Table 8.2 Future Agricultural GVA in the Basin (2005)

Item	Production (10^3 ton)	Farmgate Price at 1972 Constant Price (₱/kg)	GVA Ratio (10^3 ton)	GVA at 1972 Constant Price (10^6₱)
	(1)	(2)	(3)	(1)x(2)x(3)
I. Crops				
1. Lowland				
1) Paddy Field (Irrigated)				
- Palay	1,996	0.62	0.7547	934
- Corn and others	117	0.53	0.8372	52
				986
2) Corn Field (Rainfed)				
- Corn	384	0.53	0.8372	170
- Peanut	30	1.33	0.9800	39
- Vegetables	26	0.64	0.9060	15
- Beans	1.5	1.75	0.8507	2
				226
3) Other Annual Cropland (Rainfed)				
- Tobacco	13	1.77	0.9341	21
- Sugar Cane	600	0.05	0.8013	24
- Root Crops	34	0.16	0.8249	4
				49
2. Upland				
1) Permanent Cropland				
- Fruits & Nuts	400	0.35	0.8906	125
- Coffee	5	3.54	0.9516	17
- Coconuts	21	0.45	0.8129	8
- Others	8	0.80	0.9663	6
				156
Crop Total				1,417
II. Livestock*				
1) Carabao	110	730.21	0.6750	54
2) Cattle	114	612.13	0.5687	40
3) Hog	484	134.66	0.4757	31
4) Goat	78	27.95	0.6750	1
5) Chicken & Duck	24,562	4.21	0.3969	41
6) Egg	21.6	4.52	0.7432	73
7) Milk	15,860	1.00	0.9980	16
Livestock Total				256
III. Fishery	3.7	7.46	0.6078	17
IV. Forestry*	715	248.60	0.8270	147
Total				1,837

Note : * Units of production and price are as follows:

	Production	Price
Carabao, Cattle, Hog, Goat, Chicken & Poultry	10^3 head	₱/head
Egg	10^3 ton	₱/kg
Milk	10^3 ℓ	₱/ℓ
Forestry	10^3 m^3	₱/m^3

Source : NEDA National Account Staff

Table 8.3 Monthly Labor Requirement for Agriculture (2005)

(Unit: 10^3 man-days)

Item	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
I. Crop Production													
1. Lowland													
1) Paddy Field (Irrigated)	4,500	2,500	800	5,300	4,900	6,400	5,200	1,400	2,800	5,100	3,800	3,700	46,400
2) Corn Field (Rainfed)													
- Corn	1,500	500	500	2,100	3,300	1,500	500	500	1,800	1,800	300	1,600	15,900
- Peanut	300	140	140	450	450	-	-	-	-	-	110	350	1,940
- Vegetables	70	40	40	90	90	-	-	-	-	-	10	70	410
- Beans	20	10	10	20	20	-	-	-	-	-	10	20	110
(Total)	1,890	690	690	2,660	3,860	1,500	500	500	1,800	1,800	430	2,040	18,360
3) Other Annual Cropland													
- Tobacco	-	-	-	-	60	430	110	140	330	330	-	-	1,400
- Sugar cane	60	60	60	60	60	60	160	130	140	130	30	50	1,000
- Beet crops	20	10	10	40	30	90	30	10	10	50	40	80	420
(Total)	80	70	70	100	150	580	300	280	480	510	70	130	2,820
2. Upland													
1) Permanent Cropland													
- Fruits & Nuts	500	700	900	900	900	200	200	200	200	200	200	200	5,300
- Coffee	30	30	30	30	30	20	20	20	20	10	10	30	280
- Coconuts	80	80	80	80	80	80	80	80	80	80	80	80	960
- Others	40	40	40	40	40	40	40	40	40	40	40	40	480
(Total)	650	850	1,050	1,050	1,050	340	340	340	340	330	330	350	7,020
(Crops Total)	7,120	4,110	2,610	9,110	9,960	8,820	6,340	2,520	5,420	7,740	4,630	6,220	74,600
II. Livestock Production	300	300	300	300	300	300	300	300	300	300	300	300	3,600
III. Fishery Production	240	240	240	240	240	240	240	240	240	240	240	240	2,880
IV. Forestry Production	150	150	150	150	150	150	150	150	150	150	150	150	1,800
V. Total Labor Requirement (I, II, III & IV)	7,810	4,800	3,300	9,800	10,650	9,510	7,030	3,210	6,110	8,430	5,320	6,910	82,880
VI. Workable Days	11,680	11,680	11,680	11,680	11,680	11,680	11,680	11,680	11,680	11,680	11,680	11,680	140,160
VII. Balance (VI - V)	3,870	6,880	8,380	1,880	1,030	2,170	4,650	8,470	5,570	3,250	6,360	4,770	57,280

Note: Yearly workable days (YW) = Available laborer* x (365 x 80%)
= 480 x 10^3 x 292
≒ 140,160 x 10^3 man-day/year

Monthly workable days (MW) = YW x 1/12
= 140,160 x 10^3 x 1/12
≒ 11,680 x 10^3 man-day/month

* Available laborer = Rp x Ra x Rf
= 2,261 x 10^3 x 0.532 x 0.4
≒ 480 x 10^3

where, Rp: Rural population in the year of 2005 (2,261 x 10^3)
Ra: Ratio of age distribution between 15 and 59 (0.532)
Rf: Ratio of available laborer for agriculture (0.4)

