

フィリッピン共和国

バゴ川灌漑施設補修・増強計画

事前調査報告書

平成6年11月

社団法人 海外農業開発コンサルタント協会

フィリッピン共和国

バゴ川灌漑施設補修・増強計画

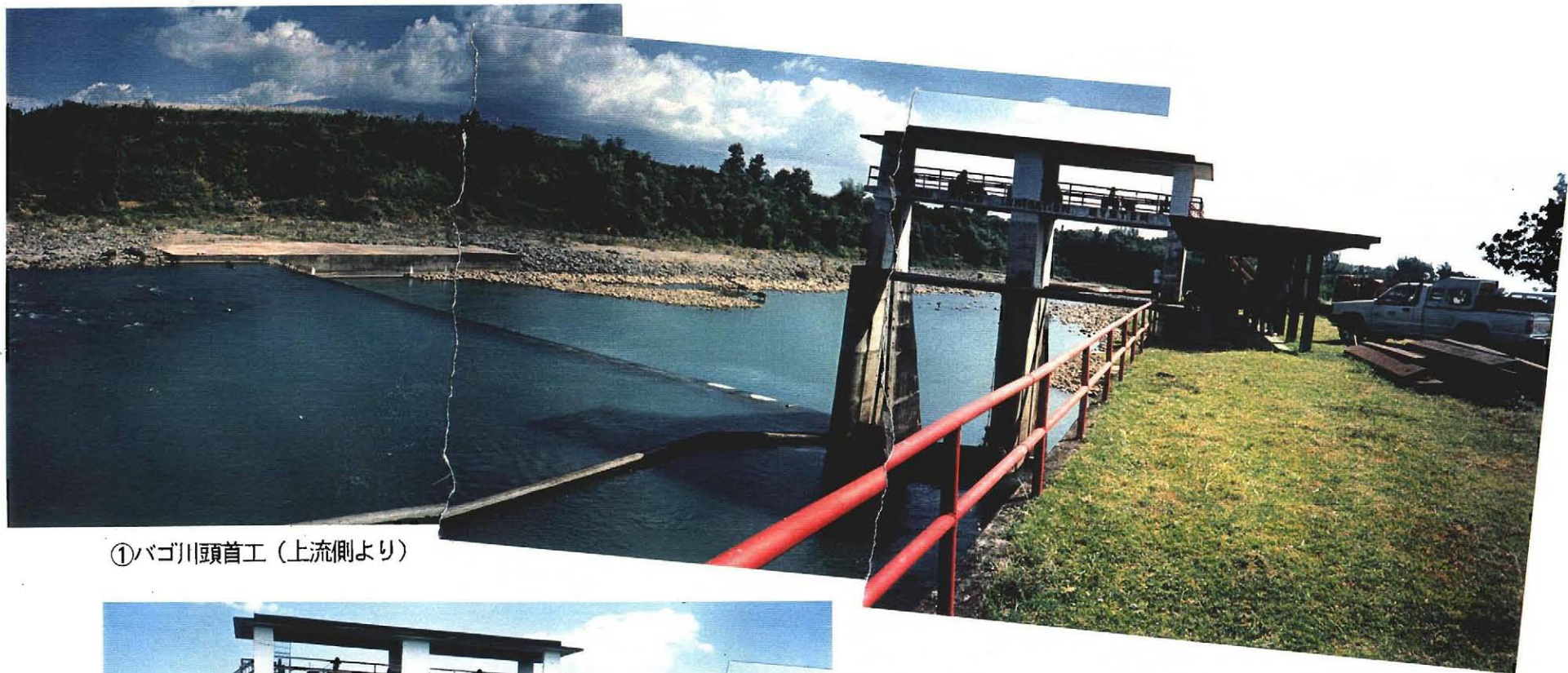
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①バゴ川頭首工（上流側より）

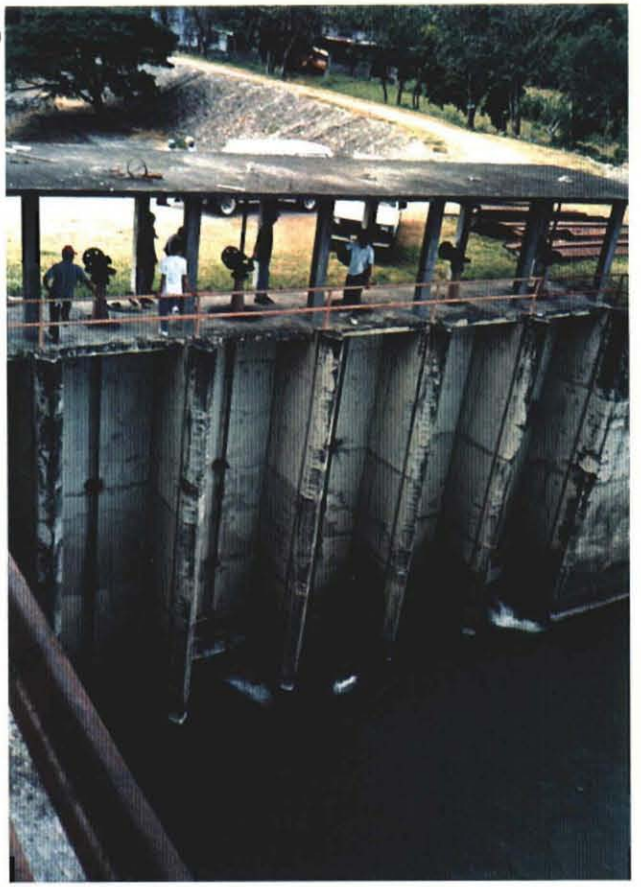


②バゴ川頭首工（下流側より）

③



④



⑤

③頭首工排砂ゲート

④取水工（前面）

⑤取水工（背面）

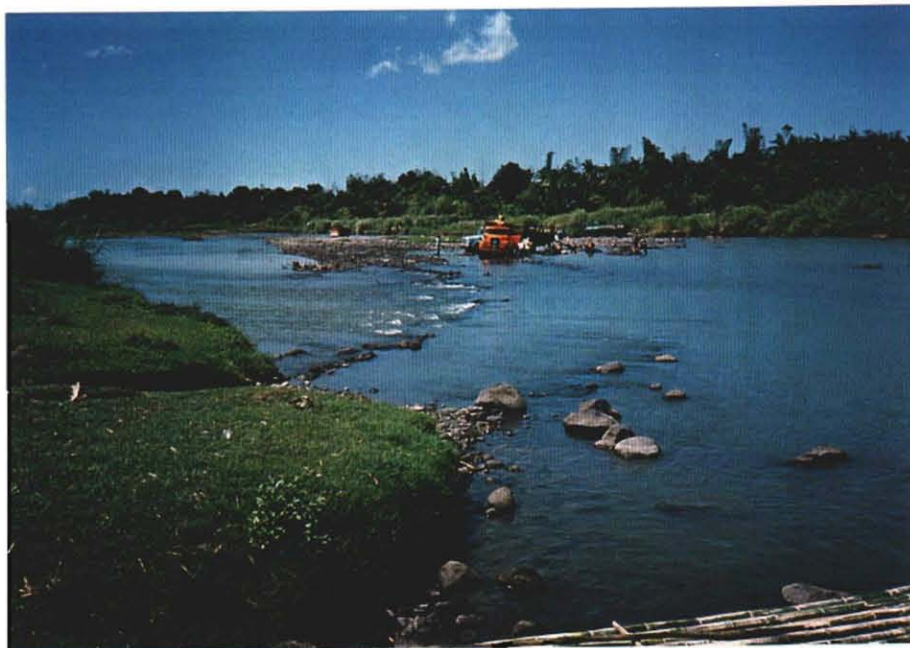
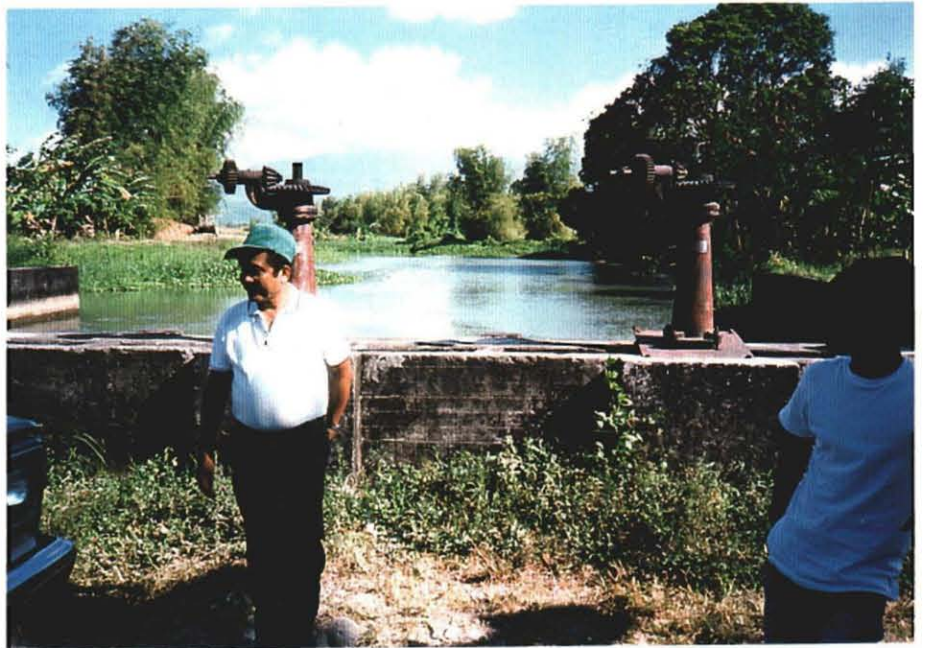
⑥  
幹線水路及び  
管理用道路





