2.2 Feasibility Study

2.2.1 Topographic Survey and Mapping

During the course of the feasibility study, PMO-SWIM, NIA and BSWM prepare maps of damsite and irrigation area. NEA prepares map only for damsite and FMB makes map for watershed area. In addition to the mapping, NEA conducts a profile survey from intake site to power station site along power tunnel and penstock route. The summary of topographic survey and mapping is shown in Table B.2.1.

The contour interval of all maps is 1.0 m, but the scale of map varies by each agency as follows:

Item	PMO-SWIM	NIA	BSWM	NEA	FMB
Damsite	1/500 or 1/1,000	1/500 to 1/4,000	1/500	1/2,000	-
Reservoir	1/500 to 1/2,000	1/2,000 or 1/4,000	1/1,000	-	-
Irrigation Area	Unknown	1/2,000 or 1/4,000	1/2,000 to 1/5,000	-	-
Watershed Area	-	-	-	-	Unknown

2.2.2 Meteorological and Hydrological Study

Based on the collected data and feasibility study reports, review on meteorological and hydrological study is made. Those review results are summarized in Table B.2.2.

(1) Meteorology

The report made by each agency shows climate type belonging to project area, and describes the meteorological conditions. The following data observed in meteorological stations in the vicinity of project area are mentioned:

i. Rainfall
ii. Relative humidity
iii. Temperature
iv. Evaporation
V. Prevailing wind direction
vi. Wind velocity
vii. Number of typhoon

Rainfall is described in most of the reports studied by each agency. Evaporation is also mentioned in the reports except by NEA and FMB.

Climate types are classified in 4 types in the Philippines from the viewpoint of rainfall distribution in the wet and dry season. Meteorology of the project is characterized referring to the location, climate type and rainfall pattern in the project area. Climatological map is shown in Fig. B.2.1.

(2) Hydrology

As hydrological analysis in plan and design of small-scale dam reservoir, DPWH, NIA and BSWM study the following items:

i. Run-off analysis: to estimate inflow into reservoir
ii. Flood analysis: to determine spillway capacity
iii. Sedimentation: to estimate sedimentation in reservoir

Since the NEA projects are of run-of-river type, only run-off analysis is made. In the FMB projects, no hydrological analysis is conducted.

(a) **Run-off Analysis**

DPWH and NIA estimate inflow into reservoir by applying rainfall-runoff regression analysis or Thomas and Fiering Model, etc. on the basis of discharge data in similar characteristic rivers.

BSWM estimates inflow by multiplying mean monthly run-off coefficients of available streamflow records in small/moderate drainage areas by the mean or 80%-dependable 10-day rainfall of representative rainfall.

NEA makes flow-duration curve, using discharge data in similar characteristic rivers.

Relation of average annual run-off to drainage area is shown in Fig.B.2.2. Run-off analysis done by each agency is summarized as follows:

Item	DPWH	NIA	BSWM	NEA	FMB
Data	flow records in similar river	flow records in similar river	flow records of small to moderate drainage area in same region	flow records in similar river	no use
Method of Analysis	rainfall run-off regression analysis or Thomas and Fiering model	rainfall run-off regression analysis or Thomas and Fiering model	using the mean monthly run-off coefficient and dependable rainfall	Flow duration curve	no study

(b) **Flood Analysis**

DPWH and NIA prepare design flood hydrograph by applying mean dimensionless hydrograph derived from actually observed flood in similar river, or design rainfall estimated from rainfall-duration frequency curve. Design flood discharges are estimated at 100-year return period in most of the projects.

BSWM makes design flood hydrograph by using the dimensionless hydrograph prepared by US Soil Conservation Service (SCS), or design run-off estimated from rainfall intensity-duration-frequency curve. Design flood discharges are computed at 25-year return period in most of the projects.

In the NEA and FMB projects, flood analysis is not made. Relation of design flood discharge to drainage area is shown in Fig.B.2.3. Summary of design flood analysis is as follows:

Item	DPWH	NIA	BSWM	NEA	FMB
Data	flood in similar river	flood in similar river	no use	no use	no use
Rainfall analysis	rainfall depth-duration-frequency curve	rainfall depth-duration-frequency curve	rainfall depth-duration-frequency curve	no use	no use
Flood analysis method	mean dimension less hydrograph	mean dimension less hydrograph	SCS dimension less hydrograph	no study	no study

(c) Sedimentation

DPWH and NIA study sedimentation in reservoir referring to available existing data. BSWM estimates sediment yield on the basis of a regression equation developed by BSWM for small drainage area. NEA and FMB do not estimate sediment yield. Relation of sediment yield to drainage area is shown in Fig.B.2.4.

2.2.3 Geological Investigation and Study

Geological investigation done by each agencies is summarized as follows:

Item	DPWH	NIA	BSWM	NEA	FMB
Recon-naissance	Ground surface geology	Ground surface geology	Ground surface geology	Ground surface geology	Ground surface geology
Investiga-tion	Boring (Average: 3 nos. Depth: 3-30 m)	Boring (Average: 5 nos. Depth: 3-30 m)	Auger boring (Average: 3 nos. Depth: 0.5-3 m)	Unknown	no study

The followings can be pointed out through the review of geological investigation and study made by each agency:

i. Investigation for the DPWH and NIA dams of which height is more than 15 m, is not enough and limited to the allowable minimum level.

ii. Permeability and standard penetration tests shall be required for the DPWH and NIA dams.

iii. More sufficient study shall be done on permeable foundations such as limestone, volcanic rock, volcanic spouting substance, sand and gravel bed in alluvium or diluvium.

2.2.4 Investigation and Laboratory Test of Construction Materials

The summary of investigation and laboratory test of construction materials done by each agency are as follows:

Item	DPWH	NIA	BSWM	NEA	FMB
Objective	fill type dam	fill type dam	fill type dam	concrete weir	small scale structure
Borrow area	in reservoir dam abutment	in reservoir dam abutment	in reservoir dam abutment	Unknown	Unknown
Concrete material	sand/gravel in main river at project area	sand/gravel in main river at project area	sand/gravel in main river at project area	sand/gravel in main river at project area	no study
Test for imperious materials	physical test mechanical test*	physical test mechanical test*	physical test mechanical test during construction	- -	- -
Test for pervious materials	no study	no study	no study	-	-

Remarks: *; Mechanical test includes compaction, permeability, triaxial compression,and consolidation tests.

Soil materials like high weathered rock are adopted to impervious zone and high permeable materials such as soft rock or gravel are adopted for pervious zone in case of zoned earthfill type dam.

2.2.5 Designs of Dam and Its Appurtenant Facilities

(1) Dam Design

(a) Dam Axis

Dam axis selected by each agency is as follows:

DPWH & NIA	:	at gorge where damsite is geologically stable and embankment volume can be minimized
BSWM	:	at narrow site of small stream
NEA	:	on weathered rock or its outcrop site

(b) **Dam Type and Zoning**

Dam type and zoning are characterized as follows:

Item	DPWH	NIA	BSWM	NEA	FMB
Dam type	zoned earthfill	zoned earthfill	homogeneous earthfill	concrete weir	concrete or masonry
Zone	impervious pervious filter toe drain	impervious pervious filter toe drain	impervious toe drain	-	-

There are a few reports in which filter or toe drain are not planned. There are three BSWM projects having concrete diversion weir.

(c) **Dam Height and Dam Section**

Dam height and section are summarized as follows:

Item	DPWH	NIA	BSWM	NEA	FMB
Dam height	10 - 29 m	14 - 33 m	0.5 - 19 m	3 - 5 m	2 - 3 m
Crest width	6 - 8 m	6 - 8 m	4 - 7 m	-	-
Slope					
- upstream	2.5 - 3.0:1	2.5 - 3.0:1	2.75:1	-	-
- downstream	2.0 - 2.5:1	2.0 - 2.5:1	2.5:1	-	-
Berm	no plan	no plan	no plan	-	-
Freeboard	1.0 - 2.9 m	1.2 - 2.6 m	0.5 - 1.5 m	-	-
Slope protection					
- upstream	riprap	riprap	riprap	-	-
- downstream	sod facing	sod facing	sod facing	-	-

Crest width of dam is determined on the basis of the following empirical formula:

DPWH : W = $0.5\ (5/3\sqrt{H} + 3.6H^{1/3} - 3)$

NIA : W = $(H/5 + 10) \times 0.33$

BSWM : W = $5/3\sqrt{H}$ (minimum 4.0 m)

w : crest width of dam

H : dam height

Adequate crest width is adopted, considering the minimum crest width of about 3.7 m.

No berm on downstream slope is planned. The berm with 2.0 m width shall be provided at every 15-20 m height for the purpose of dam maintenance and drainage of rainfall on slope.

Freeboard is calculated by the following formula:

$Fb = Hr + Hs$

$Hr = 1.5\ Hw$

$Hw = 0.032\sqrt{F.V} + 0.763 - 0.271(F)^{1/4}$

$Hs = (2\text{-}5\%)Hd$

where,

Fb; freeboard (m)

Hr; wave run-up (m)

Hw; design wave height (m)

F ; reservoir fetch (km)

V ; wind velocity (km/hr)

Hs; embankment settlement (m)

Hd; dam height (m)

(d) Filter Design

DPWH/NIA : Filter materials are planned through gradation control of materials, considering the results of grain size analysis for impervious and pervious zones.

BSWM : There is no filter zone, because BSWM plans only homogeneous earthfill type dam. Toe drain is adopted after gradation control of materials.

(e) **Embankment Settlement**

Embankment settlement is calculated as follows:

DPWH	NIA	BSWM	NEA	FMB
Hs=0.02 Hd	Hs=0.01Hd (Hd<3.0m) Hs=0.02Hd ($Hd \geq 3.0m$)	Hs=(2-5%)Hd	No study	No study

Hs : embankment settlement (m)
Hd : dam height (m)

(f) **Width of Impervious Zone**

Width of impervious zone in zoned earthfill type dam which is planned by DPWH and NIA is as follows:

DPWH	NIA
$W \geq 100\% \times Hs$	W = (80-100%) x Hs

W : width of impervious zone
Hs : water depth

The adopted width of impervious zone is sufficient against for piping action, because generally zone width is required to be more than 50% of water depth.

(g) **Stability Analysis**

Stability analysis of dam body by means of sliding surface method is made only in the NIA reports. DPWH makes stability analysis in the detailed design stage and BSWM conducts that just before construction. The cases in the stability analysis and safety factors applied by each agency are summarized below.

Item	DPWH	NIA	BSWM
Case of analysis	- immediately after completion - full reservoir condition - drawdown condition	- immediately after completion - full reservoir condition - drawdown condition intermediate water level	- immediately after completion - full reservoir condition - drawdown condition
Safety Factor	1.1 - 1.5	1.2 - 1.5	12% of dam height

Stability analysis for some concrete diversion weirs planned by BSWM is made in terms of overturning, sliding and bearing capacity. No stability analysis is made in the NEA and FMB reports.

(h) Foundation Treatment

Foundation treatment plan is described in the DPWH, NIA and BSWM reports, but not mentioned in the NEA and FMB reports. The foundation treatment plan made by DPWH,NIA and BSWM is summarized as follows:

Item	DPWH	NIA	BSWM
Seepage control	cut-off trench B=(30-150%)Hs	cut-off trench B=8m-10m blanket grouting	cut-off trench B=4m-8m
Depth of cut-off	up to bed rock or impervious stratum	up to bed rock or impervious stratum	up to bed rock or impervious stratum

B : width of cut-off trench
Hs : water depth

Through review of present study, the following matters are recommended:

- Width of contact between impervious zone and its foundation rock is narrow compared with water depth, so some measures such as blanket or grouting are necessary against hydraulic fracture.

- In order to prevent piping action, bottom of cut-off trench shall be widened and filter shall be placed at downstream portion of cut-off trench.

- In case that dam foundation is composed of unconsolidated stratum of volcanic slurry sediment, grouting is required against piping action.

- In case of small reservoir, blanket on base of whole reservoir is one of effective means.

(2) **Spillway**

(a) **Design Flood Discharge**

In general, adopted return periods on design flood discharge are 50 to 100 years for DPWH and NIA, 25 years for BSWM. The reports prepared by NEA and FMB do not mention return period. There are several exceptions as shown below:

Return Period (years)	DPWH	NIA	BSWM
25	-	-	144
50	-	36	1
100	26	46	-
300	-	1	-
500	1	1	-
1,000	-	1	-

Spillway scale is decided on the basis of design flood discharge, considering surcharge function at normal water surface in the reservoir.

(b) Layout of Spillway

Most of the spillways are placed on a part of dam body to decrease embankment volume. Since joint portion between different facilities seems to be weak point, spillway shall be placed on the sound original ground.

Center line between inlet portion and subcritical flow portion is planned to be curve, then straight line is adopted up to the stilling basin and outlet portion to the existing river.

(c) Spillway Type and Components

Spillway type and components are as follows:

Item	DPWH	NIA	BSWM	NEA	FMB
Type	chute	chute side channel	chute	chute (fixed weir)	chute (fixed weir)
Inlet portion	trapezoidal section with masonry	trapezoidal section with masonry	trapezoidal section with masonry	-	-
Overflow weir	ogee section	ogee section	without weir	ogee section	
Jet flow portion	rectangular section with concrete	rectangular section with concrete	rectangular section with concrete	-	-
Energy dissipater	hydraulic jump (type II or III) ski-jump	hydraulic jump (type II or III) ski-jump	hydraulic jump (type II or III) ski-jump	hydraulic jump (type II or III) ski-jump	-

Features of the spillways are mostly of standard type. In design of spillway, the following technical attention have to be paid:

- To check buoyancy in inlet portion of side-channel spillway
- To provide ogee section in inlet portion
- To prevent leakage through inlet portion made by masonry

(d) **Hydraulic Calculation**

Following discharge formula in general is adopted:

$$Q = CLH^{3/2}$$

Q : discharge (m^3/sec)

C : discharge coefficient

L : length of weir

H : total head

Discharge coefficient, which is one of important factors for design of spillway, varies depending on weir shape or weir height. Discharge coefficients adopted by each agency are as follows:

DPWH :	1.7 - 2.2
NIA :	1.7 - 2.1
BSWM :	1.7 for fill dam;
	1.8 for concrete weir.

Above values ranging from 1.7 to 2.2 are considered appropriate.

(e) **Height of Waterway**

Height of waterway is summarized as follows:

Item	DPWH	NIA	BSWM	NEA	FMB
Subcritical flow portion	4 - 6 m	4 - 6 m	1 - 2.5 m	-	-
Supercritical flow portion	2 - 4 m	2 - 4 m	0.5 - 1 m	-	-
Energy dissipator	4 - 9 m	4 - 9 m	-	-	-

(3) Outlet Works (Intake Structure)

(a) Location and Alignment

Locations and alignments of outlet works are summarized as follows:

Item	DPWH	NIA	BSWM	NEA
Alignment	in dam foundation	in dam foundation	in dam foundation adjacent to sand flushway	adjacent to sand flushway
Location	bottom of river	bottom of river	inactive storage level	about 20cm up from sill of sand flushway

As for the DPWH and NIA projects, outlet works are planned in lower portion, because those are used as diversion works during construction.

Outlet works of BSWM are planned at the inactive storage level, considering small scale drainage area and little run-off during construction.

Placement of the conduit through core trench shall be avoided to prevent piping action.

(b) **Type of Outlet Works**

Type of outlet works is summarized as follows:

Item	DPWH	NIA	BSWM	NEA
Intake portion	drop inlet	drop inlet	drop inlet	drop inlet
Trashrack	equipped	equipped	equipped	equipped
Conduit	concrete pipe	concrete pipe	steel pipe	concrete pipe
Control site	downside	downside	downside	downside
Control mechanism	operation of gate or valve by man-power after distribution by steel pipe			
Energy dissipator	impact box	impact box	impact box	none

In some projects, intake portion is partially placed in the dam body. It is better to align the intake portion outside of dam body from the viewpoint of dam safety. Vibration of conduit caused by earthquake or streamflow leads to leakage and piping.

2.2.6 Irrigation Development Plan

Irrigation development is included in the DPWH, NIA and BSWM projects. Review on the irrigation development plan is made only for the projects for those three agencies. Summary of general status of the irrigation study done by each agency is shown in Table B.2.3 and briefed below.

(1) **Potential Irrigation Area**

Location map is attached to the all feasibility study reports, but the following consideration is not enough in each report:

PMO-SWIM : - Potentiality of area
- Present irrigation condition
- Extent of irrigable area

NIA : - Potentiality of area

BSWM : - Potentiality of area
- Present irrigation condition

(2) Present Agriculture

Present agricultural condition is generally not enough studied in most of the reports. As for the NIA projects, in case that feasibility study is undertaken by local consultant, the NIA conducts the agricultural study and prepare the study reports. The study depth in each report is summarized as follows:

PMO-SWIM : - Present condition is not studied.

NIA : - Present condition is described in a half of the reports.
- Present cropping pattern and crop yield is not enough studied.

BSWM : - Present condition is not described.