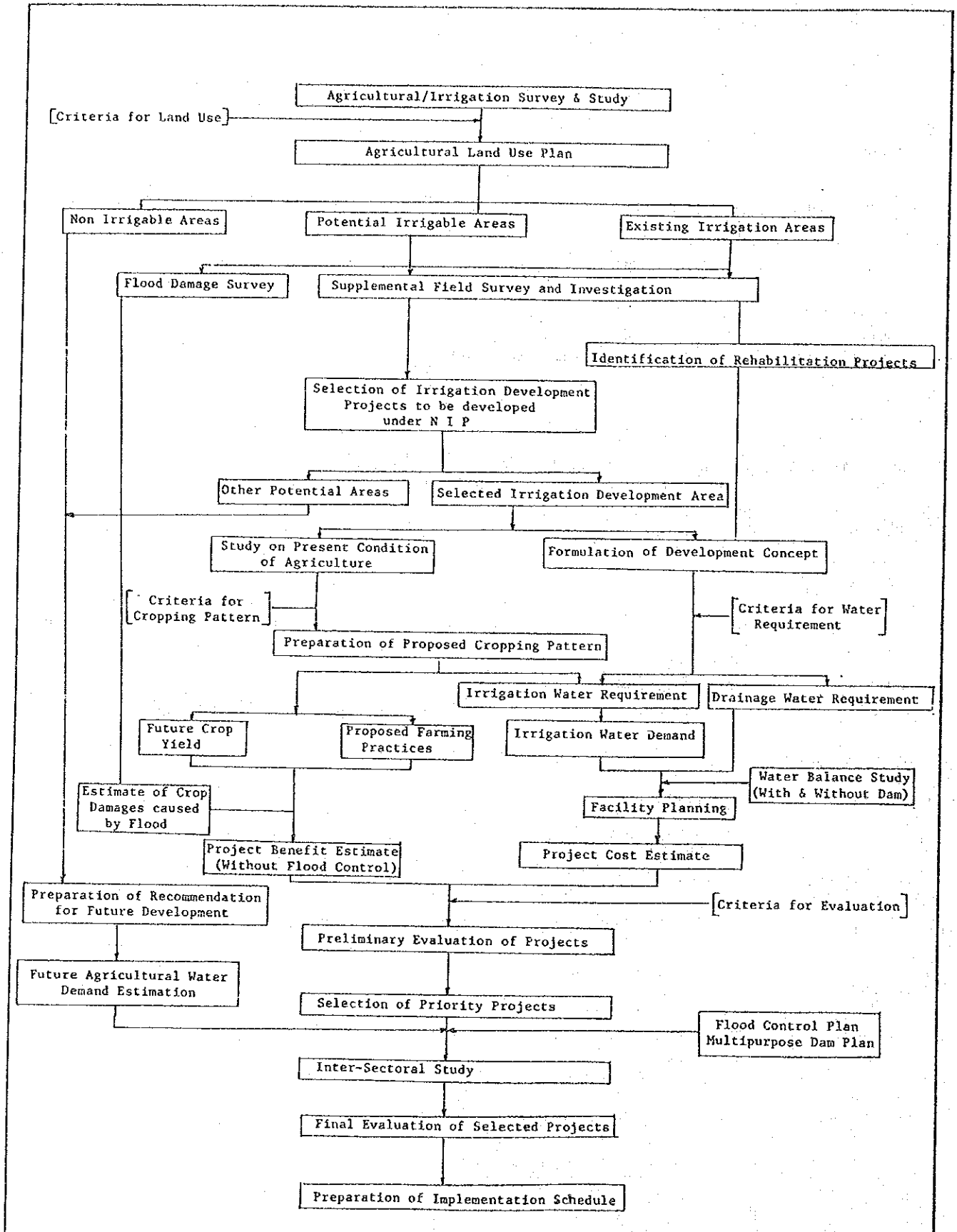


Fig. 1.1 WORK FLOW FOR AGRICULTURAL DEVELOPMENT PLAN

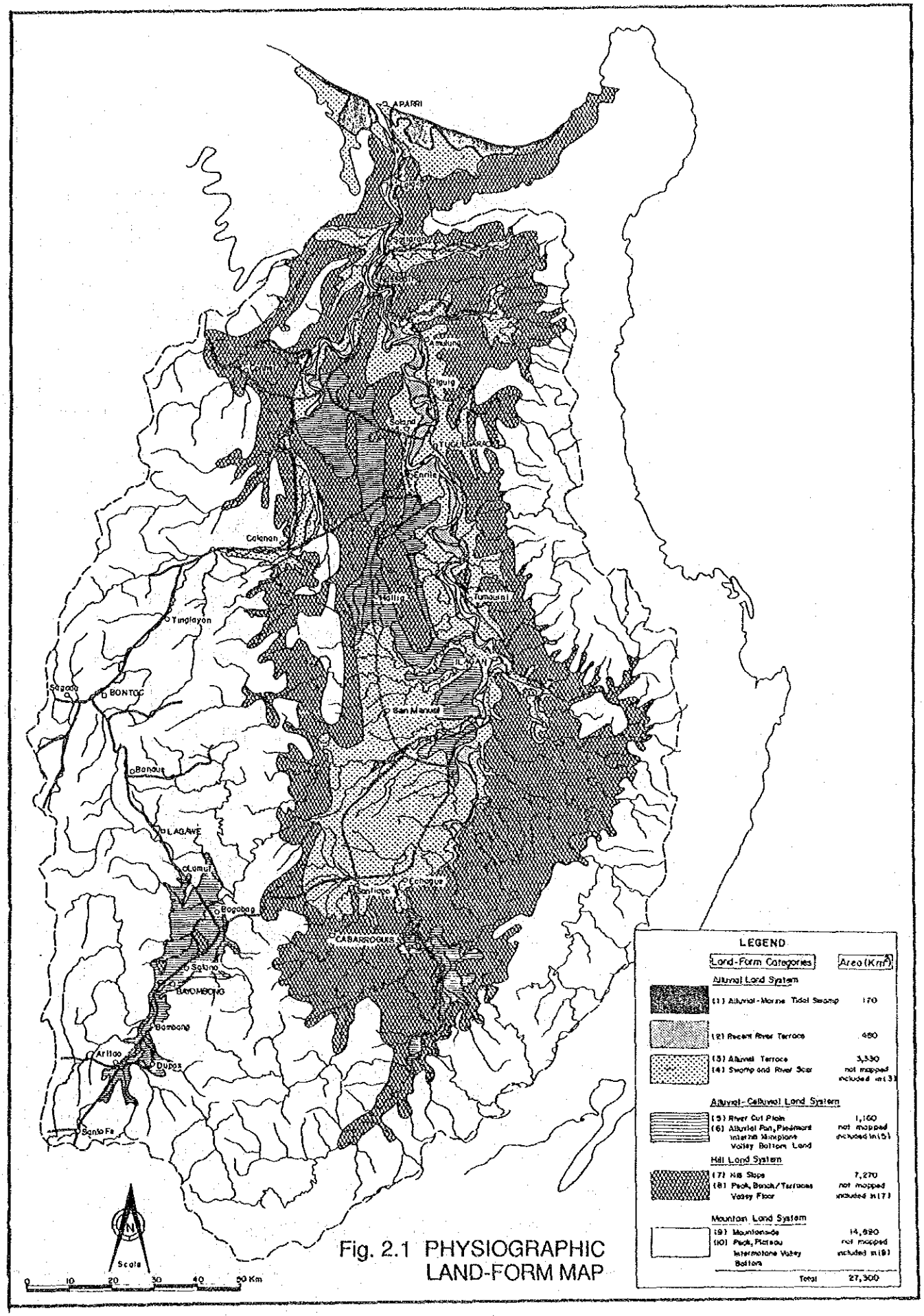


Fig. 2.1 PHYSIOGRAPHIC LAND-FORM MAP

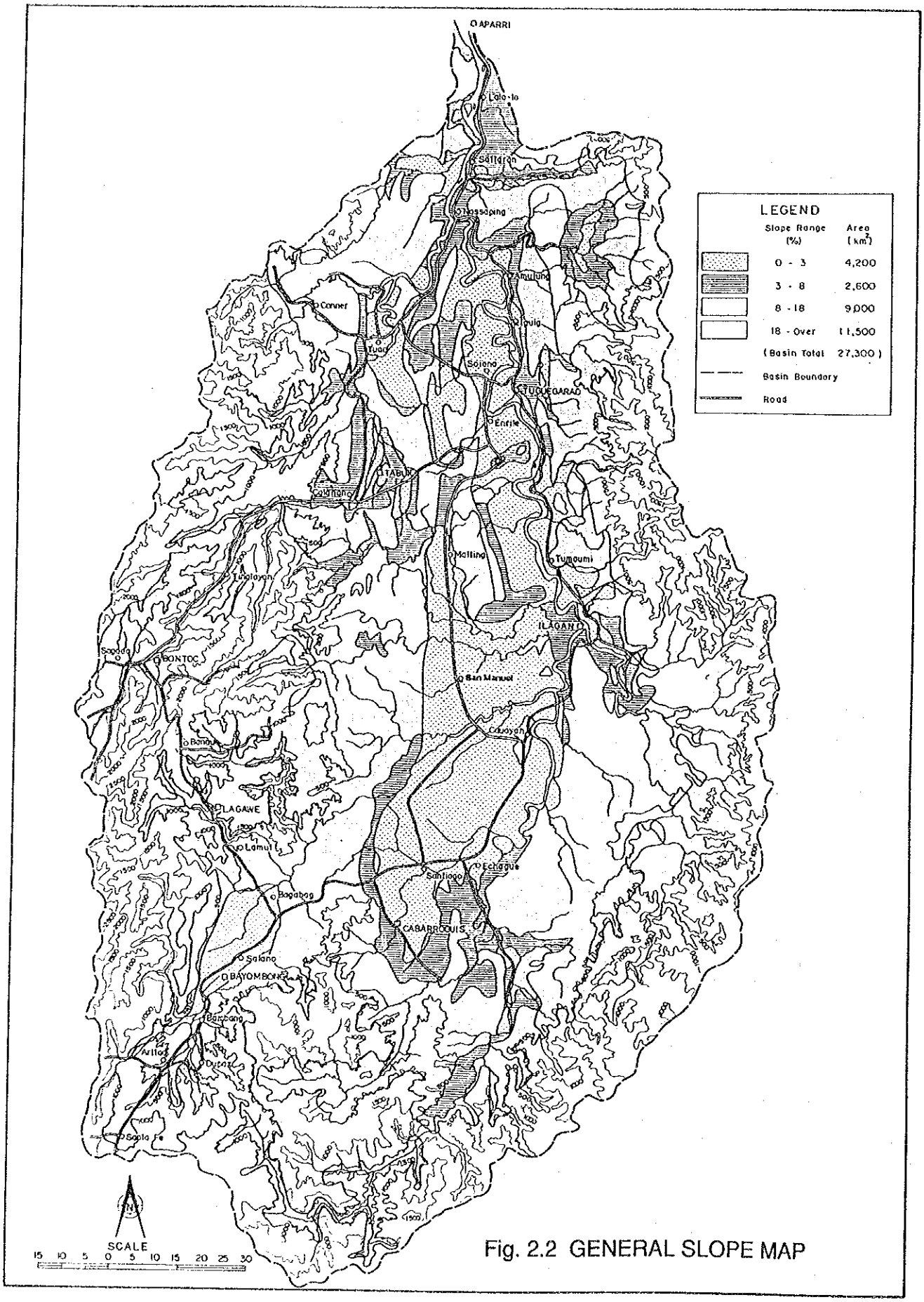


Fig. 2.2 GENERAL SLOPE MAP

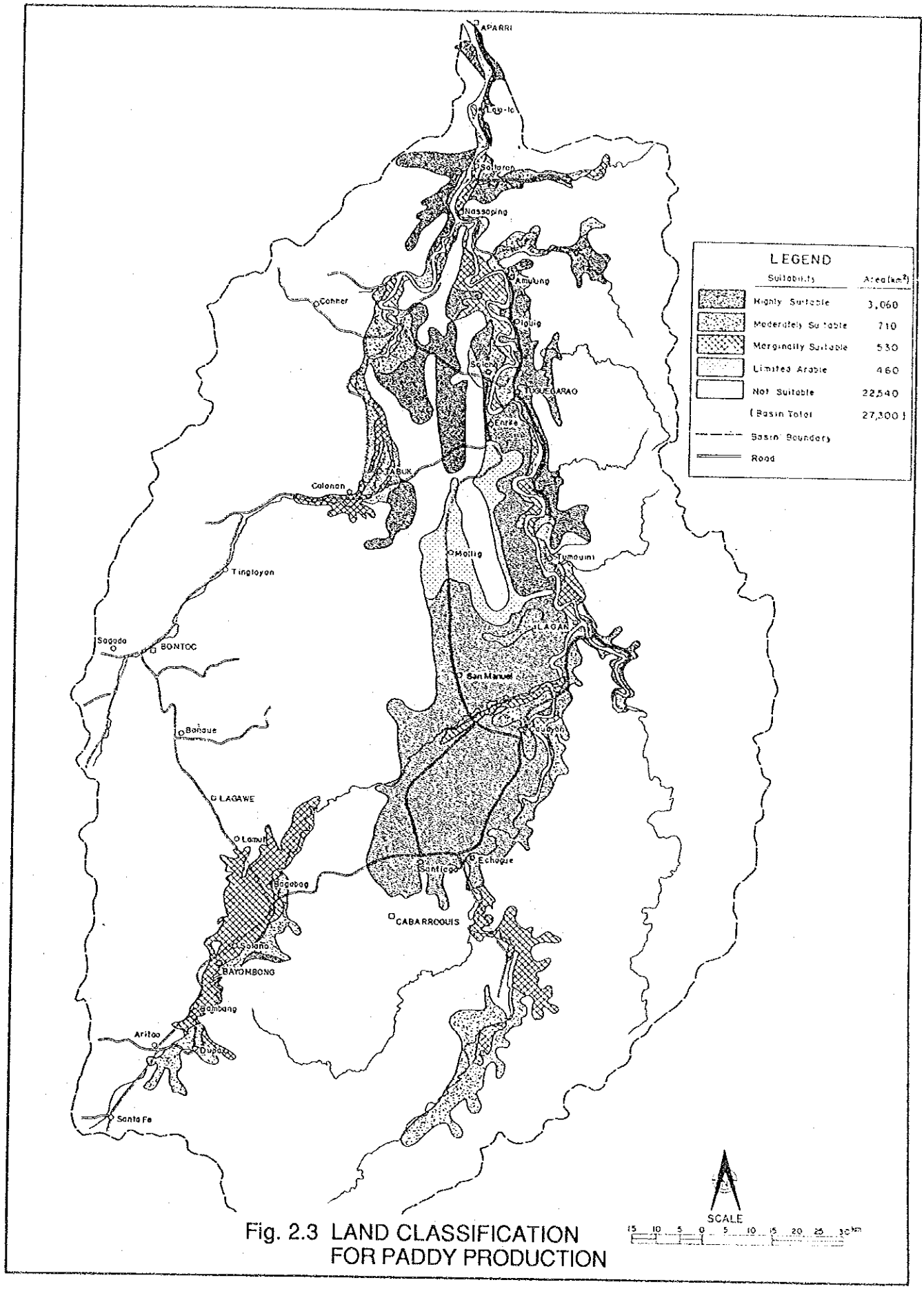


Fig. 2.3 LAND CLASSIFICATION FOR PADDY PRODUCTION

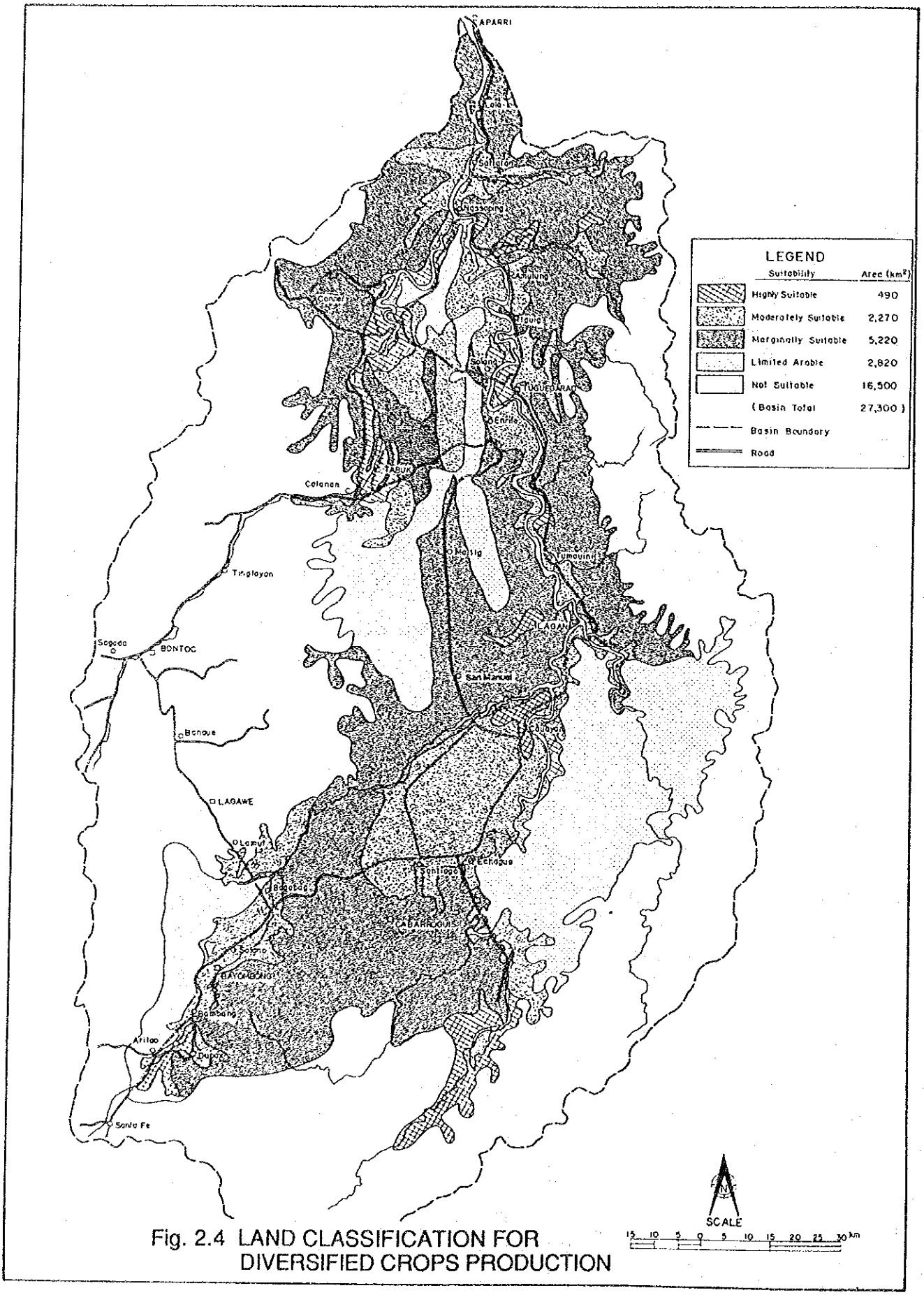


