

Site 12 (Dau Tieng Existing)

$$\begin{aligned}DQ_{12,t} &= DQ_{12,t} + IR_{12,t} \\IR_{12,t} &= UNIT_{12,t} \cdot I_{12} \\DQ_{12,t} &\leq PI_{12} \\PI_{12} &\leq DMAX_{12} \cdot y_{12}\end{aligned}$$

Site 13 (Tay Ninh Upper)

$$\begin{aligned}Q_{13,t} &= IR_{13,t} + R_{13,t} \\IR_{13,t} &= UNIT_{13,t} \cdot I_{13} \\I_{13} &\leq IMAX_{13} \cdot y_{13}\end{aligned}$$

Site 14 (Tay Ninh Lower)

$$\begin{aligned}Q_{14,t} - Q_{13,t} + R_{13,t} + IR_{13,t} \cdot RETURN_t + DQ_{12,t} &= IR_{14,t} + R_{14,t} \\IR_{14,t} &= UNIT_{14,t} \cdot I_{14} \\I_{14} &\leq IMAX_{14} \cdot y_{14}\end{aligned}$$



Site 15 (Dong Nai Reparian)

$$R_{4,t} + PQ_{4,t} + R_{6,t} = IR_{15,t} + R_{15,t}$$

$$IR_{15,t} = UNIT_{15,t} \cdot I_{15}$$

Site 16 (Long An Delta)

$$R_{14,t} + (IR_{7,t} + IR_{12,t} + IR_{14,t}) \cdot RETURN_t = IR_{16,t} + SA_{16,t}$$

$$IR_{16,t} = UNIT_{16,t} \cdot I_{16}$$

$$I_{16} \leq IMAX_{16} \cdot y_{16}$$

$$SAMIN_{16} \cdot y_{16} \leq SA_{16,t}$$

Site 17 (HCMC)

$$Q_{17,t} - Q_{7,t} + R_{7,t} + IR_{6,t} \cdot RETURN_t = IR_{17,t} + R_{17,t}$$

$$IR_{17,t} = UNIT_{17,t} \cdot I_{17}$$

$$I_{17} \leq IMAX_{17} \cdot y_{17}$$

Site 18 (Hoa An)

$$R_{15,t} + IR_{15,t} \cdot RETURN_t = DQ_{18,t} + SA_{18,t}$$

$$DQ_{18,t} = HCM_t / 86,400$$

$$SAMIN_{18} \leq SA_{18,t}$$

Site 19 (Phu Cuong)

$$R_{19,t} = DQ_{19,t} + SA_{19,t}$$

$$DQ_{19,t} = HCM_t / 86,400$$

$$SAMIN_{19} \leq SA_{19,t}$$



### Decision variables

- $S_{i,t}$  ; Active storage of the reservoir  $i$  in month  $t$ ,  $m^3$
- $R_{i,t}$  ; Release from reservoir or weir  $i$  without use in month  $t$ ,  $m^3/sec$
- $PQ_{i,t}$  ; Diversion from the reservoir or weir  $i$  for power generation in month  $t$ ,  $m^3/sec$
- $DQ_{i,t}$  ; Diversion from the reservoir or weir  $i$  for irrigation in month  $t$ ,  $m^3/sec$
- $GE_{i,t}$  ; Energy generation of plant  $i$  in month  $t$ ,  $kWh/month$
- $HV_{i,t}$  ; Head between the water level in month  $t$  and the minimum operating level,  $m$ , in the reservoir
- $P_i$  ; Maximum plant discharge of plant  $i$  or maximum diversion release for irrigation to be determined,  $m^3/sec$
- $H_i$  ; Head to be determined above  $HC_{i,n}$
- $PI_i$  ; Maximum diversion capacity from Site A to Site B,  $m^3/sec$
- $V_i$  ; Scale of reservoir  $i$  to be determined,  $m^3$
- $IR_{i,t}$  ; Irrigation requirement of month  $t$  on scheme  $i$ ,  $m^3/sec$
- $I_i$  ; Irrigation area to be developed at site  $i$ ,  $1,000$  ha
- $SA_{i,t}$  ; Release for salinity intrusion at site  $i$  on month  $t$
- $\chi_i, y_i, u_i, v_i$  ; Integer variables



## Parameters

$k_t$	; Seconds in month t, sec
$Q_{it}$	; Natural inflow of month t at point i, m <sup>3</sup> /sec
$\eta$	; Combined efficiency of turbine and generator (=0.85)
$HC_i$	; Head between the minimum operating level and the tail water level, m
$RF_i$	; Plant factor
$PQMAX_i$	; Maximum plant discharge of plant i, m <sup>3</sup> /sec
$DV_i$	; Dead storage of reservoir i
$VMAX_i$	; Topographically maximum storage volume of reservoir i, m <sup>3</sup>
$HMAX_i$	; Topographically maximum water level of reservoir i, m
$RETURN_t$	; Rate of return flow on month t
$UNIT_{it}$	; Consumption of irrigation water on month t for project i per 1,000 ha, m <sup>3</sup> /sec
$IMAX_i$	; Maximum extension of irrigation area at site i, 1,000 ha
$DMAX_i$	; Maximum diversion capacity at site i, m <sup>3</sup> /sec
$MAND_i$	; Mandatory release to the downstream reaches at site i, m <sup>3</sup> /sec
$HCM_i$	; Municipal water requirements in m <sup>3</sup> /day at site i of Ho Chi Minh City including Bien Hoa and the Economic Triangle Zone
$SAMIN_i$	; Minimum requirement for salinity intrusion at site i, m <sup>3</sup> /sec
$BP_i$	; Unit benefit for selling generated hydropower energy, US\$/kWh
$BI_1$	; Incremental benefit per 1,000 ha from rain-fed cropping to single irrigation cropping, US\$
$BI_2$	; Incremental benefit per 1,000 ha from rain-fed cropping to double irrigation cropping, US\$



- $BI_3$  ; Incremental benefit per 1,000 ha from rain-fed cropping to triple irrigation cropping, US\$
- $BI_4$  ; Incremental benefit per 1,000 ha from single irrigation cropping to double irrigation cropping, US\$
- $BI_5$  ; Incremental benefit per 1,000 ha from single irrigation cropping to triple irrigation cropping, US\$
- $BI_6$  ; Incremental benefit per 1,000 ha from double irrigation cropping to triple irrigation cropping, US\$
- $BM$  ; Average municipal water tariff, US\$/m<sup>3</sup>
- $CD_i$  ; Annual cost necessary for the construction of dam i including operation and maintenance as the function of dam height,  $H_i$
- $CT_i$  ; Annual cost required to build the waterway including generating facilities or the diversion tunnel for irrigation as the function of maximum plant discharge or maximum diversion release,  $P_i$
- $CPI_i$  ; Annual cost required to build the diversion tunnel or canal as the function of maximum diversion release,  $PI_i$
- $CI_i$  ; Annual cost necessary for the development of irrigation area per 1,000 ha including the diversion faculties as the function of irrigation area to be developed,  $I_i$
- $CM_i$  ; Annual incremental cost necessary to develop municipal water from the existing level to  $HCM_i$ , US\$/m<sup>3</sup>/day

Notes; (1) A discount rate of 10 % is applied for estimating annual cost.



## Preparation of input data

### 1. Dam Project

- a. Relationship between elevation and reservoir storage
- b. Dam cost as the function of dam height
- c. Waterway cost including generating facilities as the function of plant discharge, which shall be related with dam height
- d. Diversion canal cost as the function of irrigation canal capacity, which shall be related with dam height
- e. Long run marginal cost to estimate project benefits.

### 2. Irrigation projects

- a. Delineation of maximum irritable area for each irrigation project.
- b. Selection of irrigation development pattern out of six alternatives, i.e. rainfed to single cropping, rainfed to double cropping, rainfed to triple cropping, single to double cropping, single to triple cropping and double to triple cropping, for each irrigation project.
- c. Estimate of monthly water requirements for the proposed irrigation pattern of the irrigation project,  $\text{m}^3/\text{sec}/1,000 \text{ ha}$
- d. Estimate of project benefit based on the selected irrigation development pattern,  $\text{US\$}/1,000 \text{ ha}$
- e. Estimate of project cost necessary for the development of the proposed irrigation project,  $\text{US\$}/1,000 \text{ ha}$

### 3. Water supply projects

- a. Estimate of project cost to develop domestic water to supply to Ho Chi Minh City, including Bien Hoa and Economic Triangle Zone,  $\text{US\$}/\text{m}^3/\text{day}$
- b. Estimate of average water tariff,  $\text{US\$}/\text{m}^3$



#### 4. Hydrological data

- a. Preparation of monthly runoff data which represent 4-year drought at the proposed project sites.
- b. Runoff data of the Dong Nai and Saigon rivers at the sites,  $Q_{1,t}$  and  $Q_{7,t}$  shall be prepared by subtracting the water consumption by small irrigation projects.
- c. Release from the Thac Mo reservoir after power generation is given as inflow to the Site 5.
- d. Release from the Ham Thuan - Da Mi reservoir after power generation is given as inflow to the Site 10.



# **Attachment - 2**

**Terms of Reference  
for  
Master Plan Study on  
Rural Agricultural Development Project  
in South East Region**



**THE MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT**

**APPLICATION FOR  
TECHNICAL COOPERATION (DEVELOPMENT STUDY)  
BY THE GOVERNMENT OF JAPAN**

**FOR**

**MASTER PLAN STUDY  
ON  
RURAL AGRICULTURAL DEVELOPMENT PROJECT  
IN  
SOUTH EAST REGION**



**APPLICATION FOR  
TECHINICAL COOPERATION (DEVELOPMENT STUDY)  
BY THE GOVERNMENT OF JAPAN**

- |    |                         |  |
|----|-------------------------|--|
| 1. | Study Title             | Master Plan Study on Rural Agricultural Development Project in South East Region   |
| 2. | Location                | South East Region of Viet Nam covering nine provinces of Lam Dong, Dac Lac, Ninh Thuan , Binh Thuan ,Song Be, Dong Nai, Ba Ria - Vung Tau and Tay Ninh in the South East Region in Viet Nam  |
| 3. | Executing Agency        | The Ministry of Agriculture and Rural Development  |
| 4. | Objectives of the Study | <ul style="list-style-type: none"><li>(1) Formulation of a comprehensive master plan for Rural Agricultural Development Project in the South East Region,</li><li>(2) Pre-feasibility studies for the representative sample schemes among the selected priority small irrigation schemes, and</li><li>(3) Transfer of technical knowledge on planning and investigation to Vietnamese counterparts through their direct participation in the Study.</li></ul>    |
| 5. | Necessity of the Study  | The cropping intensity of the existing irrigation schemes is estimated at about 112% on an average and area actually irrigated is as low as around 40% of the designed scale mainly because of insufficient development of on-farm facilities, inadequate design of irrigation systems, water shortage, damage and deterioration of facilities and poor operation and maintenance. Therefore, almost all the schemes require the rehabilitation and improvement. |



All the provincial administrations have heavy stress in shortage of fund for maintenance and rehabilitation of the existing schemes, and strong intention to implement those rehabilitation and improvement works. In addition, they have many short range plans on irrigation development, which includes extension of existing irrigation schemes, water resources development encountering the present water shortage and the development of new irrigation systems.

In the light of such conditions as mentioned above, a study to prepare the comprehensive master plan is urgently required to establish an overall implementation schedule of the Rural Agricultural Development Project (RADP) and subsequently pre-feasibility studies are made for the priority sample schemes selected by the master plan for implementation. RADP aims at increasing the farmers' income, enhancing the living standard in the rural area, creating job opportunities and ultimately narrowing down the economic disparity between urban and rural areas. It is noted that the RADP in the South East Region will be the first case in Viet Nam, thereby has an important role as a model project to be extended over the country.

6. Study Period

About 24 months

7. Cooperation Requested  
to the Government  
of Japan

(1) Dispatching of a study team to undertake the  
Study composed of required expertises,



(2) Field investigation and inventory survey and preparation of master plan for Rural Agricultural Development Project in the South East Region, and

(3) Transfer of technical knowledge to Vietnamese counterparts in the course of the Study.

8. Other Related Project  
and Study

Master Plan Study on Dong Nai River and Surrounding Basins Water Resources Development by Japan International Cooperation Agency (JICA)



## 1. Introduction

Since the year 1986, the Government of Viet Nam (the Government) is carrying out drastic reforms in the political, economic and social fields under the banner of "Doi Moi" (renovation). Doi Moi has two major objectives to pursue in the economic field: (i) an economic liberalization policy at home; and (ii) an open door policy internationally. In the course of the implementation of Doi Moi policy accelerated in the year 1989, the overall economy has been steadily grown at a GDP rate of 6 to 8% per annum, although it experienced sudden recession due to Soviet Union shock in the year 1990. During the next five years, Viet Nam targets to achieve high and sustainable growth at a rate higher than the previous five years so as to fulfill the objective of doubling the 1990 per capita GDP by the year 2000, to bring the country out of poverty and underdevelopment, to improve people's living standards, to increase domestic saving, and to get ready stronger development in the 21st century.

Water resources development is one of essential elements to promote economic development, since the latter can be attained by using electricity and water gained through the development of the former. Thus, projects related to water resources have been developed in the framework of the national development programmed based on the economic reform policy. Within such the framework, the master plan study on the Dong Nai River and its surrounding basins, including Ho Chi Minh City as a pivotal area of economic development in the southern Viet Nam, was carried out by the Government with a technical assistance of Japan International Cooperation Agency(JICA) in the year 1994 to 1996. The master plan study aimed at efficient utilization and management of limed water resources available for hydropower, irrigation, water supply, flood mitigation and watershed management.

The Rural Agricultural Development Project (RADP) was selected as one of the priority master plan project in the said Master Plan Study in the agricultural sector. The RADP aims at increasing the farmers' income, enhancing the living standard in the rural area, creating job opportunities and ultimately narrowing down the economic disparity between urban and rural areas, through rehabilitating and improving the existing small irrigation schemes and constructing new small irrigation schemes scattered over the Dong Nai River and surrounding basins. With the results obtained by the Master Plan Study, the Government of Viet Nam requests the Government of Japan to provide technical assistance to carry out the Study of RADP, which prepares a comprehensive development master plan along with the feasibility studies for priority small irrigation schemes.



## 2. Development Strategy of Agriculture Sector

Viet Nam is basically an agricultural country where over 80 % of the population still live in rural areas, supported by farming, forestry and fishery. Grain crops, dominated by paddy, generate half the output value of this sector. Besides, a high proportion of industry and services derives their demand from agriculture. But, because of its vulnerability to vagaries of nature, the growth rate of agriculture witnessed larger fluctuations than that of industry. The agriculture sector, including forestry and fishery, accounted for 36% of GDP in the year 1993, nearly three-quarters of national employment and about 50% of export earnings. Due to the liberalization of distribution system in agricultural sector, paddy production recorded 26 % growth in the year 1987-89 and this permitted Viet Nam to move from a position of net importer of 700,000 - 800,000 tons of rice in the year 1986-88 to a net exporter of around 2 million tons of rice per annum in the year 1989-92.