(3) Future Agriculture

Proposed cropping pattern is shown in all the reports, but agricultural development plan is not enough mentioned in the reports which are prepared by PMO-SWIM and BSWM. The study depth is as follows:

PMO-SWIM : - Proposed cropping pattern and crop yield is mentioned, but agricultural development plan is not described.

- Rice-rice double cropping, target yield of rice is 4 to 5 ton/ha.

NIA : - Study is enough.

- Rice-rice double cropping, target yield of rice is 4 ton/ha.

BSWM : - Proposed cropping pattern is shown, but irrigation area used in water balance study differs from service area.

- Agricultural development plan is not described.
- Rice-upland crop, target yield of rice is 5 ton/ha.

(4) Irrigation Water Requirement

Method of estimation of irrigation water requirement is different among the three agencies. The standard value and method used in the estimation are as follows:

Item	DPWH	NIA	BSWM
Calculation	Monthly	Monthly	10-day basis
Evapotranspiration	from evaporation	by Penman method	from evaporation
Percolation Rate	2 mm/day	2 mm/day	1 mm/day
Land Preparation	200 - 300 mm	200 - 300 mm	Not included
Effective Rainfall	from daily balance method	from daily balance method	89% dependable rainfall
Irrigation Efficiency	40 - 70%	40 - 60%	50 - 55%
Water Requirement	1.1 - 2.8 l/s/ha	0.7 - 1.9 l/s/ha	0.7 - 3.6 l/s/ha

In the estimation of irrigation water requirement, there are some characteristics among three agencies as follows:

PMO-SWIM :
- Crop coefficient is not considered for calculation of crop water requirement.
- Diversion water requirement is estimated, but water requirement for design of irrigation facility is not estimated.

NIA :
- Crop coefficient is not considered.

BSWM :
- Crop coefficient is not considered.
- Land preparation requirement is not counted in estimation of water requirement, but it is considered at water balance study.
- Rainfall with 80% dependability is used as effective rainfall.

(5) Design of Irrigation Facility

Design water requirement for irrigation facility is not clearly mentioned in the reports. Design of irrigation facility is not made in the feasibility studies.

BSWM conducts the detailed engineering design just after the feasibility study, and the design of irrigation facility is included in the detailed drawings. The design of irrigation facilities is typicalized in the drawings.

(6) Optimization of Irrigation Development Scale

Optimization study of irrigation scale is not made in the reports. The scale is determined only to meet the available water resources through the water balance study.

2.2.7 Mini-hydropower Development Plan

Mini-hydropower development is included in the projects under PMO-SWIM/DPWH, NIA and NEA. Most of the mini-hydropower development for the DPWH and NIA projects is considered as incidental purpose. In the NEA projects, it is formulated as main purpose. Summary of present status of study is shown in Table B.2.4 and explained below.

(1) Plan Formulation

Mini-hydropower development in the DPWH and NIA projects is formulated of run-of-reservoir type with a dam. That in the NEA projects is planned to be of run-of-river type.

As for DPWH and NIA projects, determination of optimum dam scale is mostly made putting a priority on irrigation development. The dam scale is determined so as to fulfill irrigation water requirement. Water balance study is made using monthly river discharge almost for more than 10 years.

In the NEA projects, water balance study is not carried out because of their run-of-river type.

(2) Determination of Power Plant

Installed capacity and number of generator, in 30% of the DPWH and NIA projects, are determined based on the results of technical and economic analyses. In the other projects, it is decided so as to utilize river flow at maximum. Plant factor varies in the range of 30% and 80%; average is about 60%.

NEA determines installed capacity at 49% of plant factor using flow duration curve. Number of generator is decided based on the economic analysis.

(3) Power Market Survey

DPWH and NIA do not conduct power market survey, and future O&M system is not mentioned in the reports.

The NEA projects are turned over to Electric Cooperatives Inc. after implementation. NEA uses the results of power market survey done by Cooperatives.

(4) Design of Facility

In the DPWH reports, preliminary design of power facility is made. Preparation of facility design in the NIA reports is unknown. NEA conducts very preliminary design, showing a general plan and a profile between intake and tailrace.

2.2.8 Watershed Management (Development) Plan

Watershed management (development) is planned by FMB and BSWM, not by other agencies. FMB plans watershed management mainly to conserve watershed, while BSWM deals with watershed development to utilize and conserve watershed.

(1) Watershed Management Plan by FMB

Small-scale reservoir is not planned in the FMB projects. Watershed management is planned with engineering measures of check dam, terracing works, etc., and vegetative measures of reforestation.

Pre-implementing stage of the FMB projects are classified into reconnaissance stage and detailed engineering stage. At reconnaissance stage, general present conditions in watershed are grasped, and at detailed engineering stage concrete vegetative and engineering measures are planned and their costs are estimated.

The vegetative and engineering measures are summarized as follows:

(a) **Engineering Measures**

General concept of the engineering measures is summarized below and their features are shown in Fig.B.2.5.

Structure	Purpose
- check dam with concrete with wet masonry with dry masonry with gabion with log	- soil conservation - stream stabilization
- river improvement by excavation or riprap	- increase of discharge capacity
- wattling	- soil conservation
- support for vegetation	- soil conservation
- terracing	- soil conservation

(b) **Vegetative Measures**

Purpose of vegetative measures is for soil conservation and flood mitigation through water retention in watershed. Considering topography and vegetative cover, the following vegetative measures are taken up.

- bench brush layer
- enrichment planting
- reforestation
- nursery operation

The above-mentioned measures are representatives. Measures, which is suitable to ever-changing devastated watershed, should be selected site by site.

(2) Watershed Development Plan by BSWM

Main purpose of watershed development is to compensate lands for inhabitants whose lands are submerged under reservoir by dam construction, and to conserve watershed.

Watershed development plan is composed of engineering and vegetative measures and its general plan is shown in Fig.B.2.6.

Guideline of watershed development used by BSWM is as follows:

- To give priority on vegetative measures over engineering measures
- To maintain vegetation area at 60% of watershed area
- To maintain vegetation area at 50-m width of both stream/river sides
- To adopt agro-forestation on sloping cultivated land
- To apply reforestation on steep land
- To conduct enrichment planting on sparsely vegetated land
- To protect dense forest land from illegal logging and forest fire

(a) Engineering Measures

Structure	Purpose
- riprap or dry stone walls	- slope stabilization
- pole structure	- slope stabilization
- contour tillage	- slope stabilization and land preparation
- terracing	- protection of gully erosion
- check dam with masonry, logs, brush	- control of gully

(b) **Vegetative Measures**

Structure	Purpose
- reforestation	- soil conservation in watershed - increase of water retention in soil
- brush cover	- protection of gully erosion
- sodding	- prevention of occurrence of erosion
- contour orchard	- soil conservation - flood mitigation

2.2.9 Utilization of SWIM Projects for Aquaculture

Inland fishery development is considered as one of the incidental purposes in the DPWH and NIA projects, but in the BSWM projects this purpose is put the same importance as the main purpose. Generally, the basic data on the inland fishery development is not enough in any agency, nor the development plan itself. Table B.2.5 shows the comparison of the study depth on necessary data for formulation of the development plan. From the table, following aspects are pointed out in each agency.

DPWH : The socio-economic data on fish consumption lacks. Culture method proposed is mainly of intensive fish cage. Only one report refers to future demand in the adjoining municipalities based on their population and per capita annual fish consumption. However, the development plan proposed the impracticably vast amount of fish production (460 tons/year) without considering the marketing or institutional aspects.

NIA : Only one report proposes a inland fishery development in the dam reservoir. The other reports mention the possibility of the development but do not build a definite plan. Neither the present condition of fish consumption nor future fish demand

BSWM : The socio-economy is not studied. This inland fishery development is considered to contribute to improve of nutritional condition in rural area. The scale of the fish production proposed is as small as 6.7 tons annually, adopting an extensive spawning culture method.

2.2.10 Utilization of SWIM Projects for Flood Control

The SWIM project, of which main purpose is flood control, is few. Flood control effect is incidentally expected to decrease flood peak discharge by surcharge function of reservoir in the DPWH, NIA and BSWM projects.

Decreasing ratio of peak flood discharge which contributes incidentally for flood control effects is summarized as follows:

Decreasing ratio against design flood discharge (%)	Number of Project		
	DPWH	NIA	BSWM
0 - 10	4	4	21
10 - 20	3	2	14
20 - 30	1	3	24
30 - 40	3	1	22
40 - 50	0	1	21
50 - 60	1	3	15
60 - 70	2	0	9
70 - 80	1	0	12
80 - 90	0	0	7
Total	15	14	145

Remark : excluding 96 projects which were supplementally surveyed in this Study

Decreasing effect of peak flow; 30% by the DPWH and NIA, 40% by the BSWM projects, can be expected. These effects are calculated during the course of reservoir operation study on normal water surface condition, not after consideration of drainage pattern.

As for the NEA projects, the effect on flood control can't be expected because of diversion weir.

As for the FMB projects, decrease of peak flow can be expected by increasing water holding capacity of soils through improvement of watershed.

2.2.11 Environment Impact Study

The DPWH, NIA and BSWM projects includes reservoir construction, so much impacts to surrounding environment would be guessed. On the other hand, in the NEA and FMB projects, direct impacts to surrounding environment are comparatively a little, because the NEA projects are mainly composed of diversion weir and power plant, and the FMB projects are mainly composed of small scale check dam and reforestation.

The study on physical, ecological and cultural impacts to surrounding environment are reported in two (2) projects of NIA, in 13 projects of DPWH. The assessment are mainly conducted in line with the guideline of NEPC (National Environmental Protection Council).

Positive and negative environmental impacts are mentioned as follows:

(1) Positive Environmental Impacts

(a) Physical Characteristics

- Stability of stream condition
- retention of groundwater
- decrease of sediment volume to down stream

(b) Culture Factor

- agriculture security

- transportation networks
- scenic views and vistas
- creation of job opportunity
- enhancement of living standards including recreation opportunity

(2) **Negative Environmental Impacts**

(a) **Physical Characteristics**

- earth and soil outflow during construction
- coldlization of irrigation water
- decrease of dissolved oxygen
- erosion of land surrounding reservoir
- stability decrease of the ground for earthquake
- devastation of forest and nature area

(b) **Ecological Relationship**

- water-related disease vectors

The study on the environmental impacts is not particularly described in the BSWM, NEA and FMB projects.

2.2.12 Optimization of Project Development Scale

Determination of project development scale is made for the DPWH, NIA and BSWM projects in conformity with determination of dam scale. In principle, optimization study among different dam scales is not made for almost all the projects. Also alternative study to select most economical combination of project components is not carried out. The dam scale is determined based on the following procedure:

- In order to meet irrigation water requirement for potential irrigation area, scale of dam reservoir is determined.

- If possible maximum dam reservoir can not cover the above irrigation requirement, scale of dam reservoir is determined at physical maximum scale, considering available water resource. Then irrigation area is reduced to meet the dam scale.

- Study on mini-hydropower development plan is made with the above fixed dam scale, considering the maximum use of river flow in the rainy season.

During the course of water balance study, reservoir operation is made based on the following condition:

(1) Interval, period, inflow, irrigation water requirement(IWR) are as follows:

Agency	Interval	Period	Inflow	IWR
DPWH	Monthly	10-44 years	Estimated	Monthly
NIA	Monthly	17-50 years	Estimated	Monthly
BSWM	10-day	1 year	80% dependable	10-day

(2) Sedimentation volume in reservoir capacity is decided based on the following term:

DPWH : 50 years

NIA : 50 years

BSWM : 25 years

(3) Evaporation rate is considered as follows:

DPWH : 60% of pan evaporation rate

NIA : 60% of pan evaporation rate

BSWM : 100% of pan evaporation rate

(4) Criteria adopted for reservoir operation is as follows:

DPWH/NIA : following NIA criteria

(a) Maximum shortage per year should be less than 50% of the average annual demand.

(b) Maximum cumulative shortage for any successive 10 years should be less than the average annual demand.

(c) The carry-over period should be less than 12 months for small reservoir.

BSWM : Ensuring 100% of water demand

2.2.13 Construction Plan

Construction plan of dam is summarized as follows:

Item	PMO-SWIM	NIA	BSWM	NEA	FMB
Construction Method	- by machine	- by machine	- by machine	- by machine	- by machine
Construction System	- by contractor	- by contractor	- by contractor	- by contractor	- by contractor
Construction Period	2.5 - 3 years	3 years	4 months	1 year	5 years
Pre-construction	4 - 6 months	-	-	-	-
Construction	1 - 1.5 years	-	4 months	8 months	-
Post-construction	2 - 3 years	-	-	-	-

2.2.14 Project Cost Estimates

Method of cost estimates by each agency is tabulated on Table B.2.6. Followings are major findings on cost estimates in each agency:

DPWH: Project cost is estimated, being divided into two parts; (i) contract cost, and (ii) government works. Contract cost is composed of direct cost including preparatory works and civil works, and indirect cost including physical contingencies, overhead and profit, and contractor's tax. Cost of government works covers a part of direct cost such as preparatory works, mechanical works including provision of necessary machines and their installation, and indirect cost for contingencies and construction management. Factor for estimating contingencies varies project by project in the range of 10% and 15%.

Unit dam cost based on the embankment volume is US$15.9/m3 on an average, which is similar to that of NIA projects. On the other hand, the unit dam cost based on the irrigation area is US$9,654/ha, indicating between that of NIA and BSWM. Some projects do not include the cost for irrigation facilities even those projects proposed the irrigation development plan.

NIA: Costs are estimated assuming all the works would be done by contract. Costs are broken down into direct cost which comprises preparatory works, civil works and mechanical works, and indirect cost such as contingencies and engineering service/construction supervision. Indirect costs are calculated based on the direct cost.

Unit dam cost based on the irrigation area is calculated at US$18,451/ha on an average, which shows the highest unit cost.

FMB: All the project works would be implemented by task force of FMB. Costs are estimated as a total of engineering measures and vegetative measures. Costs of engineering measures are calculated at first for one site, based on the material cost, labor cost, transportation cost, and preparation of site and excavation. Then, total cost for engineering measures is estimated multiplying the unit cost by the number of site. Costs of vegetative measures is estimated in similar way to engineering measures, multiplying the unit cost per area by the project area. The FMB projects do not consider the indirect cost such as contingencies and administration cost.

NEA: Costs are broken down into four items: (i) power plant equipment, (ii) civil works, (iii) installation of electro-mechanical equipment, and (iv) contingencies. Contingencies are calculated as a 10 % of the total of other costs. These items are not broken down.

BSWM: Estimate condition is in the same way as NIA. Costs are estimated being broadly divided into five parts: (i) preparatory works, (ii) civil works (dam and irrigation works), (iii) contingencies, (iv) engineering services/ construction supervision, and (v) watershed development cost. Contingencies are calculated as 10 % of the civil works. Cost for engineering services/construction supervision works are calculated as 10 % of the sum of preparatory works, civil works, and contingencies. The details of the watershed development cost is not presented in the reports.

Unit dam cost based on the embankment is US$9.2/$m^3$ on an average, showing much lower than DPWH or NIA. Irrigation area based-unit dam cost is also lower with the value of US$3,397/ha, as compared with other agencies.

2.2.15 Project Benefit Estimate

Project benefits in SWIM projects are estimated on the basis of benefits derived from irrigation, mini-hydropower generation, watershed development, water supply, and inland fishery. Estimates of the project benefit among agencies are compared and summarized as shown on Table B.2.7. The major findings on the project benefit estimates are presented in each benefit source below.

(1) Irrigation benefit (DPWH, NIA and BSWM)

irrigation benefit is estimated as an incremental benefit between with and without project conditions. Unit irrigation benefit based on the irrigation area varies project by project, but average value is similar among agencies.

(2) Mini-hydropower generation benefit (DPWH, NIA and NEA)

Mini-hydropower generation benefit is derived from comparative cost savings out of a mini-hydropower plant versus an alternative diesel plant in DPWH and NIA projects. In these projects, similar scaled mini-hydro and diesel plants are compared in terms of installed costs (kW value) and operation and maintenance costs (kWh value). Average installed cost of power plant is US$972/kW in the DPWH projects, while US$488/kW in the NIA projects. Annual benefit estimated based on the fuel cost of the alternative diesel power plant is US$0.41/l on an average for the DPWH projects, and US$0.35/l for the NIA projects.

On the other hand, in NEA projects, only a financial study is made on the basis of the comparison with unit energy price of NAPOCOR.

(3) Watershed management / development benefit (FMB and BSWM):

Since benefits derived from the FMB projects are hard to quantify, only the socio-economic impacts of projects are mentioned. They are the effects on flood mitigation, soil conservation, erosion control, etc.

In the BSWM projects, direct benefits are derived from agro-forestry and/or animal production. The estimate method is the same as that of irrigation benefit.

2.2.16 Project Evaluation

Project evaluation is essential for judging technical soundness and economical viability of project. Each agency has its own method for project evaluation. Followings are major findings of evaluation by each agency.

(1) Economic Evaluation

DPWH, NIA and BSWM evaluate the projects in terms of NPV, B/C, and EIRR. The results of the evaluation made for existing study are presented below.