Fig. 2.4 LAND CLASSIFICATION FOR DIVERSIFIED CROPS PRODUCTION

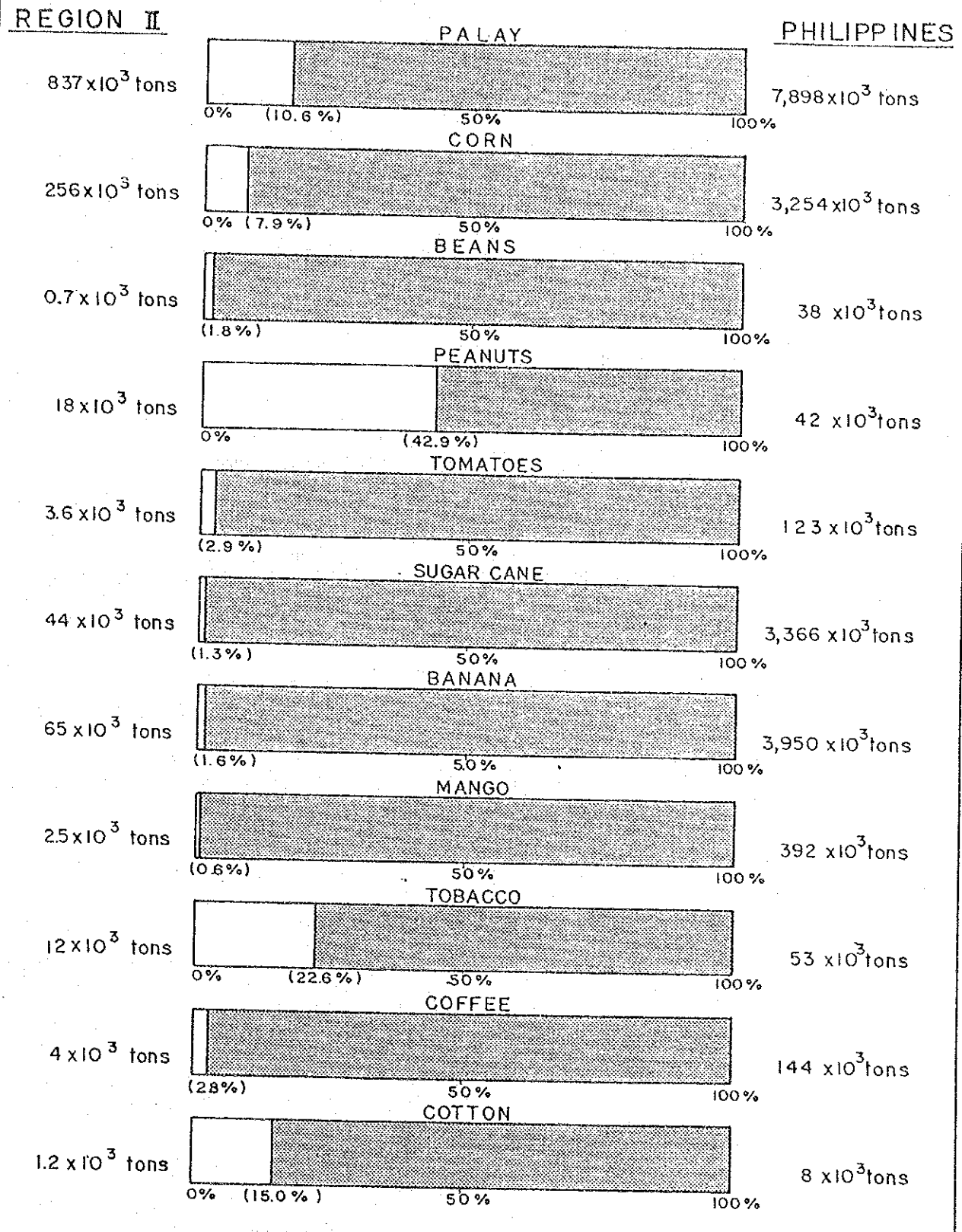


Fig. 3.1 PRESENT CROP PRODUCTIONS OF REGION II (1982 - 1984 AVERAGE)

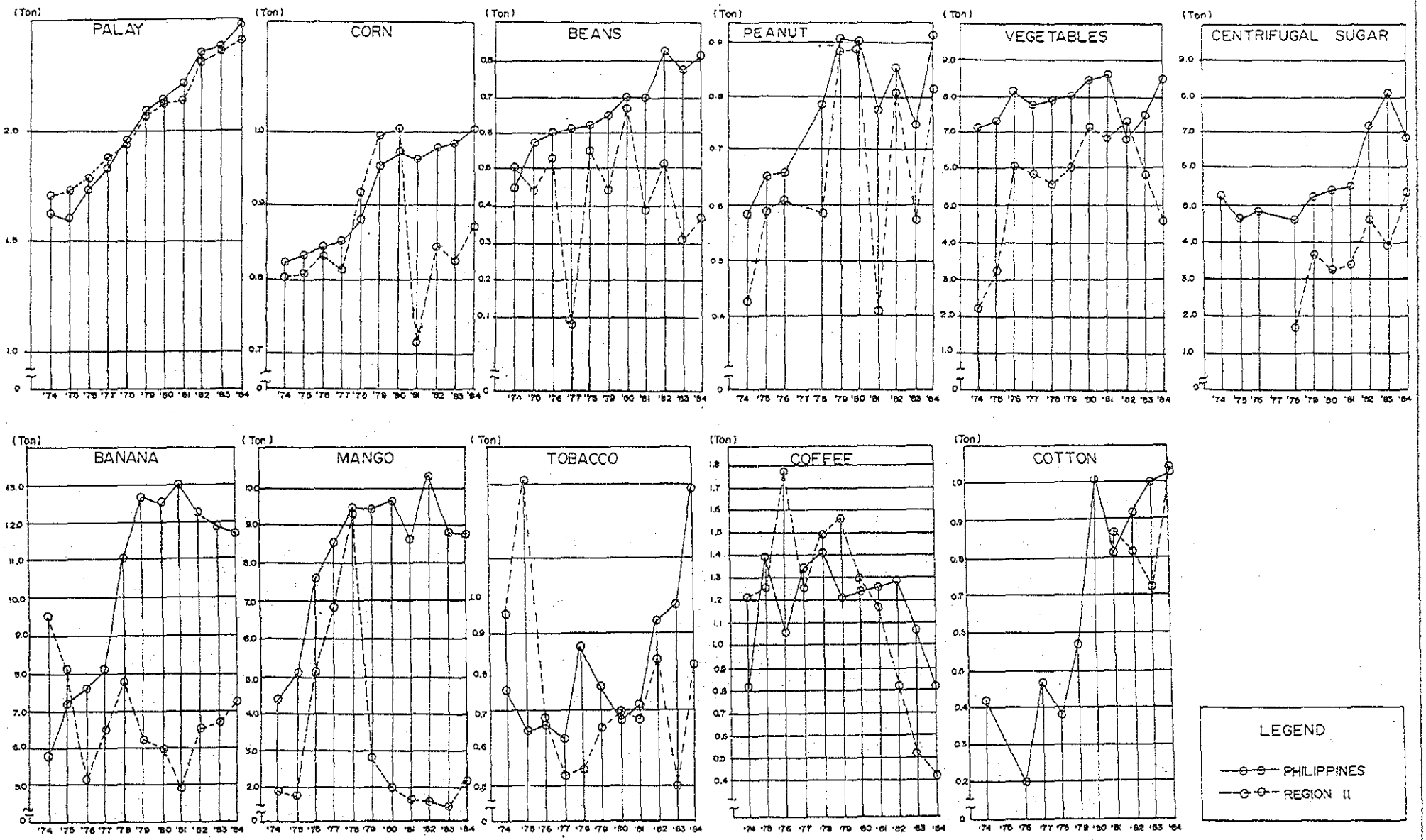


Fig. 3.2 AVERAGE CROP YIELD PER HA (1974-1984)

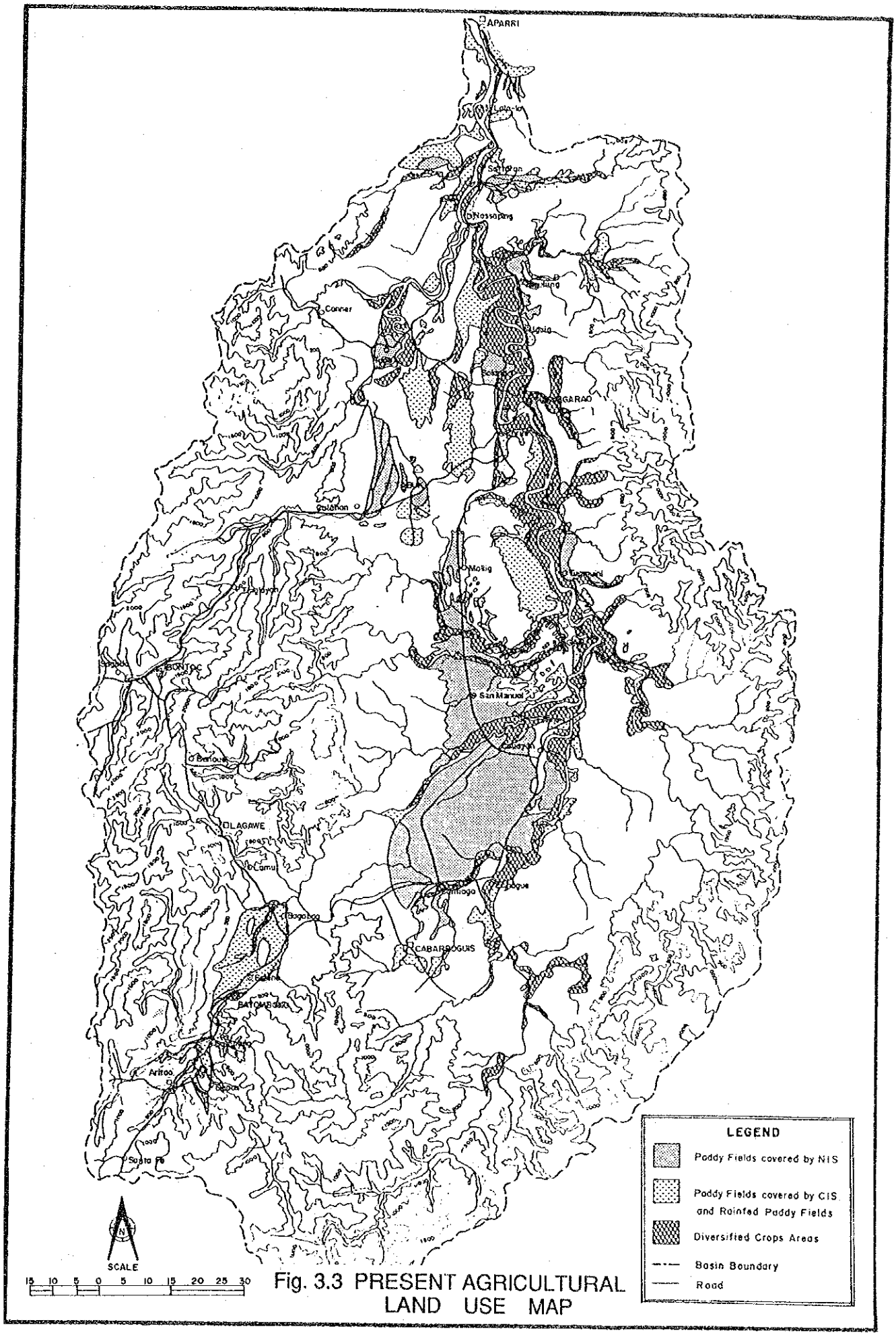


Fig. 3.3 PRESENT AGRICULTURAL LAND USE MAP

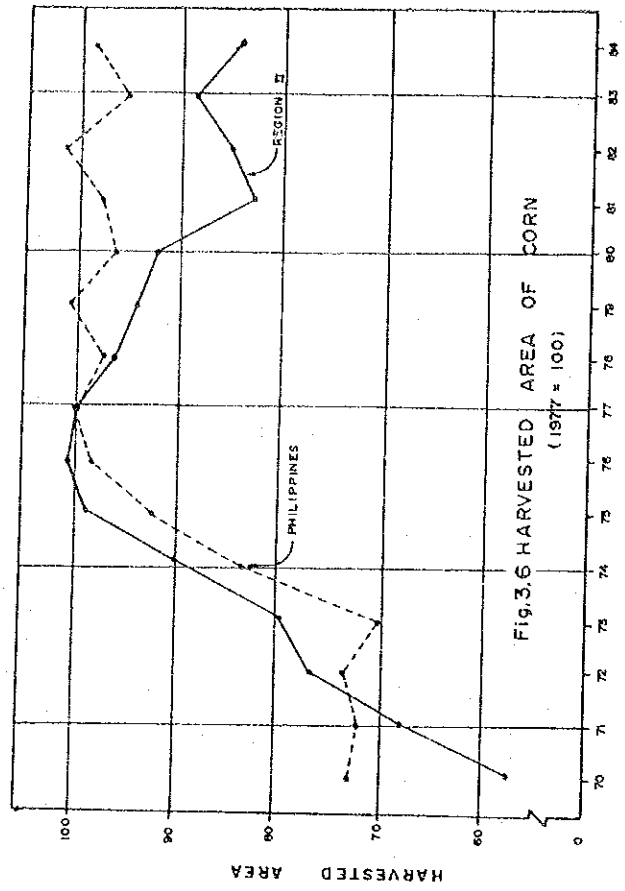


Fig.3.6 HARVESTED AREA OF CORN
(1977 = 100)