⑦幹線水路制水工

⑧  
幹線水路制水工



⑨幹線水路バゴ川  
渡河地点  
(サイフォン)



⑬作付状況  
(砂糖きび、稲)

⑭水路末端地域圃場  
(水田)



⑮水路末端圃場  
(水田)



⑩幹線水路  
(左岸側、渡河後)

⑪  
新設頭首工  
予定地点



⑫稲作付状況  
(台地は砂糖きび)





⑩Sum-ag Dam  
予定地点

⑪  
Sum-ag Dam  
予定地点



⑫Caburd Dam  
地点下流の状況

はじめに

本報告書は平成6年11月6日より11月15日の間、フィリッピン国ネグロス・オキシデンタル州バゴ川を中心に実施した「バゴ川灌漑施設補修・増強計画」に関する海外農業開発事業事前調査（現地調査）結果をとりまとめたものである。

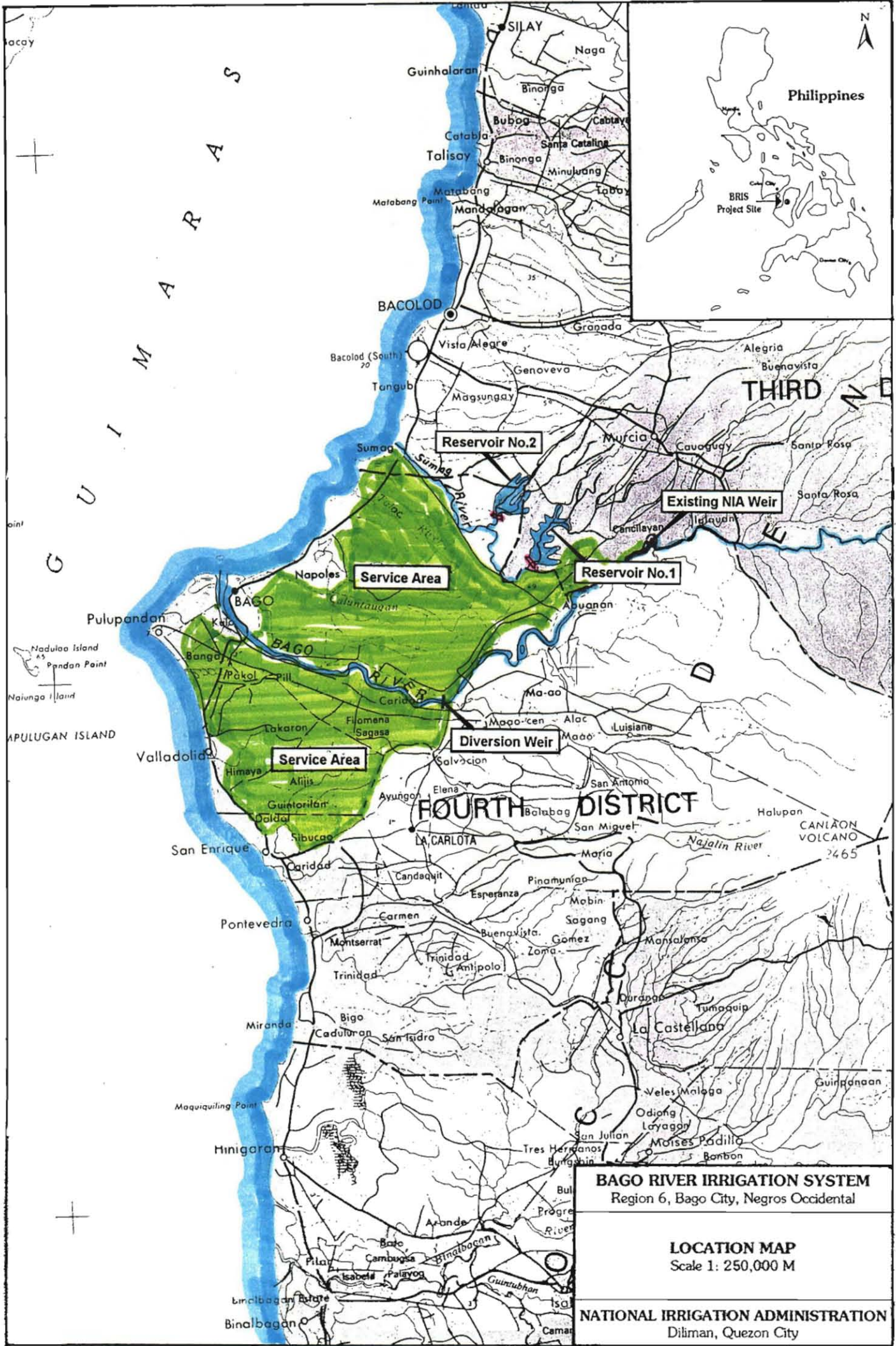
バゴ川はネグロス島西部のネグロス・オキシデンタル州北部山岳に源を発し、グイマラス海峡に面するバゴ市に注ぐ、島内有数の大河川であり（集水面積 800km<sup>2</sup>、延長 96km）、同河川の下流域に位置すバゴ川灌漑システム（The Bago River Irrigation System）は総面積約13,000haに及ぶ島内屈指の水田地帯である。関連農家数は4700戸といわれている。

1957年に着工し、10年の工期を要し完成した同灌漑システムは、バゴ川下流部の Cansilayan 附近に設けられた取水ダムにて取水された灌漑用水（最大18m<sup>3</sup>/s）を、総延長35kmの主水路と延長 142kmの支水路網によりバゴ川下流部左右岸の水田に配水するものである。（図-1参照）

しかし、完成後30年を経た現在、渇水期におけるバゴ川の水不足、水路への堆砂等により、最下流部 2,000ha、及びバゴ川左岸部の1部（1000ha）への供水は不能であり、主として天水による米作を行っている。

当該地域の標高30m～40m以上の丘陵は主として砂糖きび畑として利用され、フィリッピンでも有数の砂糖の産地として知られているが、米の供給は依然として不足しており、主としてパナイ島よりの移入に依存しており、数年前に餓死者を出した状態は根本的に解決されていない。

これらのことから、N I Aを初めとするフィリッピン政府は、これらの課題の解決に速効性のあるバゴ川灌漑システムの補修・増強計画について、我が国の支援を強く求めており、今回、A D C A調査団として現地調査、資料収集を行ったものである。



**BAGO RIVER IRRIGATION SYSTEM**  
 Region 6, Bago City, Negros Occidental

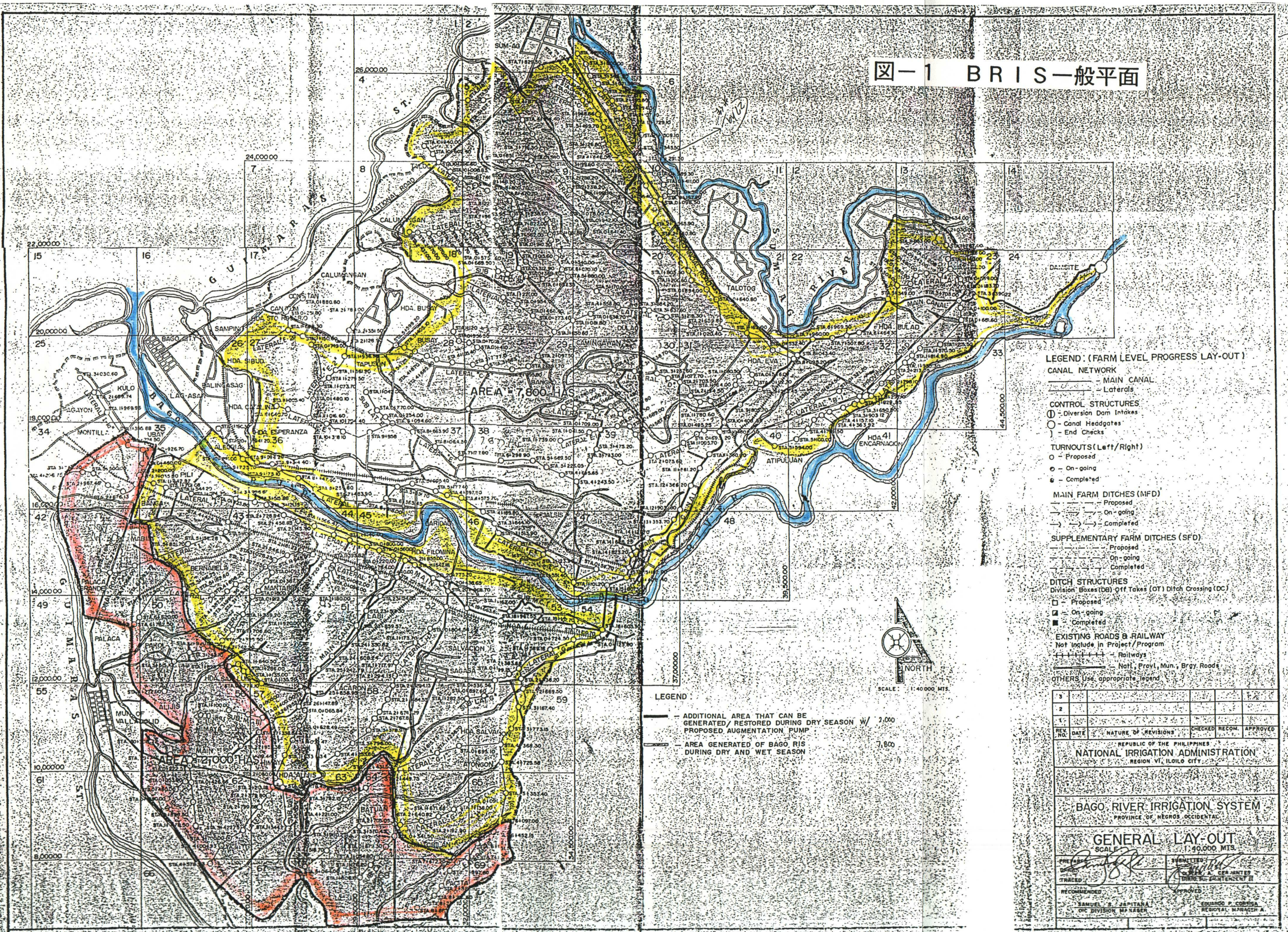
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**LOCATION MAP**  
 Scale 1: 250,000 M