EIRR (%)	DPWH	NIA	BSWM
Average	25.8	12.8	29.7
Maximum	51.9	16.4	70.0
Minimum	12.6	10.3	14.3

EIRR of the DPWH and BSWM projects shows rather higher value than that of the NIA projects. This is probably due to the optimistic or improper cost/benefit estimate in the DPWH and BSWM projects. For example, in some DPWH projects, fishery production is estimated impractically high, or the cost of alternative diesel power plant is estimated much higher than that estimated by NIA. On the other hand, the BSWM projects are evaluated including the benefit derived from watershed development which is not the real direct benefit as a result of the construction of dam. The NIA projects seem to be evaluated reasonably.

Economic evaluation is not made for the FMB projects since all of their benefits are intangible and hard to quantify. The NEA projects are not evaluated economically but financially, because the project implementation is decided by the comparison with the existing power supply price.

(2) Socio-economic Impact Study

Except for all the NEA projects and a part of the DPWH projects, socio-economic impacts of the projects are mentioned. They are summarized as below:

DPWH	:	-	Increased employment opportunity.
		-	Improve the living standard.
		-	Increase of rice production.
NIA	:	-	Stability of domestic supply of rice.
		-	Employment generation.
		-	Improve of farm income.
FMB	:	-	Soil conservation.
		-	Erosion control.
		-	Flood mitigation.
		-	Protection of soil degradation.
BSWM	:	-	Agricultural knowledge dissemination.
		-	Self-sustaining nature of the project.
		-	Family-welfare benefits

2.3 Detailed Engineering Design

2.3.1 Additional Data Collection and Field Survey

Present status on additional data collection and field survey for detailed engineering design are summarized as follows:

DPWH/NIA/BSWM: Data collection and field survey are not conducted in this stage. The results obtained in the feasibility stage are examined and used for detailed design work.

NEA: Detailed survey such as topographic survey and boring work are executed.

FMB: Detailed reconnaissance survey is made to grasp the requirement of engineering and vegetative measures.

2.3.2 Detailed Design

DPWH: Detailed design drawings to be used for tendering and detailed cost estimate are prepared. Design is carried out only for dam and appurtenant structures. Stability of dam is analyzed in the feasibility stage.

NIA: Detailed design is carried out for dam and irrigation facilities. In this stage, stability analysis of dam is made.

BSWM: Typical drawings are applied for design of dam and irrigation facilities. Stability of dam is checked just before construction.

NEA: Detailed design to be used for construction and detailed cost estimate is made.

FMB: Detailed design for the respective projects is not carried out, and only detailed cost estimate is done based on their own standards. Construction drawings are prepared in parallel with construction.

2.3.3 Technical Specifications

DPWH/NIA/
BSWM/NEA: Technical specifications are prepared by each project based on the US Standards such as ASTM and ACI.

FMB: Technical specifications are not prepared for the respective projects. FMB uses standardized technical specifications.

2.3.4 Tender Documents

DPWH/NIA/
BSWM/NEA: Tender documents for civil works are prepared based on the local competitive bidding (LCB). The tender documents for generating equipment are not prepared, since generating equipment is supplied by the government.

FMB: Since all the projects are constructed by task force of FMB, tender documents are not prepared.

3 POST-EVALUATION STUDY OF COMPLETED SWIM PROJECTS

3.1 Method and Work Flow of Post-Evaluation Study

In order to carry out the post-evaluation study, all the data and information on plans and designs of the listed ten (10) projects were collected through the relevant agencies. Visits to the selected projects sites were jointly made by the Team and the counterpart personnel from each agency in November 1988.

The Team, however, faced to the difficulties to collect the reliable data and information on the selected projects. At the time of site inspection, the Team distributed the questionnaire specially designed for each completed project to the site office of each agency concerned and asked the office to fill up the questionnaire. The answers were submitted to the Team by the end of November, 1988. In general, the answers have not fulfilled the requirement of the Team for the post-evaluation study, because the projects were already handed over from each agency to the individual cooperatives who operate the projects and most of the data and information were not kept properly by each agency any more.

3.2 General Description of the Projects for Post-Evaluation Study

Based on the collected data, the post-evaluation studies are made on the listed ten (10) projects. The general features of the projects are summarized in Table B.3.1 and the results of the post-evaluation studies for the respective projects are shown in Table B.3.2. The general description of the projects are described below.

(1) Project Implementation

In general, the each implementing agency has implemented the project from its identification to construction, except two (2) projects; the San Ramon and Calanggaman projects which were first studied by BSWM and transferred to DPWH at construction stage. The construction works of the Calanggaman project was undertaken by the Bohol Provincial Irrigation Office of NIA. The Ilihan project undertaken by NIA, was implemented without feasibility study on policy reasons.

(2) Present Status of Major Facility

Present status of each project is summarized as follows:

Project	Dam	Irrigation	Power/Others
Ilihan	Functioning	Functioning	-
Darapidap	Functioning	Functioning	-
Malinao	Functioning	Not completed	-
Pasig Timbu	-	-	Not monitored
Mantayupan	Functioning	-	Functioning
Bacnotan	Functioning	Functioning	-
Porac	Washed out	Not constructed	Not functioning
Kirong	Damaged	-	Not functioning
San Ramon	No functioning	Not constructed	-
Calanggaman	Not constructed	-	

As seen from the above table, the projects which are functioning well, are only four (4); the Ilihan (NIA), Darapidap (BSWM), Mantayupan (NEA) and Bacnotan (FSDC) projects. In the remaining projects, the project returns are not fully attained compared to the targets which are set up before construction.

(3) **O&M System**

Present status of O&M system for each project are summarized as follows:

Project	Dam	Irrigation	Power/Others
Ilihan	NIA/IA	IA	-
Darapidap	FC	FC	-
Malinao	IA	IA	-
Pasig Timbu	-	-	District Office
Mantayupan	CEBECO I	-	CEBECO I
Bacnotan	ISA	ISA	-
Porac	Not managed	Not managed	Not managed
Kirong	Not managed	-	Not managed
San Ramon	Not organized	Not organized	-
Calanggaman	Not organized	Not organized	-

Note; CEBECO I: Cebu I Electric Cooperative Inc.
IA: Irrigators' Association; FC: Farmers' Cooperative;
ISA: Integrated Services Association.

Most of the projects were transferred to Irrigators' Associations and/or Farmers' Cooperatives after implementation for their operation and maintenance of the project facilities. No Irrigators' Associations and/or farmers' Cooperatives are organized in those projects damaged such as the Porac and Kirong projects.

3.3 Major Findings of Post-Evaluation Study

The post-evaluation study on each project was made on the following three (3) categories:

(1) Technical assessment of plan, design and construction
(2) Socio-economic situation
(3) Current O&M System and problem

The major findings obtained from the post-evaluation study are briefed hereunder.

3.3.1 Technical Assessment of Plan, Design and Construction

General comments of the Team on the technical aspects of the completed projects are as follows:

(1) Planning Stage

(a) Dam plans are generally well prepared. The survey and investigation are concentrated into the dam and reservoir plans.

(b) Development plans for flood control as well as for utilization of the reservoir water such as irrigation, mini-hydropower and inland fisheries are not fully examined.

(c) Socio-economic aspects such as living conditions of beneficiaries, market demand of the products, water right, land tenure conditions of reservoir areas and irrigation ares, etc. are not sufficiently surveyed and studied.

(d) Hydrological studies on water resources are not fully made due to the general difficulties involved in data collection.

(e) The development plans are neither explained to nor confirmed with the people to be influenced before construction.

(2) Detailed Engineering Design Stage

(a) The dam body itself is generally well-designed.

(b) In case of large dams, the appurtenant structures are not designed based on the detailed field investigation.

(c) Project facilities other than the dam and its appurtenant structures, are not included in the detailed engineering designs.

(3) Construction Stage

(a) Construction period is often prolonged from original plan.

(b) Insufficient technical guidance in construction stage coupled with some faults in dam designs results in the fact that some dams have been damaged or washed out after construction.

(c) Construction plan of dam is always advanced, and it is not well harmonized with the development plan in the downstream area.

3.3.2 Socio-economic Situations

The major findings of socio-economic situations in the beneficial areas of the projects are summarized below.

(1) Internal Rate of Return (IRR)

The internal rate of return (IRR) is re-estimated under the present condition on the basis of the socio-economic data obtained from the post-evaluation study. Among 10 completed projects, only four (4) projects which are supported by data and information, were re-evaluated. Others are not re-evaluated because of insufficient data and information. The results of the re-evaluation for those projects are summarized below (refer to Table B.3.3):

The Name of the Projects	Agency	Main Purpose	IRR (%)
Ilihan SWIP	NIA	Irrigation	10.5
Darapidap SWIP	BSWM	Irrigation	3.0
Bacnotan SWIP	FSDC	Irrigation	14.2
Mantayupan Falls SWIP	NEA	Mini-hydropower	8.5

The Ilihan and Bacnotan projects are successfully operated and attained higher economic performances in terms of IRR. The beneficiaries of those projects have improved in their living condition through increased rice production and thereby increased income level. The Mantayupan mini-hydropower project is also well operated with adequate value of IRR. Its accumulated generated energy has attained about 5,586 MWh which corresponds to 80 % of its original target. The Darapidap project shows low IRR, reflecting poor performance of rice production and less irrigation area in the dry season. However, since this project is still within the build-up period, IRR would be improved in near future.

(2) Socio-economic Impact

In general, the SWIM projects have contributed much to the beneficiaries in the rural areas through following points:

i. increased crop and fish production,
ii. stable supply of power energy,
iii. improvement of nutrition condition,
iv. creation of income generating opportunity,
v. increased income level, and thereby
vi. enhancement of living standard.

For further improvement of the SWIM projects, following points would be considered:

i. overall development of small river basin, which includes the development plans in the downstream areas and watersheds, centering construction of small water impounding reservoirs,

ii. enforcement of planning activities for the projects,

iii. close cooperation among agencies concerned, and

iv. participation of rural people to the projects.

3.3.3 Current Operation and Maintenance System

The general findings on the O&M systems of the completed projects are summarized as follows:

(a) No guideline and/or criteria for O&M have been established.

(b) Only the projects that O&M system is established, are successfully operated.

(c) Insufficient number of technical staff often makes proper O&M system difficult, and

(d) Shortage of annual budgets for proper O&M is often observed.

TABLES

Table B.2.1 Topographic Survey and Mapping of the Existing SWIM Projects

ITEM	PMO-SWIM	NIA	BSWM	NEA	FMB
1. Damsite	-Preparing map on a scale of 1/500 to 1/4,000, mostly 1/500 or 1/1,000 with a contour interval of 1 m.	-Preparing map on a scale of 1/500 to 1/4,000 with a contour interval of 1 m.	-Preparing map on a scale of mostly 1/500 with a contour interval of 1 m.	-Preparing map on a scale of 1/2,000 with a contour interval of 1 m.	-Not surveyed.
2. Reservoir	-Preparing map on a scale of 1/400 to 1/4,000, mostly in the range of 1/500 to 1/2,000, with a contour interval of 1 m.	-Preparing map on a scale of 1/2,000 or 1/4,000 with a contour interval of 1 m.	-Preparing map on a scale of mostly 1/1,000 with a contour interval of 1 m.	-Not surveyed.	-Not surveyed.
3. Irrigation Area and Others	-Unknown	-Preparing map of irrigation area on a scale of 1/2,000 or 1/4,000 with a contour interval of 1 m.	-Preparing map of irrigation area on a scale of 1/2,000 to 1/5,000 with a contour interval of 1 m.	-Profile survey along penstock route is carried out to ensure gross head for power genertion.	-Topographic map of watershed area is prepared on a scale of about 1/20,000. This base map is used for survey on land use, soils, vegetative cover.

Table B.2.2 Meteo-Hydrological Study of the Existing SWIM Projects

STUDY ITEM	PMO-SWIM/DPWH	NIA	BSWM	NEA	FMB
1. Meteorology					
(1) Rainfall	-Using data of adjacent meteorological station	-Using data of adjacent meteorological station	-Using data of adjacent meteorological station	-Using data of adjacent meteorological station	-Using data of adjacent meteorological station
(2) Evaporation	-Using data of adjacent meteorological station	-Using data of adjacent meteorological station	-Using data of adjacent meteorological station	-Not mention	-Not mention
2. Hydrology					
(1) Run-off Analysis					
-Basic Data	-Using data of adjacent similar river.	-Using data of adjacent similar river.	-Using data of adjacent similar river in the same water resurces region	-Using direct measurement data for a few projects, for others unknown	-Using data of rivers in the proposed watershed area for a few projects
-Method	-Using rainfall-run-off relationship, Thomas Fiering Method, drainage area proportion, run-off coefficient, etc.	-Using rainfall-run-off relationship, Thomas Fiering Method, drainage area proportion, run-off coefficient, etc.	-Using monthly run-off coefficient in the same region	-Only making flow duration curve	-Unknown
(2) Flood Analysis					
-Basic Data	-Using data of adjacent similar river. For a few projects, using data of proposed river.	-Using data of adjacent similar river.	-Not use	-Not studied	-Not studied
-Analysis of Design Storm	-Using rainfall depth-duration -frequency curve	-Using rainfall depth-duration -frequency curve	-Using rainfall depth-duration -frequency curve	-Not studied	-Not studied
-Analysis of Design Flood	-Using method of mean dimensionless unit hydrograph	-Using method of mean dimensionless unit hydrograph	-Using method of US Soil Conservation Service (SCS) dimensionless unit hydrograph	-Not studied	-Not studied
-Return Period	-1/100	-1/100	-1/25	-Not studied	-Not studied
(3) Sedimentation	-Estimating based on the existing data.	-Estimating based on the existing data and results of laboratory test.	-Estimating from the relationship between sediment volume and catchment area.	-Not studied	-For a few projects, estimating based on the results of laboratory test

Table B.2.3 Irrigation Plan of the Existing SWIM Projects

STUDY ITEM	PMO-SWIM/DPWH	NIA	BSWM
1. Potential Irrigation Area	-Location map of area is attached, but present irrigation condition is not mentioned.	-Location of area is specified and present irrgation condition is described.	-Location map of area is attached, but area is not specified.
2. Present Agriculture	-Present condition is not enough surveyed. Present cropping pattern and crop yield are not described.	-Present condition is described for half of the reports. Especially for cropping pattern and crop yield, study is not enough.	-Present condition is not described.
3. Future Agriculture	-Proposed cropping pattern is shown, but agricultural study is not made. -Rice-rice double cropping -Target yield of rice: 4 to 5 ton/ha	-Study on agricultural development is made. -Rice-rice double cropping -Target yield of rice: 5 ton/ha	-Proposed cropping pattern is shown, but irrigation area used in water balance study differs from service area. -Rice-upland crop -Target yield of rice: 5 ton/ha
4. Water Requirement			
-Calculation Basis	-Monthly Basis	-Monthly Basis	-10-day Basis
-Evapotranspiration	-Calculated from Evaporation	-Calculated by Penman Method	-Calculated from Evaporation
-Crop Coefficient	-Coefficient is not used. Evapotrans. is directly used.	-Coefficient is not used. Evapotrans. is directly used.	-Coefficient is not used. Evapotrans. is directly used.
-Percolation Rate	-2 mm/day on an average	-2 mm/day on an average	-1 mm/day on an average
-Land Preparation	-200 to 300 mm Breakdown is not shown.	-200 to 300 mm Breakdown is not shown.	-Requirement is not included, but considered at water balance study.
-Effective Rainfall	-Calculated by Daily Balance Method	-Calculated by Daily Balance Method	-Apply rainfall with 80% dependability
-Irrigation Efficiency	-Wet season: 38 to 70% Dry season: 40 to 70%	-Wet season: 40 to 58% Dry season: 43 to 58%	-Wet season: 51% (paddy) Dry season: 54% (upland)
-Water Requirement	-1.1 to 2.8 l/s/ha	-0.7 to 1.9 l/s/ha	-0.7 to 3.6 l/s/ha
5. Design of Facility	-Design is not made in the F/S Report.	-Design is not made in the F/S Report.	-Design is not made in the F/S Report, but made in Detailed Engineering Design.
6. Optimization Study	-Study is not made.	-Study is not made.	-Study is not made.

Table B.2.4 Mini-hydropower Development Plan of the Existing SWIM Projects

ITEM	PMO-SWIM/DPWH	NIA	NEA
1. Formulation of Development Plan			
-Development Type	-Reservoir type	-Reservoir type	-Run-of-river type
-Water Balance Study	-Monthly basis -In most of the projects, study is made using monthly river discharge of more than 10 year. But in 30% of the projects, operation study is made only for one year.	-Monthly basis -Study is made using monthly river discharge of more than 10 years.	-Not studied Due to lack of river flow data, flow duration curve is estimated by multiplying monthly rainfall by run-off coefficient for one year.
-Priority	-In most of the projects, priority is given to irrigation for determination of dam scale.	-Priority is given to irrigation for determination of dam scale.	-Single purpose of hydropower
2. Determination of Power Plant -Installed Capacity	-In 30% of the projects, capacity is decided based on the results of economic analysis. In other projects, capacity is decided to utilize all available water.	-In 30% of the projects, capacity is decided based on the results of economic analysis. In other projects, capacity is decided to utilize all available water.	-Based on the flow duration curve, capacity is decided at 49% of plant factor.
-No. of generator	-Same as above	-Same as above	-Based on economic analysys
-Plant Factor	-Range ; 29% - 82% -Average ; 57%	-Range ; 41% - 71% -Average ; 58%	-49%
3. Power Market Survey	-Not surveyed	-Not surveyed	-Project is turned over to Cooperative. Using power market suvey results done by Cooperative
4. Design of Facility	-Preliminary design is done.	-Unknown	-Very preliminary design is done.