The Government has set an agricultural sector program in the next Five Year Plan with a title of "Socio-economic Stabilization and Development Strategy to the year 2000", emphasizing to:

- re-structure the agricultural production towards the sustainable market oriented agriculture;
- diversify the farming structure introducing more cash and industrial crops;
- continue to increase food production to attain 30 million tons by the year 2000, bringing per capita food output to 366 kg per year in order to achieve food security and to increase rice export to about 2 million tons a year;
- produce regionally compatible crops using new variety of high yield and good quality, particularly for paddy and maize; and
- expand industrial and fruit crops plantations together with processing plants like cotton, sugar cane, rubber, coffee and tea.

Under such a development policy in the agricultural sector, the public investment should be expanded in factors fundamental to the agricultural developments, most notably research and extension services, irrigation and water resources management and rural infrastructure. Along with this development strategy and as a critical element in developing the agricultural sector, the Government intends to continue to rehabilitate, upgrade and repair existing irrigation, dikes, drainage structures, as well as expand the irrigation and water resource management systems in many parts of the country. In addition, the Government is to strengthen rural infrastructure and the linkages with economic growth areas. Particular attention will be given to improving farm-to-market



roads, rural electrification, supply of safe drinking water and sanitation facilities. These improvement will encourage the commercialization of the agricultural sector and rural employment diversification. This policy aims to increase the farmers income, enhance the living standard in the rural area and ultimately mitigate the regional gap in the social and economic conditions.

### **3. The Project**

#### **3.1 Project Background**

The Dong Nai River and surrounding basins are situated close to the Southern Focal Economic Area (SFEA) where the industrialization is rapidly developing, placing the center in the so-called economic triangle zone linking three cities of Ho Chi Minh City (HCMC), Bien Hoa and Vung Tau. Whereas, the rural area in this region is kept poorly economic conditions, represented by low cropping intensity and low crop yields due mainly to the lack of and deteriorated agricultural production facilities and shortage of irrigation water. These factors coupled with the lack of agricultural supporting services brakes the diversification of agriculture in this region. Such socio-economic situation is accelerating the economic disparity between urban and rural areas and driving the concentration of population unnecessarily in the urban areas. To cope with such situation, the Government is launching an overall water resources development plan in the Dong Nai River and its surrounding basin which dominate the most part the South East Region and have a relatively ample water resources, aiming at not only sustainable economic development but also narrowing-down of prevailing economic disparity and enhancement of social well-being in the region. As an output of this development study, several large scale irrigated agricultural development plans are being proposed and being discussed for further procedure of implementation. Besides the above, the Rural Agricultural Development Project (RADP) is desired for the existing irrigation schemes and new small irrigation schemes which are not bestowed the benefit of the water resources development project of the Dong Nai River and scattered over the South East Region. The RADP aims at increasing the farmers' income, enhancing the living standard in the rural areas, creating job opportunities and ultimately eliminating the economic disparity between urban and rural areas.

#### **3.2 Candidate Irrigation Schemes for RADP**

The objective areas of RADP are those of the existing irrigation schemes and new small scale irrigation schemes in the Study Area, excluding HCMC and Long An province where a development project is separately contemplated. The candidate irrigation



schemes for RADP are listed in Table 1 and those locations are shown in Figure 1. The number and area of candidate irrigation schemes are identified at 229 in total and 128,987 ha in total respectively by the result of inventory survey carried out in the master plan study on Don Nai River and surrounding basins. These are further classified into the existing and new schemes in the respective provinces in the Study Area as shown below

Province	Existing Schemes		New Schemes		Total	
	Nos.	Area (ha)	Nos.	Area (ha)	Nos.	Area (ha)
Lam Dong	25	10,809	3	3,050	28	13,859
Dac Lac	1	120	0	0	1	120
Ninh Thuan	15	3,932	3	6,400	18	10,332
Binh Thuan	56	20,033	2	608	58	20,641
Song Be	16	4,581	20	11,094	36	15,675
Dong Nai	33	16,930	7	9,770	40	26,700
BR - VT	15	8,080	18	8,450	33	16,530
Tay Ninh	3	3,260	12	21,870	15	25,130
Total	164	67,745	65	61,242	229	128,987

These candidate schemes will be screened for RADP, first by a factor that whether schemes are involved in the integrated large irrigation projects to be implemented in near future. The priority selection in RADP will be based on future sustainability of schemes, composed of five aspects: (i) technical aspect; (ii) socio-economic aspect; (iii) institutional aspect, (iv) economic and financial aspect and (v) environmental aspect.

#### 4. Necessity of the Study

As the results of inventory survey for the existing irrigation schemes made in the Master Plan Study, it was found that the cropping intensity is estimated at about 112% on an average and area actually irrigated is as low as around 40% of the designed scale mainly because of insufficient development of on-farm facilities, inadequate design of irrigation systems, water shortage, damage and deterioration of facilities and poor operation and maintenance. Therefore, almost all the schemes require the rehabilitation and improvement. All the provincial administrations have heavy stress in shortage of fund for maintenance and rehabilitation of the existing schemes, and strong intention to implement those rehabilitation and improvement works. In addition, they have many short range plans on irrigation development, which includes extension of existing irrigation schemes, water resources development encountering the present water shortage and the development of new irrigation systems.

In the light of such conditions as mentioned above, a study to prepare the comprehensive master plan is urgently required to establish an overall implementation schedule of the Rural Agricultural Development Project (RADP) and subsequently pre-



feasibility studies are made for the priority sample schemes selected by the master plan for implementation. It is noted that the RADP in the South East Region will be the first case in Viet Nam, thereby has an important role as a model project to be extended over the country.

## **5. Objectives of the Study**

The objectives of the proposed Study are to:

- (1) formulate of a comprehensive master plan for Rural Agricultural Development Project in the Dong Nai River and surrounding basins;
- (2) carry out pre-feasibility studies for the priority small irrigation schemes which are selected in the comprehensive master plan; and
- (3) transfer technical knowledge on planning and investigation to Vietnamese counterparts through their direct participation in the Study.

## **6. Scope of Works**

### **6.1 Study Area and Objective Schemes**

The Study Area shall cover nine provinces of Lam Dong, Dac Lac, Ninh Thuan, Binh Thuan, Song Be, Dong Nai, Ba Ria - Vung Tau and Tay Ninh within the Dong Nai River and surrounding basins. The objective small irrigation schemes shall be those of the existing irrigation schemes and new small scale irrigation schemes located in the Study Area, with a number of 229 in total comprising 164 existing schemes and 65 new schemes. Names of these schemes are tentatively as listed in Table 1 and those locations are shown in attached Figure 1.

### **6.2 Phasing of the Study**

The Study shall be divided into the following two Phases:

Phase I: Study of small irrigation schemes for Rural Agricultural Development Project (RADP); and

Phase II: Formulation of a master plan for RADP and pre-feasibility study for the representative sample schemes



## 6.3 Scope of Works

### 6.3.1 Phase I Study

#### (1) Demand study

- (a) projection of population increase
- (b) projection of irrigated crop consumption

These estimate will be made in provincial level on the basis of existing data and information.

#### (2) Irrigation and drainage rehabilitation potential stud

- a) identification and evaluation of rehabilitation potential of water and land resources
- b) estimation of irrigation and drainage rehabilitation cost

These estimate will be made in provincial level on the basis of existing data and information

#### (3) Study on irrigated agriculture and drainage development plans in provinces

Collection, review and analysis of relevant existing data and information including:

- a) the Sector Review Study for Water Resources Development by MOARD and Provincial Peoples Committee
- b) the Water Resources Sector Review by ADB/FAO/World Bank /NGO
- c) Master Plan Study on Dong Nai River and Surrounding Basins Water Resources Development
- d) natural conditions (topography, meteorology, hydrology, geology, pedology, water quality, sea water intrusion),
- f) social and economic conditions (regional socio-economy, labor force and unemployment rate, regional development programs, agricultural sector plan, social infrastructure, farmers organization, ethnic minority problem, ,woman in development)
- g) agriculture (land use, cropping pattern, yield/production, crop



- diversification, farming practices, farmers economy, land tenure, processing, marketing),
- h) agricultural supporting services (extension services, credit, market, information and facilities, cooperatives)
- i) agricultural infrastructure (existing irrigation and drainage systems, needs of rehabilitation, operation and maintenance),
- j) social and natural environmental impacts (resettlement, deforestation, water pollution, erosion, sedimentation)
- k) others

The study will be conducted on the basis of existing data and information.

- (4) Establishment of database of existing and proposed small irrigation schemes by the inventory survey
  - a) preparatory works for inventory survey including setting of items to be surveyed, preparation of inventory format ,notification and explanation to the provincial authorities, preparation of computerized database system, etc.
  - b) data collection by inventory survey
  - c) compilation of inventory data
  - d) data analysis and evaluation
  - e) classification of irrigation schemes
- (5) Screening and priority ranking
  - a) preparation of screening criteria of candidates schemes for RADP
  - b) preparation of guidelines for project priority ranking
  - c) screening of candidate schemes and priority ranking of selected schemes

### 6.3.2 Phase II Study

- (1) Establishment of long term irrigation and drainage rehabilitation target
  - a) target of rural agricultural development projects based on the rehabilitation and improvement of the existing small irrigation schemes and construction of new small irrigation schemes up to year 2015
  - b) cost estimate and fund management



(2) Formulation of comprehensive master plan of Rural Agricultural Development Project

- a) preparation of guidelines for project priority ranking
- b) development sequence by rehabilitation and construction scale, type of project and province
- c) rolling plan of development program
- d) identification of a top-priority project to be urgently implemented
- e) preparation of organizational improvement and strengthening plans of the executing agencies of RADP for implementation and O&M in both the central and provincial levels including farmers' organization.

(3) Pre-feasibility study for the representative sample schemes

- a) supplemental field survey and collection of data and information for the selected priority schemes
- b) study on topography, hydrology, meteorology, soil, etc.
- c) agro-economic study placing emphasis on crop diversification
- d) socio-economid study
- e) preliminary designs of the project facilities including social infrastructure
- f) study on environmental impact and woman in development (WID)
- g) cost and benefit analysis and economic evaluation

### 6.3.3 Transfer of Technology

For technology transfer and training, expatriates of the Study Team will initiate in-service training and technology transfer program to the counterpart staff and the Government personnel concerned during the study period. This shall be conducted as part of their involvement in the Study as well as in the form of training seminars, in accordance with the needs of the Study and the individual counterpart staff, and to the extent consistent with the orderly conduct of the work.

## 7. Work Program

### 7.1 Work Schedule

The Study will be carried out in two phases within a time period of 24 months in accordance with the tentative schedule as shown in Figure 2 attached hereto.



## 7.2 Reports

Following reports are prepared and submitted during the course of the Study:

	<u>Copy Nos.</u>	<u>Submission Time</u>
(1) Inception Report	30	Within 1st month from the commencement
(2) Progress Report (1)	30	Within 7th month from the commencement
(3) Interim Report (1)	30	Within 10th month from the commencement
(4) Progress Report (2)	30	Within 13th month from the commencement
(5) Interim Report (2)	30	Within 16th month from the commencement
(5) Draft Final Report	30	Within 22nd month from the commencement
(6) Final Report	50	Within 24th month from the commencement

## 7.3 Expertise Input

To perform the above scope of work of the Study, the Study Team will be composed of the following experts:

- Team Leader/Rural Agricultural Development Planning Expert
- Irrigation and Drainage Expert
- Agronomist
- Agro-economist
- Socio-economist
- Hydrologist
- Dam Expert
- Computer System Design and Analysis Expert
- Construction Planning Expert
- Project economist
- Institutional Expert
- Environmental Expert
- Geodetic Expert

## 8. Undertaking of the Government of Viet Nam

8.1 The Government of Vietnam shall facilitate the carrying-out of the Study in accordance with the prevailing laws and regulations stipulated by the Vietnamese state as below:

- (1) To secure the safety of the Study Team;



- (2) To permit the member of the Study Team to enter, leave and safety in Vietnam for duration of their assignment therein, and exempt them from foreign registration requirement and consult fees;
- (3) To exempt the members of the Study Team from taxes, duties and other charges on equipment, machinery and other materials brought into and out of Vietnam for the conduct of the Study;
- (4) To exempt the members of the Study Team from income taxes and other charges of any kind imposed on or in connection with any emolument or allowance paid to the members of the Study Team for their services in connection with the implementation of the Study;
- (5) To provide necessary facilities to the Study Team for remittances as well as utilization of the funds introduced into Vietnam from Japan in connection with the implementation of the Study;
- (6) To obtain permission for entry into special area for the purpose of implementing the Study;
- (7) To secure permission which is considered to be necessary and issued by the relevant authorities for the Study Team to take out all data and documents including maps and aerophotographs related to the Study out of Vietnam to Japan; and
- (8) To provide medical services as needed and its expense will be chargeable on the members of the Study Team.

8.2 The Government of Vietnam shall bear claim, if any arisen against members of the Study Team resulting from, occurring in the course of the Study or otherwise connected with the discharge of their duties in the implementation of the Study, except when such claims arise from gross negligence or willful misconduct on the part of the members of the Study Team.

8.3 The Ministry of Agriculture and Rural Development (MOARD) shall act as counterpart agency to the Japanese Study Team and also as coordinating body in relation with other governmental and non-governmental organizations concerned for the smooth implementation of the Study.