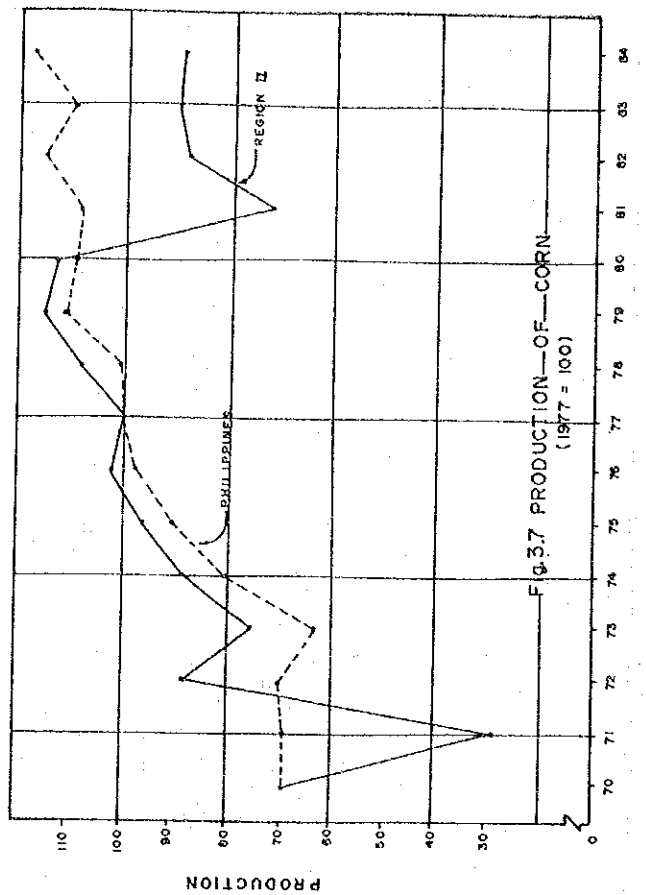


Fig.3.7 PRODUCTION OF CORN
(1977 = 100)

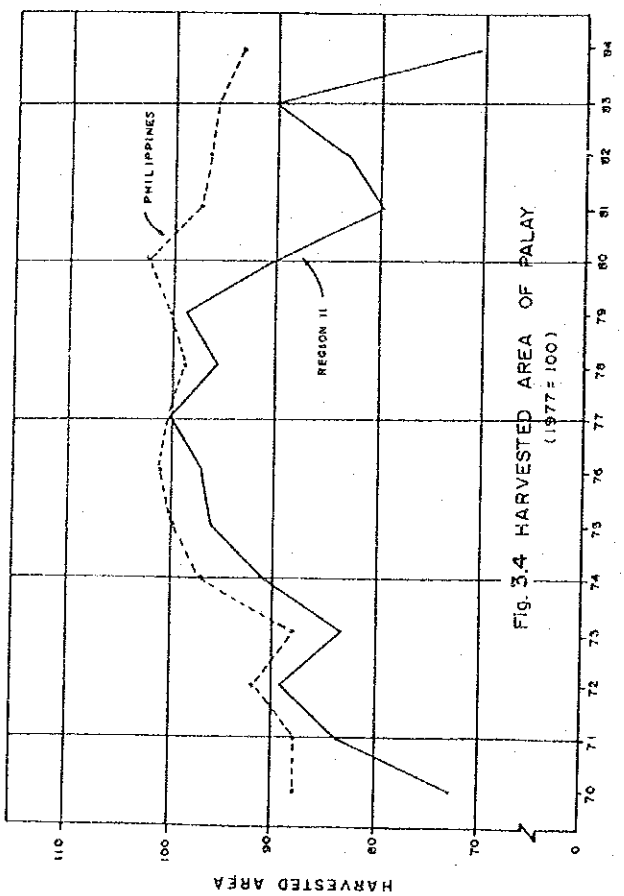


Fig. 3.4 HARVESTED AREA OF PALAY
(1977 = 100)

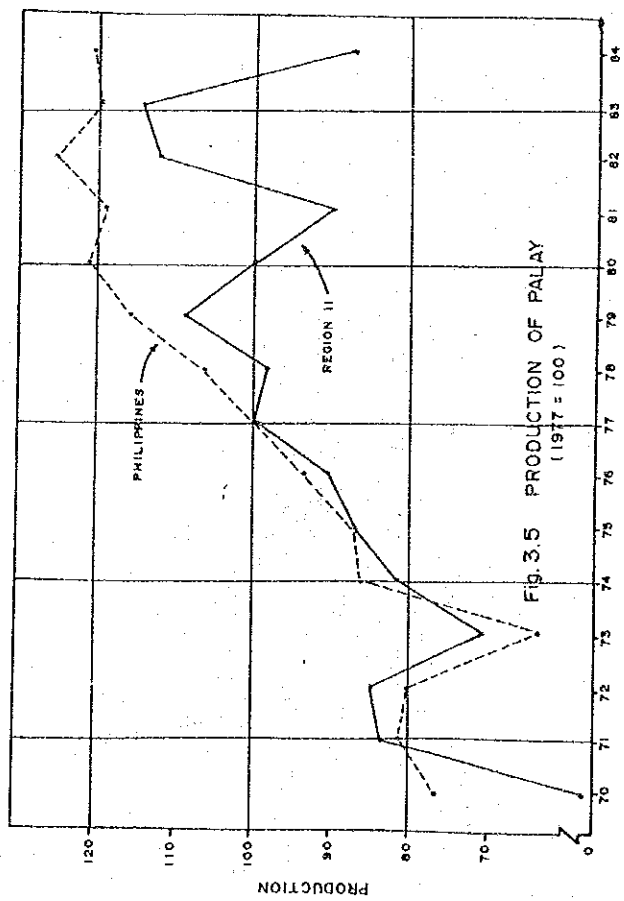


Fig. 3.5 PRODUCTION OF PALAY
(1977 = 100)