Table B.2.5 Inland Fishery Development Plan of the Existing SWIM Projects

STUDY ITEM	PMO-SWIM/DPWH	NIA	BSWM
1. Present Condition of Fish Consumption	- a few reports mentioned based on the statistical data. Study is not enough.	- Not mentioned	- Not mentioned
2. Future Demand Study (development scale)	- a few reports mentioned on the basis of population and per capita consumption. Study is not enuogh.	- Not studied	- Not studied - considered necessary for rural residents to improve nutritional condition.
3. Water Quality	- Not studied.	- Not studied.	- Not studied.
4. Development Plan			
(1) Selection of Fish Species	- Tilapia	- Tilapia and carp	- Tilapia
(2) Selection of Culture Method	- Fish cage	- Free spawning	- Free spawning
(3) Proposed Culture Practice	- Mentioned	- Not mentioned	- Not mentioned
(4) Marketing	- Mentioned, but unrealistic.	- Not mentioned	- Not mentioned but considered to be consumed within a beneficial area.
(5) Implementing institution	- Not mentioned	- Not mentioned	- Not mentioned

Table B.2.6 Cost Estimates of the Existing SWIM Projects

ITEM	DPWH	NIA	FMB	NEA	BSWM
I. Construction Cost Estimates					
1. Condition of Cost Estimates	Costs are divided into two parts; (i) contract costs and (ii) government works	All works are done by contract base.	All works are done under direct management of FMB.	Civil works are done by contract base.	All works are done by contract base.
2. Direct Cost					
(1) Preparatory Works	Mobilization and demobilization, clear and grub, temporary works, access road, care of river, right of way	Right of way, damages, access road, clearing reservoir, service facilities, and mobilization.	Site preparation and excavation	Included in the civil works.	Camp, access road, mobilization and demobilization, clear and grub.
(2) Civil Works					
- Dam and appurtenant	Dam embankment, dam foundation, outlet works, spillway and bridges.	Dam Embankment, Dam Foundation, Spillway, Outlet Works	Not broken down, included in the engineering measures.	Included in the civil works.	Dam embankment, excavation, spillway and outlet works.
- Irrigation	Considered in two projects only.	Considered at evaluation by NIA evaluation division	Not planned.	Not Planned.	Considered and broken down.
- Power	Power house, tailrace and bypass structure, excavation		Not planned.	Costs of all civil works is shown but not broken down.	Not planned.
- Watershed	Not Planned	Not Planned.	Engineering measures and vegetative measures	Not planned.	Considered but not broken down.
- Water Supply	Main line and ditribution line.	Not Planned.	Not planned.	Not planned.	Not planned.
(3) Mechanical Works					
- Power Plant	Mini-hydro plant, substation, battery charger, switchboards, electrical systems.	Turbine-generator, Auxillary Switchyard equipment, etc.	Not planned.	Power plant equipment and electro-mechanical works.	Not planned.
- Gate, pipe, etc.	Penstock, valves, pipes	Penstock, tailrace, valve, etc.	Not planned.	Not mentioned.	Not planned.
3. Indirect Cost					
(1) Land Acquisition	Not mentioned.	Not mentioned.	All lands are of state own.	Not mentioned.	Not mentioned.
(2) Engineering Service (E/S)	(Total cost + contingencies) * 10%	(Total Cost) * (10% - 20%)	Not mentioned.	Not mentioned.	((Direct cost - cost for watershed development) + contingencies) * 10%
(3) Governmental Admi.	Considered in several projects	Not mentioned.	Not mentioned.	Not mentioned.	Not mentioned.
(4) Contingencies					
- Physical	(Total cost) * 10%	(Total Cost) * (10% - 15%)	Not mentioned.	(Cost of civil and electro-mechanical works) * 10%	(Direct cost - cost for watershed development) * 10%
- Price	Not mentioned	Not mentioned.	Not mentioned.	Not mentioned.	Not mentioned.
(5) Others	Tax, overhead and profit.				
II. O&M Cost and Replacement Cost	O&M cost only.	Considered at evaluation by NIA	Not mentioned.	Not mentioned.	Not mentioned.
Dam cost/Embankment volume (US$/m3)	ave: 15.9 (range: 2.3 - 33.5)	ave: 15.4 (range: 4.0 - 37.1)			ave: 9.2 (range: 0.8 - 98.9)
Dam cost/Irrigation area (US$/ha)	ave:9,654(range:1,204-42,752)	ave:18,451(range:5,071-47,075)			ave: 3,397(range: 395-13,693)

Table B.2.7 Benefit Estimates of the Existing SWIM Projects

ITEMS	UNIT	DPWH	NIA	FMB	NEA	BSWM
1. Irrigation Benefit						
- Estimate Method		Incremental benefit between with and without project conditions	Incremental benefit between with and without project conditions	-	-	Incremental benefit between with and without project conditions
(1) Unit benefit (service area basis)	US$/ha	ave: 1,497 (434 - 6,402)	ave: 1,108 (480 - 1,911)	-	-	ave: 1,405 (78 - 4,940)
(2) Unit benefit (storage water volume basis)	US$/m3	ave: 0.35 (0.04 - 1.62)	ave: 0.28 (0.10 - 0.73)	-	-	ave: 1.07 (0.04 - 13.58)
(3) Unit benefit (embankment volume basis)	US$/m3	ave: 2.93 (0.49 - 9.06)	ave: 3.7 (1.1 - 10.9)	-	-	ave: 4.96 (0.11 - 18.6)
2. Mini-hydropower Benefit						
- Estimate Method		alternative diesel plant cost.	alternative diesel plant cost.	-	Financial study only (comparison with unit energy price of NAPOCOR)	-
(1) Investment Cost (power plant)	US$/kW	ave: 972 (427 - 1,723)	ave: 488 (431 - 530)	-	-	-
(2) Annual Cost						
(i) Fuel Consumption Rate	lit/kWh	ave: 0.34 (0.26 - 0.44)	not presented	-	-	-
(ii) Fuel Cost	US$/lit	ave: 0.41 (0.24 - 0.53)	ave: 0.35 (0.31 - 0.37)	-	-	-
3. Watershed Development/Management Benefit						
- Source of Benefit		-	-	Flood mitigation, Soil conservation, Erosion control, etc.	-	fruits and/or animal production
(1) Unit benefit (service area basis)	US$/ha	-	-	Not counted	-	ave: 1,123 (43 - 6,870)
4. Water Supply						
- Estimate Method		an alternative deep well	-	-	-	-
(1) Unit Benefit (water demand volume basis)	US$/m3	ave: 2.7 (0.2 - 5.2)	-	-	-	-
(2) Unit Benefit (embankment volume basis)	US$/m3	ave: 3.4 (0.5 - 6.3)	-	-	-	-
5. Inland Fishery Benefit						
(1) Unit Benefit (reservoir area basis)	US$/ha	ave: 17,880 (883 - 50,587)	321	-	-	ave: 3,373 (130 - 24,037)
(2) Unit Benefit (embankment volume basis)	US$/m3	ave: 2.29 (0.36 - 6.17)	0.01	-	-	ave: 0.62 (0.03 - 3.96)

Remarks: All values shown are adjusted based on the exchange rate between Philippine pesos and US dollars.

Table B.3.1 Major Features of 10 Completed Projects for Post-Evaluation Study

PROJECT NO. / PROJECT NAME / IMPLEMENTING AGENCY		No.1 Ilihan NIA	No.2 Darapidap BSWM	No.3 Malinao BSWM	No.4 Pasig Timbu FMB	No.5 Mantayupan NEA
PURPOSE						
-Major		Irrigation -150ha	Irrigation -30ha	Irrigation -20ha	Watershed Mana. -7,440ha	Mini-hydro. -500 kW
-Incidental		Flood Control	Watershed Devel. Inland Fishery Flood Control	Watershed Devel. Inland Fishery	Flood Control	Irrigation
PRESENT STATUS						
-Dam		Functioning	Functioning	Functioning	No Monitoring	Functioning
-Irri./Power/Others		Functioning	Functioning	Not completed	No Monitoring	Functioning
BACKGROUND						
-For F/S		Not prepared	1983, BSWM	1983, BSWM	?, FMB	1980, NEA
-For D/D		1980, NIA	1983, BSWM	1983, BSWM	1981, FMB	1981, NEA
-For Construction		1980-1983, NIA 1985, Repaired	1983-1984, BSWM	1983-1984, BSWM	1981-1984, FMB	1982-1984, NEA
O&M SYSTEM						
-Dam		Association/NIA	Cooperative	Association	FMB Dist.Office	Cooperative
-Irri./Power/Others.		Association	Cooperative	Association	FMB Dist.Office	Cooperative
MAJOR DIFFERENCE OF PROJECT FEATURE						
-Dam Height	Plan	23 m	12.9 m	6.6 m	-	2 m
	Actual	25 m	12.9 m	9 m	-	2 m
-Storage Capacity	Plan	700,000 m3	90,090 m3	50,000 m3	-	-
	Actual	775,000 m3	90,090 m3	76,800 m3	-	-
-Irrigable Area						
Wet Season	Plan	150 ha	30 ha	20 ha	-	-
	Actual	150 ha	30 ha	4 ha	-	-
Dry Season	Plan	150 ha	30 ha	4 ha	-	-
	Actual	100 ha	5 ha	0 ha	-	-
-Installed Capacity	Plan	-	-	-	-	500 kW
	Actual	-	-	-	-	500 kW
-Construction Period	Plan	3.8 years	-	-	-	1 years
(Dam)	Actual	3.5 years	10 months	1.7 years	3 years	2.3 years
-Construction Cost	Plan	P10,963,837	-	-	P1,223,725	-
	Actual	P13,379,543	P1,804,860	P2,238,000	P1,447,015	P12,583,000
-Economic (IRR)	Plan	-	-	-	-	Cost: 0.97 P/kWh
	Actual	10.5%	3.0%	-	-	8.5%

PROJECT NO. / PROJECT NAME / IMPLEMENTING AGENCY		No.6 Bacnotan FSDC	No.7 Porac PMO-SWIM/DPWH	No.8 Kirong PMO-SWIM/DPWH	No.9 San Ramon PMO-SWIM/DPWH	No.10 Calanggaman BSWM/DPWH/NIA
PURPOSE						
-Major		Irrigation -199ha	Mini-hyrdo. -100 kW	Flood Control	Irrigation -50ha	Irrigation -100ha
-Incidental		Flood Control	Irrigation Flood Control Inland Fishery	Irrigation	Watershed Devel. Inland Fishery Flood Control	Inland Fishery Flood Control Water Supply
PRESENT STATUS						
-Dam		Functioning	Washed away	Damaged	No functioning	Under Construct
-Irri./Power/Others		Functioning	No functioning	No functioning	Not constructed	Not constructed
BACKGROUND						
-For F/S		1978, FSDC	1981, DPWH	1983, DPWH	1983, BSWM	1983, BSWM
-For D/D		1979, FSDC	1981, DPWH	1984, DPWH	1983, BSWM	1983, BSWM
-For Construction		1980-1986, FDSC	1982-1984, DPWH 1986,washed away	1984-1987, DPWH	1987, DPWH	1987-present,DP actually by NIA
O&M SYSTEM						
-Dam		Association	Not managed	Not managed	Not organized	Not organized
-Irri./Power/Others.		Association	Not managed	Not managed	Not organized	Not organized
MAJOR DIFFERENCE OF PROJECT FEATURE						
-Dam Height	Plan	24 m	25 m	-	13 m	17.5 m
	Actual	24 m	25 m	3 m	13 m	-
-Storage Capacity	Plan	1,570,000 m3	672,500 m3	-	91,370 m3	390,500 m3
	Actual	1,570,000 m3	672,500 m3	-	91,370 m3	-
-Irrigable Area						
Wet Season	Plan	199 ha	240 ha	-	50 ha	100 ha
	Actual	155 ha	-	-	0 ha	-
Dry Season	Plan	70 ha	120 ha	-	-	-
	Actual	50 ha	-	-	0 ha	-
-Installed Capacity	Plan	-	100 kW	-	-	-
	Actual	-	-	-	-	-
-Construction Period	Plan	-	3 years	-	-	-
(Dam)	Actual	6.5 years	-	3.5 months	5 months	-
-Construction Cost	Plan	-	P8,212,000	-	-	P6,700,000
	Actual	P7,600,000	P11,813,254	P1,180,678	P3,886,247	-
-Economic (IRR)	Plan	-	18.5 %	-	-	49.5 %
	Actual	14.2%	-	-	-	-

Table B.3.2 Results of Post-Evaluation Study (1/10)
- Ilihan SWIP -

PROJECT NUMBER	:	No.1
PROJECT NAME	:	Ilihan SWIP
AGENCY	:	National Irrigation Administration (NIA)
LOCATION	:	Region VII, Bohol, Tubigon

PROJECT DESCRIPTION

PURPOSE :

Major	:	Irrigation, Plan : 150 ha Actual : 150 ha
Incidental	:	Flood Control

PRESENT STATUS :

Dam	:	Functioning well
Irrigation	:	Functioning well

BACKGROUND :

F/S	:	Not prepared
D/D	:	1980 by NIA Central Office
Construction	:	1980-1983 by NIA Bohol Provincial Irrigation Office. Repaired in 1985 by NIA Bohol POI.
O&M	:	Dam & Irrigation by Southeastern Tubigon Irrigators' Association

PRINCIPAL FEATURE :

		Plan	Actual
Dam Type	:	Zoned Earthfill	Zoned Earthfill
Dam Height	:	23 m	25 m
Crest Length	:	125 m	145 m
Embankment Volume	:	-	95,000 m^3
Reservoir Area	:	21 ha	22 ha
Effective Storage Capacity	:	700,000 m^3	775,000 m^3
Irrigation Area	:		
Wet season	:	150 ha	150 ha
Dry season	:	150 ha	100 ha
Irrigation Canal	:	8.0 km	8.0 km
Construction Period	:		
Dam	:	3.75 years	3.5 years
Irrigation	:	2.33 years	2.17 years
Construction Cost	:		
Dam	:	₱ 8,784,534	₱ 8,626,772
Irrigation	:	₱ 2,179,303	₱ 2,098,084
Total	:	₱ 10,963,837	₱ 10,724,856
Repairing Cost of Dam	:		₱ 2,654,687

ENGINEERING AND TECHNICAL ASPECTS

1. During the first year of dam operation just after completion of the dam, seepage occurred at the upper part of downstream slope when the water level reached at EL 45.0 m. This would be caused by insufficient height and width of impervious core and its loose compaction. Considering the dam safety, the repair works to raise the height of impervious core and dam crest were conducted in 1985 at a cost of P2.66 Million.

2. During the construction, the spillway was relocated from the right abutment to the left abutment, considering the weak foundation (highly weathered rock) and the hauling of borrow materials for dam embankment.

3. Due to deterioration of slope of irrigation canals, rehabilitation of canals such as canal lining will be required.

SOCIO-ECONOMIC ASPECTS

1. Due to shortage of irrigation water during the dry season, the cropping area of rice in the dry season is limited to 100 ha.

2. The dam is almost functioning as planned, serving the irrigation area of 150 ha benefiting 460 farmers in the area. The project resulted in the increase of food production in the area thereby enhancing the economic condition of the farmers.

3. EIRR is estimated at 10.5% on the present condition, but the project contributes to enhance farmers' living standards.

O&M ASPECTS

1. Irrigation fee is collected from the farmers at the rate of ₱ 150/ha in 1988. Total irrigation fee of ₱ 22,500 is used for O&M of the irrigation facilities. Other than the irrigation fee, the Association is subsidized the O&M cost of ₱3,000/annum from the NIA Central Office for O&M of the dam.

2. The present O&M cost allocated from the NIA Central Office is not enough for safety monitoring and well maintenance of the dam.

3. The access road leading to the damsite is not properly maintained.

Table B.3.2 Results of Post-Evaluation Study (2/10)
- Darapidap SWIP -

PROJECT NUMBER	:	No.2
PROJECT NAME	:	Darapidap SWIP
AGENCY	:	Bureau of Soils and Water Management
LOCATION	:	Region II, Nueva Vizcaya, Aritao

PROJECT DESCRIPTION

PURPOSE :

Major	:	Irrigation, Plan ; 30 ha Actual; 30 ha
Incidental	:	Watershed Development Inland Fishery Flood Control

PRESENT STATUS :

Dam	:	Functioning well
Irrigation	:	Functioning well

BACKGROUND :

F/S	:	1983 by BSWM Central Office
D/D	:	1983 by BSWM Central Office
Construction	:	1983-1984 by BSWM Central Office
O&M	:	Dam and Irrigation; by Darapidap Water Impounding Service Cooperative, Inc.