8.4 The MOARD shall, at its own expense, provide the Study Team with the following, in cooperation with other organizations concerned:

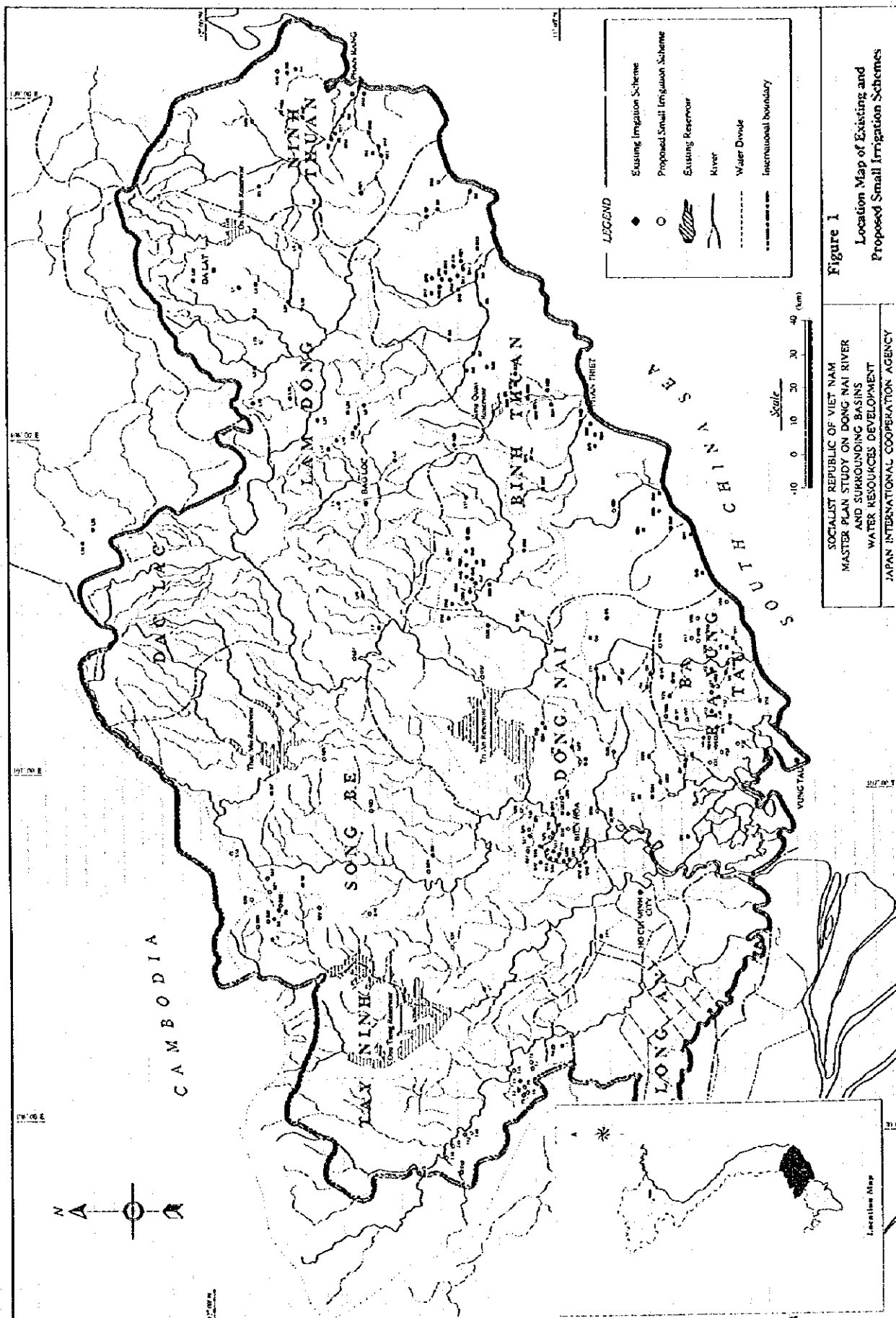
- (1) Available data and information related to the Study;
- (2) Necessary number of counterpart personnel including project coordinator throughout the Study period;
- (3) Credential or identification card;
- (4) Suitable office space for the Study Team and the Counterpart Team with necessary equipment and clerical services; and
- (5) Appropriate number of vehicles with drivers during the Study in Viet Nam



Table 1 List of Existing and New Small Irrigation Schemes for RADP

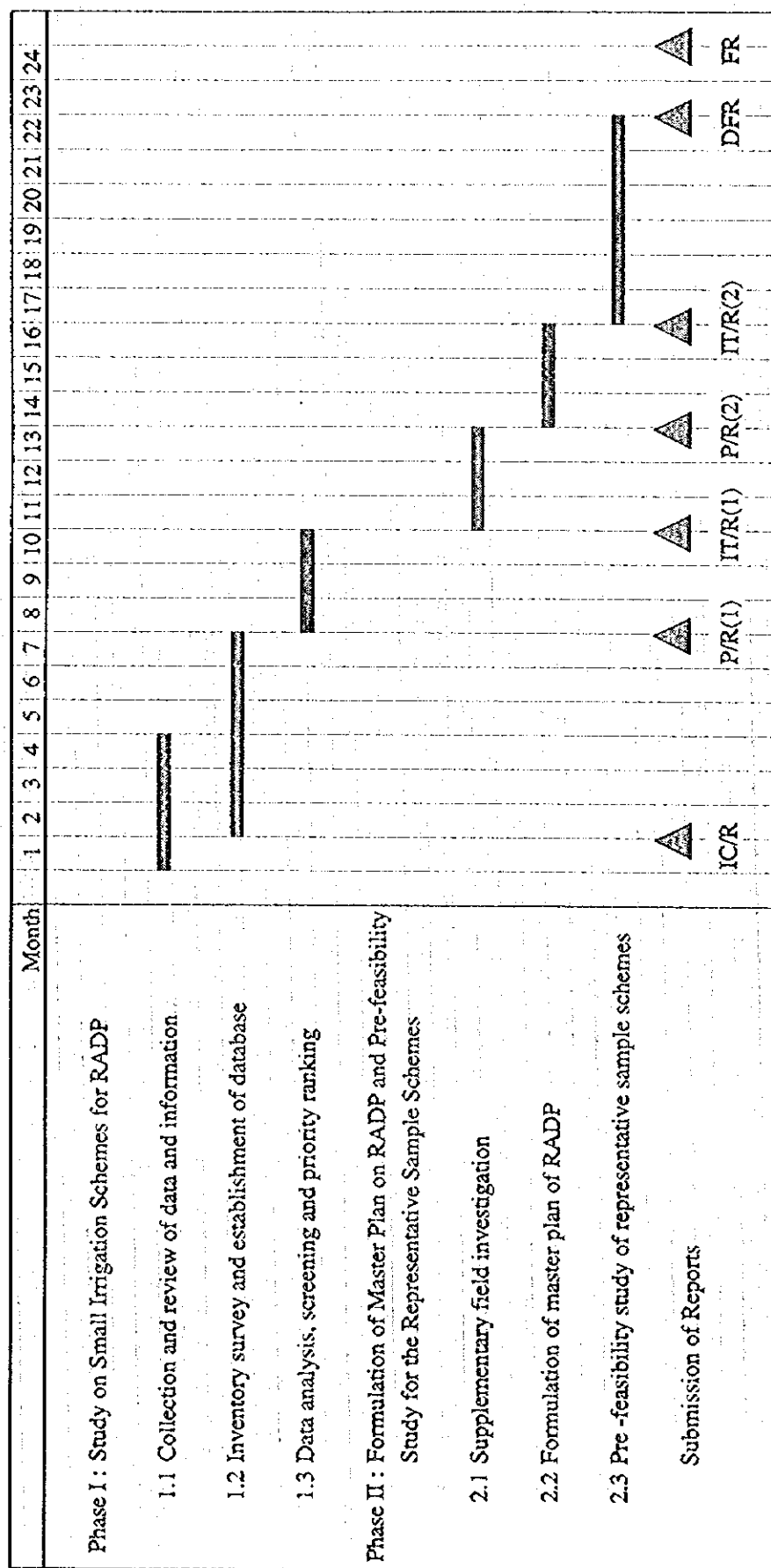
Unit: ha											
Code	Name of Scheme	Designed Area	Code	Name of Scheme	Designed Area	Code	Name of Scheme	Designed Area	Code	Name of Scheme	Designed Area
Lam Dong Province			Binh Thuan Prov. (cont.)			Dong Nai Prov. (cont.)			Tay Ninh Prov. (cont.)		
1.1	Tuyen Lau	2,832	B27	Cam Hong	120	D12	Tan Huu	250	112	Cu Ba Chau	2,700
1.2	Cam Ly Thuong	400	B28	Cay Khe	1,800	D13	Hoa An	110	113	Ban Suoi	3,700
1.3	Dai Duu	2,700	B29	O Xuyen	1,500	D14	Hiep Hoa	350	114	Cay Oi	2,900
1.4	Dinh An	150	B30	Kim Long	1,500	D15	Tan An	100	115	Ban Dinh	2,500
1.5	Tan Rai	140	B31	Bau Tiet	150	D16	Thien Tan	350	Proposed Total		19,300
1.6	La Oo	190	B32	Sien Giang	500	D17	Long Chien	100	Total		22,560
1.7	Da Nam	400	B33	Dau Sach	1,000	D18	Mieu Van	150	Legend		
1.8	Ka La I	150	B34	Thay Nghe	120	D19	Loi Hoa	300			
1.9	PRoh	415	B35	Gieng Feh	120	D20	Binh Phuoc	100			
1.10	Phu Hoi	150	B36	Ba Nao	100	D21	Binh Hoa	350			
1.11	Da Mi	120	B37	Suoi Du	650	D22	Bau Han	150			
1.12	Ta Nung	200	B38	Nui Dat	270	D23	Suoi Ca	600	Scheme excluded from candidate schemes for RADP		
1.13	Cho Mo Da Quyen	200	B39	Tan Ha	120	D24	Long An	250			
1.14	Da Tien tang	100	B40	Co Kieu	230	D25	Song May	1,300			
1.15	Da Sa	150	B41	Suoi Do	120	D26	Thanh Nien	100			
1.16	Fiscron	230	B42	Lung Da	200	D27	Ba Long	110			
1.17	So 2	152	B43	Suoi Le	150	D28	Suoi Dam	250			
1.18	So 5	200	B44	Cho Lu	150	D29	Nam Sao	350			
1.19	Loc An	240	B45	Suoi Lach	120	D30	Dong Hiep	600			
1.20	East Di Linh	100	B46	Uc Sang	200	D31	Ong Tho	150			
1.21	Darmoi I	150	B47	KHo	100	D32	Ong Binh	100			
1.22	Chiem Thang	500	B48	Cau Chay	120	D33	Da Ton	1,400	Existing Total		
1.23	West Di Linh	250	B49	Tra Tan	610	Existing Total		16,930			
1.24	Lien Khuong	620	B50	Vo Ka	5,000	D34	Da Vang	180			
1.25	Ro Mon	160	B51	Ta Bua	500	D35	Cau Moi	3,000			
Existing Total		18,809	B52	H 74	250	D36	Suoi Nam	1,540			
1.26	Da Te	2,000	B53	Suoi Cat	110	D37	Da Ka Ya	350			
1.27	Da Kio	800	B54	Tra Cap	150	D38	Song Thao	700			
1.28	Caden	250	B55	Suoi Chua	300	D39	La Buong	400			
Proposed Total		3,050	B56	Cay Xoi I, II	180	D40	Xom Mai	200			
Total		13,859	B57	Cau Chay	150	Proposed Total		6,370			
Dac Lac Province			Existing Total			Total			23,300		
D11	Cau Tu	120	B57	Da Bac	500	Song Be Province					
Existing Total		120	B58	Ta Moa	108	S1	Can Nam	350			
Ninh Thuan Province			Proposed Total			S2	Ta Te	120			
N1	Song Pha	4,710	Total			25,641	S3	Tong Le Chan	120		
N2	Nha Trinh-Lam Cam CK7	12,800	Ba Ria-Vun Tau Province			S4	Tan An	411			
N3	O Cam-Nha Hoi	100	V1	Kim Long	200	S5	Suoi Giai	1,670			
N4	Binh Phu	300	V2	Song Dinh I	600	S6	Bu Mon	180			
N5	Dong Nhiep	100	V3	Song Xoi	1,000	S7	Dak Tol	100			
N6	Ba Ho	392	V4	Chau Pha	150	S8	An Khuong	110			
N7	Ta Noi	110	V5	Suoi Do B	300	S9	Lee Khanh	150			
N8	Ca Tien	120	V6	Gia Hoi	650	S10	Suoi Sau	300			
N9	Cha Vinh	420	V7	Suoi Giu	1,200	S11	Da Bang	400			
N10	Ma Ren	250	V8	Xuyen Moc	450	S12	Ong Hou	150			
N11	Binh Tu	500	V9	Lo O	400	S13	Bach Dang	140			
N12	Tuan Tu	150	V10	Song Ray	800	S14	Tan An	150			
N13	Bai Que	100	V11	Cau Moi	250	S15	Tan My I	130			
N14	Phuoc An	250	V12	Da Bang	1,300	S16	Thuong Tan II	100			
N15	Phuoc Thien	560	V13	Suoi Mao	150	Existing Total		4,581			
N16	Da	400	V14	Bat Thien	250	S17	Loc Quang	378			
Existing Total		180	V15	Suoi Cai	380	S18	Suoi Ong	100			
N18	Song Trau	2,500	V16	Bat Ngua	800	S19	Thanh Hoa	173			
N19	Song sat	1,600	V17	Sum Duc	900	S20	Suoi Kai	324			
N20	Tan Giang	2,300	V18	Suoi Lao	800	S21	Suoi Trao	800			
Proposed Total		4,400	V19	Suoi Soc	800	S22	Can Le	180			
Total		27,842	V20	Ben Ke	900	S23	Dong Xoi	4,600			
Binh Thuan Province			V21	Lo O 3	200	S24	Nuoc Trong	1,200			
B1	Tuy Tinh	1,200	V22	Lo O 2	500	S25	Duc Lieu	450			
B2	Ba Ra	150	V23	Tan Bo	1,000	S26	Thuong Tan	123			
B3	Ba Nao	220	V24	Chau Pha	700	S27	Tan Loi	353			
B4	Vinh Hao	100	V25	Ciao Kro	500	S28	Tong Nhim	200			
B5	Dong Moi	1,200	V26	Ap Ba	100	S29	Cho Chet	110			
B6	Song Khong	150	V27	Suoi Chinh	200	S30	Chanh My	330			
B7	Ta Son	135	V28	Bao Nop	300	S31	Phu Hoi	250			
B8	B12	150	V29	Binh Chau	200	S32	Rung Cam	350			
B9	Xuan Quang	150	V30	Da Bang 2	300	S33	MRoa	265			
B10	Uy Thay	1,000	V31	Suoi Sao	150	S34	Da Yeu	25			
B11	Cha Yau	350	V32	Rach Chanh	100	S35	An Tay Phu An	500			
B12	E Chim	500	V33	Nuoc Ngot	100	S36	Bu Nau	128			
B13	Ma Tang	170	Proposed Total		1,450	Proposed Total		18,869			
B14	Ma O	250	Total			16,530	Total		15,450		
Dong Nai Province			Tay Ninh Province								
B15	Tam Ru	324	D1	Cu Nhi	250	T1	Phuoc Chi	2,260			
B16	Cau Rang	225	D2	Gia Hoi I	250	T2	Long Thuan	700			
B17	Ta Ma	300	D3	Gia Hoi II	200	T3	Long Khanh	300			
B18	Dong Mang	130	D4	Suoi Ran	600	Existing Total		3,260			
B19	Ma Ni	250	D5	Gia Ai	560	T4	Phuoc Luu	2,600			
B20	Dong Gon	120	D6	Nui Le	400	T5	Long Khanh B	700			
B21	Nha Mung	150	D7	Suoi Vong	1,100	T6	Long Hong	1,000			
B22	Phung Nam	130	D8	Phuoc Thai	100	T7	Dia Xu B	2,500			
B23	Tien Loi	600	D9	Ong Kro	5,400	T8	Dia Xu A	700			
B24	Dong De	250	D10	Phuoc Tan	100	T9	Long Thuan B	1,000			
B25	Song Linh	100	D11	Long Thanh	450	T10	Tra Cu	2,700			
B26	Phu Sung	100	D12	Long Thanh	450	T11	Hoa Hoi	3,100			