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**NATIONAL IRRIGATION ADMINISTRATION**  
 Diliman, Quezon City

图-1 BRIS一般平面



**LEGEND: (FARM LEVEL PROGRESS LAY-OUT)**

**CANAL NETWORK**  
 ———— MAIN CANAL  
 - - - - - Laterals

**CONTROL STRUCTURES**  
 ⊕ - Diversion Dam Intakes  
 ○ - Canal Headgates  
 } - End Checks

**TURNOUTS (Left/Right)**  
 ○ - Proposed  
 ● - On-going  
 ● - Completed

**MAIN FARM DITCHES (MFD)**  
 - - - - - Proposed  
 - - - - - On-going  
 - - - - - Completed

**SUPPLEMENTARY FARM DITCHES (SFD)**  
 - - - - - Proposed  
 - - - - - On-going  
 - - - - - Completed

**DITCH STRUCTURES**  
 Division Boxes (Db) Off Takes (OT) Ditch Crossing (DC)  
 □ - Proposed  
 ■ - On-going  
 ■ - Completed

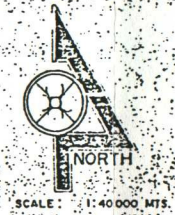
**EXISTING ROADS & RAILWAY**  
 Not include in Project/Program  
 - - - - - Railways  
 - - - - - Natl, Provl, Mun., Brgy. Roads

OTHERS Use appropriate legend

**LEGEND**

— (Yellow shaded area) — ADDITIONAL AREA THAT CAN BE GENERATED/RESTORED DURING DRY SEASON W/ PROPOSED AUGMENTATION PUMP 7,000

— (Red shaded area) — AREA GENERATED OF BAGO RIS DURING DRY AND WET SEASON 7,800



REV. NO.	DATE	NATURE OF REVISIONS	CHECKED	RECOM.	APPROVED
REPUBLIC OF THE PHILIPPINES <b>NATIONAL IRRIGATION ADMINISTRATION</b> REGION VI, ILOILO CITY					
<b>BAGO RIVER IRRIGATION SYSTEM</b> PROVINCE OF NEGROS OCCIDENTAL					
<b>GENERAL LAY-OUT</b> SCALE: 1:40,000 MTS.					
PREPARED BY	DRAWN BY		CHECKED BY	APPROVED BY	
TRACED	RECOMMENDED		APPROVED	APPROVED	
SAMUEL S. JAMITARA DIC DIVISION MANAGER			EDUARDO P. CORJISA REGIONAL MANAGER		

## 1. 調査団構成

入江章演 (株)アイ・エヌ・エー 顧問  
 山川精一 (株)アイ・エヌ・エー 海外部次長（現地参加）  
 Gerry E. Lopez (株)アイ・エヌ・エー マニラ事務所長代理（現地参加）  
 Clemeute Alanano I N A 計画部課長  
 Genavo V. Cacho JR I N A Region 6 技師

## 2. 調査日程

調査日程は平成6年11月6日より11月15日までであった。

詳細日程は以下の通りである。

日順	月 日	行 程	調 査 内 容
1	11/ 6 (日)	成 田→マニラ	移動
2	11/ 7 (月)	マニラ→イロイロ	N I A本部訪問, 移動
3	11/ 8 (火)	イロイロ→バコロド→バゴ	N I A Bago支所訪問, 現地調査
4	11/ 9 (水)	バコロド→イロイロ→マニラ	N I A Region 6 事務所訪問, 移動
5	11/10 (木)		N I A訪問, 資料収集
6	11/11 (金)		N I A訪問, 調査報告・ 打合せ
7	11/12 (土)		資料収集
8	11/13 (日)		資料整理
9	11/14 (月)		日本大使館訪問, 調査報告
10	11/15 (火)	マニラ→成 田	移動

### 3. 主要面談者

山内勝彦氏	在フィリピン日本大使館一等書記官
石田武士氏	在フィリピンN I A駐在専門家
MR. Almentia	N I A計画部 次長
MR. Alanano	N I A計画部 課長
MR. Salanio	N I A Region 6 技術部長
MR. Asencio	N I A Region 6 設計課長
MR. Cacho JR	N I A Region 6 Bago支所技師

### 4. 計画の概要

#### 4.1 計画の名称及び位置

名称：バゴ川灌漑施設補修・増強計画

位置：ネグロス・オキシデンタル州 バゴ市

#### 4.2 相手国担当機関

国家灌漑庁（N I A）

#### 4.3 計画の目的

本計画は、既設バゴ川灌漑システム（The Bago River Irrigation System）及び隣接する砂糖きび畑を対象として、灌漑可能区域を現状の 7,000haより当初計画の 9,000ha～10,000haに復旧し、米作、畑作、果樹及び養魚等農村経営の多角化及び安定化を計ることを目的として、渇水期補給貯水池の新設を主体として、流入土砂対策、水路復旧、農産物搬出用道路の整備等農業基盤諸施設の機能回復、増強を計るものである。

#### 4.4 バゴ川灌漑システム（B R I S）の現況と計画の背景

バゴ川灌漑システムはネグロス島・西部のネグロス・オキシデンタル州バゴ川下流域の水田約12,700haを対象に計画された大規模灌漑システムである。

工事は1957年に着工し、約10年の歳月で完工した。

竣工以来30年経過しているが、取水ダム、主水路ともに保守状況は良好で、現在、渇水期においても、7,000haの灌漑を行っている。（図－1参照）

しかし、当初計画（10,000～15,000ha）に対し、約 3,000haの非灌漑地区をかかえており、その原因としては次の事が考えられる。

- (1) 主水路が永年の堆砂等により、その通水量が減少している。
- (2) バゴ川本流の渇水期流量が計画時に比し小さかった。（表－1 参照）
- (3) 支水路の不備

これらの原因について、現地調査時N I A Rigion 6 の技師等と種々論議した。Rigion 6 によれば主として堆砂により主水路の能力が低下しているとしているが、バゴ川の濁度・主水路流速等より、かならずしもそれが主原因とは考えられなかった。

従って、現地においてN I Aに対し、本灌漑システムの設計図及び水文資料の提出を求め、これによって主原因の解明を行うつもりであったが、何分30年前の工事であり、水路及び水文についての全資料は滞在中に入手不能であった。

入手済流量資料によれば、バゴ川渇水期の流量は年平均の 1/3、又19年間の年平均流量を下廻る年数は16年に及んでいる。この事から当初対象面積が過大であったとも考えられる。（表－1 参照）

いずれにしても、N I Aは全対象灌漑地区への給水を強く要望しており、特に貯水池をもつことによる営農の安定化を計りたいとしている。

表一1 B R I S主水路流量資料 (STA 0+000)

(單位 m<sup>3</sup>/s)

年	1月	2月	3月	4月	5月	6月	7月	8月	9月	10月	11月	12月	合計
1991	15.4	6.8	2.4	-	10.5	11.4	18.0	13.5	17.1	19.7	18.4	17.2	150.4
1992	15.7	8.4	3.3	4.1	8.0	10.4	16.7	17.3	16.8	17.5	18.9	14.9	152.0
1993	11.6	13.6	15.1	4.5	5.4	14.7	18.2	18.2	18.5	18.1	16.1	17.9	171.9
1994	19.3	16.5	15.4	18.1	18.2	15.9	13.9	16.7	17.6	-	-	-	151.6



#### 4.5 補修・増強計画

本計画は既設バゴ川灌漑システムの灌漑可能面積 7,000haを当初計画に近い 10,000haに復旧し、ネグロス島には1ヶ所もない農業用貯水池を持つ事で農業経営の安定化を計る目的で、バゴ川下流部に隣接して流れるスマーグ川及びその支流に2つの貯水池を設ける。これにバゴ川豊水期の水を導水貯溜し、渇水期に主としてバゴ川右岸地区(4,800ha)の灌漑用水に当てる。

更に前記2つの貯水池によって生み出された右岸の余剰水と既設サイフォン附近に新設される頭首工第2(図一 参照)にて取水された用水(既設第1頭首工の残流域)を合せてバゴ川左岸地区(5,000ha)の灌漑用水に当てる。