PRINCIPAL FEATURE :

		Plan	Actual
Dam Type	:	Earthfill	Earthfill
Dam Height	:	12.9 m	12.9 m
Crest Length	:	130 m	130 m
Embankment Volume	:	70,257 m^3	70,257 m^3
Effective Storage Capacity	:	90,090 m^3	90,090 m^3
Irrigation Area	:		
Wet season	:	30 ha	30 ha
Dry season	:	30 ha	5 ha
Irrigation Canal	:	3 km	3 km
Construction Period	:		
Dam	:	-	10 Months
Irrigation	:	-	-
Construction Cost	:		
Dam	:	-	₱ 1,804,860
Irrigation	:	-	-
Total	:	-	₱ 1,804,860

ENGINEERING AND TECHNICAL ASPECTS

1. No serious technical problem is found out.
2. The slope land of the borrow area is eroded. Some vegetation measures are required.
3. Due to shortage of irrigation water especially in the dry season, the raising of the dam crest is required if water resource is available.

SOCIO-ECONOMIC ASPECTS

1. The irrigation area in the wet season is 30 ha ; rice of 25 ha , upland crops of 5 ha. While, the irrigation area in the dry season is only 5 ha due to shortage of water to ensure the water rights downstream of the dam. This is caused by insufficient investigation of the water rights in and around the dam during the planning stage.
2. After completion of the dam, 18,000 of fingerlings of Tilapia were supplied by BFAR in 1984 and 1985. Farmers catched 1 to 3 kg of Tilapia at intervals of about one month. Since 1986, supply of Tilapia fingerling from BFAR has been stopped when it attained its propagation level.
3. Reforestation has been conducted by FMB in cooperation with the Cooperative. Juvilins (or paper tree) planted has not grown well because of infertile soil and drought.
4. EIRR is estimated at 3.0%, but the project contributes to enhance farmers' living condition through increase of rice production.

O&M ASPECTS

1. The irrigation fee is collected from the farmers at the rate of ₱100/ha/cropping. This irrigation fee covers all the costs necessary for the O&M works managed by the Cooperative. However, the Cooperative encounters sometimes money shortage for proper O&M works.
2. In addition to the shortage of irrigation water due to the water rights, the operation efficiency of the dam is very low because a proper operation manual of the dam and irrigation facilities is not prepared.

Table B.3.2 Results of Post-Evaluation Study (3/10) - Malinao -

PROJECT NUMBER	:	No.3
PROJECT NAME	:	Malinao SWIP
AGENCY	:	Bureau of Soils and Water Management
LOCATION	:	Region VIII, Southern Leyte, Sogod

PROJECT DESCRIPTION

PURPOSE :

Major	:	Irrigation, Plan : 20 ha Actual: 4 ha
Incidental	:	Watershed Development Inland Fishery

PRESENT STATUS :

Dam	:	Functioning
Irrigation	:	Functioning, but not fully completed

BACKGROUND :

F/S	:	1983 by BSWM Central Office
D/D	:	1983 by BSWM Central Office
Construction	:	1983-1984 by BSWM Central Office
O&M	:	Dam and Irrigation; by Farmers' Association

PRINCIPAL FEATURE:

		Plan	Actual
Dam Type	:	Homogeneous	Homogeneous
Dam Height	:	6.6 m	9 m
Crest Length	:	176 m	174 m
Embankment Volume	:	- m^3	45,144 m^3
Reservoir Area	:	2.4 ha	2.6 ha
Effective Storage Capacity	:	50,000 m^3	76,800 m^3
Irrigation Area	:		
Wet season	:	20 ha	4 ha
Dry season	:	4 ha	0 ha
Irrigation Canal	:	- km	0.8 km
Construction Period	:	-	1.7 years
Construction Cost	:		
Dam	:	-	P 2,238,000
Irrigation	:	-	P
Total	:	-	P 2,238,000

ENGINEERING AND TECHNICAL ASPECTS

1. Sedimentation problem arises in the dam reservoir.

2. The sound design was done for the small scale dam in the height of 9 m;

   Crest width : 4.0 m
   Upstream slope : 1 : 3.0
   Downstream slope: 1 : 2.0
   Freeboard : 2.45 m

3. The irrigation facilities are not completed yet. The implementation plan should be set up soon to efficiently utilize water reserved by the dam.

SOCIO-ECONOMIC ASPECTS

1. Although the irrigation area was scheduled to be 20 ha of rice field in both wet and dry seasons, the present irrigation area is only 4 ha in the wet and none in the dry season due to no provision of irrigation facilities and uncontrol of reservoir operation.

2. After completion of the dam, some fingerlings of Tilapia were released by BFAR. Since 1984, supply of fingerlings from BFAR has been stopped when it attained its propagation level.

3. Reforestation works have not been done. This work will be handled by FMB.

O&M ASPECTS

1. The irrigation fee is not fully collected from the farmers. Therefore, the Association encounters sometimes money shortage for proper O&M works.

2. The operation efficiency of the dam is very low because a proper operation manual of the dam and irrigation facilities is not prepared. The farmers open the gate in their own ways.

Table B.3.2 Results of Post-Evaluation Study (4/10)
- Pasig Timbu Watershed Rehabilitation Project -

PROJECT NUMBER : No.4
PROJECT NAME : Pasig Timbu Watershed Rehabilitation Project

AGENCY : Forest Management Bureau (FMB)
LOCATION : Region III, Pampanga, Porac

PROJECT DESCRIPTION

PURPOSE :
- Major : Watershed Management
- Incidental : Flood Control

PRESENT STATUS :
- Facility : No monitoring, partly damaged
- Vegetation : No monitoring

BACKGROUND :
- Identification : by FMB District Office
- D/D : 1981 by FMB Central Office
- Implementation : 1981-1984 by FMB District Office
- O&M : Actually not organized specially for the project but to be done by the FMB District Office

PRINCIPAL FEATURE :

	Plan	Actual
Watershed Area	7,440 ha	7,440 ha
Protection Area	2,090 ha	2,090 ha
Reforestation Area	1,200 ha	1,200 ha
No. of Check Dam	17 Nos.	-
No. of Retaining Wall	7 Nos.	-
Stream Channel Improvement	2 places	-
Wattling and Spot Planting	5 places	-
Construction Period	1 years	3 years
Construction Cost	P 1,223 725	P 1,447,015

ENGINEERING AND TECHNICAL ASPECTS

1. The treatment should emphasize mostly on the biological/vegetative measures to stabilize slope land. The number of check dam should also be increased, which would prevent the movement of sediments in the stream going down to the flood plain. While, the retaining wall, bank protection and stream channelling or dredging of the stream bed are not appropriate and practical for the purpose of watershed management.

2. During the implementation of the project, lack of the necessary technical know-how by the field personnel was found out. The training program for them will be required.

3. In the formulation of the project, ecological and environmental aspects should be considered.

4. Manual for design and implementation of watershed management should be prepared.

SOCIO-ECONOMIC ASPECTS

1. The watershed management project do not bear the visual or direct benefits. However, during the implementation, local inhabitants were employed as labor and their incomes were improved.

O&M ASPECTS

1. Since implementation of the project, no inventory of the project condition was done. In order to have a comprehensive measures for damaged structures and maintenance of plants, a periodical monitoring must be done. For O&M of the project, the appropriate budget will be required.

2. Guideline for operation and management of a comprehensive watershed management project is necessary.

3. Accessibility from the existing roads to the watershed is very low. This results in lack of operation and maintenance works.

Table B.3.2 Results of Post-Evaluation Study (5/10)
- Mantayupan Fall SWIP -

PROJECT NUMBER	:	No.5
PROJECT NAME	:	Mantayupan Falls SWIP
AGENCY	:	National Electrification Administration
LOCATION	:	Region VII, Cebu, Barili

PROJECT DESCRIPTION

PURPOSE :

Major	:	Mini-hydropower(Plan; 500 kW, 2,144 MWh)
Incidental	:	Irrigation

PRESENT STATUS :

Dam	:	Functioning well
Power Plant	:	Functioning well

BACKGROUND :

F/S	:	1980 by NEA Central Office
D/D	:	1981 by NEA Central Office
Construction	:	1982-1984 by NEA Central Office
O&M	:	Dam and Mini-hydropower Plant; by Cebu I Electric Cooperative, Inc. (CEBECO I)

PRINCIPAL FEATURE:

	Plan	Actual
Type of Development	: Run-of-river	Run-of-river
Diversion Dam Type	: Ogee Concrete	Ogee Concrete
Dam Height	: 2 m	2 m
Crest Length	: 15 m	15 m
Crest Elevation	: EL.132 m	EL.132 m
Tailrace Elevation	: EL. 34 m	EL. 34 m
Gross Head	: 98 m	98 m
Net Head	: 95 m	95 m
Installed Capacity	: 500 kW :(250kW x 2nos.)	500 kW (250kW x 2nos.)
Average Energy Generation	: 2,144 MWh/year	1,719 MWh/year
Design Discharge	: 0.73 m^3/sec	0.73 m^3/sec
Construction Period	: 1 year	2.25 years
Construction Cost	:	
Dam	: -	P 1,230,206
Power Plant	: -	P11,352,794
Total	: -	P12,583,000
O & M Cost	: -	P 254,244/year
Power Generation Cost	: 0.97 P/kWh	1.05 P/kWh

ENGINEERING AND TECHNICAL ASPECTS

1. No serious technical problem on the dam and power plant was found.

2. All electrical equipment were imported from the People's Republic of China.

3. The power station is connected to the power grid of CEBECO I and generated power energy is efficiently used.

SOCIO-ECONOMIC ASPECTS

1. Actual power generation since the commencement of the operation is as follows:

Generated Power	;	545 kW - 100 kW
Generated Energy	;	
1985 (from July)		1,072 MWh
1986		1,871 MWh
1987		1,568 MWh
1988 (as of Sept.)		1,075 MWh
Total		5,586 MWh
Average Generated Energy	;	1,719 MWh
Generation Cost	;	1.05 P/kWh

Actual power generation is attained at about 80 % of the proposed generation, though the generation cost is a bit higher than the NPC generation rate of 0.9P /kWh. The power tariff of CEBECO I in 1988 is as follows:

Public/Residence	:	1.6 P/kWh
Commercial	:	1.64 P/kWh
Industry	:	1.58 P/kWh
Street	:	1.41 P/kWh

2. Water utilized for power generation is used for irrigation in the area downstream of the station.

3. EIRR is estimated at 8.5% under the present condition.

O&M ASPECTS

1. After completion of construction, the project was turned-over to the CEBECO I for O&M. The CEBECO I amortizes all investment costs to NEA within 15 years.

2. The O&M of the project is made by one operator for power station and one inspector of the dam in three shift a day.

Table B.3.2 Results of Post-Evaluation Study (6/10) - Bacnotan SWIP -

PROJECT NUMBER	:	No.6
PROJECT NAME	:	Bacnotan SWIP
AGENCY	:	Farm Systems Development Corporation
LOCATION	:	Region I, La Union, Bacnotan

PROJECT DESCRIPTION

PURPOSE :

Major	:	Irrigation, Plan ; 199 ha Actual; 155 ha
Incidental	:	Inland Fishery Flood Control

PRESENT STATUS :

Dam	:	Functioning well
Irrigation	:	Functioning well

BACKGROUND :

F/S	:	1978 by FSDC Central Office
D/D	:	1979 by FSDC Central Office
Construction	:	1980-1986 by FSDC Central Office
O&M	:	Dam and Irrigation: by Bannuar Integrated Service Association

PRINCIPAL FEATURE:

		Plan	Actual
Dam Type	:	Zoned Earthfill	Zoned Earthfill
Dam Height	:	24 m	24 m
Crest Length	:	100 m	100 m
Embankment Volume	:	190,800 m^3	190,800 m^3
Effective Storage Capacity	:	1,570,000 m^3	1,570,000 m^3
Reservoir Area	:	18 ha	18 ha
Irrigation Area	:		
Wet season	:	199 ha	155 ha
Dry season	:	70 ha	50 ha
Irrigation Canal	:	- km	- km
Construction Period	:	-	6.5 years
Construction Cost	:		
Dam	:	-	₱ 6,500,000
Irrigation	:	₱ 1,000,000	₱ 900,000
Total	:	-	₱ 7,400,000
O & M Cost (in 1988)	:		
Amortization	:	-	₱ 45,000
Repair/Maintenance	:	-	₱ 12,000
Honoraria/Salaries	:	-	₱ 27,000
Office Supplies	:	-	₱ 1,000
Total	:	-	₱ 85,000

ENGINEERING AND TECHNICAL ASPECTS

1. No technical serious problem on the dam was found.
2. The sound design was done for the dam. However, the followings should be considered:
   (a) Considering the dam height of 24 m, berm and drainage gutter are required on the downstream slope for dam safety.
   (b) To prevent bend of spindle of intake gate, the inclined-conduit type intake should not be placed on the embankment but on the sound foundation.
   (c) The crest width of 8 m is not economical, because the crest is used only as maintenance road.

SOCIO-ECONOMIC ASPECTS

1. Although the irrigation area was scheduled to be 199 ha of rice field in the wet season and 70 ha of rice in the dry season, the present irrigation area is 150 ha in the wet and 50 ha in the dry season due to shortage of water. The Association plans crop diversification from rice to other upland crops in the dry season.
2. After completion of the dam, the inland fishery was undertaken by the Association as planned. In addition, BFAR component of the project stocked Tilapia fingerlings in the reservoir.
3. The village people in and around the project could attain a self sufficiency in food.
4. The project could contribute to increase the farmers' incomes by at least 10% per year.
5. EIRR is estimated at 14.2%, and the project contribute to improve the nutritional condition in the vicinity of the project.

O&M ASPECTS

1. The irrigation fee is collected from the farmers at the rate of ₱450/crop/ha, but collection percentage is in the range of 80 to 85 % per annum due to insufficient irrigation.
2. There is shortage of skilled staff for further efficient utilization of the dam.

Table B.3.2 Results of Post-Evaluation Study (7/10)
- Porac Dam -

PROJECT NUMBER	:	No.7
PROJECT NAME	:	Porac Dam and Reservoir Project
AGENCY	:	PMO-SWIM/DPWH
LOCATION	:	Region III, Pampanga, Porac

PROJECT DESCRIPTION

PURPOSE :

Major	:	Mini-hydropower (Plan: 100 kW)
Incidental	:	Irrigation (Plan: 240 ha) Inland Fishery Flood Control

PRESENT STATUS :

Dam	:	Not functioning, Washed away
Mini-hydropower	:	Not functioning

BACKGROUND :

F/S	:	1981 by PMO-SWIM/DPWH
D/D	:	1981 by PMO-SWIM/DPWH
Construction	:	1982-1984 (at 99 % completion) by PMO-SWIM/DPWH. The dam was washed away in 1986.

PRINCIPAL FEATURE:

	Plan	Actual
Dam Type	Zoned Earthfill	Zoned Earthfill
Dam Height	25 m	25 m
Crest Length	188 m	188 m
Embankment Volume	106,600 m^3	106,600 m^3
Effective Storage Capacity	672,500 m^3	672,500 m^3
Reservoir Area	12.8 ha	12.8 ha
Installed Capacity	100 kW	- kW
Power Generation	548 MWh	- MWh
Irrigation Area		
Wet season	240 ha	- ha
Dry season	120 ha	- ha
Irrigation Canal	- km	- km
Construction Period	3 years	-
Construction Cost		
Dam	₱ 7,596,000	₱ 11,146,233
Electro-Mechanical/Power Plant	₱ 616,000	₱ 667,021
Irrigation	-	-
Total	₱ 8,212,000	₱ 11,813,254

ENGINEERING AND TECHNICAL ASPECTS

1. In September 1986, the dam was washed away.

2. The reasons of collapse of the dam are conceived as follows:

   (a) The bulk headgate of intake was accidentally shut down at 99 % completion of the dam in 1984 and the reservoir water level rose rapidly due to flood caused by typhoon. The gate was broken with dynamite and then rapid drawdown of water level occurred. At that time, some cracks occurred in the dam embankment and sliding occurred on the upper part of the upstream slope. Those made the dam body weak against flood.

   (b) The spillway was not constructed properly on the rock foundation. The piping action occurred in the base of the spillway and the retaining wall of the spillway would be flushed out by flood.

   (c) The wall connecting the dam body with the spillway was made with earthfill. This embankment portion was slided due to piping action. This wall should be made with concrete.

   (c) The flood over the spillway capacity attacked the dam. The flood might overtop the dam embankment.