**Figure 2 Tentative Work Schedule for Master Plan Study on Rural Agricultural Development Project in South East Region**



**Note** RADP : Rural Agricultural Development Project

### IC/R : Inception Report

P/R: Progress Report

IT/R: Interim Report

DF/R : Draft Final Report

F/R : Final Report



# **Attachment-3**

**Terms of Reference**

**for**

**Preparation of Implementation Programme**

**for Rural Water Supply Project**

**in the Dong Nai River Basin Area**







 THE GOVERNMENT OF THE SOCIALIST REPUBLIC OF VIET NAM

THE MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT

**APPLICATION FOR  
TECHNICAL COOPERATION  
BY THE GOVERNMENT OF JAPAN**

 **FOR**

**PREPARATION OF IMPLEMENTATION PROGRAMME**

**FOR RURAL WATER SUPPLY PROJECT**

**IN**

**THE DONG NAI RIVER BASIN AREA**

 **OFFICE OF CENTRAL RURAL WATER SUPPLY PROJECT**



APPLICATION FOR  
TECHNICAL COOPERATION (DEVELOPMENT STUDY)  
BY THE GOVERNMENT OF JAPAN

1. Study Title                      Preparation of Implementation Programme for Rural Water Supply Project in the Dong Nai River Basin Area
2. Location                        Dong Nai River Basin Area including the provinces of Tay Ninh, Song Be, Dac Lac, Lam Dong, Ninh Thuan, Binh Thuan, Ba Ria-Vung Tau, Dong Nai and Long An
3. Executing Agency            The Ministry of Agriculture and Rural Development, in which the Office of Central Rural Water Supply Project will represent as the technical counterpart organization responsible for the Study
4. Objectives of the Study
  - (1) Preparation of the Master Programme for the rural water supply in the Study Area for Stage 1 to Stage 4 covering 1,207 rural water supply projects to be implemented within next two decades
  - (2) Prioritization of the Communes and establishment of the Community Development Programme
  - (3) Preparation of the Detailed Integrated Rural Water Supply Management Programme for Stage 1 for prioritized communes including cost estimate of the project for prioritized communes
  - (4) Transfer of technical knowledge on planning and investigation to Vietnamese counterparts through their direct participation in the Study



5. Necessity of the Study

The funds for UNICEF, which is the sole overseas donor to promote a systematic rural water supply programmes in Viet Nam at the moment, including the counter budget of the Vietnamese Government, fall short of sufficiency. Thus financial sources from other international agencies and developed countries are strongly sought to spur the implementation of rural water supply projects in the Study Area.

Furthermore, people living in the rural areas still have a big burden to collect drinking water even in the completion of UNICEF's programme, since the UNICEF's programme mainly drills shallow wells with a hand pump, requiring local people to come to the well and to collect water by hand-pumping. Moreover, the areas where shallow aquifers are available are limited in the Quaternary-Neogene deposit layer extending in the lower-plain area.

It is therefore deemed urgent to introduce a new rural water supply programme with a small supply system. That is, local people receive potable water from public stands installed every 50m for instance, whilst tap area equipped for such public facilities as hospitals, schools and government offices to access to drinking water.

6. Study Period

About 18 months

7. Cooperation Required to the Government of Japan

- (1) Dispatching of a study team to undertake the Study. Expert inputs required will be about 90 man-months.
- (2) Field survey and investigation relevant to the Study will be carried out.
- (3) Transfer of technical knowledge through the course of the Study.



8. Other Related Project

- (1) Dong Nai Master Plan Project funded by Japan International Cooperation Agency
- (2) Above-mentioned rural water supply projects funded by UNICEF.



TERMS OF REFERENCE  
FOR  
PREPARATION OF IMPLEMENTATION PROGRAMME FOR  
RURAL WATER SUPPLY PROJECT  
IN  
THE DONG NAI RIVER BASIN

**1. Introduction**

There are one city and nine provinces in the Dong Nai River basin; Tay Ninh, Song Be, Dac Lac, Lam Dong, Ninh Thuan, Binh Thuan, Ba Ria-Vung Tau, Dong Nai, Ho Chi Minh City and Long An. Domestic water supply of urban area lying in the basin is in an incipient stage except for large cities and towns such as Ho Chi Minh City and Bien Hoa. This fact implies that any systematic water supply projects have rarely been established in the rural areas in this region. In fact, people living in the rural areas rely on small wells privately dug, sand filtration system, rainwater tanks (roof catchment) as drinking water sources.

Small wells mainly dug in the rural areas are normally shallow with a depth of 20 m to 30 m, showing less reliability on supply in the dry season probably due to the fact that water level in the well rapidly draws down in coincidence with rapid falling of river water level starting from the beginning of the dry season. Dry-up of wells in the dry season makes local people have no alternatives but to buy for getting drinking water. In particular, the long lasting dry season in the year 1995 made most of shallow wells drilled in the rural area dried up, resulting in serious shortage of drinking water. For example, hundreds of patients and the staff of Health Care Centre of Be Dan district, Song Be province, had to share a well, which only has supply capacity of 1 m<sup>3</sup>/day. Even if wells are barely available for use, there is a hygienic problem, since there are high chances that the release of water used for daily life including toilet water to the ground would contaminate the well.

It can be said that the life of people, who have wells, even if those are not good in quality, is rather easy compared with those do not have wells. They have to collect drinking water from the nearby river or canal no matter how water quality is, or to buy it. In case of buying drinking water, local people have to buy it with the price to 10 to 100 times higher than that of tap water.



## 2. Background Information

The Government of the Socialist Republic of Viet Nam launched an economic reform in the year 1986 by proposing the Doi Moi policy, which gradually shifts from the planned economy to the market-oriented economy. Thanks to the introduction of the Doi Moi policies, Vietnamese economy enjoyed high growth rates of 8 % in terms of the annual GDP growth rate in the last few years. The Government launched a medium-term economic development programme toward the year 2000, so called "Socio-economic Stabilization and Development Programme toward the year 2000, in which economic development is targeted to sustain 7.5% in the annual GDP growth rate. The World Bank predicts 6.0% of GDP growth over a period of the year 1990 to 2010 as the most probable scenario.

The Southern Focal Economic Area (SFEA), which covers the main part of the Study Area, acts as a locomotive of economic development in the nation along with the Hanoi-Hai Phong area and the Da Nang area. This area covers the whole of Ho Chi Minh City, Dong Nai province and Ba Ria-Vung Tau province and a part of Song Be, Tay Ninh, Long An and Binh Thuan provinces with a land area of 12,400 km<sup>2</sup> and a population of 7.8 million. It includes the so-called "Economic Triangle Zone" that is formed by the three places of Ho Chi Minh City, Bien Hoa and Vung Tau and is emerging as a focal place of economic development in Viet Nam.

Migration of people seeking job opportunities from rural areas to large towns such as Ho Chi Minh City, called mechanical increase, not only has merits to supply labour force necessary for sustaining economic development of the SFEA, which is a locomotive of national economic development, but also brings side-effects to deteriorate urban amenity as represented by squatters' houses built along the rivers and canals. Excessive migration of people to urban area is mainly a result of the living condition of rural area staying at a subsistence level.

Considering the above conditions noted for the rural area, matters to be carried out for the socio-economic development in the Dong Nai River Basin Area most urgently are to improve social amenity and to create job opportunities in the rural area. The task given for the rural water supply project is to improve social amenity by supplying safe drinking water to the rural area and to narrow down the social disparity existing between urban and rural areas.

Furthermore, in order for the rural water supply project to be sustainable in future, it is necessary to develop the people's capacity to install and maintain the wells and water supply systems. This can be achieved through community development approach by encouraging the participation of the people living in the rural areas to the project activities.

In the Study Area, women play a key role in the everyday economic and social activities. Improvement of their living standards is considered a must for the overall improvement of the



area. Therefore, community development strategy will be integrated in the project with special attention to gender consideration.

### 3. Necessity of the Study

Based on the rural water supply situation in Viet Nam, i.e. incipient stage, the United Nations Children's Fund (UNICEF), with the assistance of Central Rural Water Supply Project, Ministry of Labour, War-invalids and Social Affairs, which was in charge of rural water supply projects in Vietnamese government at that time, commenced in the year 1980 their assistance to improve the rural water supply in Viet Nam. The project aims to protect children's life by raising hygienic level in the rural area. Its assistance spurred based on the proclamation of the International Drinking Water and Sanitation Decade (1981 - 1990) by the United Nations. It is noted that the office of Central Rural Water Supply Project, which belonged to the Ministry of Labour, War-invalids and Social Affairs, administratively shifted to the Ministry of Agriculture and Rural Development in November 1995.

At the end of the year 1994, only a fraction of 27.6% of people living in the rural part of the Study Area, compared with the national average of 35%, receives the benefit of rural water supply projects under the condition that the number of beneficiaries is 120 persons for a water source and that annual increase rate of population is 2.68 % between the year 1989 and 1994. By province, Tay Ninh, Song Be, Dac Lac and Dong Nai are situated in the area with the poorest performance rate of lower than 10%.

Two provinces, Lam Dong and Ba Ria-Vung Tau, show a slightly higher performance rate of 14% to 18%, whilst three provinces, Ninh Thuan, Binh Thuan and Long An, performed rural water supply projects with a higher rate of more than 60% due to the following facts:

- (a) These three provinces can provide enough counter-budget for the UNICEF's programme;
- (b) UNICEF mainly provided drilling machines suitable for drilling the Quaternary-Neogene deposit layer extending in the lower-plain area;
- (c) Rural water supply projects started from the areas where shallow aquifers are available; and
- (d) It is not until the year 1993 that the machines, which can drill deep wells, became available.

A total of 3,949 rural water supply projects, which are largest in number compared with other nine provinces in the Study Area, were implemented by the end of the year 1994 in Ho Chi



Minh City including the zones defined to be an urban area. The above result gives an impression that poor provinces are left behind in terms of improvement of amenities indispensable for daily life.

The Vietnamese Government launched a programme to increase the water supply rate in rural areas to 80% by the year 2000. In the Study Area, six provinces, Tay Ninh, Song Be, Dac Lac, Dong Nai, Lam Dong and Ba Ria-Vung Tau, area far distant from the target of the Government, requiring an intensive programme to disseminate rural water supply projects especially in those six provinces.

The funds for UNICEF, which is the sole overseas donor to promote a systematic rural water supply programmes in Viet Nam at the moment, including the counter budget of the Vietnamese Government, fall short of sufficiency. Thus financial sources from other international agencies and developed countries are strongly sought to spur the implementation of rural water supply projects in the Study Area. Furthermore, people living in the rural areas still have a big burden to collect drinking water even in the completion of UNICEF's programme, since the UNICEF's programme mainly drills shallow wells with a hand pump, requiring local people to come to the well and to collect water by hand-pumping. Moreover, the areas where shallow aquifers are available are limited in the Quaternary-Neogene deposit layer extending in the lower-plain area. It is therefore deemed urgent to introduce a new rural water supply programme with a small supply system. That is, local people receive potable water from public stand installed every 50m for instance, whilst tap area equipped for such public facilities as hospitals, schools and government offices to access to drinking water.

#### **4. Objectives of the Study**

Based on the questionnaire survey conducted by the Dong Nai Master Plan Study, it was found that 170 communes require urgent implementation of 1,207 rural water supply projects due to the unavailability of drinking water supply facilities.

As it is not possible to implement 1,207 projects at one set of Japanese development assistance scheme, this overall development target is divided into four stages, from Stage 1 to Stage 4. It is noted that financial commitment is not sought to the Japanese government for all four stages. This Study consists of preparation of the Master Programme for all four stages and preparation of Detailed Integrated Rural Water Supply Management Programme for Stage 1.

Therefore, the objectives of the proposed Study are

- (1) Preparation of the Master Programme for the rural water supply in the Study Area covering 170 communes to be implemented within next two decades;



- (2) Prioritization of the Communes and establishment of the Community Development Programme;
- (3) Preparation of the Detailed Integrated Rural Water Supply Management Programme for Stage 1 for prioritized communes including cost estimate of the project for prioritized communes; and
- (4) Transfer of technical knowledge on planning and investigation to Vietnamese counterparts through their direct participation in the Study.

## **5. Scope of Work**

### **5.1 Study Area**

The Study Area shall cover nine provinces in the Dong Nai River basin; Tay Ninh, Song Be, Dac Lac, Lam Dong, Ninh Thuan, Binh Thuan, Ba Ria-Vung Tau, Dong Nai and Long An. Ho Chi Minh City is excluded from the Study Area due to the fact all the city area is planned to be supplied with piped water.

### **5.2 Preparation of the Master Programme**

The Master Programme which outlines an overall development plan for the 170 communes in the Study Area which will be implemented in the next two decades will be prepared.

#### **(1) Review of Existing Data and Information**

Following data and information shall be collected and reviewed:

- Previous reports regarding the rural water supply projects in the region,
- Topographic data including topographic maps, results of triangulation and levelling surveys,
- Geological data including geological maps and drilling logs,
- Data on groundwater including aquifer maps, groundwater quality and pump test results,
- Hydrological data including rainfall, salinity intrusion and acid water,



- Socio-economic data including population, gross domestic product, governmental and provincial budgets,
- Existing rural water supply plans in the Study Area,
- Projected drinking water demand within the Study Area by communes,
- Data and information on natural environment such as vegetation, ecology, public health, etc., and
- Other necessary data and information.

## (2) Demand projection of required water

Future drinking water demands will be projected by drawing attention on aerial distribution and development schedule of the rural area.

## (3) Field reconnaissance

The Study Area will at first be reconnoitered by the Study Team and the counterparts to clarify the site condition. Major items to be clarified will be as follows:

- Current condition on the rural water supply of each province,
- Current condition on the areas afflicted by less rainfall, salinity intrusion and acid water where collecting drinking water is most severe,
- Current condition on the remote communes, in particular communes in the highland area where minority groups live and suffer from collecting drinking water,
- Potential areas of groundwater, and
- Existing drinking water supply facilities.

## (4) Preparation of the Master Programme

- Preparation of the Master Programme in the Study Area covering 170 communes to be implemented with rural water supply projects within next two decades will be



prepared. This Master Programme consists of Four Stages with each stage covering a period of 5 years.