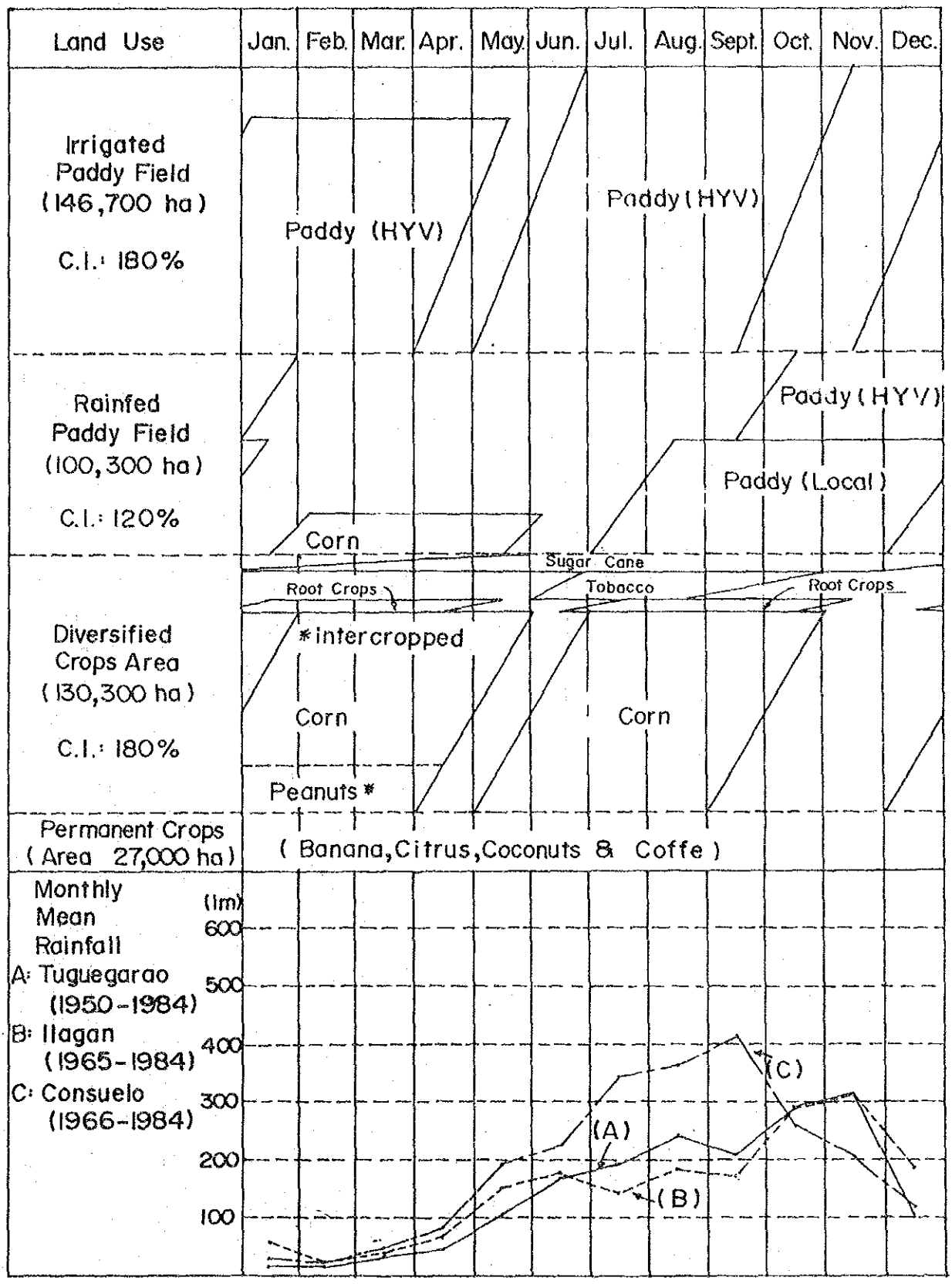


Fig. 3.8 PRESENT CROPPING PATTERN IN CAGAYAN RIVER BASIN

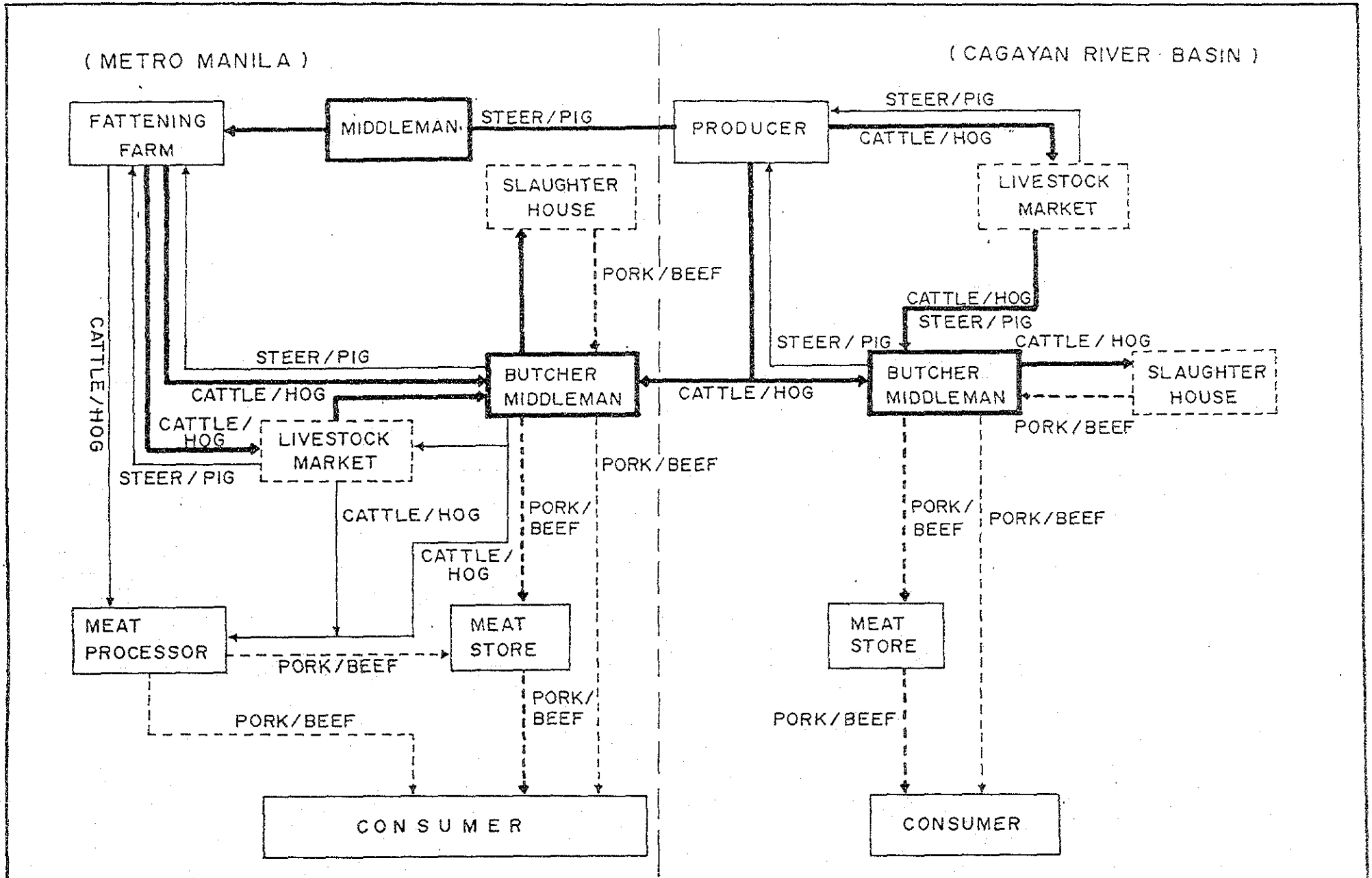


Fig. 3.9 BEEF AND PORK MARKETING CHANNEL

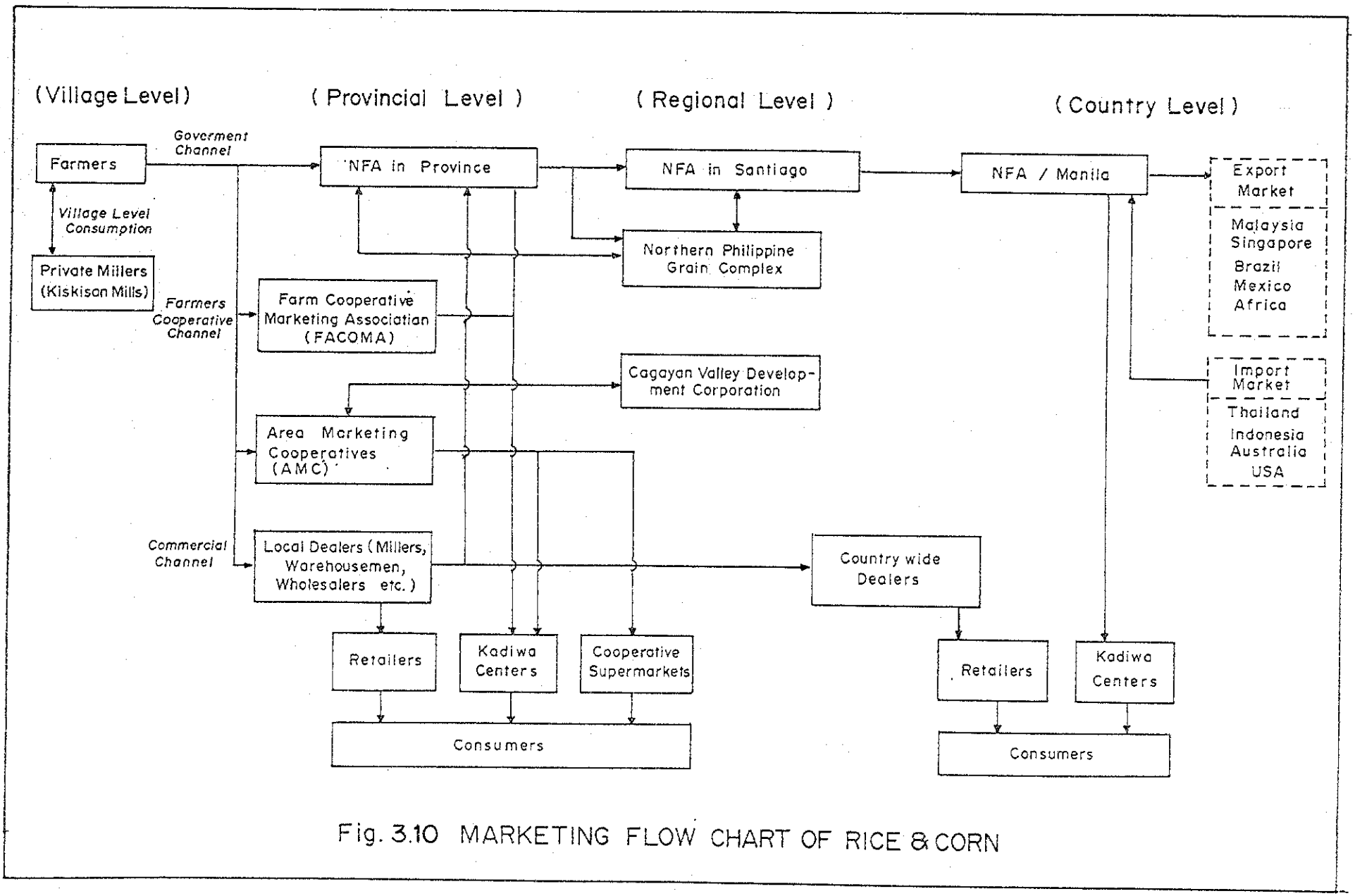


Fig. 3.10 MARKETING FLOW CHART OF RICE & CORN

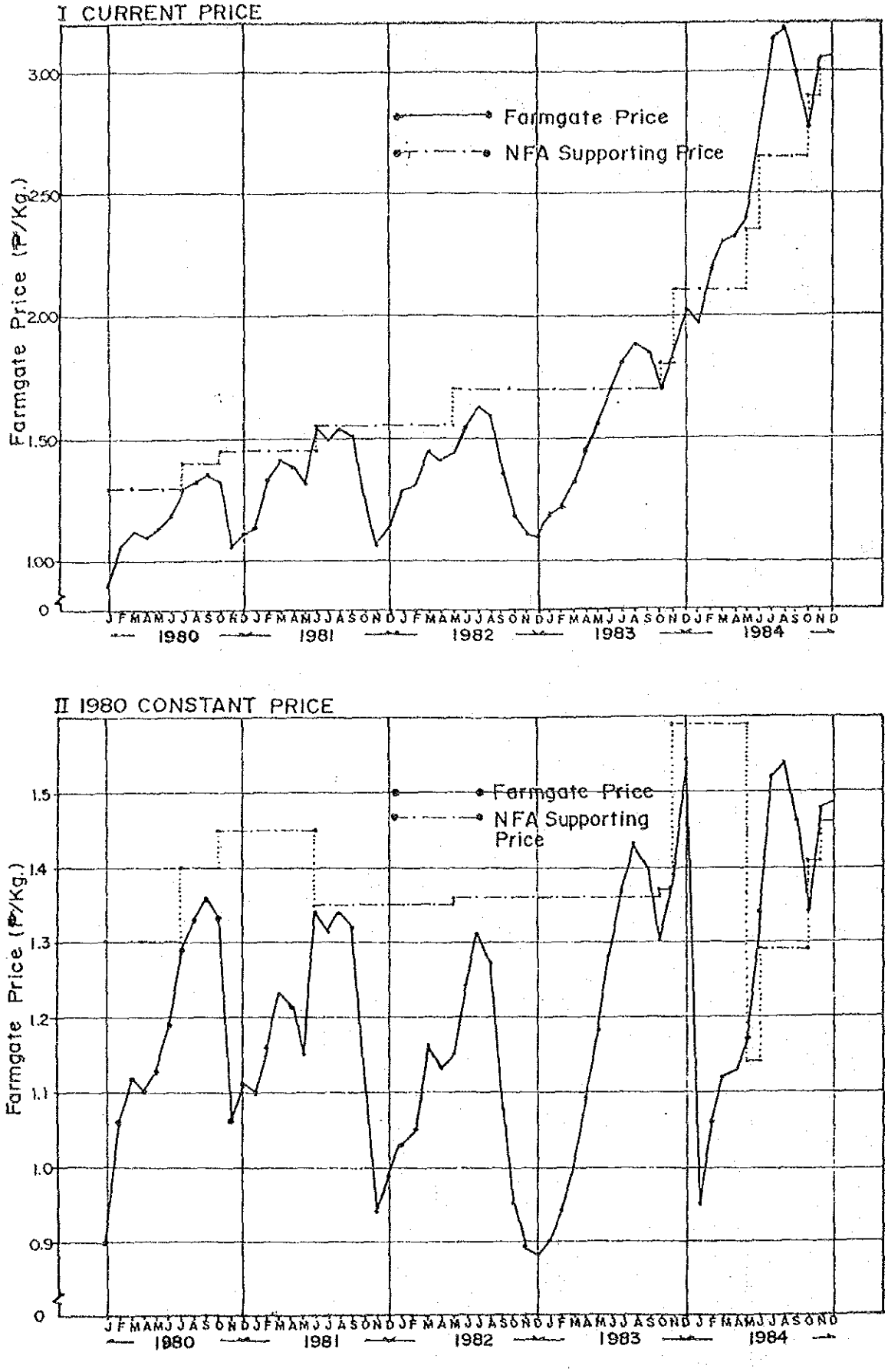


Fig. 3.11 FARMGATE PRICE OF PALAY IN THE CAGAYAN RIVER BASIN

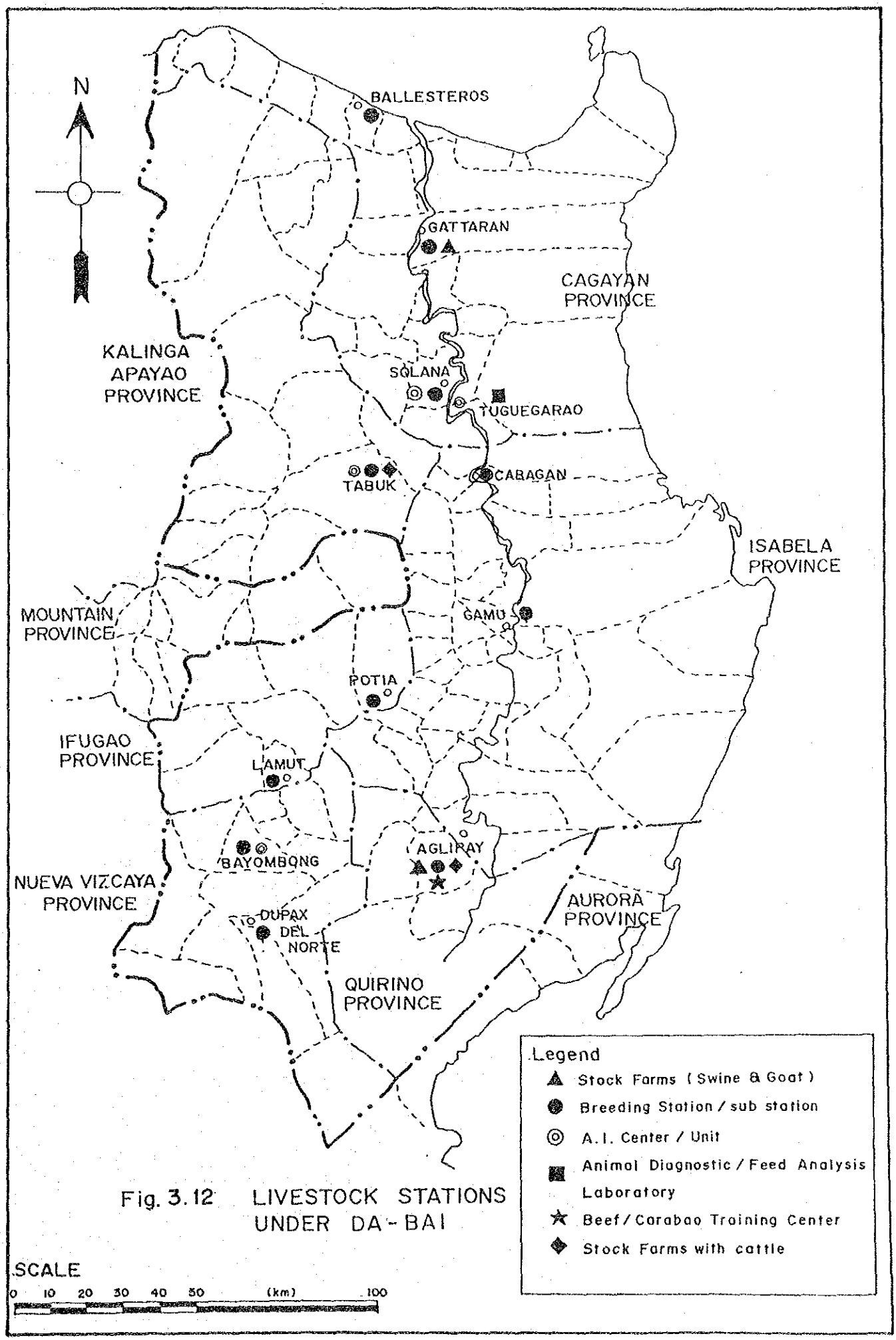
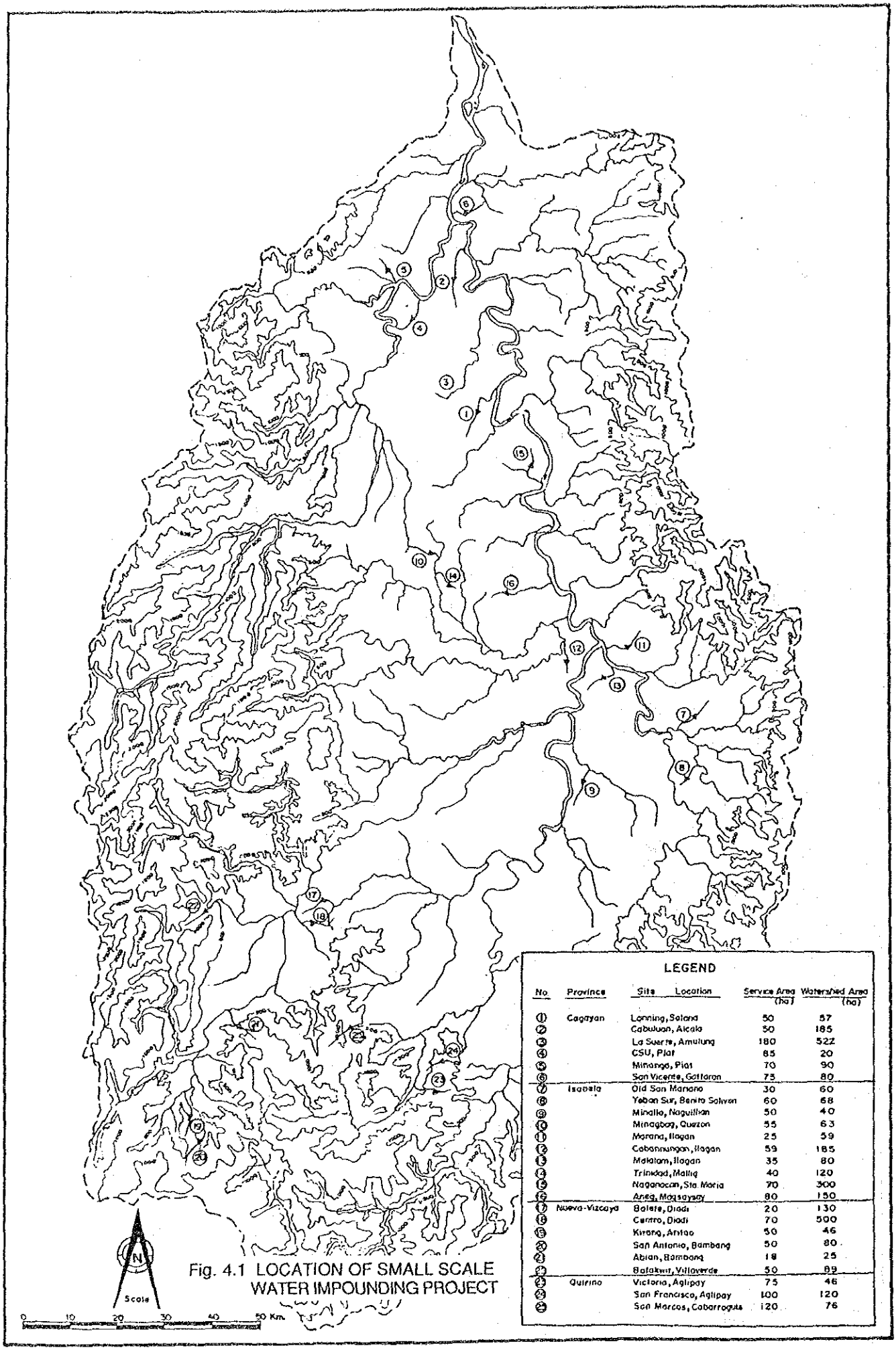


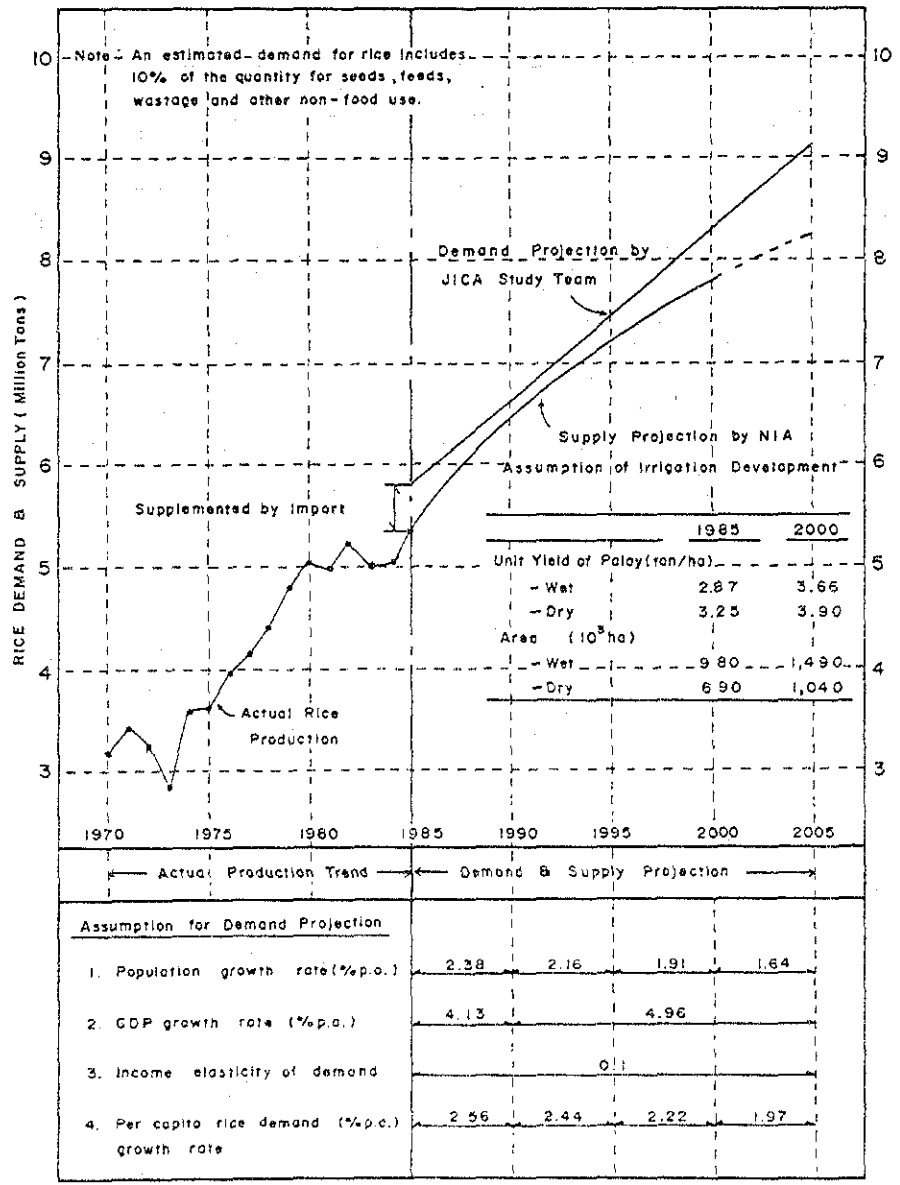
Fig. 3.12 LIVESTOCK STATIONS UNDER DA-BAI



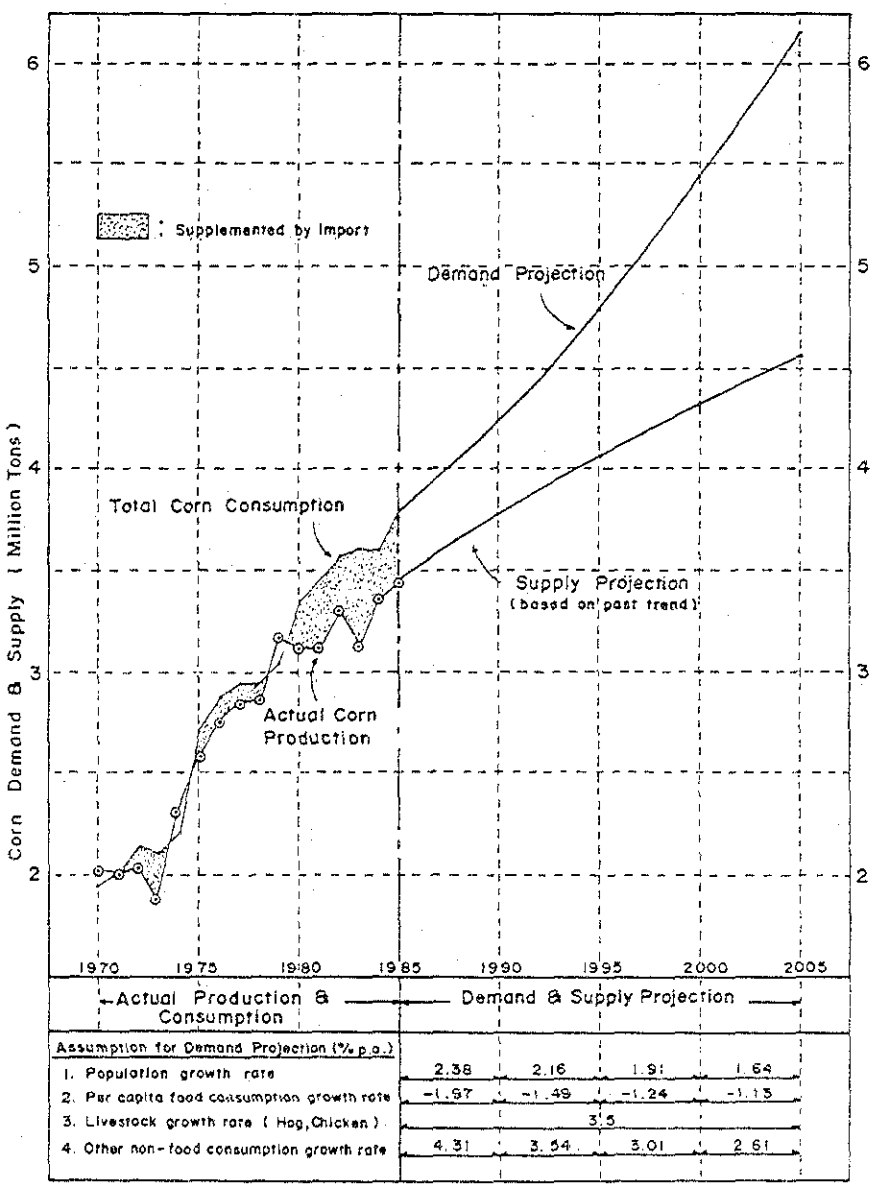
LEGEND

No.	Province	Site Location	Service Area (ha)	Watershed Area (ha)
①	Cagayan	Lanning, Solana	50	57
②		Cabuluan, Alcala	50	185
③		La Suerte, Amulung	180	522
④		CSU, Piat	85	20
⑤		Minanga, Piat	70	90
⑥		San Vicente, Gattaran	75	80
⑦	Isabela	Old San Mariano	30	60
⑧		Yeban Sur, Benito Soliven	60	68
⑨		Minallo, Naguilian	50	40
⑩		Minagbag, Quezon	55	63
⑪		Marana, Ilagan	25	59
⑫		Cabannungan, Ilagan	59	185
⑬		Malalam, Ilagan	35	80
⑭		Trinidad, Mallig	40	120
⑮		Naganacan, Sta. Maria	70	300
⑯		Aneg, Maqsaysay	80	150
⑰	Nueva-Vizcaya	Balete, Diadi	20	130
⑱		Centro, Diadi	70	500
⑲		Kirang, Aritao	50	46
⑳		San Antonio, Bambang	50	80
㉑		Abian, Bambang	18	25
㉒		Bafakeng, Villaverde	50	89
㉓	Quirino	Victoria, Aglipay	75	46
㉔		San Francisco, Aglipay	100	120
㉕		San Marcos, Cabarroguis	120	76