SOCIO-ECONOMIC ASPECTS

1. The beneficiaries of the dam are eager for re-construction of the dam.

O&M ASPECTS

Table B.3.2 Results of Post-Evaluation Study (8/10) - Kirong Dam -

PROJECT NUMBER	:	No.8
PROJECT NAME	:	Kirong Dam and Reservoir Project
AGENCY	:	PMO-SWIM/DPWH
LOCATION	:	Region III, Bataan, Hermosa

PROJECT DESCRIPTION

PURPOSE :

Major	:	Flood Control
Incidental	:	Irrigation

PRESENT STATUS :

Dam (Weir)	:	Damaged and not functioning
Flood Control	:	Not functioning

BACKGROUND :

F/S	:	1983 by District Office/DPWH
D/D	:	1984 by PMO-SWIM/DPWH
Construction	:	1984-1987 by PMO-SWIM/DPWH Phase I ; 1984-1985 Phase II; 1986-1987 (Repair Works)
O&M	:	Not organized yet

PRINCIPAL FEATURE:

		Actual
Weir Type	:	Concrete Diversion Weir
Weir Height	:	3 m
Size of Sluice Gate Portion	:	1.8m(W) x 1.8m(H) x 2nos.,
	:	1.8m(W) x 2.2m(H) x 1no.
Diversion Canal	:	
Type	:	Trapezoidal Earth Canal
Side Slope	:	1:1.5
Base Width	:	2 m
Height	:	2 m
Construction Period	:	3.5 months
Repair Works	:	1.5 months
Construction Cost	:	
Phase I	:	₱ 734,396
Phase II	:	₱ 446,282
Total	:	₱ 1,180,678

Note: The above feature of the weir is shown based on the results of the field investigation, because of no existing data available.

ENGINEERING AND TECHNICAL ASPECTS

1. After completion in 1985, the piping action occurred in the foundation of the weir and the weir suffered from overturning. Although the repair works of the weir for overturning were done in 1986-1987, the piping action was not stopped.

2. According to the results of hearing from the local people in Hermosa Municipality, the project is not functioning against the flood and the people suffers from flood damages sometimes a year.

3. The reasons for the above are envisaged as follows:

   For piping and overturning:

   (a) Insufficient consideration of foundation treatment
   (b) Insufficient creep length
   (c) Inadequate construction of foundation

   For diversion of flood:

   (a) Piping of water through the foundation
   (b) Inadequate canal base elevation of the diversion canal

4. The improvement plans for the above are considered as follows:

   For piping and overturning:

   (a) Placing of soil blanket on the upper apron
   (b) Grouting of the foundation
   (c) Rehabilitation of the lower apron

   For diversion of flood:

   (a) Rehabilitation of the diversion canal

SOCIO-ECONOMIC ASPECTS

1. The beneficiaries of the project are eager for rehabilitation works of the project to mitigate the flood damages.

O&M ASPECTS

1. Nobody handles the O&M Works.

Table B.3.2 Results of Post-Evaluation Study (9/10)
- San Ramon Dam -

PROJECT NUMBER	:	No.9
PROJECT NAME	:	San Ramon Dam and Reservoir Project
AGENCY	:	PMO-SWIM/DPWH
LOCATION	:	Region III, Pampanga, Floridablanca

PROJECT DESCRIPTION

PURPOSE :

Major	:	Irrigation, Plan : 50 ha Actual: 0 ha
Incidental	:	Inland Fishery Flood Control Watershed Development

PRESENT STATUS :

Dam	:	Constructed but not utilized
Irrigation	:	Not yet start construction

BACKGROUND :

F/S	:	1983 by BSWM Central Office
D/D	:	1983 by BSWM Central Office
Construction	:	Dam : 1987 by PMO-SWIM/DPWH Irrigation : not constructed to be undertaken by BSWM
O&M	:	Actually not organized

PRINCIPAL FEATURE:

		Plan	Actual
Dam Type	:	Homogeneous	Homogeneous
Dam Height	:	13 m	13 m
Crest Length	:	196 m	196 m
Embankment Volume	:	28,000 m^3	28,000 m^3
Effective Storage Capacity	:	91,370 m^3	91,000 m^3
Reservoir Area	:	5 ha	5 ha
Irrigation Area	:		
Wet season	:	50 ha	0 ha
Dry season	:	-	0 ha
Irrigation Canal	:	2.7 km	0 km
Construction Period (Dam)	:	-	5 months
Construction Cost	:		
Dam	:	-	P 3,886,247
Irrigation	:	-	P
Total	:	-	P 3,886,247

ENGINEERING AND TECHNICAL ASPECTS

1. Before and during the construction of the dam, the following problems were encountered:

   (a) right-of-way in the damsite and reservoir area
   (b) selection of local labor
   (c) far hauling distance to borrow area
   (d) peace and order condition

   The above problems were successfully solved through good communication and public relations.

2. The dam crest elevation might be lower by 2 m than that designed. The dam crest elevation is also lower by 0.5 m than the floor elevation of the spillway. One of the reasons is the excess settlement of the dam embankment. Considering the dam safety against the flood, the dam crest will be required to be raised. The Municipality of Floridablanca prepared the repair plan of the dam embankment and submitted it to the DPWH Regional Office in 1988.

SOCIO-ECONOMIC ASPECTS

1. Since completion of the dam in 1987, the reserved water is not utilized efficiently, because the irrigation canal is not constructed yet. After completion of the dam, the dam was formally turned-over to the BSWM who organize a farmers' association. The farmers' association will shoulder the construction of canals and other irrigation facilities.

2. The fingerlings of about 5,000 were released for aqua culture in this year but not produced yet.

3. The watershed development is not yet implemented.

O&M ASPECTS

1. The Farmers' Association is not firmly organized. Actually the Association is not activated.

Table B.3.2 Results of Post-Evaluation Study (10/10)
- Calanggaman SWIP -

PROJECT NUMBER	:	No.10
PROJECT NAME	:	Calanggaman SWIP Phase I
AGENCY	:	PMO-SWIM/DPWH Bureau of Soils and Water Management NIA (Bohol Provincial Irrigation Office)
LOCATION	:	Region VII, Bohol, Ubay

PROJECT DESCRIPTION

PURPOSE :

Major	:	Irrigation, Plan; 100 ha
Incidental	:	Inland Fishery Flood Control Water Supply

PRESENT STATUS :

Dam	:	Not yet completed
Irrigation	:	Not yet start construction

BACKGROUND :

F/S	:	1983 by BSWM Central Office
D/D	:	1983 by BSWM Central Office
Construction	:	1987-present, under-construction by PMO-SWIM/DPWH, Actually being constructed by NIA Bohol PIO (Phase I)
O&M	:	Not organized yet

PRINCIPAL FEATURE:

		Plan
Dam Type	:	Zoned Earthfill
Dam Height	:	17.5 m
Crest Length	:	140 m
Embankment Volume	:	- m^3
Effective Storage Capacity	:	390,500 m^3
Reservoir Area	:	- ha
Irrigation Area	:	
Wet season	:	100 ha(detail unknown)
Irrigation Canal	:	- km
Construction Cost	:	
Dam(Phase I)	:	₱ 4,200,000
Dam(Phase II)	:	₱ 2,500,000
Irrigation	:	₱
Total	:	₱ 6,700,000

ENGINEERING AND TECHNICAL ASPECTS

1. The dam was originally formulated with a dam height of 12.5 m, serving water for irrigation area of 35 ha by BSWM. However, considering availability of water resources, the dam feature is revised so as to irrigate 100 ha of rice field with a dam height of 17.5 m. In the Phase I works, the dam was constructed up to the height of 12.5 m and in the Phase II works the dam will be raised up to 17.5 m. The construction fund of ₱ 2.5 million for the Phase II works is requested to the DPWH. The construction works is suspended now. The Phase II works is scheduled to be done in 1989.

2. The development plan of the irrigation facilities is not set forth yet. This plan will be made by BSWM.

SOCIO-ECONOMIC ASPECTS

1. After completion of the Phase II works, the dam will serve water for irrigation area of 100 ha, benefiting at least 300 farmers.

2. The project will contribute an increase of agricultural production and enhancement of living standards of farmers.

O&M ASPECTS

1. Not operated yet.

Table B.3.3 Preliminary Economic Analysis of the Completed Projects for Post-Evaluation Study

IRRIGATION PROJECTS

ITEMS	UNIT	ILIHAN (No.1)	DARAPIDAP (No.2)	BACNOTAN (No.6)
Investment Cost	Pesos			
- Dam		7,073,953	1,479,985	5,330,000
- Irrigation		1,720,429	0	738,000
Annual Cost	Pesos	18,450	2,870	69,700
Construction Period	Year	4	1	6
Repair Works	Pesos	2,176,843	-	-
Irrigation Area	ha			
- with condition				
wet season		150	30	155
dry season		100	5	70
- without condition				
wet season		150	15	155
Crop Yield	ton/ha			
- with condition				
wet season		4	2.3	4.4
dry season		4	1.5	4.6
- without condition				
wet season		2.5	1	2.5
Price of Rice	pesos/kg	3	3	3
Production Cost	pesos/ha			
- with condition		3,150	3,150	3,150
- without condition		2,520	1,050	2,520
Gross Benefit	pesos			
- with condition		3,000,000	229,500	3,012,000
- without condition		1,125,000	45,000	1,162,500
Balance		1,875,000	184,500	1,849,500
Production Cost	pesos			
- with condition		787,500	110,250	708,750
- without condition		378,000	15,750	390,600
Balance		409,500	94,500	318,150
Incremental Benefit	pesos	1,465,500	90,000	1,531,350
IRR	%	10.53	2.97	14.19

MINI-HYDROPOWER PROJECT

ITEMS	UNIT	MANTAYUPAN (No.5)
Investment Cost	US$	
- Dam		56,043
- Mini-hydropower plant		517,183
Annual Cost	US$	9,928
Construction Period	year	3
Power Generated Energy	kWh	1,719,000
NPC Power Generation Rate	P/kWh	0.9
Annual Power Benefit	US$	73,671
IRR	%	8.54

Remarks : Condition of the caluculation of IRR for the Irrigation Projects

(1) Cost : Local Currency
(2) Price of rice : Prevailed in the Philippines.

FIGURES

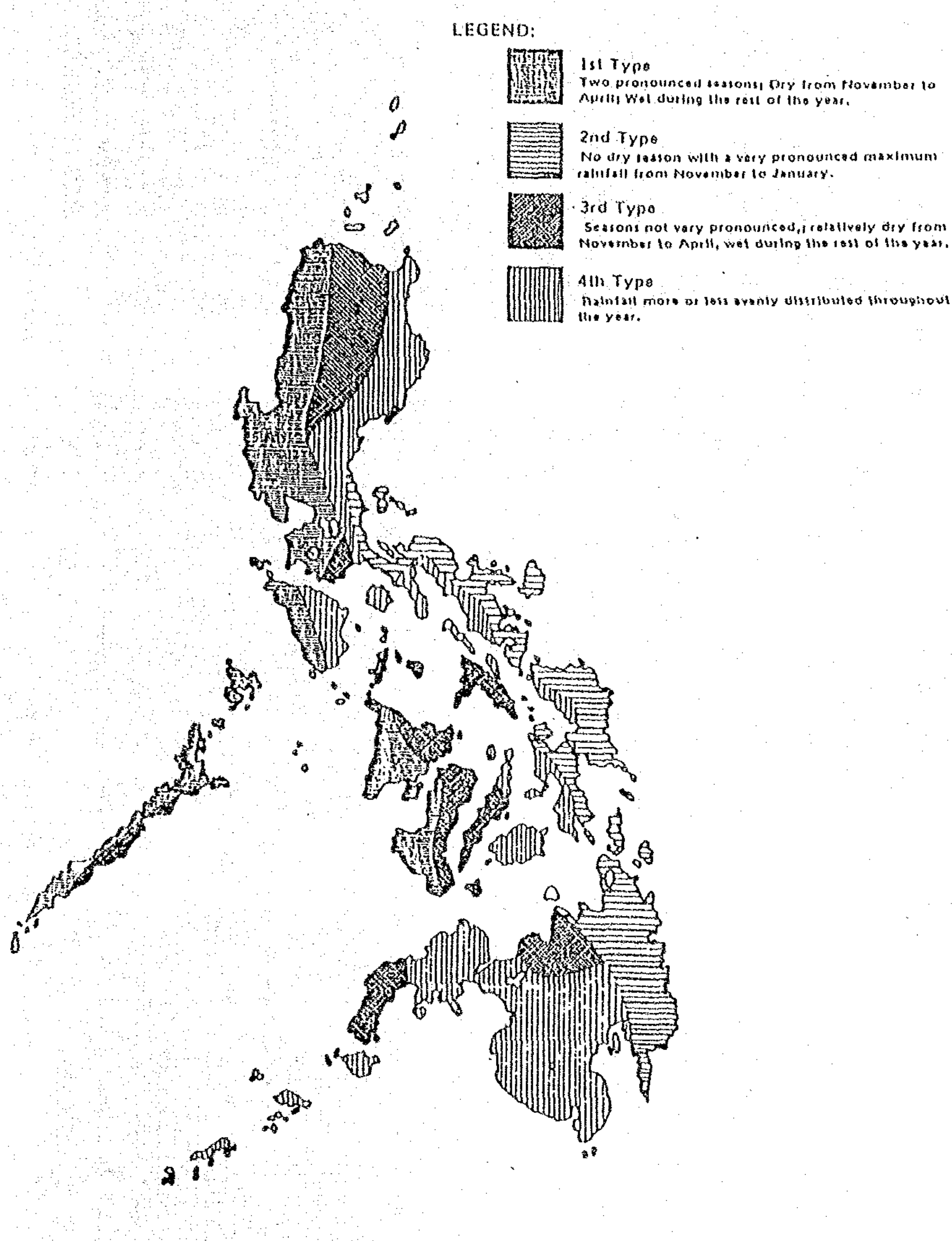

Fig.B.2.1 CLIMATOLOGICAL MAP

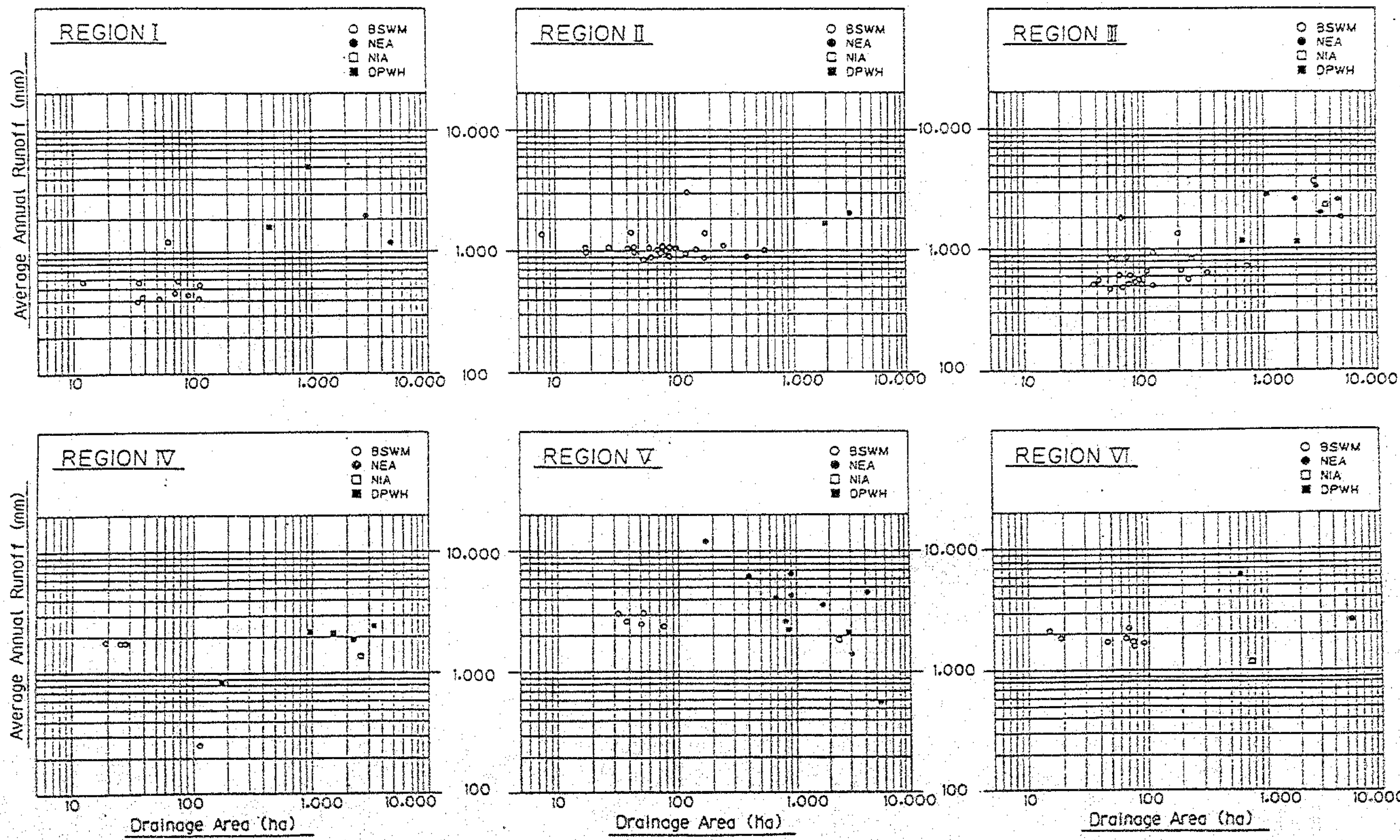

Fig.B.2.2 RELATIONSHIP OF AVERAGE ANNUAL RUNOFF-DRAINAGE AREA ON EACH WATER RESOURCES REGION (1/2)