### 5.3 Prioritization of the Communes and Establishment of the Community Development Programme

#### (1) Consideration on the criteria to be used for screening the communes

- Identification of the communes
- Current water supply conditions
- Initial geological survey
- Socio-economic survey, including gender survey
- Environmental survey
- Community development survey

#### (2) Prioritization of the Communes to be included in the First Stage

Utilizing the criteria set in the above consideration and survey, communes to be included in Stage 1 will be selected.

#### (3) Establishment of the Community Development Programme

Once the communes are selected for Stage 1, Community Development Programme, which covers communes selected for Stage 1, will be established for all districts by discussing various implementation schemes with the residents of the districts/communes and government officials.

Discussions would include as follows:

- Clarification on the division of responsibilities and scope of work among residents, local government, and JICA;
- Assessment of the requirements related to rural water supply in each district/commune;
- Making aware of the importance of participatory development approach in rural water supply such as knowing methods of operation and maintenance of rural water supply systems; and
- Establishment of the coordination body for installation, operation and maintenance including residents and government officials.



#### **(4) Field Investigation**

In parallel with the establishment of Community Development Programme noted above, the geological investigation including field investigation and assessment of potential development volume will be performed by the Study Team members and counterpart teams. Approximately 10 drilling will be performed in the field investigation.

#### **(5) Selection of Sites for Rural Water Supply System**

Based on the results of field investigation, sites for rural water supply system will be selected after discussion with the coordination body noted above. A total of 300 sites for Stage 1 implementation will be selected.

#### **(6) Initial Environmental Impact Survey**

As soon as the sites for rural water supply system are selected, an initial environmental impact survey will be conducted to examine positive/negative environmental impact which may affect the surrounding area.

### **5.4 Preparation of the Detailed Integrated Rural Water Supply Management Programme for the First Stage**

#### **(1) Preparation of Technical and Administrative Programme**

In collaboration with the coordination body established based on the community development programme noted in the Section 5.3 above, a detailed Integrated Rural Water Supply Management Programme for Stage 1 regarding the installation of rural water supply system will be prepared for each village/commune. This programme will include both the technical and administrative programme involving the residents of the communes. Technical programme will include rural water supply systems to be used, e.g. consideration and preparation of the water distribution networks, consideration on the type of systems to be installed (e.g. stand post type), etc. Administrative programme will review the discussion held in 5.3 (3) above and clearly define the division of responsibilities between the residents, local government and JICA during the implementation stage.

#### **(2) Basic design**

The basic development plan of the projects included in the First Stage will be designed. As part of basic design, a preliminary construction plan will be prepared.



### **(3) Cost estimate of the project for prioritized communes**

Construction cost required for the implementation of the projects included in the Stage 1 will be estimated on basis of unit prices and work quantity obtained based on the basic design. Disbursement of the construction cost will also be prepared based on the construction plan.

### **(4) Environmental assessment**

Of the projects included in Stage 1, Environmental Impact Assessment (EIA) will be carried out for the projects which are identified to cause significant impacts to the surrounding environment, and will be based on the guidelines internationally recognized.

The main focal points of EIA are:

- Deterioration of water quality due to the creation of rural water supply system,
- Impacts to the ecosystem,
- Effects to scenic beauty,
- Effects to archaeological and cultural heritage,
- Adverse effects to the existing infrastructure and other water supply facilities available nearby,
- Effects to downstream water use,
- Water-borne endemic diseases such as malaria, schistosomiasis, etc., and
- Environmental effects during construction.

### **5.5 Transfer of technical knowledge**

For technology transfer and training, expatriates of the Study Team shall encompass provision of in-service training and technology transfer programme to the counterpart staff during the course of the Study. This shall be conducted as part of their involvement in the Study as well as in the form of training seminars, in accordance with the needs of the Study and the individual counterpart staff, and to the extent consistent with the orderly conduct of the work.



## 6. Work Programme

### 6.1 Work Schedule

The Study shall be carried out within a time period of 18 months, as its work schedule given in Figure 1.

### 6.2 Study Outputs (reports) to be Submitted

Following reports are prepared and submitted during the course of the Study:

	<u>Number of copies</u>	<u>Submission time</u>
(1) Inception Report	30	Upon arrival to the project site
(2) Progress Report	30	Within 4 months from the commencement
(3) Interim Report	30	Within 10 months from the commencement
(4) Draft Final Report	30	Within 16 months from the commencement
(5) Final Report	50	Within 18 months from the commencement.

### 6.3 Expertise Input

The Study Team will prepare the Master Programme, Community Development Programme and Detailed Rural Water Supply Management Programme in the Study Area consistent with the objective and scope of the technical assistance outlined above. The Study will require 10 experts and a total of 90 man-months as follows:

- Team Leader,
- Water Supply Planner/Engineer,
- Hydrogeologist (A),
- Community Development Planner,
- Construction Planner/Cost Estimate Specialist,
- Hydrogeologist (B),
- Gender and Development Specialist,
- Socio-Economist,
- Environmentalist, and
- Design Engineer.



## **7. Undertaking of the Government of Viet Nam**

**7.1** The Government of Viet Nam shall facilitate the execution of the Study in accordance with the prevailing laws and regulations stipulated by the Vietnamese Government as below:

- (1)** To secure the safety of the Study Team;
- (2)** To permit the members of the Study Team to enter, leave and stay in Viet Nam for duration of their assignment therein, and exempt them from foreign registration requirement and consular fees;
- (3)** To exempt the members of the Study Team from taxes, duties and other charges on equipment, machinery, and other materials bought into and out of Viet Nam for the conduct of the Study;
- (4)** To exempt the members of the Study Team from income taxes and other charges of any kind imposed on or in connection with any emolument or allowance paid to the members of the Study Team for their services in connection with the implementation of the Study;
- (5)** To provide necessary facilities to the Study Team for remittances as well as utilization of the funds introduced into Viet Nam from Japan in connection with the implementation of the Study;
- (6)** To obtain permission for entry into special areas for the purpose of implementing the Study;
- (7)** To secure permission which is considered to be necessary and issued by the relevant authorities for the Study Team to take out all data and documents including maps and aerophotographs related to the Study out of Viet Nam to Japan; and
- (8)** To provide medical services as needed and its expense will be chargeable on the members of the Study Team.

**7.2** The Government of Viet Nam shall bear claim, if any arisen against members of the Study Team resulting from, occurring in the course of the Study or otherwise connected with the discharge of their duties in the implementation of the Study, except when such claims arise from gross negligence or willful misconduct on the part of the members of the Study Team.



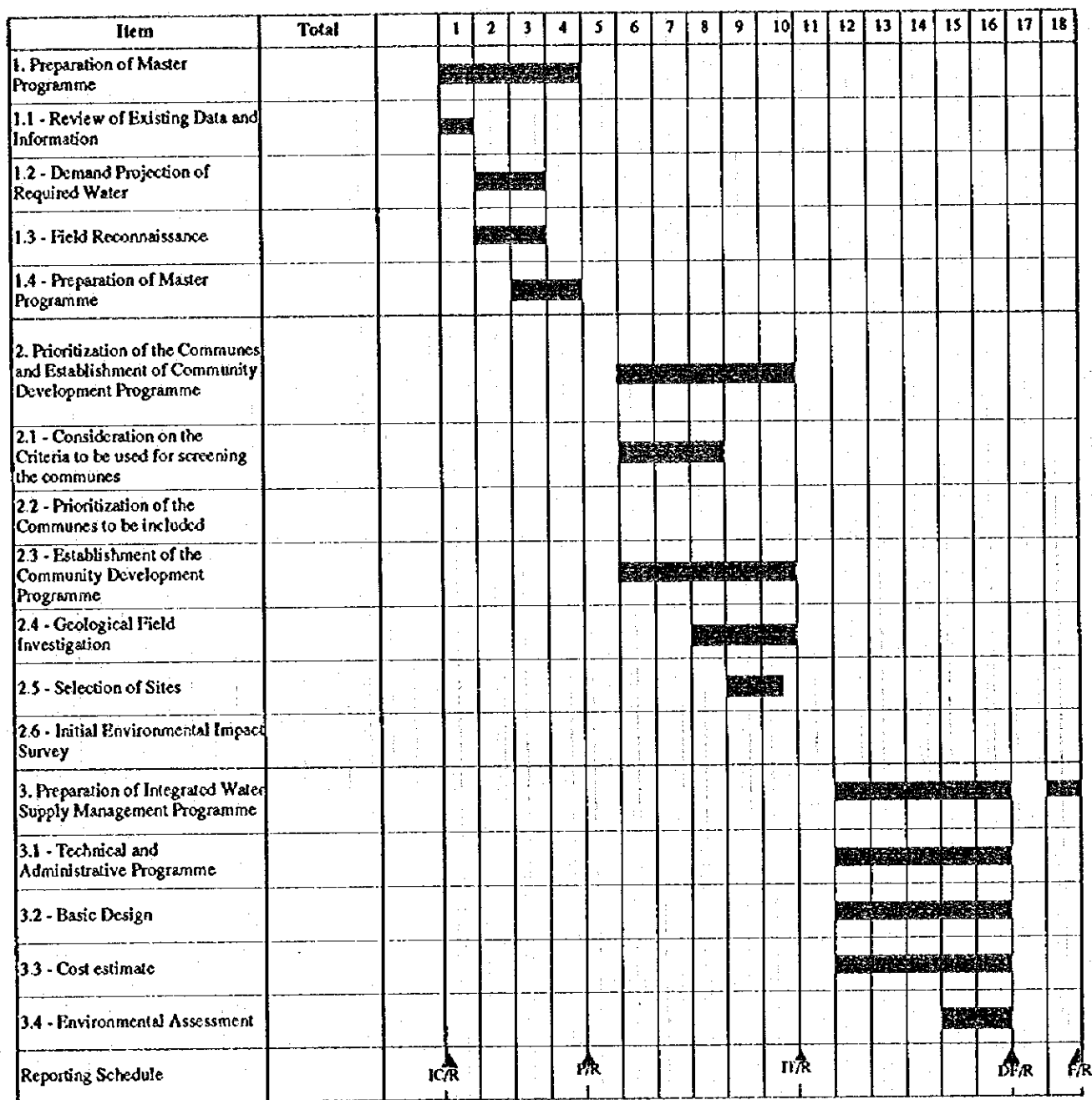
7.3 The Ministry of Agriculture and Rural Development (MOARD) shall act as a counterpart agency to the Study Team. Within the MOARD, the Office for Central Rural Water Supply Project will be in charge of handling technical issues. The MOARD will also act as a coordinating body in relation to other governmental and non-governmental organizations concerned such as the State Planning Committee, the Ministry of Science, Technology and Environment and the related People's Committee of provinces involved for the smooth implementation of the Study.

7.4 The MOARD shall, at its own expense, provide the Study Team with the following in cooperation with other organizations concerned:

- (1) Available data and information related to the Study;
- (2) Necessary number of counterpart personnel including the project coordinator throughout the Study period;
- (3) Credential or identification card;
- (4) Suitable office space for the Study Team and the Counterpart Team with necessary equipment and clerical services in Ho Chi Minh City; and
- (5) Appropriate number of vehicles with drivers during the Study in Viet Nam.



**Figure 1 Work Schedule - Rural Water Supply in the Dong Nai River Basin Area**





# **Attachment-4**

**Terms of Reference**

**for**

**Feasibility Study on the Dong Nai Middle Reach**

**Hydropower Cascade Projects**

**(Dong Nai No. 3 and No. 4)**



**THE GOVERNMENT OF THE SOCIALIST REPUBLIC OF VIET NAM**

**MINISTRY OF INDUSTRY**

**APPLICATION FOR  
TECHNICAL COOPERATION  
BY THE GOVERNMENT OF JAPAN**

**FOR**

**FEASIBILITY STUDY ON THE DONG NAI MIDDLE REACH  
HYDROPOWER CASCADE PROJECTS  
(DONG NAI NO. 3 AND NO. 4)**

**NATIONAL CORPORATION**

**OF**

**GENERAL CONSTRUCTION CONSULTANTS**



**APPLICATION FOR  
TECHNICAL COOPERATION  
BY THE GOVERNMENT OF JAPAN**

- |                            |  |
|----------------------------|--|
| 1. Study Title             | Feasibility Study on Dong Nai Middle Reach Hydropower Projects (Dong Nai No. 3 and No. 4)  |
| 2. Location                | Dong Nai River Middle Reach where the cascade hydropower projects No.3 and No.4 are located. The stretch is approximately 60 km long between 180 km to 240 km upstream from the confluence of the Dong Nai River and the Be River  |
| 3. Executing Agency        | Viet Nam Power Corporation (VPC)   |
| 4. Objectives of the Study | <ul style="list-style-type: none"><li>(1) Formulation of an optimum development plan (scale optimization) for the cascade projects consists of Dong Nai No.3 and No.4 projects in the middle reach of the Dong Nai River from the technical, economic and environmental viewpoints under the framework of the national power development plan.</li><li>(2) Feasibility study of the Dong Nai No.3 and Dong Nai No.4 with optimal development scale.</li><li>(3) Transfer of technology to Vietnamese counterpart personnel during the course of the Study.</li></ul> |
| 5. Necessity of the Study  | The hydropower potentials in the middle reach of the Dong Nai River is remained undeveloped at present, however the development of this reach is essential to cope with the growing power demand in the near future especially at the economic triangle zone including Ho Chi Minh City in the Southern Region. The projects such as Dong Nai No.3 and No.4 in this reach were identified as a cascade development in the previous studies (mostly desk study level) and some  |



field investigations were carried out for Dong Nai No.4 Project by PIDC No.1.

Since the middle reach is the only remaining large scale hydropower development potential area, to establish the most economical hydropower development plan, special attention should be given to the optimization study to determine the development scale of these identified projects taking into account the cascade effects among the projects so that the hydropower potentials in the stretch can be most effectively utilized from view point of the long-term hydropower development strategy in the country.

The development priority of Dong Nai No.3 and No.4 projects among the other candidate hydropower potential schemes in the Southern Region were confirmed in the "Master Plan Study on Dong Nai River and Surrounding Basins Water Resources Development" carried out by JICA Study (1994-1996). According to the above study, these projects are required to be commenced their operation in the year 2005 to 2008. Taking into consideration the lead time required for the various pre-construction activities including the detail design and finance arrangement, the feasibility study for the these projects should be immediately followed so that the projects can be timely implemented to cope with the growing power demand in the Southern Region.

**6. Study Period**

Approximately 21 months

**7. Cooperation Required**

- (1) Despatch of a study team for carrying out the Study.  
The approximate expert input : 130 man-months
- (2) Undertaking of field survey and investigation relevant to the Study
- (3) Transfer of Technology through carrying out the Study



**TERMS OF REFERENCE  
FOR  
FEASIBILITY STUDY  
ON  
DONG NAI MIDDLE REACH  
HYDROPOWER CASCADE PROJECTS  
(DONG NAI NO.3 and NO.4)**

**1. BACKGROUND**

The energy sector in Vietnam is substantially different in each of the three main regions, the north, the central and the south region. There is an excess supply capacity of hydropower along with coal-based generation in the north, while the southern and central regions have generation deficiencies, and consequently are experiencing severe power shortages.