新設される主な構造物の諸元は次の通りである。

##### (1) 第1ダム及び貯水池 (Sumag Dam)

###### 貯 水 池

流域面積	(km <sup>2</sup> )	46.79
常時満水位	(m)	EL. 40.00
低水位	(m)	EL. 36.00
全貯水量	(10 <sup>6</sup> m <sup>3</sup> )	6.38
有効貯水量	(10 <sup>6</sup> m <sup>3</sup> )	5.63

###### ダ ム

型 式	均一型	アースダム
高 さ	(m)	10.50
堤 頂 長	(m)	300
堤 体 積	(m <sup>3</sup> )	74,000
余 水 吐	ゲートなしシュート型式	

##### (2) 第2ダム及び貯水池 (Buluuan-Cabuva Dam)

###### 貯 水 池

流域面積	(km <sup>2</sup> )	17.64
常時満水位	(m)	EL. 30.00
低水位	(m)	EL. 22.00

全貯水量 (10<sup>6</sup> m<sup>3</sup>) 11.50

有効貯水量 (10<sup>6</sup> m<sup>3</sup>) 8.50

ダム

型式 均一型 アースダム

高さ (m) 18.00

堤頂長 (m) 460.00

堤体積 (m<sup>3</sup>) 260,000

余水吐 ゲートなしシュート型式

(3) 第2頭首工

ダム

型式 直線重力式コンクリート

高さ (m) 4

堤頂長 (m) 200

堤体積 (m<sup>3</sup>) 2,000

(4) 連絡水路 (既設主水路と新設貯水池を結ぶ水路)

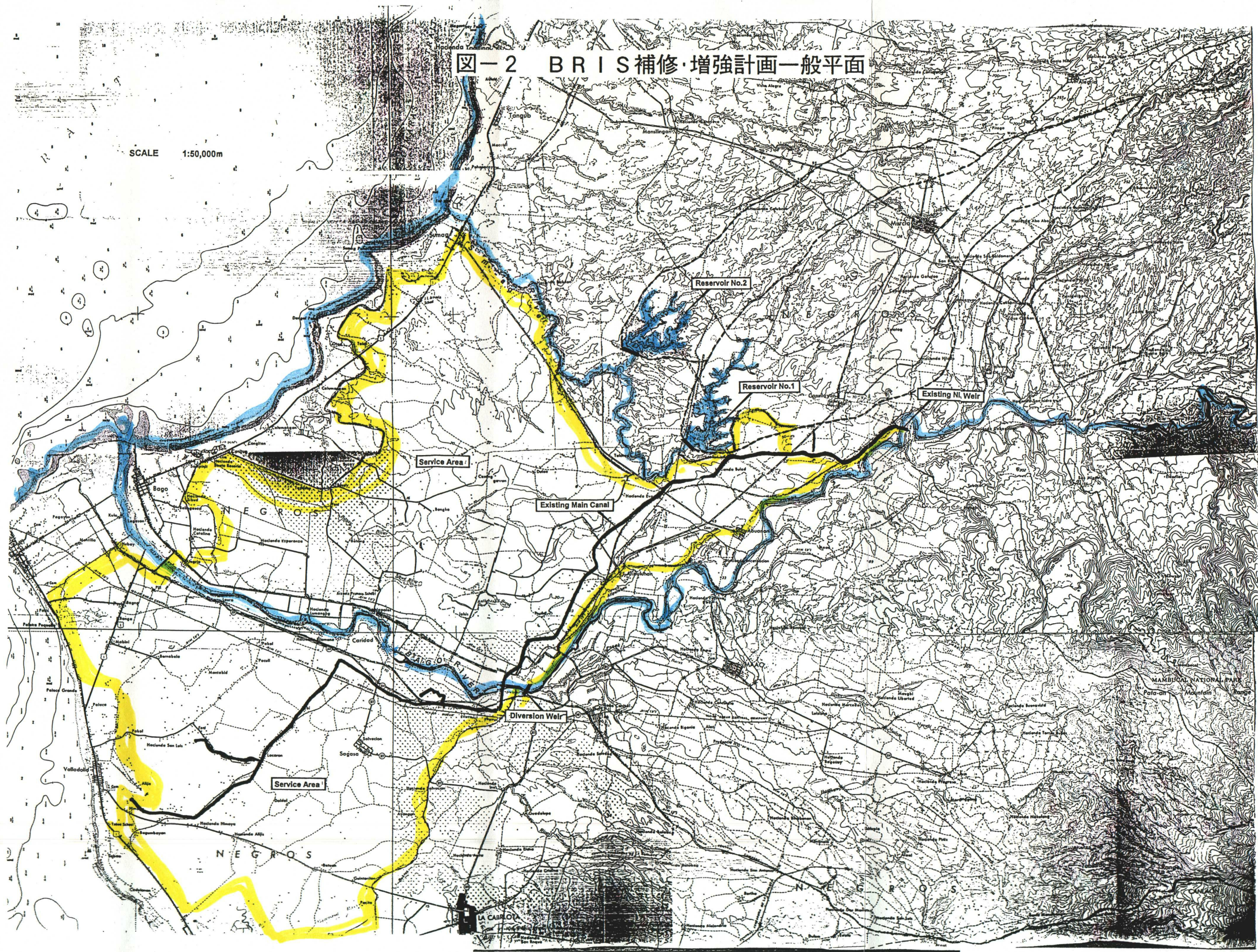
総延長 (km) 15

(5) 周辺整備道路

総延長 (km) 20

図-2 BRIS補修・増強計画一般平面

SCALE 1:50,000m



#### 4.6 推定建設工事費及び工事工程

4.5 に記述された新設構造物の建設費は約18億円と推定され、工事工程は基本設計、詳細設計を含み4ヶ年とした。

#### 4.7 維持管理

既設バゴ川灌漑システム（BRIS）は完成以来NIA Region 6 バゴ支所によって管理運営されている。

対象地域（12,700ha）は16地区に区分され、1992年における各地区の雨季、乾季における耕作状況および料金回収状況等に表-2に示す通りである。表-3は1992年の収入と費用を対比したものである。