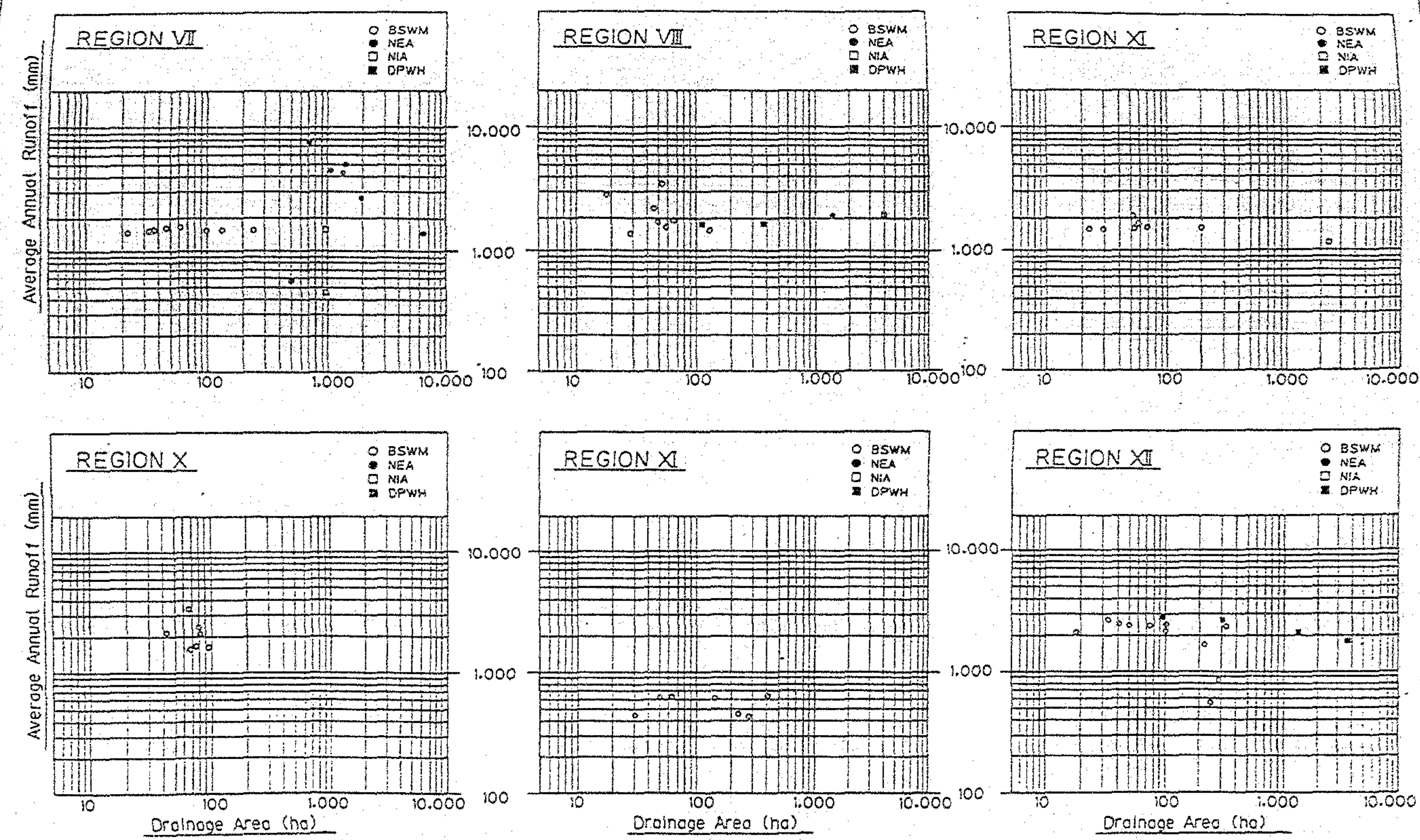

Fig.B.2.2 RELATIONSHIP OF AVERAGE ANNUAL RUNOFF-DRAINAGE AREA ON EACH WATER RESOURCES REGION (2/2)

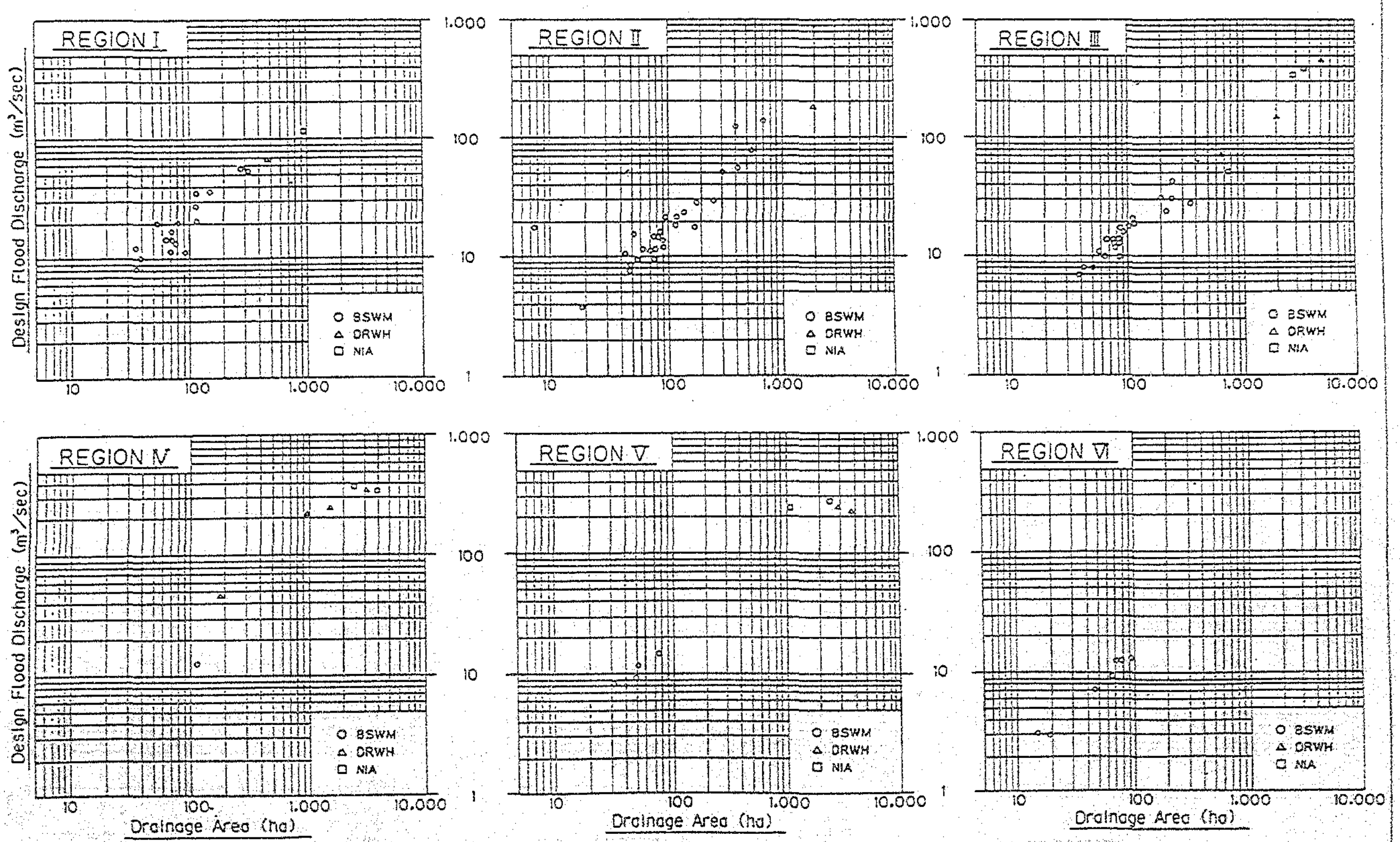

Fig.B.2.3 RELATIONSHIP OF DESIGN FLOOD DISCHARGE-DRAINAGE AREA ON EACH WATER RESOURCES REGION (1/2)

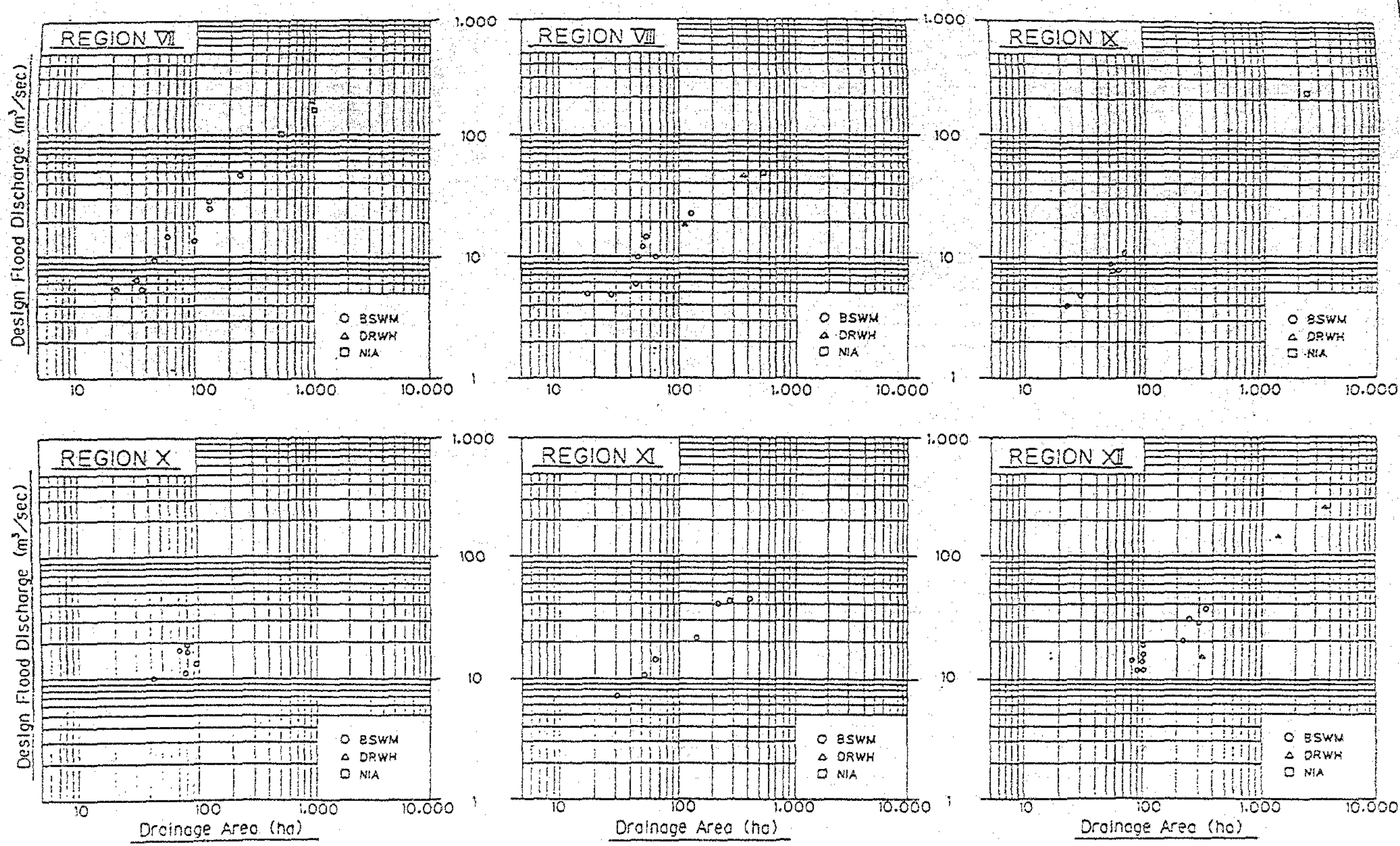

Fig.B.2.3 RELATIONSHIP OF DESIGN FLOOD DISCHARGE-DRAINAGE AREA ON EACH WATER RESOURCES REGION (2/2)