In the year 1994, the Government constructed a single-circuit 500 kV transmission line to interconnect the three power systems and has started sending the surplus power of the north to the south. The system will pave the way for the integrated development of the national power system and provide an opportunity to minimize the overall system reserve requirement.

Nevertheless, the industrial gross product in the southern region accounted for over 50 % to the country total and the annual growth rate of power consumption during last 10 years was approximately 10%. This trend will be further intensified by the fact that the Government has recently launched a programme to develop the areas including Ho Chi Minh City, Bien Hoa and Vung Tau, so-called economic triangle zone (or Southern Focal Economic Area, SFEA) as an industrial development zone aiming to maintain its economic growth rate of over 10 to 15 % per year. To support the nation's economic activities and enhance the social well-being of the people, the development of the stable and reliable electric power supply is essential.

The Dong Nai River basin is the largest river basin in the southern region and the second largest in the whole country next to the Da River in the northern region. The existing hydropower plants on the Dong Nai River are Da Nhim Hydropower Plant (160 MW, 1964) at the upper most reach and Tri An Hydropower Plant (400 MW, 1989) at the lower most reach. Dai Ninh Hydropower Project, located in the upper reach of the river and approximately 40 km downstream of the existing Da Nhim, is considered to be one



of the prospective projects to be developed and its feasibility study was completed by PIDC No.2 in 1994.

The hydropower potentials in the middle reach is remained undeveloped at present, however the development of this reach is essential to cope with the growing power demand in the near future. The projects such as Dong Nai No.3 and No.4 in this reach were identified as a cascade development in the previous studies (mostly desk study level) and some field investigations were carried out for Dong Nai No.4 Project in particular by PIDC No.1.

Since the middle reach is the only remaining area where a large scale hydropower development can be implemented due to its topographical advantages and with scarce population which will minimize possible resettlement problem, special attention should be paid to a optimization study to determine the development scale of Dong Nai No.3 and No.4 projects taking into account the cascade effects among the projects so that the hydropower potentials in the stretch can be most effectively utilized from view point of the long-term hydropower development strategy in the country.

The development priority of these two projects among the other candidate hydropower potential schemes in the Southern Region were confirmed in the "Master Plan Study on Dong Nai River and Surrounding Basins Water Resources Development" carried out by JICA Study (1994-1996). According to the above study, these projects are required to be commenced their operation in the year 2005 to 2008.

Once the optimized development scale of Dong Nai No.3 and No.4 is determined, the feasibility study should be immediately followed so that the financial arrangement for the detail design and the construction can be smoothly made and the project can be timely implemented to cope with the fast growing power demand.

## **2. OBJECTIVES OF THE STUDY**

The principal objectives of the Study are:

- (1) to formulate an optimum development plan of the cascade projects consisting of Dong Nai No.3 and No.4 in the middle reach of the Dong Nai River and to determine the development scenario/sequence.



- (2) to carry out a full-scale feasibility study for the Dong Nai No.3 and No.4 based on the study results of (1)
- (3) to transfer technical knowledge to the Vietnamese counterpart personnel through various studies, analysis, investigations, etc. to be carried out during the Study

### **3. SCOPE OF WORK**

#### **3.1 Study Area**

The Study Area is the Dong Nai River Middle Reach, where the cascade hydropower projects No.3 and No.4 are located. The stretch is approximately 60 km long from 180 km to 240 km upstream from the confluence of the Dong Nai River and the Be River

#### **3.2 Phasing of the Study**

In accordance with the Study Objectives defined above, the Study will be broadly divided into two phases: Phase 1 as Cascade Development Optimization Study to formulate the optimum development scale and its development scenario/sequence for Dong Nai No.3 and No.4, and Phase 2 as Full scale Feasibility Study for these two projects to prepare the definitive design of the projects and confirm its technical, economic, financial, socio-environmental viability.

##### **3.2.1 Phase 1 : Cascade Development Optimization Study**

- (1) Collection and review of existing data and information related to the Study, covering topographic maps, meteo-hydrology, geology and seismology, soils, land uses, power market, socio-economy, previous water/power resources studies, and social and natural environmental aspects.
- (2) Identification of all possible alternative dam sites and layouts for Dong Nai No.3 and No.4.
- (3) Field reconnaissance to the projects identified to confirm their topographic and geological conditions



- (4) Study on power market data, demand projections, review of system expansion programs for generating facilities and transmission lines, costs and tariff data for thermal and hydro plants, fuel consumption rate of thermal plants, etc.
- (5) Project scale optimization study for the cascade projects to maximize power benefit from the hydropower potential available in the Dong Nai middle reach
- (6) Clarification of possible development scenarios and assessment of the development sequence using a project input timing analysis (generation expansion plan analysis)
- (7) Study on the impacts of the various development scenarios on natural/social environment, downstream projects, water utilization, salinity intrusion, irrigation development, etc.
- (8) Establishment of the optimum development scale and the implementation scenario.

### 3.2.2 Phase 2 : Feasibility Study

- (1) Undertaking of field investigation work including preparation of technical specifications for the following items which will be let to local investigation firms.
  - (a) Topographic Survey
    - 1/5,000 photogrammetric mapping covering reservoir area and proposed project facility area
    - 1/1,000 topographic map (with contour interval 1m) for main structure sites such as dam, spillways, waterways and power houses
    - Longitudinal and cross section surveys at dam sites and along waterway including river cross sections at dams and power houses
  - (b) Geological investigation including geological mapping, core drilling, seismic refraction prospecting tests at main structure sites, rock quarry and other material borrow areas.



- (c) Construction material survey including test pitting, trench cut, auger boring, material sampling and laboratory test
- (d) Hydrological investigation including;
  - installation of water level gages
  - discharge measurement
  - measurement of sediment load
  - sampling and analysis of water quality
- (e) Environmental and sociological survey
  - Land utilization mapping
  - Population / ethnic group, etc
- (2) Hydrological analysis including low and high flow analysis, sediment yield estimate
- (3) Survey of construction cost including availability of labor, materials and equipment in domestic and/or international construction market, accessibility and transportation, site conditions
- (4) Socio-economic survey on population, economic indices, social statistics, etc.
- (5) Assessment of impacts on downstream projects including water supply, flood mitigation, irrigation and salinity intrusion control
- (6) Study on power demand/supply balance and justification of the project in the national power supply grid
- (7) Plan formulation study of the Project including selection of least cost layout plan through alternative layout studies



- (8) Design of main structure and facilities including civil works, electric-mechanical equipment, transmission line and substation, and other associated facilities
- (9) Study of construction plan and method, and estimate of construction cost of the Project
- (10) Project justification including economic and financial evaluation of the Project
- (11) Environmental Impact Assessment of the Project in respect of the natural and social aspects such as ecology, resettlement and compensation problem in the feasibility study level . Preparation of practical solutions and countermeasures if required.
- (12) Preparation of detail follow-up action program (project implementation program)

### **3.3 Transfer of Technology**

For technology transfer and training, the Study Team will initiate in-service training and technology transfer program to the counterpart staff and the Government personnel concerned during the study period. The major topics will be :

- Activities of field survey and investigation
- Hydropower planning and design
- Technique of optimization study
- Methodology of generation expansion planning

The above transfer of technology will be carried out in the form of on-the-job training and overseas training in Japan during the course of the Study.



## **4. WORK PROGRAM**

### **4.1 Work Schedule**

The total period required for the Study will be 21 months as shown in Figure 1.

### **4.2 Reports and Documents**

During the course of the Study, following reports and documents shall be prepared in English within the prescribed time from the commencement of the Study:

	No. of copies	Schedule
Inception Report	30 copies	1st month
Progress Report (1)	30 copies	4th month
Interim Report	50 copies	9th month
Progress Report (2)	30 copies	13th month
Draft Final Report	50 copies	19th month
Final Report	50 copies	21st month

### **4.3 Expertise Input**

The Study will require the input of the following expatriate experts:

- (1) Team Leader
- (2) Hydropower Planner
- (3) Hydrologist
- (4) Dam Engineer
- (5) Hydraulic Design Engineer
- (6) Structural Design Engineer
- (7) Geologist
- (8) Soil Mechanics Engineer
- (9) Electrical Engineer
- (10) T/L & S/S Engineer
- (11) Construction Planner
- (12) Natural Environmental Expert
- (13) Social Environmental Expert
- (14) Project Economist
- (15) Geophysicist



- (16) Survey Guidance Engineer
- (17) Aerial Photo Mapping Expert

The total expatriate expert input required is estimated to be 130 man-months excluding local manpower for field survey and investigations to be carried out under the local contract.

#### **4.4 Field Investigation and Equipment Supply**

Following field investigations will be carried out by employing local investigation firms under the direct supervision of the Study Team:

- Aerial photogrammetric shooting and mapping for the Project area (1/5,000)
- Topographic survey at main structure sites and cross section survey
- Hydrological measurement and gage installation
- Geological investigation including geological mapping, core drilling and seismic refraction prospecting
- Construction material survey including sampling and laboratory test

Following equipment will be provided for use in the field investigation:

- Automatic rain gages
- Automatic water level gages
- Evaporation pan
- Current meter
- Sediment sampler
- Echo sounder
- Personal computers and printers



## **5. UNDERTAKING OF THE GOVERNMENT OF VIETNAM**

**5.1** The Government of Vietnam shall facilitate the carrying-out of the Study in accordance with the prevailing laws and regulations stipulated by the Vietnamese state as below:

- (1) To secure the safety of the Study Team;
- (2) To permit the member of the Study Team to enter, leave and safety in Vietnam for duration of their assignment therein, and exempt them from foreign registration requirement and consult fees;
- (3) To exempt the members of the Study Team from taxes, duties and other charges on equipment, machinery and other materials brought into and out of Vietnam for the conduct of the Study;
- (4) To exempt the members of the Study Team from income taxes and other charges of any kind imposed on or in connection with any emolument or allowance paid to the members of the Study Team for their services in connection with the implementation of the Study;
- (5) To provide necessary facilities to the Study Team for remittances as well as utilization of the funds introduced into Vietnam from Japan in connection with the implementation of the Study;
- (6) To obtain permission for entry into special area for the purpose of implementing the Study;
- (7) To secure permission which is considered to be necessary and issued by the relevant authorities for the Study Team to take out all data and documents including maps and aerophotographs related to the Study out of Vietnam to Japan; and
- (8) To provide medical services as needed and its expense will be chargeable on the members of the Study Team.

**5.2** The Government of Vietnam shall bear claim, if any arisen against members of the Study Team resulting from, occurring in the course of the Study or otherwise connected with the discharge of their duties in the implementation of



the Study, except when such claims arise from gross negligence or willful misconduct on the part of the members of the Study Team.

5.3 Viet Nam Power Corporation shall act as counterpart agency to the Japanese Study Team and also as coordinating body in relation with other governmental and non-governmental organizations concerned for the smooth implementation of the Study.

5.4 Viet Nam Power Corporation shall, at its own expense, provide the Study Team with the following, in cooperation with other organizations concerned:

- (1) Available data and information related to the Study;
- (2) Necessary number of counterpart personnel including project coordinator throughout the Study period;
- (3) Credential or identification card;
- (4) Suitable office space for the Study Team and the Counterpart Team with necessary equipment and clerical services; and
- (5) Appropriate number of vehicles with drivers during the Study in Viet Nam.



Work Item	1st Year				2nd Year			
	I	II	III	IV	I	II	III	IV
<b>PHASE 1 : Cascade Development Optimization Study</b>								
(1) Review of existing data and information	■							
(2) Field reconnaissance	■							
(3) Photogrammetric mapping	■	■						
(4) Analysis for power demand/supply balance		■						
(5) Scale optimization of cascade projects		■	■					
(6) Generation expansion planning		■	■					
(7) Study on development scenarios			■	■				
<b>PHASE 2 : Feasibility Study for Dong Nai No.3 &amp; No.4</b>								
(1) Hydrological survey and analysis	■	■	■	■	■			
(2) Topographic survey		■	■	■				
(3) Geological survey			■	■	■			
(4) Construction material survey				■	■			
(5) Project layout study				■	■			
(6) Structural optimization					■	■		
(7) Design for civil, electrical and mechanical					■	■		
(8) Construction plan and cost estimate						■	■	
(9) Economic and financial evaluation							■	■
(10) Environmental impact assessment			■	■	■	■	■	■
Transfer of Technology	■	■	■	■	■	■	■	■
<b>Report</b>								
(1) Inception Report	▲							
(2) Progress Report (1)		▲						
(3) Interim Report				▲				
(4) Progress Report (2)					▲			
(5) Draft Final Report							▲	
(6) Final Report								▲

**Figure 1 : Work Schedule for Feasibility Study for Dong Nai No.3 and No.4**



# **Attachment - 5**

**Terms of Reference  
for  
Feasibility Study on  
Phan Ri - Phan Thiet Irrigation Project**







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

**APPLICATION FOR  
TECHNICAL COOPERATION (DEVELOPMENT STUDY)  
BY THE GOVERNMENT OF JAPAN**

**FOR  
FEASIBILITY STUDY  
ON  
PHAN RI - PHAN THIET IRRIGATION PROJECT**



-



The East Coast area is characterized as one of the poorest region in Viet Nam, however having a large potential for agro-based industrial development and tourism industry, and also receiving migration mainly from the northern region. These factors will have to be coupled with the formulation of the Project in terms of optimum and fair water allocation to other development sectors and environmentally sound land development.

Under such circumstance, a study to prepare a comprehensive development plan is urgently required to mobilize all the available land and water resources in the project area, in due consideration of time time-frame condition of the Dai Ninh hydropower project which is scheduled to be commissioning in the year 2003.

- |    |  |   |
|----|--|---|
| 6. | Study Period                                     | About 24 months   |
| 7. | Cooperation Requested to the Government of Japan | <ul style="list-style-type: none"><li>(1) Dispatching of a study team to undertake the Study composed of required expertises,</li><li>(2) Feasibility study of the Phan Ri - Phan Thiet irrigation project based on the comprehensive land and water resources development plan in the Study Area and in consideration of stage-wise development for an area of 42,000 ha, and</li><li>(3) Transfer of technical knowledge to Vietnamese counterparts in the course of the Study.</li></ul> |
| 8. | Other Related Project and Study                  | Master Plan Study on Dong Nai River and Surrounding Basins Water Resources Development by Japan International Cooperation Agency (JICA)   |



## 1. Introduction

Since the year 1986, the Government of Viet Nam (the Government) is carrying out drastic reforms in the political, economic and social fields under the banner of "Doi Moi" (renovation). Doi Moi has two major objectives to pursue in the economic field: (i) an economic liberalization policy at home; and (ii) an open door policy internationally. In the course of the implementation of Doi Moi policy accelerated in the year 1989, the overall economy has been steadily grown at a GDP rate of 6 to 8% per annum, although it experienced sudden recession due to Soviet Union shock in the year 1990. During the next five years, Viet Nam targets to achieve high and sustainable growth at a rate higher than the previous five years so as to fulfill the objective of doubling the 1990 per capita GDP by the year 2000, to bring the country out of poverty and underdevelopment, to improve people's living standards, to increase domestic saving, and to get ready stronger development in the 21st century.