Fig. 4.1 LOCATION OF SMALL SCALE WATER IMPOUNDING PROJECT



DEMAND AND SUPPLY PROJECTION FOR RICE

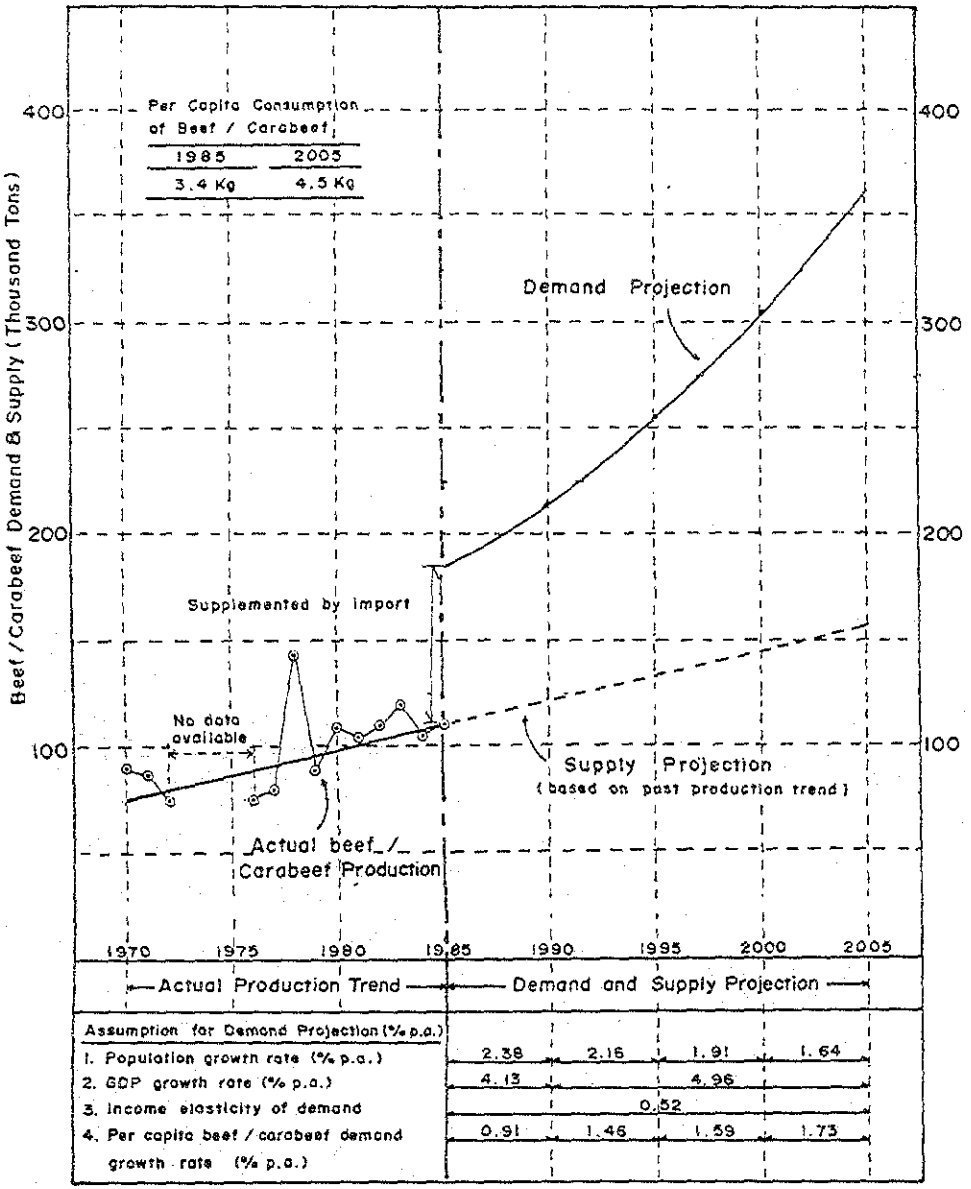


DEMAND AND SUPPLY PROJECTION FOR CORN

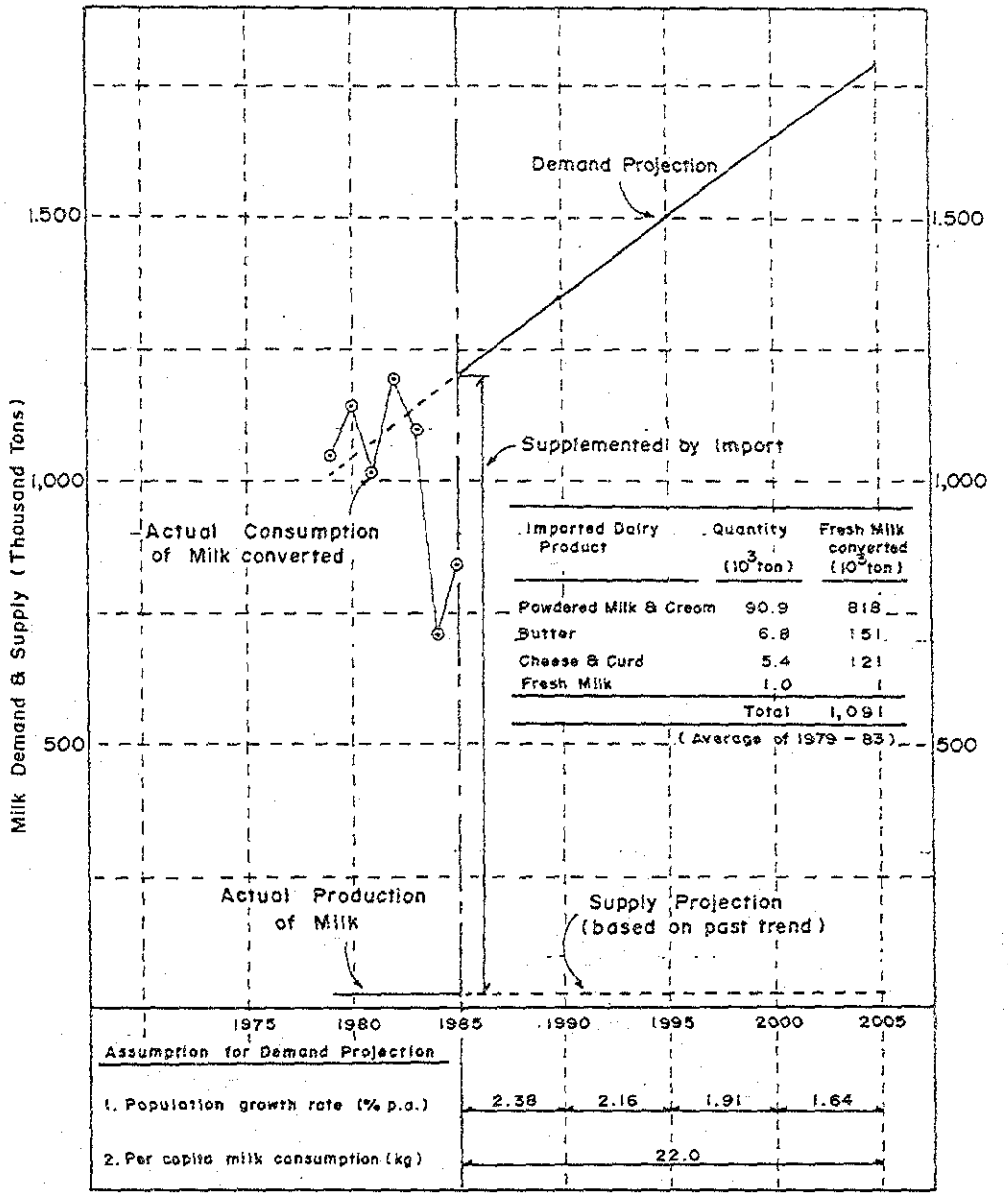
Fig. 4.2 DEMAND AND SUPPLY PROJECTIONS FOR MAJOR AGRICULTURAL COMMODITIES IN THE PHILIPPINES

(to be continued)

(continuation)