NIA Region 6 の担当官によれば、平均的に年1.5カバン（50kg）/ha相当分の料金を徴収しているとの事であった。

本計画（バゴ川灌漑施設補修・補強計画）によって新設される各構造物（第1貯水池、第2貯水池、第2頭首工及び連絡水路）は引続きNIAによって維持管理される。

表一 2

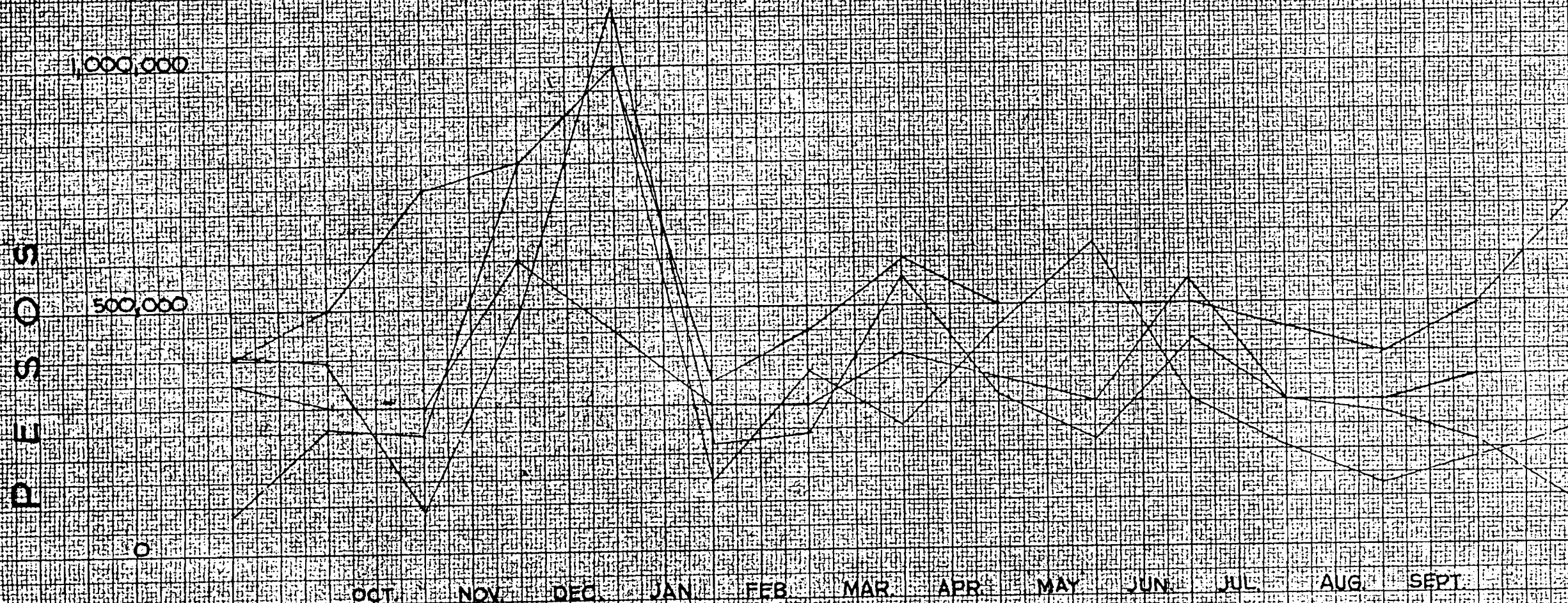
## COMPARATIVE DATA ON O&amp;M AND ISF EFFICIENCIES

1992

DIVISION/IA	O & M EFFICIENCIES										ISF EFFICIENCIES						
	SA (HAS)	WTD %WT	P.A W	(HAS) D	B.A W	(HAS) D	ICI	MAINT OF CANALS & STRUCTURES %	MEASURING DEVICE CONTROL GATE (%)	O & M EFF %	CURRENT ACCOUNT COLLECTIBLES (P)	COLLECTION (P)	CAGE (%)	BACK ACCOUNTS COLLECTIBLES (P)	COLLECTION (P)	RACE (%)	ISF EFF (%)
A ABUDAMATIP	680	5.35	680	48	459.94	426.34	32.88	16.43	0	49.3	588,200	363,186.70	61.74	896,400	50,574.40	5.64	47.7
B ABDUF	692	5.45	435	366	396.43	331.76	38.92	2.25	0	60.17	478,300	255,349.80	53.38	769,500	55,419.00	7.20	41.83
C ATIDU	590	4.64	400	357	290.80	266.94	3.74	16.43	0	48.7	369,800	177,836.70	48.10	542,300	18,290.00	3.37	36.9
D TABUNAN LAT C-10	640	5.04	607	535	549.62	377.84	34.78	14.6	0	48.94	597,200	177,651.10	29.75	1,333,000	22,829.43	1.71	22.74
E WMPA	930	7.32	784	745	775.70	695.86	4.42	16.43	0	57.85	971,800	306,286.98	31.52	2,043,500	29,694.08	1.45	24.00
F BUSCAD	916	7.21	750	613	657.42	461.79	35.44	16.43	0	51.87	722,300	421,089.80	58.30	914,500	70,534.8	7.71	45.68
G AMANA	735	5.79	725	609	634.75	652.75	4.57	10.76	0	52.33	863,400	237,040.58	27.45	2,027,300	32,324.74	1.60	20.98
H BUNASABALA	914	7.20	712	663	658.28	294.91	29.81	16.43	0	46.24	588,800	266,680.00	45.29	1,236,000	7,859.00	0.64	34.13
I MAN	863	6.80	450	403	464.92	397.85	48.00	10.76	0	53.76	368,000	316,281.05	55.83	830,900	44,987.18	5.41	43.22
J CASABAY	896	7.05	668	60	645.08	330.00	33.00	10.76	0	43.76	610,000	147,490.55	24.18	1,106,300	19,683.75	1.78	18.57
K GUINTOBATO	864	6.80	450	224	316.40	196.91	32.75	10.76	0	43.51	327,300	98,879.10	30.21	555,600	5,983.20	1.08	22.93
L SGADLAN	862	6.79	668	634	659.36	623.88	42.43	16.43	0	58.86	853,400	527,185.71	61.77	932,300	36,907.05	3.96	47.52
M STO PAMA	760	6.00	450	378	366.99	491.61	43.00	10.76	0	53.76	591,800	147,898.50	25.00	1,396,400	21,505.84	1.54	19.13
N PAMAPA	800	6.30	650	509	637.63	205.36	31.35	10.76	0	42.11	505,900	91,482.60	18.09	1,181,400	30,523.10	2.58	14.21
O PALABA	818	6.44	650	609	393.78	412.26	27.51	18.13	0	45.64	541,500	257,793.40	47.61	1,459,700	21,641.60	1.50	36.08
P VALSEN	740	5.82	600	366	502.27	361.39	38.70	10.76	0	49.46	558,700	117,655.30	21.06	1,289,000	2,209.50	0.95	16.04
TOTAL	12,700	100	9,723	8,093	8,409.37	6,525.45	35.93	14.25	0	50.14	9,736,400	3,909,789.87	40.15	18,493,400	480,866.05	2.60	30.76

表-3 COLLECTION VS EXPENSES CY 1992

COB (P 4,500,000.00)	300,000	600,000	1,450,000	300,000	800,000	400,000	350,000	300,000	550,000	300,000	300,000	350,000
COLL. TARGET (P 6,800,000.00)	750,000	800,000	1,000,000	350,000	450,000	600,000	500,000	500,000	400,000	450,000	400,000	500,000
DEM. EXPENSES P	88,300	496,300	1,140,800	228,500	241,200	357,300	311,600	224,900	428,400	300,000	271,500	216,800
COCC ACTUAL P	243,200	798,600	1,020,800	143,800	365,200	255,500	455,400	421,900	305,200	207,500	129,300	181,600



## 5. 収集資料リスト

本調査により現地で収集したB R I Sに関する基礎資料は以下のとおりである。

- (1) 計画地点1 : 50,000地形図 ..... 4 葉
- (2) 計画地点地質図 ..... 1 葉
- (3) B R I S計画一般図 ..... 1 葉
- (4) ネグロス島農業開発一般図 ( 1 : 200,000) ..... 2 葉
- (5) B R I S管理資料 (Comparative Data on O&M and ISF Efficiencies,  
1991年~1993年) ..... 3 葉
- (6) 第1頭首工 (既設) 設計図 ..... 5 葉
- (7) 月別雨量データ (第1頭首工・1991年1月~1994年9月)
- (8) B R I S主水路 (station (0+000)月別流量1991年1月~1994年9月)
- (9) La Gavanja観測所における月別蒸発量 (1980年~1994年7月)
- (10) Bago川 (C. A = 382km<sup>2</sup>) における推定月別平均流量 (1950年~1978年)

帰国後、入手した基礎資料は以下のとおりである。

- (1) 既設頭首工の流量資料 (1977年~1990年)
- (2) MA-AO観測所 (C. A 683 km<sup>2</sup>) の流量資料
- (3) La Gvanja の雨量資料
- (4) Bago川流域の土壌分類
- (5) 主水路設計図 ..... 13葉
- (6) ネグロスオキシデンタル州地質図 ( 1 : 250,000)

## 6. Appendix

6.1 ネグロス島概要

6.2 水文資料

6.3 土壌分類

6.4 計画地点地質図



## 6.1 ネグロス島概要

## **NEGROS ISLAND**

### **Geography**

Negros Island is composed of two provinces namely, Negros Occidental and Negros Oriental located in central Philippines lying between 122° to 124° east longitude and 9° to 11° north latitude. It is bounded on the north by the Visayan Sea, on the east by the Tanon Strait which separates it from Cebu, on the northwest by Guimaras Strait and on the south by the Sulu Sea. Negros Oriental occupies the southeastern section of the Island and is separated from Negros Occidental on the north and west by a chain of rugged mountains. The terrain consists mainly of rolling hills, a few plateaus, and mountain peaks with foothills extending up to the coast. On the other hand, Negros Occidental occupies the western portion of the Negros Island characterized largely by level plains and gently rolling slopes with mountainous portions of varying elevations.

Negros Island is composed of nine cities and 47 municipalities which are further subdivided into 1,205 barangays. It has a total land area of 13,328.4 sq km.

### **Climate**

Negros has a climate which varies in the two provinces comprising the Island. The climate of Negros Occidental falls under Type I characterized by two pronounced seasons - the dry season from late December to May for the northern part and from November to May for the southern part; and the wet season for the rest of the year. On the other hand, the climate of the whole eastern part of Negros Oriental falls under Type III with no pronounced maximum rainfall and a short dry season from one to three months. The other half of the province falls under the first type characterized by a distinct wet and dry season.

### **Population**

As of 1990, the Island of Negros has a population of 3,182,000. In the same year, the Island had a population density of 238.7 persons per square kilometer.

### **Fishing and Aquatic Resources**

Negros Island has an extensive coastal marine resources, making marine fishing one of the major livelihoods in the area. In 1982, Negros Island had a total production of 214,212.62 metric tons of fish. The Visayan Sea, Sulu Sea, Tanon Strait, Guimaras Strait and Panay Gulf provide rich fishing grounds for the whole

Island.

### **Mineral Resources**

The Island is rich in mineral resources. It has metallic deposits of gold, silver, copper, iron, titaniferous magnetite sands and molybdenum. Its copper deposits in Negros Occidental and Negros Oriental are the second and the fifth largest in the country, respectively. Nonmetallic mineral reserves include clay, gypsum, sand and gravel, cobbles and boulders, pebbles, quartz, rock phosphate, salt, lime, coral, guano, quicklime, silica sand, and cement.

### **Economic Activity**

#### *Agriculture*

Sugar is the primary agricultural crop and is considered the "lifeblood" of the Island. The Island has a total arable land of 633,178.48 ha planted to sugarcane, corn, coconut and palay, which are the principal agricultural products grown in the Island. Aside from agriculture which is considered as the major economic activity of the people in the Island, poultry and livestock production, as well as fish production, are other sources of livelihood for the citizenry.

#### *Establishments*

Based on the National Census and Statics Office (NCSO) Census of Establishments, the wholesale and retail trade industry had the most number of establishments at 17, 695 in 1978. The community, social, and personal services industry followed.

#### *Tourism*

Tourist attractions in the Island include several landmarks such as the Victorias Milling Company which is the biggest mill and refinery in the world. The Mambucal Summer Resort located on the slope of Mt. Canlaon and fine beaches like the Jara and Balulan beach which are all found in Negros Occidental. Tourist attractions in Negros Oriental include Siliman University, and the Canlaon and Cuernos de los Negros mountains which are considered highest in the Island. Complementing these are the Island's 140 hotels with 523 rooms.

### **Income Distribution**

Income distribution figures of the NCSO show that Negros Occidental had an average quarterly family income of P2,613 during the first quarter of 1983 compared to the regional quarterly income of P1,638. About 13.4% or 53,573 families subsist on quarterly incomes below P1,000. Majority of the families earn from P2,000 to P3,000 while only 16,814 families earn above P15,000.