Water resources development is one of essential elements to promote economic development, since the latter can be attained by using electricity and water gained through the development of the former. Thus, projects related to water resources have been developed in the framework of the national development programmed based on the economic reform policy. Within such the framework, the master plan study on the Dong Nai River and its surrounding basins, including Ho Chi Minh City as a pivotal area of economic development in the southern Viet Nam, was carried out by the Government with a technical assistance of Japan International Cooperation Agency(JICA) in the year 1994 to 1996. The master plan study aimed at efficient utilization and management of limed water resources available for hydropower, irrigation, water supply, flood mitigation and watershed management.

The Phan Ri and Phan Thiet Irrigation Project (the Project) was selected as one of the priority master plan project in the said Master Plan Study in the agricultural sector. The Project aims at increasing the agricultural productions in the Phan Ri - Phan Thiet plains with a total area of 42,000 ha in net, introducing diversified farming under the year-round irrigation which will be realized by the trains-basin diversion of water in Dong Nai River basin to the Luy River in the East Coast through the Dai Ninh hydropower project. The implementation of the Project is expected to increase the farmers' income, enhancing the living standard in the economically depressed East Coast, creating job opportunities and ultimately narrowing down the economic disparity between urban and rural areas. With the results obtained by the Master Plan Study, the Government of Viet Nam requests the Government of Japan to provide technical assistance to carry out the



Study of the Project, which prepares a feasibility report for the irrigation development in the Phan Ri and Phan Thiet plains.

## **2. Development Strategy of Agriculture Sector**

Viet Nam is basically an agricultural country where over 80 % of the population still live in rural areas, supported by farming, forestry and fishery. Grain crops, dominated by paddy, generate half the output value of this sector. Besides, a high proportion of industry and services derives their demand from agriculture. But, because of its vulnerability to vagaries of nature, the growth rate of agriculture witnessed larger fluctuations than that of industry. The agriculture sector, including forestry and fishery, accounted for 36% of GDP in the year 1993, nearly three-quarters of national employment and about 50% of export earnings. Due to the liberalization of distribution system in agricultural sector, paddy production recorded 26 % growth in the year 1987-89 and this permitted Viet Nam to move from a position of net importer of 700,000 - 800,000 tons of rice in the year 1986-88 to a net exporter of around 2 million tons of rice per annum in the year 1989-92.

The Government has set an agricultural sector program in the next Five Year Plan with a title of "Socio-economic Stabilization and Development Strategy to the year 2000", emphasizing to:

- re-structure the agricultural production towards the sustainable market oriented agriculture;
- diversify the farming structure introducing more cash and industrial crops;
- continue to increase food production to attain 30 million tons by the year 2000, bringing per capita food output to 366 kg per year in order to achieve food security and to increase rice export to about 2 million tons a year;
- produce regionally compatible crops using new variety of high yield and good quality, particularly for paddy and maize; and
- expand industrial and fruit crops plantations together with processing plants like cotton, sugar cane, rubber, coffee and tea.

Under such a development policy in the agricultural sector, the public investment should be expanded in factors fundamental to the agricultural developments, most notably research and extension services, irrigation and water resources management and rural infrastructure. Along with this development strategy and as a critical element in developing the agricultural sector, the Government intends to continue the expansion of the irrigation and water resource management systems in many parts of the country as



well as rehabilitating, upgrading and repairing existing irrigation, dikes, drainage structures. In addition, the Government is to strengthen rural infrastructure and the linkages with economic growth areas. Particular attention will be given to improving farm-to-market roads, rural electrification, supply of safe drinking water and sanitation facilities. These improvement will encourage the commercialization of the agricultural sector and rural employment diversification. This policy aims to increase the farmers income, enhance the living standard in the rural area and ultimately mitigate the regional gap in the social and economic conditions.

### **3. The Project**

#### **3.1 Project Background**

The South Central Coast region or so called the East Coast Area in the Dong Nai River and surrounding basins, covering Ninh Thuan and Binh Thuan provinces, is characterized by small rainfall ranging from 800 mm per annum in its coastal part to 1,500 mm per annum in its mountainous part with a large annual fluctuation. The coastal rivers drain the catchment area in the range of 1,000 to 2,000 km<sup>2</sup> at most. These unfavorable climatological and hydrological conditions limit to increase crop production. Irrigation systems are fed by many small rivers, and the rate of irrigated area is about 40%. However, the absolute shortage of water in the dry season causes a low cropping intensity of about 140% in paddy cultivation of Binh Thuan province, and in addition the deterioration of irrigation facilities accelerates this condition. Such conditions keep the east coast area in economically lagging behind from the neighboring other regions. Nevertheless, this area has the highest physical potential of irrigated agriculture development when diverting water from the Dong Nai River basin to the coastal area in addition to the full exploitation of local water resources available in the coastal area. Further, this region has natural advantage to introduce the more diversified cropping system including sugar cane, cotton and fruits. The total area of the potential irrigation schemes is estimated at more than 40,000 ha. Available water in the area falls short of developing these potential schemes, and the possible measure to solve this problems is to divert water from the Dong Nai River basin to the coastal area. This scheme has been contemplated long since the 1960s, and a large hydropower project named Dai Ninh Project has been approved to enter into implementation. At present, the Dai Ninh power project is scheduled for commissioning in the year 2003, by that discharge of about 25 m<sup>3</sup>/sec released constantly to the Luy River from the Dai Ninh power station. This enable to irrigate an area of 42,000 ha in the Phan Ri - Phan Thiet plains with regulating by the proposed Luy reservoir. The 42,000 ha includes the existing paddy field of 20,000 ha and upland crops area of 6,500 ha, and in addition an



area of 12,000 ha would be reclaimed for agricultural land which contributes the settlement of small land holder.

### 3.2 Project Features

The Phan Ri - Phan Thiet Irrigation Project is formulated with a full potential area of 42,000 ha, consisting of 32,000 ha in Phan Ri plain and 10,000 ha in Phan Thiet plain by utilizing the tail water of Dai Ninh hydropower station in conjunction with water available in both the plains. The general layout of the Phan Ri and Phan Thiet Irrigation Project is shown in Figure 1. The major features of the project are summarized below:

Description		Unit	Headwork	
			Ca Giay Res.	Luy Res.
Water Source	From own basin	m <sup>3</sup> /sec	1.39	5.26
	From Dong Nai Basin	m <sup>3</sup> /sec	0	24.46
Net Reservoir Storage Volume		Mil. m <sup>3</sup>	30	110
Irrigation Area	Phan Ri plain	ha	2,000	30,000
	Phan Thiet plain	ha	0	10,000
Max. Diversion Water Requirement		m <sup>3</sup> /sec	2.36	47.20

The proposed Luy dam is located on the main stream of the Luy River, about 1 km downstream from the confluence of its tributary named the Da Ke Trou River and about 24 km north-west from Phan Ri town, capital of Bac Binh district of Binh Thuan province. The proposed site of Luy dam has a relatively flat topography on the about 4 km wide river bed and moderately steep abutments. The geology at the dam site is characterised by intrusive granite and overlying basaltic rocks, having sufficient bearing strength except for possible leakage from the reservoir through probable unconsolidated river deposits lying beneath the basaltic rocks. Judging from the topographic and geological conditions, a rock fill type dam is conceivable utilizing rock and filter materials widely available in and around the dam site. Its major features are summarized below:

- Type of dam		Center core rockfill
- Full supply level (FSL)	EL. m	129.0
- High water level (HWL)	EL. m	132.0
- Dead water level (DWL)	EL. m	120.0
- Gross storage volume	Mil. m <sup>3</sup>	137.0
- Net storage volume	Mil. m <sup>3</sup>	110
- Dam Height and crest length		
Main dam	m	33.0 and 1,870
Sub-dam - 1	m	4.0 and 430
Sub-dam - 2	m	5.0 and 580
- Type of spillway		Side overflow
- Design flood discharge	m <sup>3</sup> /sec	1,000
- Max. outlet discharge	m <sup>3</sup> /sec	48
- Total embankment volume	m <sup>3</sup>	2,751,000



Two main canals are required, one is the west main canal commanding west half of the project area and also conveying water to the Phan Thiet Plain of 10,000 ha area and the other east main canal. The proposed routes of main canals have a relatively flat topography, however it may encounter rock layer at relatively shallower depth in several places. The major features of main canals are summarized below:

		West Main Canal	East Main Canal
Command Area	ha	24,000	16,000
Length	Km	25.5	8.0
Head discharge	m <sup>3</sup> /sec	28.3	18.9
Canal slope		1 : 10,000	1 : 10,000
Canal base width	m	12.0 to 6.0	9.0 to 5.0
Canal height	m	3.5 to 3.3	3.5 to 2.5

#### 4. Necessity of the Study

The Project is formulated to irrigate a total area of 42,000 ha consisting of the existing paddy and upland crop fields of 30,000 ha and the newly reclaimed bush and grass land of 12,000 ha in net (or 20,000 ha in gross) by full utilization of water released from the proposed Dai Ninh power station with a constant discharge of about 24.5 m<sup>3</sup>/sec in conjunction with local water resources in the Luy River basin. This is realized by constructing the proposed large scale Luy reservoir which has a enough storage capacity to regulate the fluctuation of seasonal irrigation demand between the dry and rainy seasons.

Water from the Dai Ninh power station together with natural flow of the Luy River, the proposed Ca Giay reservoir and other small existing irrigation systems would be able to irrigate an area of about 24,300 ha even without the proposed Luy reservoir. The proposed Ca Giay reservoir, which is estimated to have a capacity to irrigate an area of 2,000 ha with diversified farming of 240% cropping intensity, is scheduled to be implemented from the year 1996. These conditions will make it possible to implement the Project on a stagewise development basis, probably i.e., construction of irrigation systems distributing Dai Ninh water first and secondary construction of the Luy dam and land reclamation of new development land.

The East Coast area is characterized as one of the poorest region in Viet Nam, however having a large potential for agro-based industrial development and tourism industry, and also receiving migration mainly from the northern region. These factors will have to be coupled with the formulation of the Project in terms of optimum and fair water allocation to other development sectors and environmentally sound land development.



Under such circumstance as mentioned above, a study to prepare a comprehensive development plan is urgently required to mobilize all the available land and water resources in the project area, in due consideration of time-frame condition of the Dai Ninh hydropower project which is scheduled to be commissioning in the year 2003.

## **5. Objectives of the Study**

The objectives of the Study are to:

- (1) carry out a feasibility study of the Phan Ri - Phan Thiet irrigation project based on the comprehensive land and water resources development plan in the Study Area and in consideration of stage-wise development for an area of 42,000 ha; and
- (2) transfer technical knowledge on planning and investigation to Vietnamese counterparts through their direct participation in the Study.

## **6. Scope of the Study**

### **6.1 Study Area**

The Study Area shall cover an entire area of the Luy, the Quao and Ca Ty River basins with a total area of about 4,000 km<sup>2</sup> situated in the central part of Binh Thuan belonging to in the South Central Coast Region of Viet Nam.

### **6.2 Phasing of the Study**

The Study shall be divided into the following three Phases:

**Phase I:** Formulation of integrated rural and agricultural development in the Study Area based on the land and water resources development study;

**Phase II:** Perpetration of topographic maps and geological investigation; and

**Phase III:** Feasibility study on the Phan Ri - Phan Thiet irrigation project covering the existing and newly reclaimed agricultural lands with a total area of 42,000 ha in net



## 6.3 Scope of Works

### 6.3.1 Phase I

(1) Collection, review and analysis of relevant existing data and information including:

- a) existing overall development plan so far prepared by the MOARD, provincial administration and other agencies concerned;
- b) master plan study on Dong Nai River and surrounding basins water resources development prepared by the Government with an assistance of JICA;
- c) studies on the Dai Ninh hydropower development projects;
- d) natural conditions (topography, meteorology, hydrology, geology, pedology, water quality, sea water intrusion),
- e) social and economic conditions (regional socio-economy, labor force and unemployment rate, regional development programs, agricultural sector plan, social infrastructure, farmers organization, ethnic minority problem, woman in development)
- f) agriculture (land use, cropping pattern, yield/production, crop diversification, farming practices, farmers economy, land tenure, processing, marketing),
- g) agricultural supporting services (extension services, credit, market, information and facilities, cooperatives)
- h) agricultural infrastructure (existing irrigation and drainage systems, needs of rehabilitation, operation and maintenance),
- i) social and natural environmental impacts (resettlement, deforestation, water pollution, erosion, sedimentation)
- j) others

(2) Meteorological and hydrological investigation and analysis

- a) installation of rain and hydrological gauging stations at the appropriate sites in and around the Study Area; and
- b) analysis of meteorological and hydrological data for irrigation and drainage planning and design.

(3) Soil and land use investigation and analysis



- a) Soil survey and classification; and
- b) Land use survey and analysis of land capability.

(4) Agriculture and agro-economic survey and planning

- a) review of existing cropping pattern, farming practices, crop yields, etc.;
- b) farmers' intention survey and analysis;
- c) survey and assessment of farmer's economy
- d) survey and assessment of present prices and marketing of farm products and inputs;
- e) price prospect of crops and farm inputs;
- f) assessment of national and regional demand and supply of major crops;
- g) formulation of agricultural development including proposed cropping patterns, farming practices, etc.; and
- h) estimate of economic and financial benefit.

(5) Socio-economic and institutional survey and study

- a) assessment of regional socio-economic situation and future prospect;
- b) assessment of the present agricultural supporting services;
- c) assessment of the present farmers' cooperatives;
- d) assessment and planning of resettlement in the newly reclaimed land;
- e) assessment of woman in development (WID); and
- f) recommendation of the proposed institutional settings including agricultural supporting services; farmers' cooperatives, etc.

(6) Irrigation and drainage development

- a) inventory survey of existing irrigation schemes and related rural facilities;
- b) estimate of irrigation and drainage requirements and domestic and industrial water demands;
- c) layout of irrigation and drainage canals and structures including rural facilities;
- d) topographic survey for the major irrigation and drainage canals and structures including rural facilities;
- e) preliminary design of the Luy dam; and
- f) preliminary cost estimate of irrigation and drainage canals and structures including rural facilities.