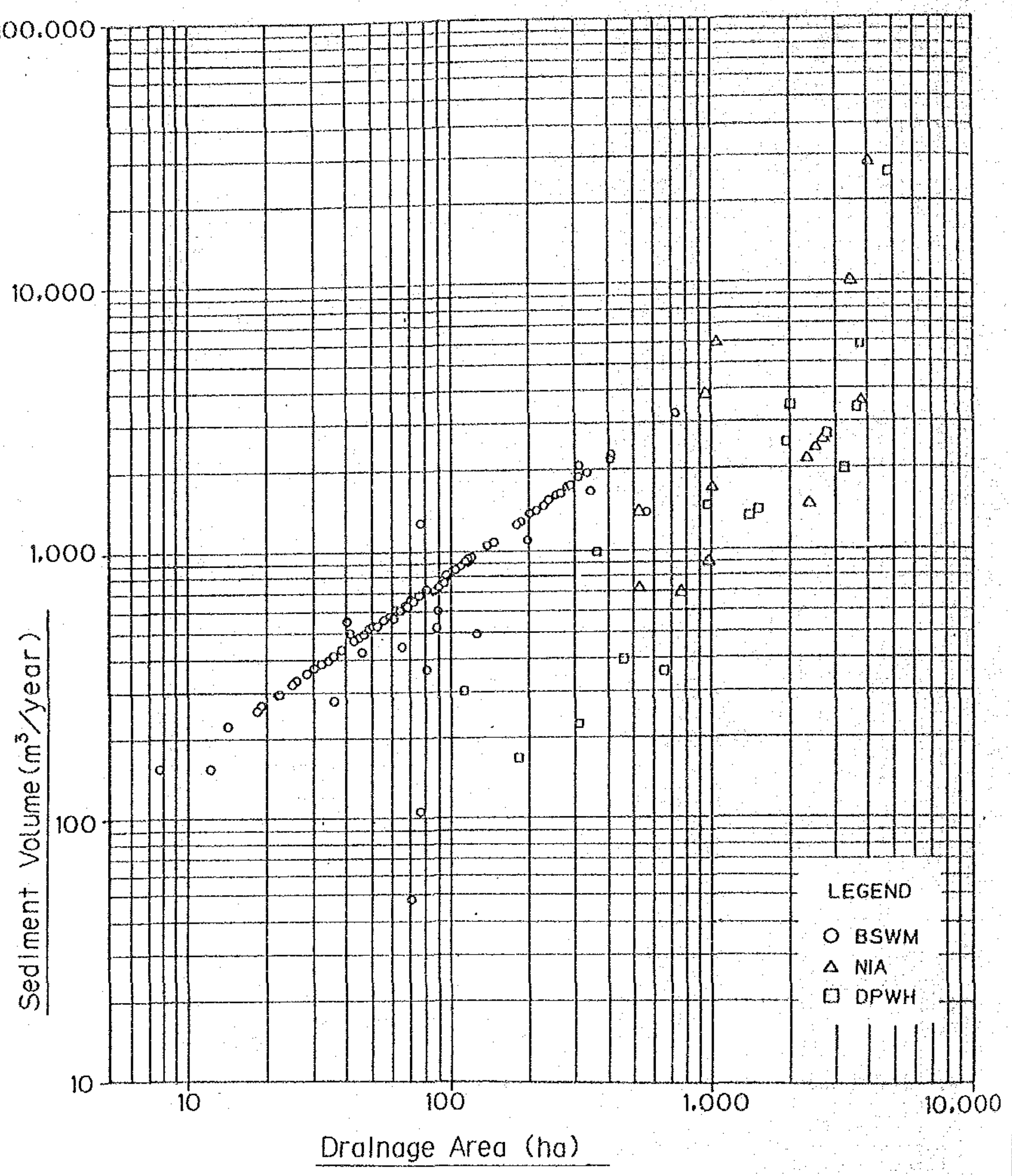

Fig.B.2.4 RELATIONSHIP OF SEDIMENT VOLUME-DRAINAGE AREA

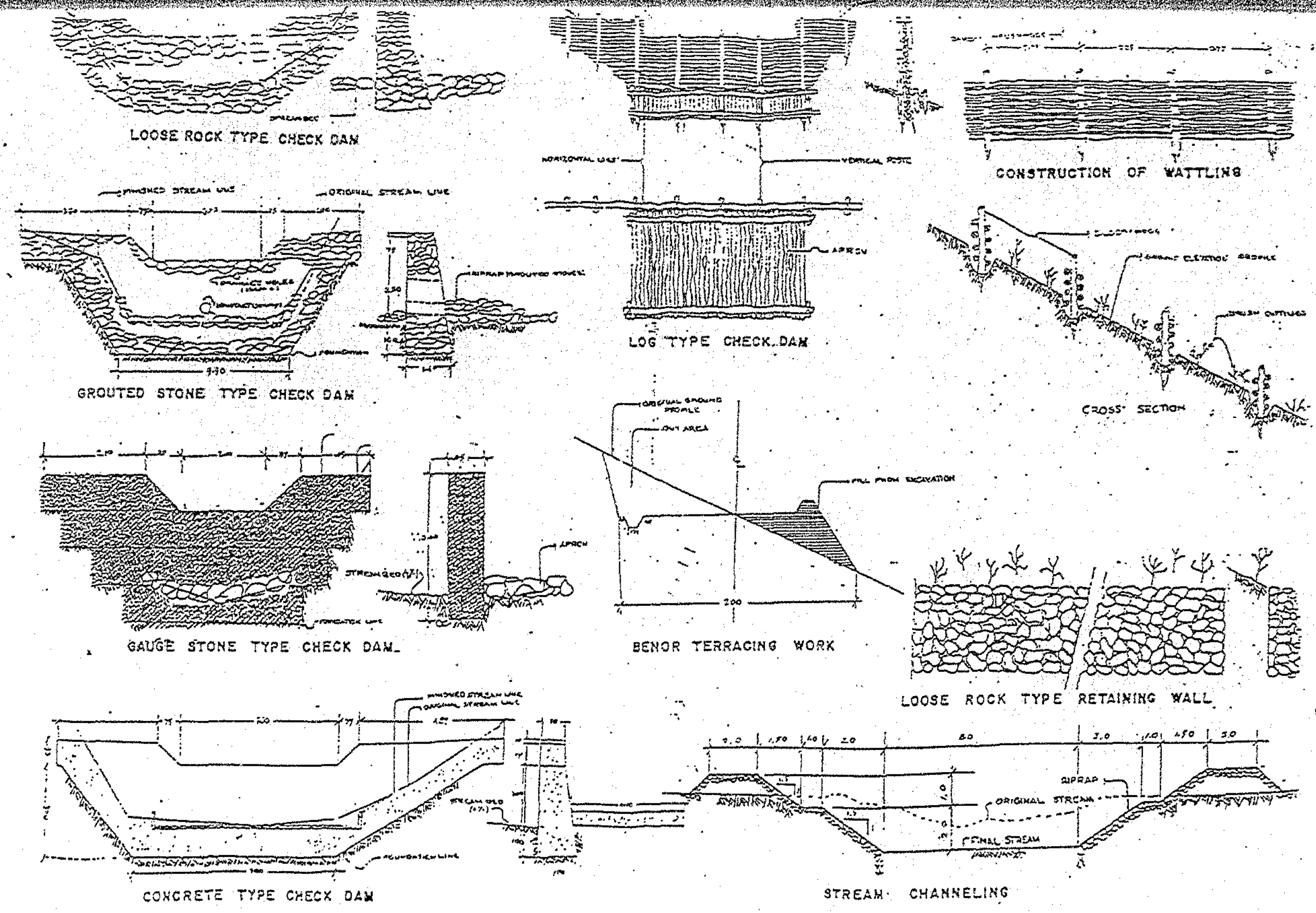

Fig.B.2.5 TYPICAL DESIGNS OF ENGINEERING MEASURES PROPOSED BY FMB

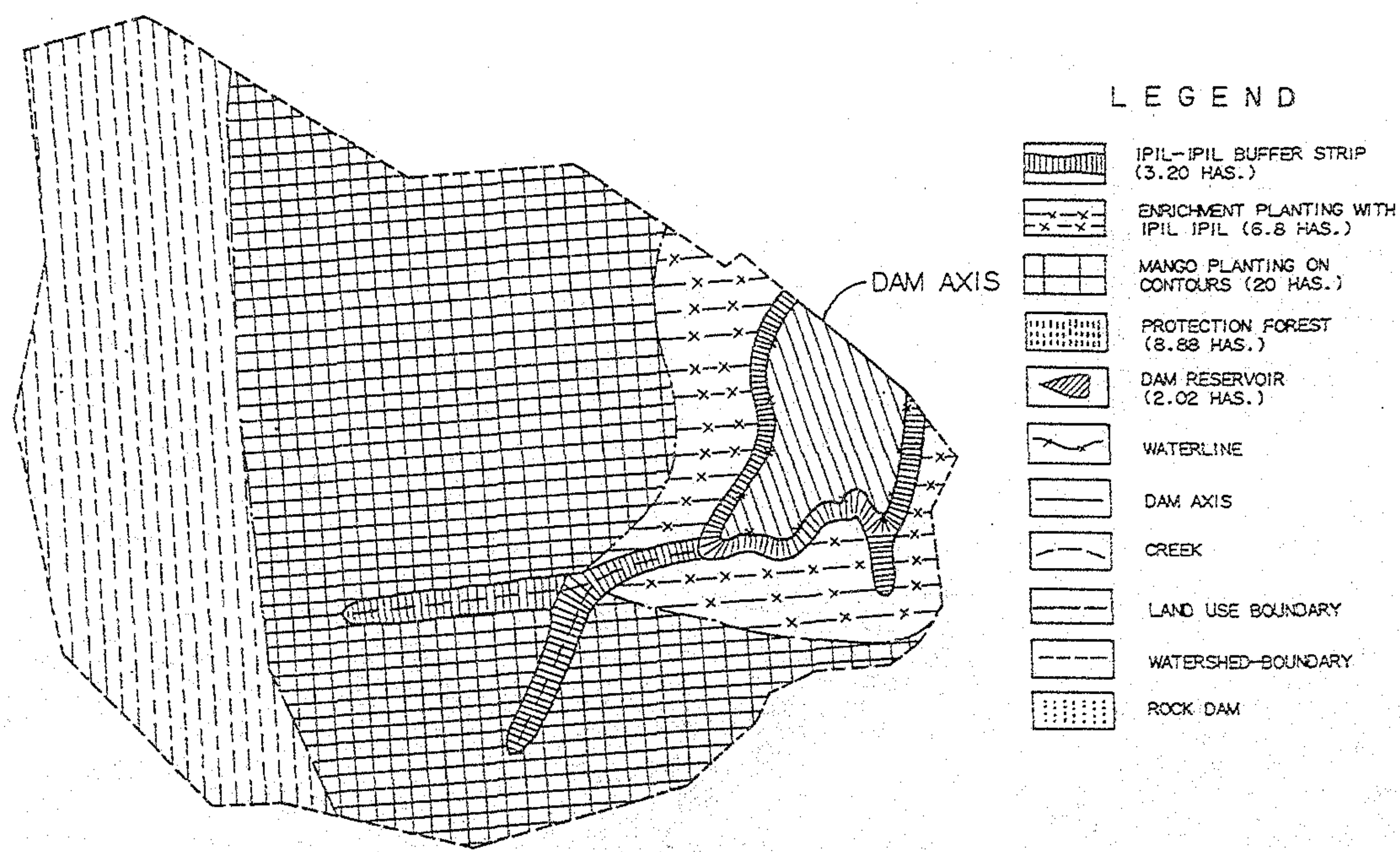

Fig.B.2.6 SCHEMATIC WATERSHED DEVELOPMENT PLAN PROPOSED BY BSWM

ANNEX C

CONCEPTS AND IMPLEMENTING GUIDELINES OF SWIM PROJECTS

ANNEX C CONCEPTS AND IMPLEMENTING GUIDELINES OF SWIM PROJECTS

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ANNEX C CONCEPTS AND IMPLEMENTING GUIDELINES OF SWIM PROJECTS

1. CLASSIFICATION OF SWIM PROJECTS BY CATEGORIES

The 501 projects were listed as candidate projects in the Master Plan Study (refer to ANNEX A). After the review of those projects (refer to ANNEX B), it was realized that they had a wide variety of functions and scale of development, and were not always conforming to the present basic definition of SWIM Projects; i.e., those small scale water impounding dams with a structural height of not more than 30 m and/or a volume of storage not exceeding 50 MCM.

The candidate SWIM projects were broadly categorized/classified into the following three (3) types.

Type-I (with storage dam and reservoir)

Basic Objective : Flood control
Major Objectives : Multi-purpose water resources development on a small scale
Implementing Agency : DPWH, NIA, BSWM

Type-II (without storage dam and reservoir)

Basic Objective : Flood control
Major Objectives : Soil erosion control, watershed protection and management
Implementing Agency : FMB

Type-III (without storage dam and reservoir)

Basic Objective : Flood control
Major Objectives : Rural electrification
Implementing Agency : NEA

2. CONCEPT AND DEFINITION OF SWIM PROJECTS

For screening and qualification of the candidate SWIM projects, the following guideline was set:

(1) The proposed project must be conformable to the definitions, purposes and objectives of the SWIM projects.

(2) The proposed project must be conformable to the provisions of the "Philippines Water Code" regarding appropriation and utilization of water.

(3) The proposed project should be supported by in depth technical studies which cover necessary study items, and must be verified to be technically sound for implementation.

(4) The proposed project must show higher economic viability than the minimum acceptable in terms of EIRR, B/C and NPV.

(5) An environmental impact study must be carried out before project implementation, and an environment compliance certificate from the environmental management bureau be obtained if the project falls within the category of environmentally critical project, or within an environmentally critical area.

(6) The proposed project must be acceptable to the people of the areas to be influenced. In particular, the project should not have land acquisition problem.

(7) The proposed project must be financially viable and affordable for the project beneficiaries to pay the annual charges for operation and maintenance of the project.

(8) Any other projects considered necessary under special administrative requirement.

Among the above guideline, only items (1) and (2) were applied for the qualification of the SWIM Projects under the Master Plan Study. The other items of the guideline could not be applied because of the incompleteness of the existing studies and other pre-construction activities. These incomplete studies and activities, however, can be supplemented by each agency in future, and therefore such incompleteness is not considered as the decisive factor for the qualification.

Although all the projects are conformable to the item (2) of the said guideline, all candidate projects categorized in the Type-II and Type-III projects are not conformable to the item (1).

3. IMPLEMENTING GUIDELINES OF SWIM PROJECTS

The following implementing guidelines were also be established for qualifying the candidate projects.

(1) The project shall preferably be a multi-purpose water resources development on a small scale and at the same time, provide a first line of defence against floods.

(2) The project shall include small scale water-impounding dam which have structural height of not more than 30 m and/or a volume of storage not exceeding 50 MCM.

(3) The project shall include both engineering and vegetative protection works in the watershed area of the prospective dam and reservoir.

(4) The watershed area to be protected shall not be more than 100 km^2.

(5) The irrigation development area shall not be more than 500 ha.

(6) The installed capacity of hydropower generation shall not be more than 5,000 kW.

(7) The construction cost of dam and its appurtenant structures shall not exceed 50 million pesos (at 1989 constant price).

Note: In the case of multi-purpose projects, the principal feature of the project should be properly identified in order to establish the priority of water utilization.

By applying the above guidelines, some other projects in Type-I are disqualified.

4. QUALIFIED SWIM PROJECTS

With the above concept of SWIM, only 230 out of 501 projects are qualified. Out of remaining 271 projects, 101 projects are disqualified and 170 projects are not supported with existing data and reports (see Tables C.4.1 to C.4.3):

Present status of the qualified SWIM projects is as shown below:

QUALIFIED SWIM PROJECTS
(CANDIDATE PROJECTS FOR TEN-YEAR ACTION PROGRAM)

Implementing Agency	Present Status of Projects			Total
	Pre-F/S	F/S	D/D	
DPWH	10	4	9	23
NIA	59	0	8	67
BSWM	0	0	140	140
Total	69	4	157	230

The overall procedure and results of screening or qualifying SWIM projects are shown on the following chart:

SCREENING/QUALIFYING PROCESS OF SWIM PROJECTS

SWIM PROJECTS FOR JICA MASTER PLAN STUDY
TOTAL NUMBER OF PROJECTS : 550

BEFORE CONSTRUCTION PROJECTS
(Nos. of Projects : 501)

CONSTRUCTED AND ON-GOING PROJECTS
(Nos. of Projects : 49)

Post evaluation studies are made for 10 projects under Phase-I.

with Existing Studies and Designs
(Nos. of Projects : 331)

Those 331 projects are examined for preparation of 10 Year Action Program.

DPWH	:	27
NIA	:	85
BSWM	:	145
FMB	:	27
NEA	:	47
Total		331

without Existing Studies and Designs
(Nos. of Projects : 170)

The feasibility studies plan for 170 projects is incorporated into the 10 Year Action Program.

DPWH	:	6
NIA	:	128
BSWM	:	7
FMB	:	29
NEA	:	0
Total		170

(Implementing Guidelines)

Qualified Projects
(Nos of Projects : 230)

		PreF/S	F/S	D/D
DPWH :	23	10	5	8
NIA :	67	59	0	8
BSWM :	140	0	0	140
Total	230	69	5	156

Disqualified Projects
(Nos of Projects : 101)

DPWH	:	4
NIA	:	18
BSWM	:	5
FMB	:	27
NEA	:	47
Total		101

TABLES

Table C.4.1 List of Qualified Projects (1/5)

No.	Agency No.	Project Name	Region	Province Name	Municipality Name	Present Status
DPWH						
1	DPWH-1	Saytan Dam & Reservior	I	La Union	Saytan, Pugo	D/D
2	DPWH-2	Bolo Dam & Reservoir 1/	CAR	Kalinga-Apayao	Tabuk	D/D
3	DPWH-3	Sacrifice Valley Dam & Reservoir	III	Bataan	Hermosa	F/S
4	DPWH-6	Tulariquin Dam & Reservoir	IV	Palawan	Roxas	D/D
5	DPWH-7	Burdeos River	IV	Quezon	Burdeos, Polillo Is.	D/D
6	DPWH-8	San Jose Dam & Reservoir	IV	Rizal	Morong	D/D
7	DPWH-9	Cubacub Dam & Reservoir 1/	IV	Rizal	Pililla	D/D
8	DPWH-11	Debesmac Dam & Reservoir	V	Masbate	Mandaon	F/S
9	DPWH-13	San Juan Dam & Reservoir	VIII	Northern Samar	Mondragon	D/D
10	DPWH-14	Guimba Dam & Reservoir	XII	Lanao del Sur	Guimba, Marawi City	D/D
11	DPWH-15	Magpet Dam & Reservoir 1/	XII	North Cotabato	Magpet	D/D
12	DPWH-16	Banayal Dam & Reservoir	XII	North Cotabato	Tulunan	F/S
13	DPWH-17	Acop Dam & Reservoir	I	Pangasinan	Acop, Rosales	Pre-F/S
14	DPWH-18	Calitlitan Dam & Reservoir	I	Pangasinan	Calitlitan, Umingan	Pre-F/S
15	DPWH-19	Kita-Kita Dam & Reservoir	I	Pangasinan	Kita-Kita, Balungao	Pre-F/S
16	DPWH-20	Salvacion Dam & Reservoir	I	Pangasinan	Salvacion, Rosales	Pre-F/S
17	DPWH-21	San Angel Dam & Reservoir	I	Pangasinan	San Angel, Rosales	Pre-F/S
18	DPWH-22	Ligtos	VI	Iloilo	Ligtos, Igbaras	Pre-F/S
19	DPWH-25	Abian (FSDC)	II	Nueva Viscaya	Bambang	Pre-F/S
20	DPWH-26	Cattebagan (FSDC)	II	Isabela	Anig, Delfin Albano	Pre-F/S
21	DPWH-27	Malalinta (FSDC)	II	Isabela	San Manuel	Pre-F/S
22	DPWH-28	Calubayan (FSDC)	IV	Oriental Mindoro	Calubayan, Socorro	Pre-F/S
23	DPWH-33	Libasan (FSDC)	XI	Davao del Norte	Nabunturan	F/S
NIA						
1	NIA-4	Parpagoja SWIP 1/	IV	Romblon	San Andres	D/D
2	NIA-6	Potot SWIP 1/	V	Masbate	Milagros	D/D
3	NIA-7	Caramoan SWIP 1/	V	Camarines Sur	Caramoan	D/D
4	NIA-9	Nasig-id SWIP	VII	Negros Oriental	Zamboanguita	D/D
5	NIA-11	Tugas SWIP 1/	VII	Bohol	Candijay	D/D
6	NIA-12	Ilaya SWIP 2/	VII	Bohol	Ubay	D/D
7	NIA-14	Sagudsuron SWIP 2/	VIII	Northern Samar	Catubig	D/D
8	NIA-15	Bucacao SWIP 1/	IX	Zamboanga del Sur	Alicia	D/D
9	NIA-20	Maloyo SWIP	I	La Union	Balaoan	Pre-F/S
10	NIA-21	Magsiping SWIP	I	La Union	Luna	Pre-F/S
11	NIA-22	San Felipe SWIP	I	La Union	Rosario	Pre-F/S
12	NIA-23	Macabato SWIP	I	La Union	Tubao	Pre-F/S
13	NIA-25	Masidem SWIP	I	Pangasinan	Bani	Pre-F/S
14	NIA-26	Oboy-Oboy SWIP	I	Pangasinan	Bani	Pre-F/S
15	NIA-27	Vega SWIP	I	Pangasinan	Dasol	Pre-F/S
16	NIA-29	Alibeng SWIP	I	Pangasinan	Sison	Pre-F/S
17	NIA-31	Digap SWIP	I	Pangasinan	Umingan	Pre-F/S
18	NIA-32	Diket SWIP	I	Pangasinan	Umingan	Pre-F/S
19	NIA-47	Mayamot SWIP	III	Nueja Ecija	Guimba	Pre-F/S
20	NIA-48	San Felipe SWIP	III	Nueja Ecija	Guimba	Pre-F/S
21	NIA-49	Bayog SWIP	III	Nueja Ecija	Laur	Pre-F/S

Remarks: 1/: OECF Candidate Projects; 2/: Projects to be funded by CARP;
3/ Project funded by JICA Grant Aid. 4/: Projects funded by ADB.