In Negros Oriental about 67,360 families subsisted on quarterly incomes below P1,000. About 40,250 families earn from P1,000 to P1,999 while 4,166 families earn above P15,000.

## **Health**

The programs and projects of the sector, directed towards the improvement of the general health status of the people in the Island, achieved varying degrees of accomplishment.

The Primary Health Care Program focuses on providing essential health services nationwide. Communities in the Island were organized into committees/functional entities capable of attaining self-reliance in health. The Control of Diarrheal Disease Program was likewise launched to reduce morbidity and mortality due to diarrheal disease. In support of the program, Oresol has been distributed as a medium of control. The Malaria Eradication Program aims to eliminate the last reservoir of infective cases of malaria, maintain the gains previously achieved and prevent newly developing areas from becoming malarious.

Actual birth and death rates for Negros Oriental in 1982 stood at 18.52% and 3.5%, respectively, with a projected life expectancy of 61.2 years. For Negros Occidental, actual birth and death rates in 1982 stood at 14.2% and 5.06%, respectively, with a projected life expectancy of 61.8 years.

## **Agrarian Reform**

During the transition period, a total of 110,314 registered lease contracts were issued to 100,176 tenants covering an area of 93,338 ha.

A total of 14,882 Certificates of Land Transfer (CLTs) were issued to 9,250 tenant recipients working on an area of 12,628.4 ha. On the other hand, the number of Emancipation Patents (EPs) issued to 2,863 farmer-beneficiaries totalled 3,721 covering 3,561.3 ha.

## **Sugar Production**

Production of sugar mills in the Island indicate a fluctuating trend during the transition period. To cite an example, sugar produced in the province of Negros Occidental averaged 19.4 million piculs in 1978-83 while sugar production in the mills of Negros Oriental grew by a yearly average of 3% during the same year. The Philippine Sugar Commission (PHILSUCOM) desiring to improve sugar production in the Island, introduced several programs in this regard. Old and low-yielding varieties of sugarcane were replaced by high-yielding varieties. Tech-

River : Bago River

Location of Station : Ma-ao, Bago, Negros Occidental

Latitude : 10 deg 34' 30 "

Longitude : 123 deg 02' 00"

Drainage Area : 683.00 sq km

Mean Monthly Discharge in cu m/s													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1949	*****	*****	*****	*****	*****	*****	*****	*****	41.18	82.64	202.89	37.35	364.06
1950	23.31	14.55	19.17	12.00	15.20	29.05	41.73	16.81	121.22	52.00	110.52	45.67	501.23
1951	28.36	31.19	23.87	20.96	53.55	38.44	66.37	42.55	63.31	97.27	40.50	85.03	591.40
1952	21.10	28.10	15.46	11.30	30.83	52.30	123.38	61.48	133.28	223.67	73.72	72.18	846.80
1953	29.74	32.52	17.53	15.23	17.69	45.41	26.35	120.75	41.67	52.82	50.18	78.52	528.41
1954	23.84	21.63	32.34	18.47	45.60	28.13	52.33	43.12	89.38	34.89	70.34	78.29	538.36
1955	47.55	27.27	21.92	21.73	22.25	24.55	23.71	23.73	37.74	37.70	95.95	91.89	475.99
1956	50.40	19.16	20.61	57.61	50.94	39.06	79.64	78.49	77.05	54.40	44.12	105.91	677.39
1957	779.21	35.38	20.38	14.02	12.94	15.82	35.41	56.38	57.00	37.02	21.47	15.22	1,100.25
1958	15.64	14.60	13.42	14.32	15.31	*****	27.90	18.45	36.92	54.72	46.51	29.64	287.43
1959	22.07	15.87	16.48	15.29	17.39	*****	54.71	61.12	46.97	44.23	41.76	33.62	369.51
1960	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
1961	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
1962	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
1963	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
1964	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
1965	*****	28.20	27.52	18.90	14.37	38.03	65.55	57.18	60.15	64.95	28.16	34.36	437.37
1966	15.40	13.79	12.75	*****	76.21	*****	154.34	142.21	47.81	43.63	25.54	32.61	564.29
1967	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	0.00
1968	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	0.00
1969	*****	*****	7.47	21.66	*****	27.30	79.83	38.28	67.50	33.75	12.48	14.17	302.44
1970	6.36	*****	*****	*****	*****	*****	*****	*****	*****	66.47	52.15	21.07	146.05
1971	30.88	25.51	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	56.39
1972	*****	*****	*****	15.59	6.57	*****	*****	*****	*****	*****	35.38	31.66	89.20
1973	22.28	27.26	36.32	24.12	4.59	12.75	32.80	40.23	35.90	*****	*****	*****	236.25
1974	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	0.00
1975	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	0.00
1976	*****	*****	*****	*****	*****	*****	*****	*****	23.38	14.47	8.90	6.94	53.69
1977	7.62	4.30	0.50	0.31	5.26	10.55	72.52	185.80	289.47	19.34	10.58	5.72	611.97
1978	40.31	5.37	2.26	2.14	3.61	8.37	6.04	4.50	4.83	37.22	11.17	6.22	132.04
1979	1.90	2.17	2.10	2.10	7.45	6.49	*****	*****	*****	*****	*****	*****	22.21
Min	1.90	2.17	0.50	0.31	3.61	6.49	6.04	4.50	4.83	14.47	8.90	5.72	
Mean	68.59	26.23	21.41	21.42	31.13	34.10	56.12	55.41	73.54	74.71	78.85	67.78	
Max	779.21	35.38	36.32	57.61	76.21	52.30	154.34	185.80	289.47	223.67	202.89	105.91	
S.D.	264.40	7.17	5.11	15.13	16.68	11.89	33.31	33.06	35.05	59.73	54.28	29.06	
N	17	17	17	17	17	14	16	16	18	18	19	19	

Note : \*\*\*\*\* indicates missing data, not included in calculation of statistical parameters

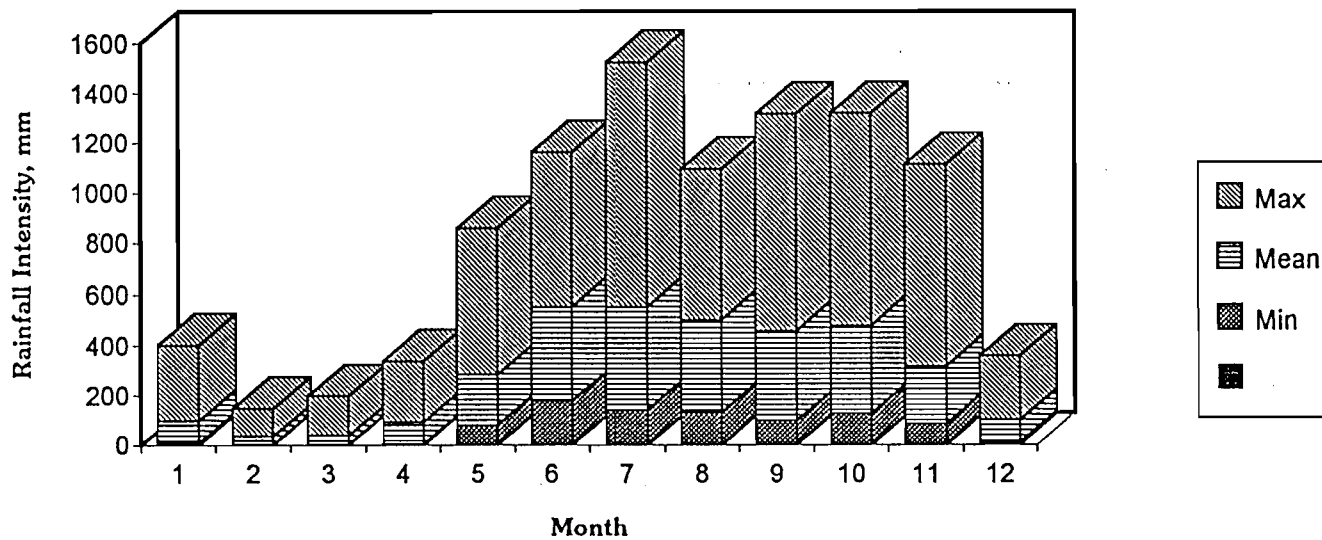
nical assistance on all aspects of sugarcane production were likewise provided to sugarcane planters. For proper and efficient use of fertilizers, soil samples have been collected and analyzed to serve sugarcane planters.

### **Industry**

Although the Island is predominantly agricultural and sugar production has always been considered as the prime mover of the Island's economy, the government's efforts are also geared towards the development of the cottage, small and medium industries. Appropriate production technology, techniques and processes, liberalized credit schemes, managerial and technical services are being provided to spur the development and promotion of these industries.