(7) Study of project management and O&M

- a) assessment of the present O&M activities including organization, staffing, budget, collection of water charges. etc.; and
- b) study and recommendation of proposed project management and O&M framework.

(8) Environmental assessment

- a) Identification and focusing of Initial Environmental Examination (IEE) based on the international and domestic guidelines.

(9) Formulation of integrated rural and agricultural development in the Study Area

- a) formulation of land and water resources development;
- b) formulation of irrigation agricultural development including related rural development; and
- c) cost estimate and economic evaluation of the development projects.

6.3.2 Phase II

- (1) Aerial photo shooting on a scale of 1 : 20,000 covering about 4,000 km<sup>2</sup> of the Luy, the Quao and Ca Ty River basins and preparation of topographic maps covering the existing and newly reclaimed agricultural lands with a total area of about 80,000 ha on a scale of 1 : 5,000, with contour interval of 0.5 m in the low-lying lands and 1.0 m in the high lands.
- (2) Aerial photo mapping covering the proposed Luy reservoir area of about 30 km<sup>2</sup> on a scale of 1 : 10,000.
- (3) Topographic maps at the proposed Luy dam site on scales of 1 : 1,000 and 1 : 500 depending upon the nature of structures.
- (4) Geological investigation at the proposed Luy dam sites and along the main irrigation canals.

6.3.3 Phase III



- (1) Collection of supplemental data and information in addition to those collected in the Phase I study.
- (2) Updating meteorological and hydrological data based on the supplemental data and information and data recorded by the rain and hydrological gauging stations installed by the Study Team.
- (3) Detailed classification of soil and land capability for the proposed irrigation development project area
- (4) Agriculture and agro-economic planning
  - a) formulation of agricultural development including proposed cropping patterns, farming practices, etc. for the proposed irrigation development project area ;
  - b) estimate of farm budget; and
  - c) estimate of economic benefit by the irrigation development.
- (5) Socio-economic and institutional survey and study
  - a) recommendation of resettlement planning in the newly reclaimed land; and
  - b) recommendation of the proposed institutional settings including agricultural supporting services, farmers' cooperatives in the irrigation development project area.
- (6) Irrigation and drainage development
  - a) determination of irrigation and drainage requirements and domestic and industrial water demands;
  - b) layout of irrigation and drainage canals and structures including rural facilities;
  - c) construction material survey;
  - d) basic design of the Luy dam and cost estimate
  - e) preliminary design of irrigation and drainage canals and structures including rural facilities;
  - f) cost estimate of irrigation and drainage canals and structures including rural facilities; and



- g) preparation of project implementation schedule and estimate of fund requirement
- (7) Recommendation of proposed project management and O&M framework including organization, staffing, budget, collection of water charges. etc.
- (8) Initial Environmental Examination (IEE) based on the international and domestic guidelines with regard to items identified and focused in the Phase I study.
- (9) Cost estimate and economic evaluation of the irrigation development project.

#### 6.3.4 Transfer of Technology

For technology transfer and training, expatriates of the Study Team will initiate in-service training and technology transfer program to the counterpart staff and the Government personnel concerned during the study period. This shall be conducted as part of their involvement in the Study as well as in the form of training seminars, in accordance with the needs of the Study and the individual counterpart staff, and to the extent consistent with the orderly conduct of the work.

### 7. Work Program

#### 7.1 Work Schedule

The Study will be carried out in three phases within a time period of 24 months in accordance with the tentative schedule attached in Figure 2.

#### 7.2 Reports

Following reports are prepared and submitted during the course of the Study:

	<u>Copy Nos.</u>	<u>Submission Time</u>
(1) Inception Report	30	Within 1st month from the commencement
(2) Interim Report	30	Within 6th month from the commencement
(3) Progress Report (1)	30	Within 10th month from the commencement
(4) Progress Report (1)	30	Within 14th month from the commencement
(5) Progress Report (1)	30	Within 18th month from the commencement
(6) Draft Final Report	30	Within 22nd month from the commencement
(7) Final Report	50	Within 24th month from the commencement

#### 7.3 Expertise Input



To perform the above scope of work of the Study, the Study Team will be composed of the following experts:

- Team Leader/Rural and Agricultural Development Planning Expert
- Irrigation and Drainage Expert
- Agronomist
- Agro-economist
- Soil Expert
- Socio-economist
- Hydrologist
- Dam Expert
- Geologist
- Construction Planning Expert
- Project economist
- Institutional Expert
- Environmental Expert
- Geodetic Expert

## **8. Undertaking of the Government of Viet Nam**

8.1 The Government of Vietnam shall facilitate the carrying-out of the Study in accordance with the prevailing laws and regulations stipulated by the Vietnamese state as below:

- (1) To secure the safety of the Study Team;
- (2) To permit the member of the Study Team to enter, leave and safety in Vietnam for duration of their assignment therein, and exempt them from foreign registration requirement and consult fees;
- (3) To exempt the members of the Study Team from taxes, duties and other charges on equipment, machinery and other materials brought into and out of Vietnam for the conduct of the Study;
- (4) To exempt the members of the Study Team from income taxes and other charges of any kind imposed on or in connection with any emolument or allowance paid to the members of the Study Team for their services in connection with the implementation of the Study;



- (5) To provide necessary facilities to the Study Team for remittances as well as utilization of the funds introduced into Vietnam from Japan in connection with the implementation of the Study;
  - (6) To obtain permission for entry into special area for the purpose of implementing the Study;
  - (7) To secure permission which is considered to be necessary and issued by the relevant authorities for the Study Team to take out all data and documents including maps and aerophotographs related to the Study out of Vietnam to Japan; and
  - (8) To provide medical services as needed and its expense will be chargeable on the members of the Study Team.
- 8.2 The Government of Vietnam shall bear claim, if any arisen against members of the Study Team resulting from, occurring in the course of the Study or otherwise connected with the discharge of their duties in the implementation of the Study, except when such claims arise from gross negligence or willful misconduct on the part of the members of the Study Team.
- 8.3 The Ministry of Agriculture and Rural Development (MOARD) shall act as counterpart agency to the Japanese Study Team and also as coordinating body in relation with other governmental and non-governmental organizations concerned for the smooth implementation of the Study.
- 8.4 The MOARD shall, at its own expense, provide the Study Team with the following, in cooperation with other organizations concerned:
- (1) Available data and information related to the Study;
  - (2) Necessary number of counterpart personnel including project coordinator throughout the Study period;
  - (3) Credential or identification card;
  - (4) Suitable office space for the Study Team and the Counterpart Team with necessary equipment and clerical services; and



(5) Appropriate number of vehicles with drivers during the Study in Viet Nam



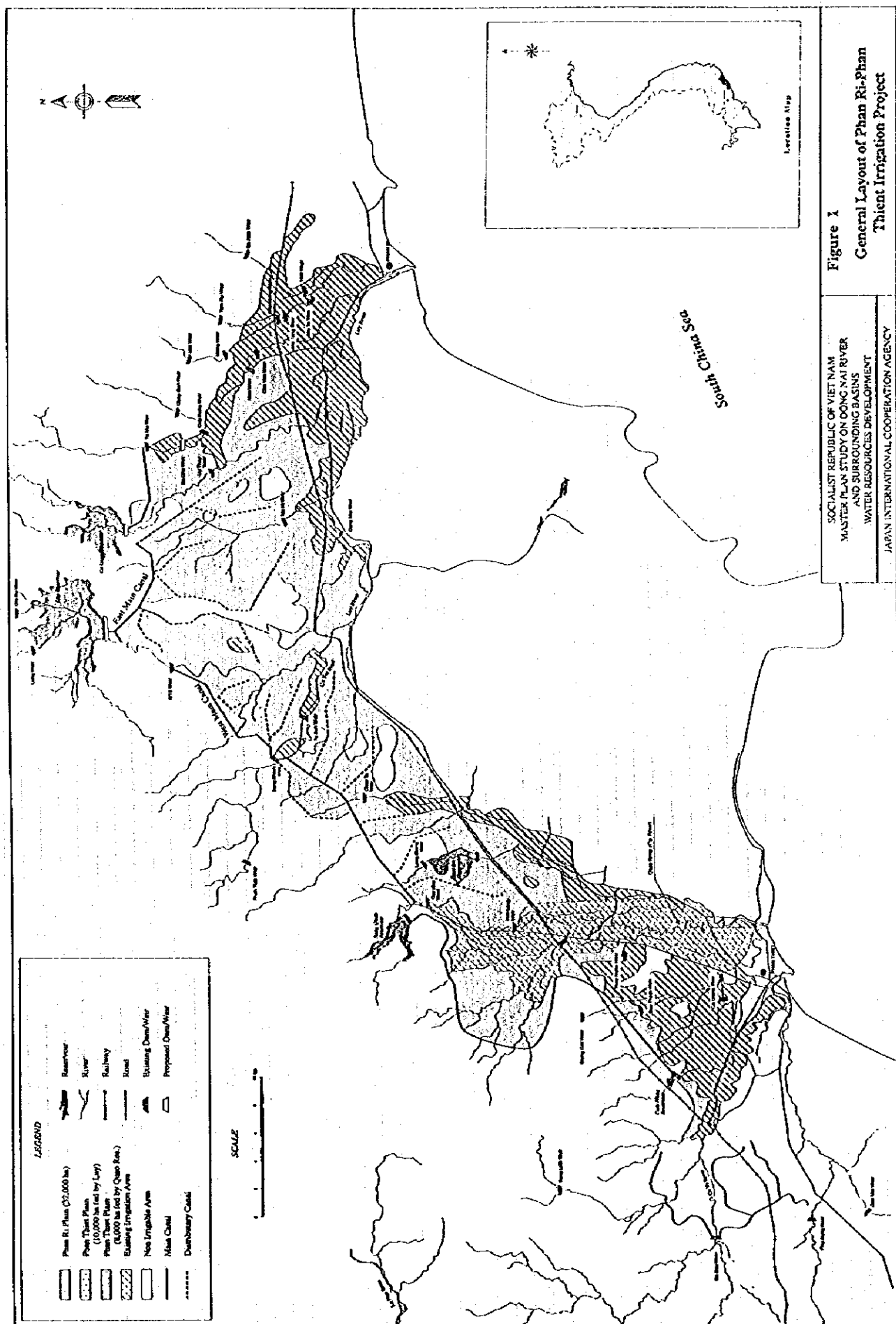


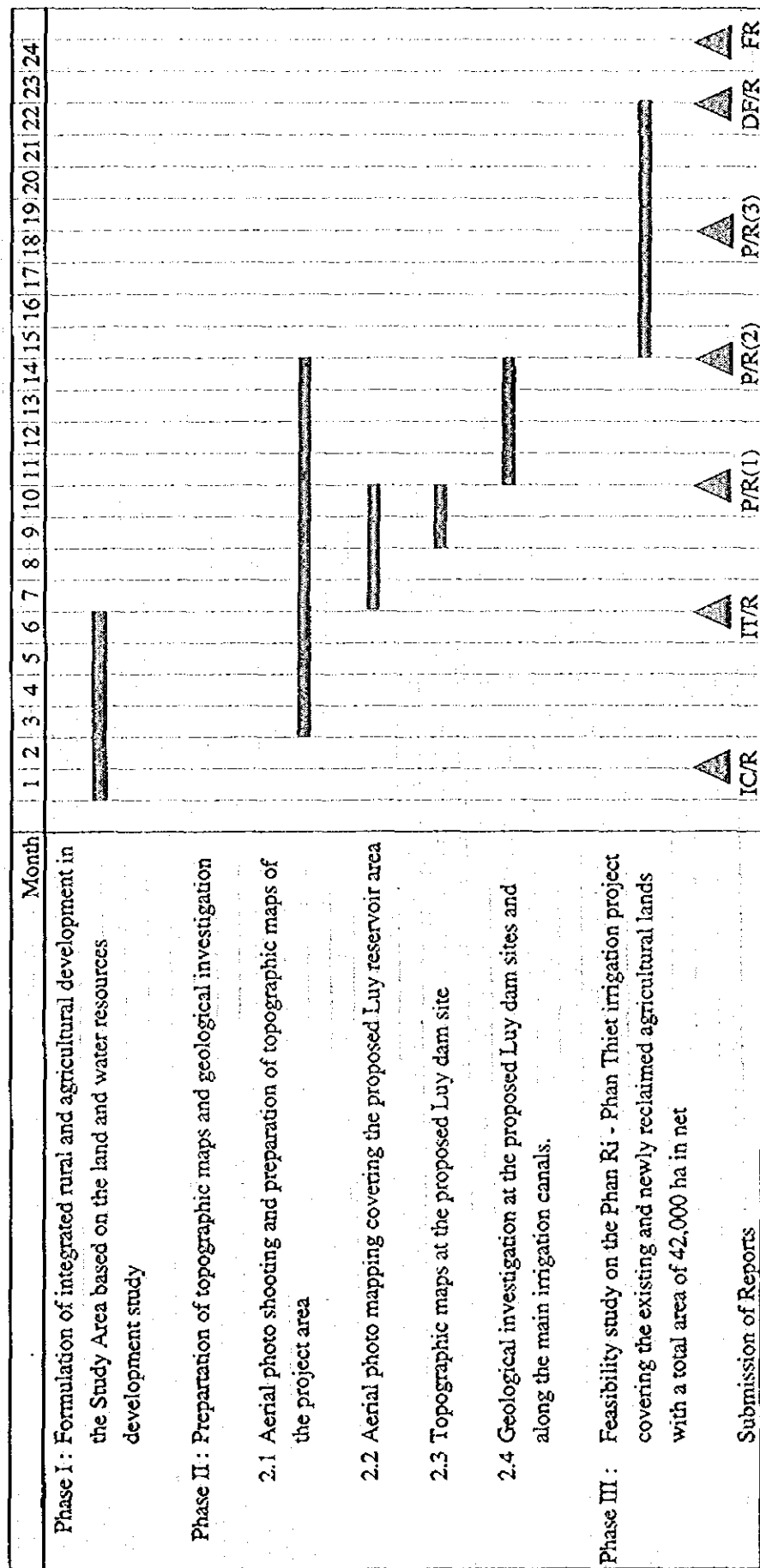
Figure 1

# General Layout of Phan Ri-Phan Thient Irrigation Project

SOCIALIST REPUBLIC OF VIET NAM  
MASTER PLAN STUDY ON DONG NAI RIVER  
AND SURROUNDING BASINS  
WATER RESOURCES DEVELOPMENT  
JAPAN INTERNATIONAL COOPERATION AGENCY



Figure 2 Tentative Work Schedule for Feasibility Study on Phan Ri - Phan Thiet Irrigation Project



Note

IC/R : Inception Report

P/R : Progress Report

IT/R : Interim Report

DF/R : Draft Final Report

F/R : Final Report