## 6. 2 水 文 資 料

Monthly Rainfall, La Granja Exp. Station, Negros Occ. (1967-1991)





## 6.3 土壤分類

**TABLE V-8**  
**SLOPE COMPLEX CATEGORIES, CHARACTERISTICS AND AREA COVERAGE**  
**BAGO BINALBAGAN BASINS**

Slope Category	Description	Area (Sq. Km.)	Percentage (%)
1	Include all level or flat to nearly level lands with slopes ranging from 0 to 3 per cent. Areas belonging to this category are the most suitable for irrigation because of their flat terrain. Depending on soil physical condition, 3 per cent is the maximum slope if the land is to be used for lowland rice production.	2,402.0	53.1
2.	Consist of gently sloping and gently undulating lands with slopes ranging from 3 to 8 per cent. Gently sloping lands are suitable for irrigation but require slight terrain modification in terms of contouring or terracing. Depending on soil and climatic condition in the area, 8 per cent is about the maximum slope for upland crop production that will require more complex and expensive soil conservation practices.	269.0	5.9
3.	Consist of moderately sloping and moderately undulating lands with slopes ranging from 8 to 15 per cent. Due to terrain restriction, irrigation for purposes of lowland rice production will not be feasible. Intensive soil conservation measures are necessary to keep the soil in place when cultivated.	332.0	7.3
4.	Include steeply sloping, rolling and undulating lands between 15 to 25 percent. On these lands, cultivated crops can not be produced continuously over an extended period of time. Tree crops however can be grown.	366.0	8.1
5.	Include those that are steeply sloping to hilly and mountainous terrain, with slope greater than 25 per cent. This slope category is not suited to any type of cultivated crops and should be left under forest cover.	1,157.0	25.6
TOTAL		4,526.0	100.0

### B.3 Geology

The volcanic regions of the northwestern part, the alluvial fans in the western central plain, and the undulating and rolling lands which include Mt. Canlaon and Mt. Mandalagan are geologically young.

The various geologic formations in the basins are shown in Figure V-B-2. Their corresponding areas are presented on Table V-9.

**TABLE V-9**  
**GEOLOGIC FORMATIONS, CHARACTERISTICS AND AREA COVERAGE**  
**BAGO-BINALBAGAN BASINS**

Symbol	Description	Area (Sq. Km.)	Percentage (%)
R	A. Sedimentary and Metamorphic Rocks (Recent) Coastal and river deposits, sheetwash of mud, clay, silt, sand, gravel volcanic ejecta, organic remains.	755.0	16.7

(Source: Framework Plan for Bago-Binalbagan Basin  
March 1983, by NWRC.)

N <sub>2</sub> S	(Middle to Upper Miocene) Conglomerates, sandstone, calcareous and carbonaceous shale, impure limestone and coal beds.	164.00	3.6
N <sub>1</sub> L	(Early to middle miocene) Marly to coralline limestone.	20.00	0.4
	B. Igneous Rocks		
N <sub>3</sub> =Q <sub>1</sub> L	(Pliocene to Pleistocene) Limestone, conglomeratic marly, sandy, locally with pelecypods, gastropods, coral heads, coral fingers and macrofossils.	350.0	7.7
	C. Volcanic Rocks		
Q <sub>AV</sub>	(Pleistocene to Recent) Andesite lava and breccia flow and overlying poorly compacted ash to boulder deposits. Mt. Kanlaon active volcano.	219.0	4.8
Q <sub>VP</sub>	(Pleistocene) Re-worked volcanic debris, mud and ash flow, tuff, river deposits at lower elevations; agglomerate, breccia, massive andesite at higher elevations.	2,299.0	50.8
Q <sub>V</sub>	(Pliocene to Recent) Andesite lava and breccia flow, intercalated tuff and poorly compacted ash boulder deposit.	595.0	13.2
N <sub>1V</sub>	(Early to middle miocene) andesite lava and breccia flows.	50.0	1.1
N <sub>1s</sub>	(Late oligocene to Early miocene) Volcanic conglomerate, graywacks, calcareous and tuffaceous fine sandstone, siltstone, claystone, mudstone, shale, sandy limestone and intercalated volcanics.	74.0	1.6
TOTAL		4,526.0	100.0

#### B.4 Soils and Capabilities

##### B.4.1 soil classification

Soils in the basin were classified in order to determine the suitability of land for agriculture.

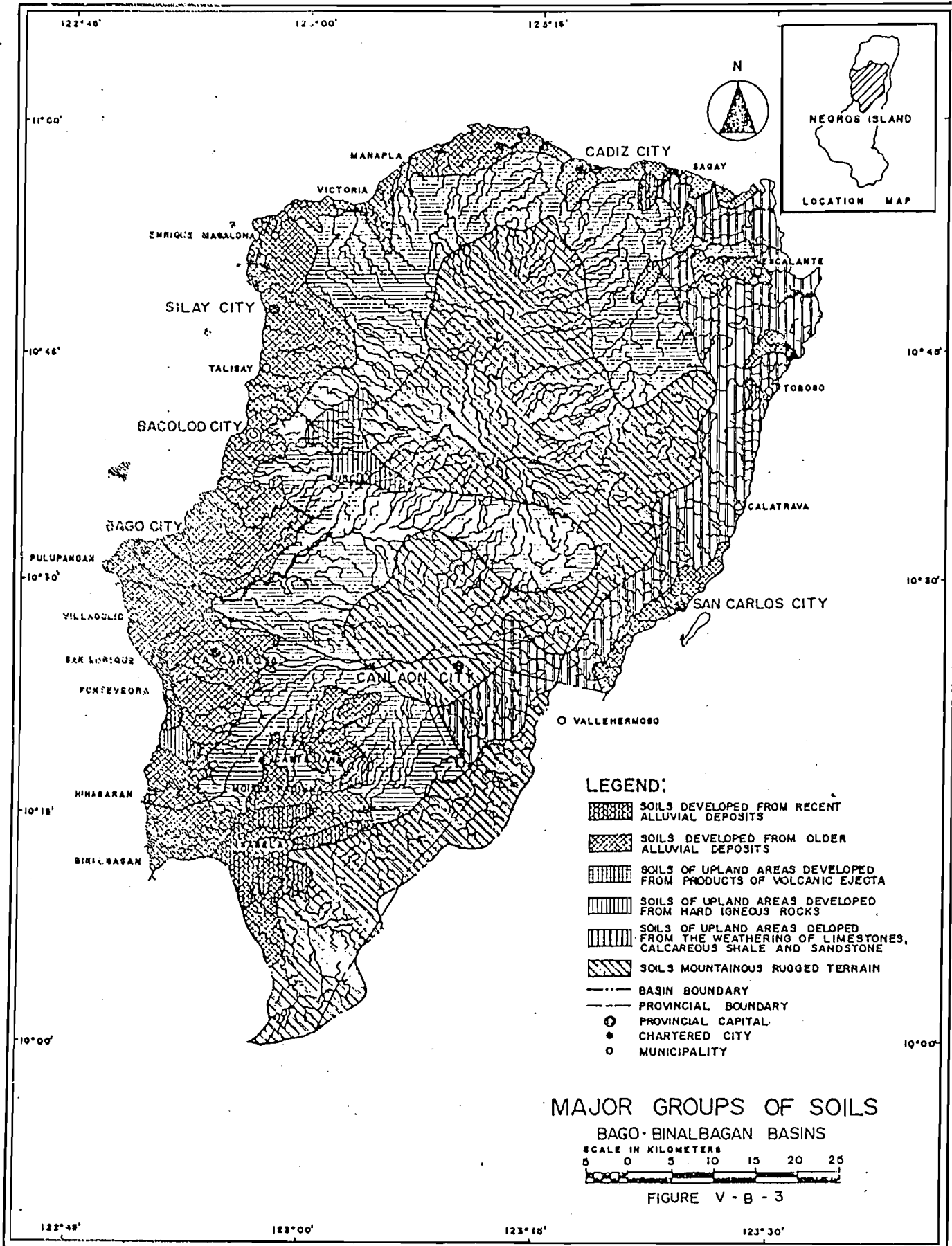
Classifications were primarily based on the origin, profile, texture, relief, and drainage characteristics of the soil.

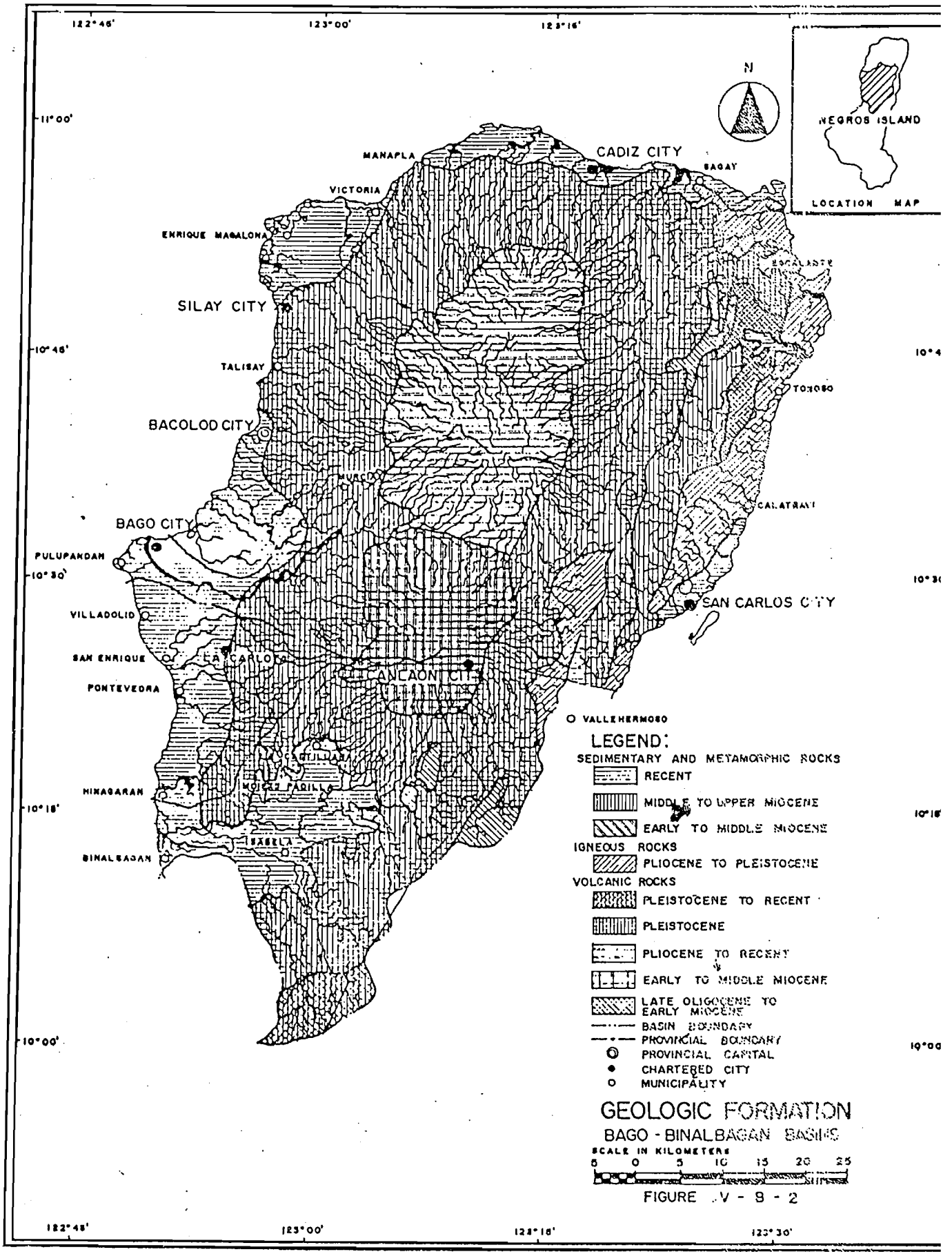
About 24 per cent of the basin's soils are classified as alluvial, while upland soils constitute some 42 per cent. More than one-third of the basin soils include mountainous and rugged terrain and have not been classified due to terrain restrictions.

Soil groups identified in the basins with the areal extent are presented in Table V-10 and Figure V-B-3.

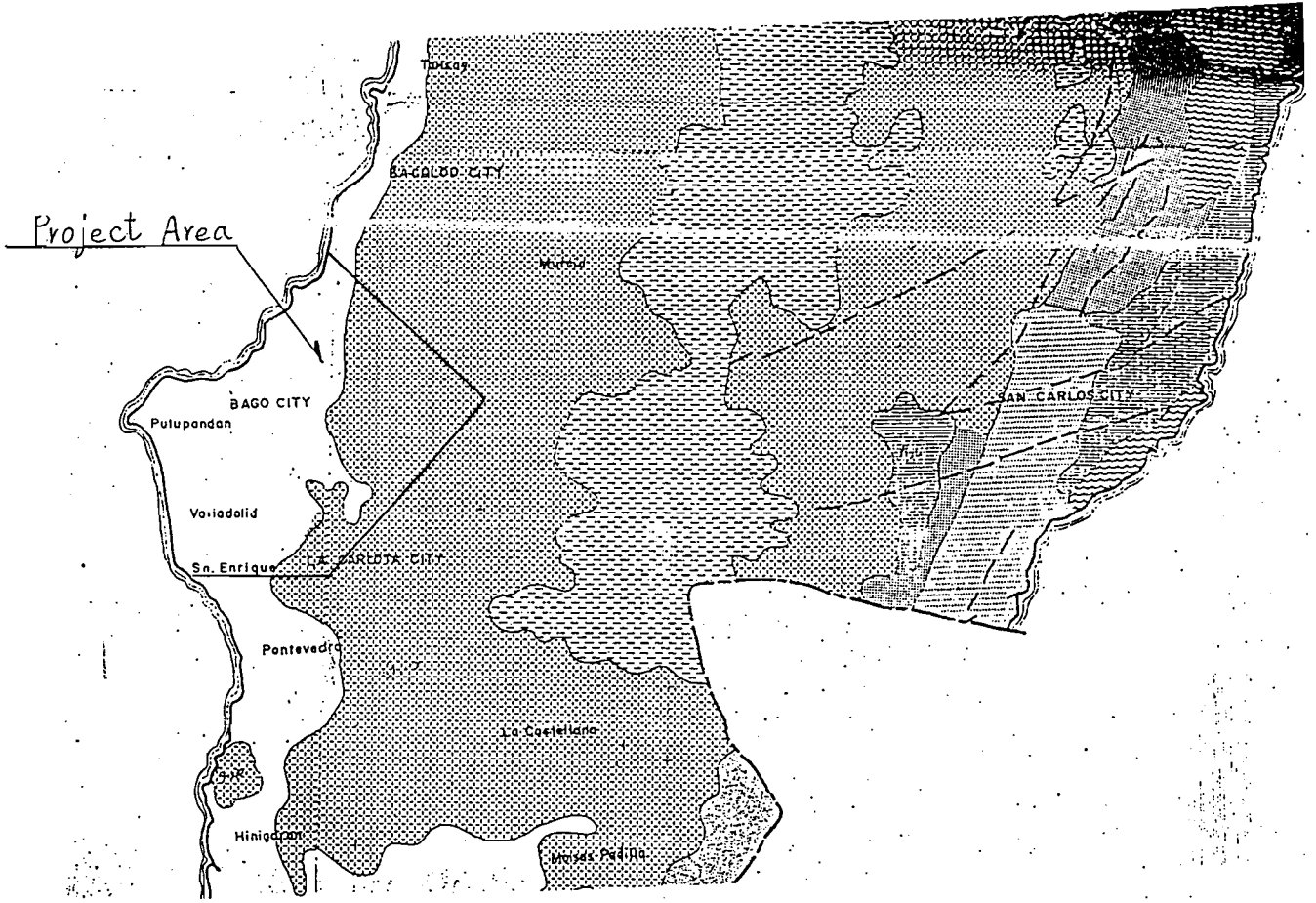
**TABLE V-10**  
**MAJOR GROUP OF SOILS, CHARACTERISTICS AND AREA COVERAGE**  
**BAGO-BINALBAGAN BASINS**

Class	Description	Area (Sq. Km.)	Percentage (%)
a	The soils under this class were developed from recent alluvial deposits. They have medium to coarse texture from A down to the C horizon. The relief is generally level or nearly so. Drainage condition is good to partly excessive. Permeability is very rapid to moderately rapid.	93.0	2.1





#### 6. 4 計画地点地質図



EXPLANATION

LEGEND :

AGE

	- PLEISTOCENE TO RECENT
	- PLIOCENE TO RECENT
	- PLIOCENE TO RECENT
	- PLIOCENE TO PLEISTOCENE
	- PLIOCENE TO PLEISTOCENE
	- MIDDLE MIOCENE TO PLIOCENE
	- MIDDLE MIOCENE TO PLIOCENE
	- LATE OLIGOCENE TO MIDDLE MIOCENE
	- OLIGOCENE TO MIDDLE MIOCENE
	- LATE MIOCENE TO PLIOCENE
	- OLIGOCENE TO MIDDLE MIOCENE
	- LATE PALEOCENE
	- CRETACEOUS TO PALEOCENE
	- CRETACEOUS TO PALEOCENE
	- Pattern denotes limestone bodies on the symbol assigned to sedimentary rock of the same age.

LITHOLOGY

- Unconsolidated talus, sheetwash, valley fill, floodplain and coastal deposits of clay, silts, sands, gravels, boulders and of variable thickness, length and width. Up to 30m. thick.
- Dominantly pyroclastic deposits, partly rework by river and sea water. Includes loose volcanic ash, tuff, agglomerate, siltstone, mudstone, conglomerate, minor flows and dikes. Up to 500 m.
- Andesite and basalt lava, breccia, agglomerate and ash flows which occupy volcanic cones. Generally fairly to der volcanic cones. Up to 1,000 m.
- Coralline to marly limestone with conglomerate and sandy facies. Concentrations of pelecypod gastropods, coral coral heads, and other megafossils occur. Up to 500 m.
- Poor to fair cemented claystone, mudstone, shale, siltstone, sandstone, conglomerate, boulder deposits, tuffs and Compositus is dominantly volcanic.
- Well bedded to massive, coralline and fossiliferous limestone with lenses of marl and calcarenite. It is fairly ind. to crystallized.
- Fair cemented shale, siltstone, sandstone, local conglomerate, partly calcareous, tuffaceous and carbonaceous a minor impure limestone, tuff and coal beds.
- Thickly bedded to massive coralline limestone with sandy and marly facies.
- hard cemented, partly calcareous and tuffaceous mudstone, claystone, shale, siltstone, conglomerate, sand, limestone, intercalated lava, breccia and agglomerate flow, pyroclastic, dikes and sills.
- Andesite and basalt lava, breccia, agglomerate and ash flows and pyroclastics.
- Dacite, andesite, basalt lava, breccia, agglomerate and ash flow and pyroclastics.
- Quartz diorite and gabbro pluton, intrusive on Paleocene and older rocks in Southwestern Negros.
- Partly metamorphosed dacite, andesite and basalt flows (V) agglomerates and tuffs (P) and intercalated partly metamorphosed sedimentary rocks.

GEOLOGIC SYMBOLS

- High angle fault. Dashed where inferred, indicate strike-slip movement.
- Anticlinal axis with plunge.
- Synclinal axis with plunge.

GEOLOGIC MAP  
PROVINCE OF NEGROS OCCIDENTAL