DEMAND AND SUPPLY PROJECTION FOR BEEF/CARABEEF



DEMAND AND SUPPLY PROJECTION FOR MILK

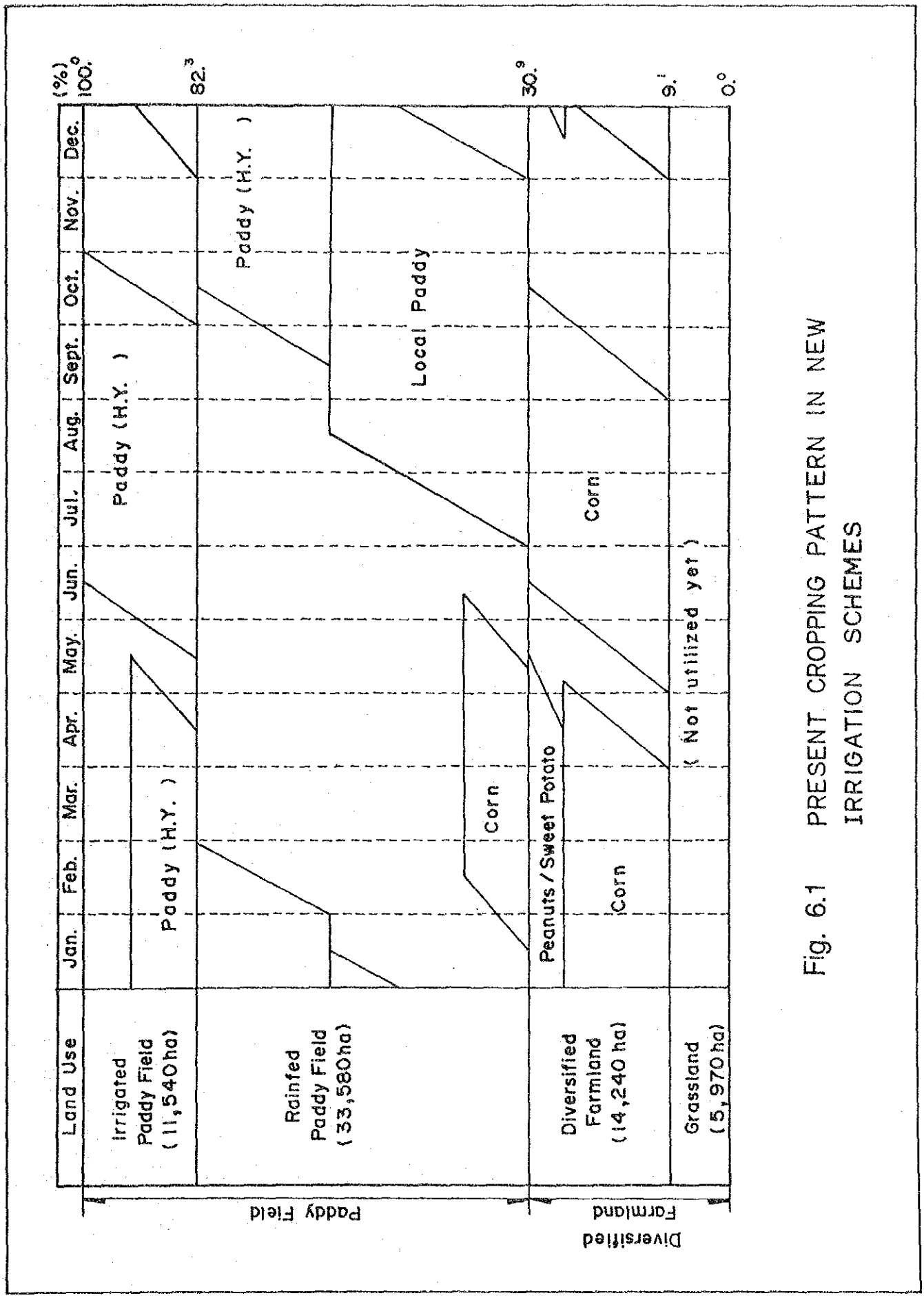


Fig. 6.1 PRESENT CROPPING PATTERN IN NEW IRRIGATION SCHEMES

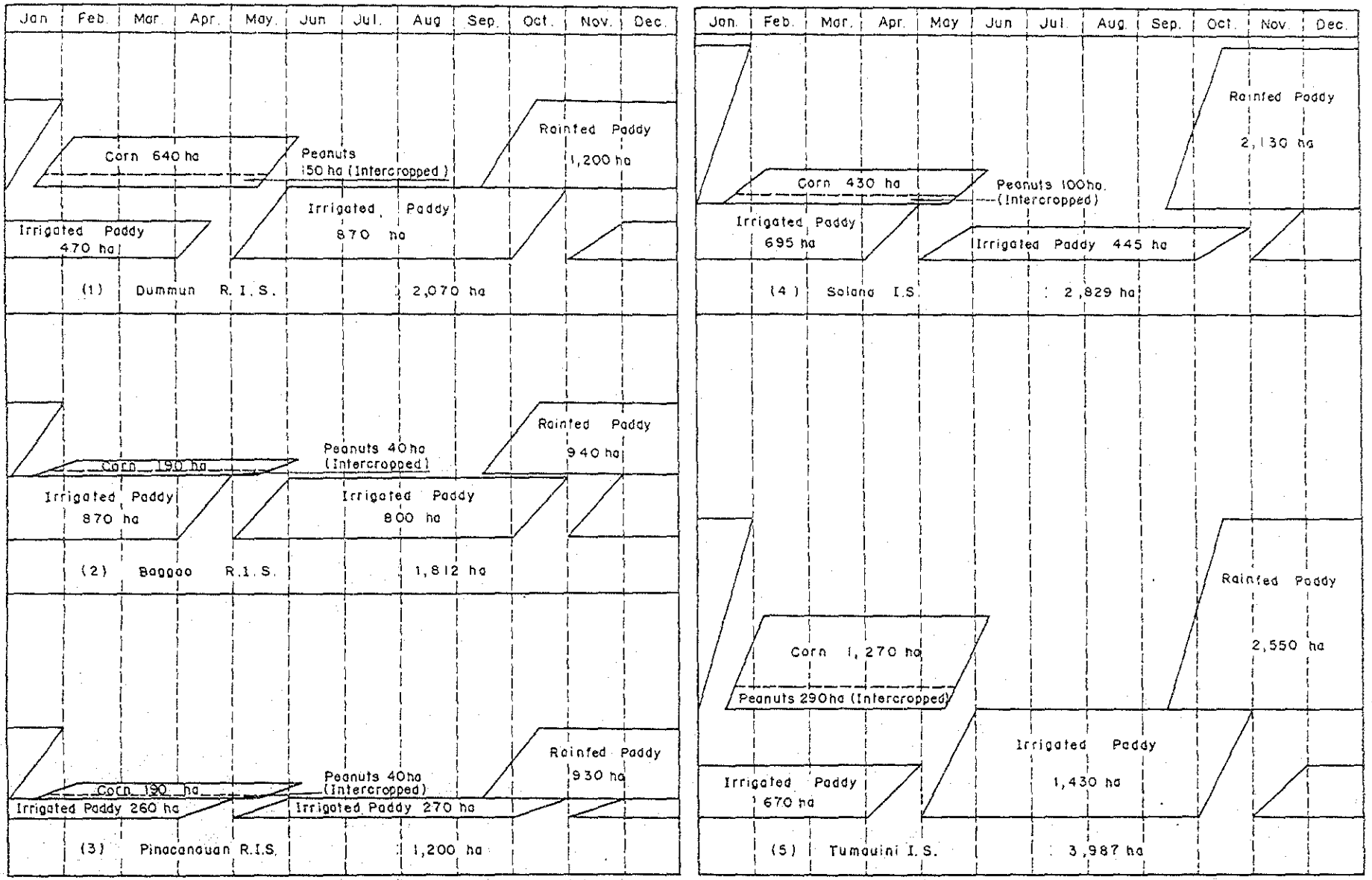


Fig. 6.2 PRESENT CROPPING PATTERN IN REHABILITATION/IMPROVEMENT SCHEMES

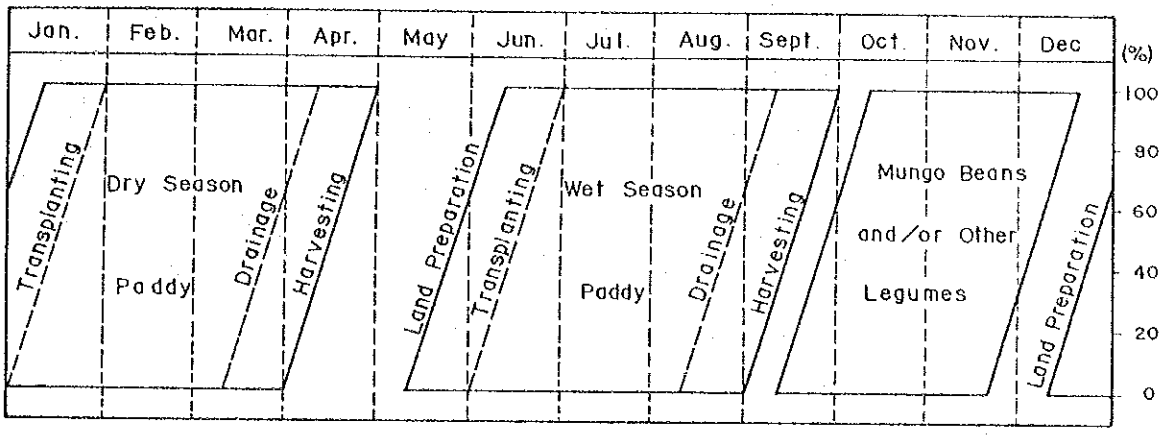


Fig. 6.3 PROPOSED CROPPING PATTERN (A) IN THE PADDY FIELD AREA

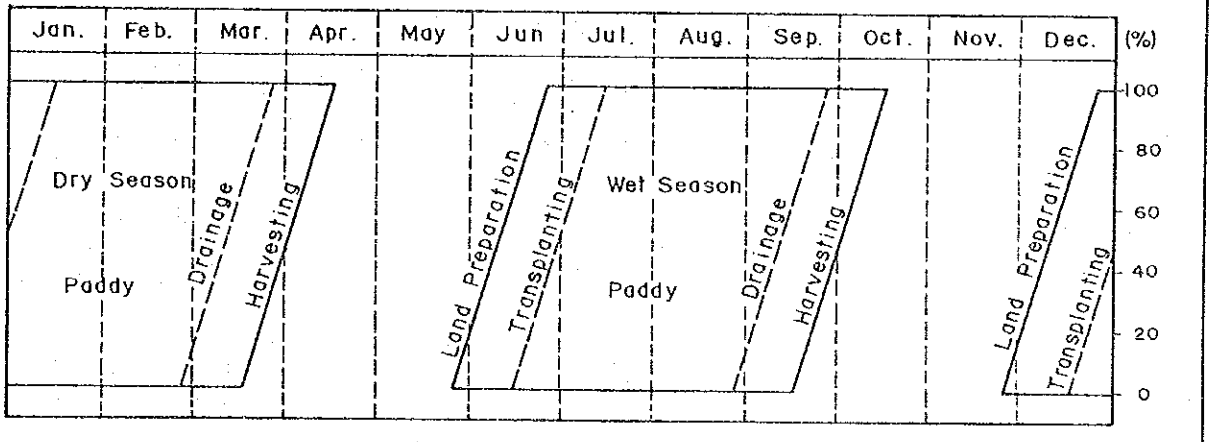


Fig. 6.4 PROPOSED CROPPING PATTERN (B) IN THE PADDY FIELD AREA

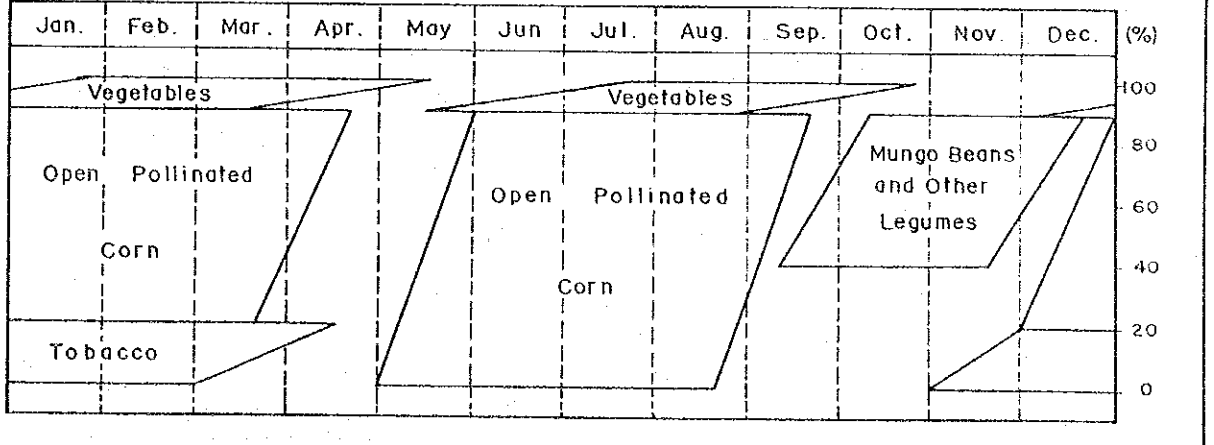


Fig. 6.5 PROPOSED CROPPING PATTERN (C) IN THE DIVERSIFIED CROP AREA

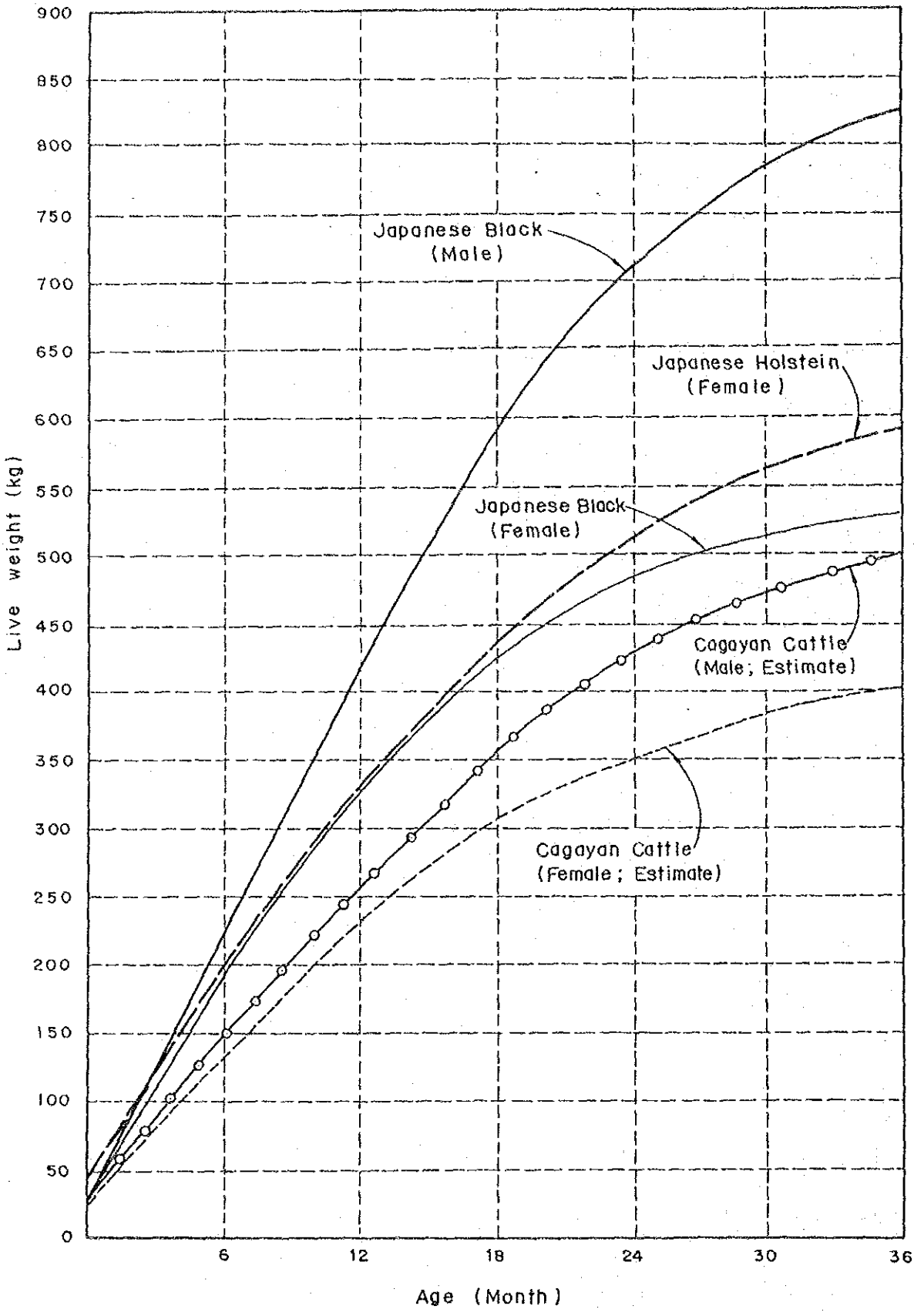


Fig. 7.1 BODY-WEIGHT GAIN CURVE OF CATTLE

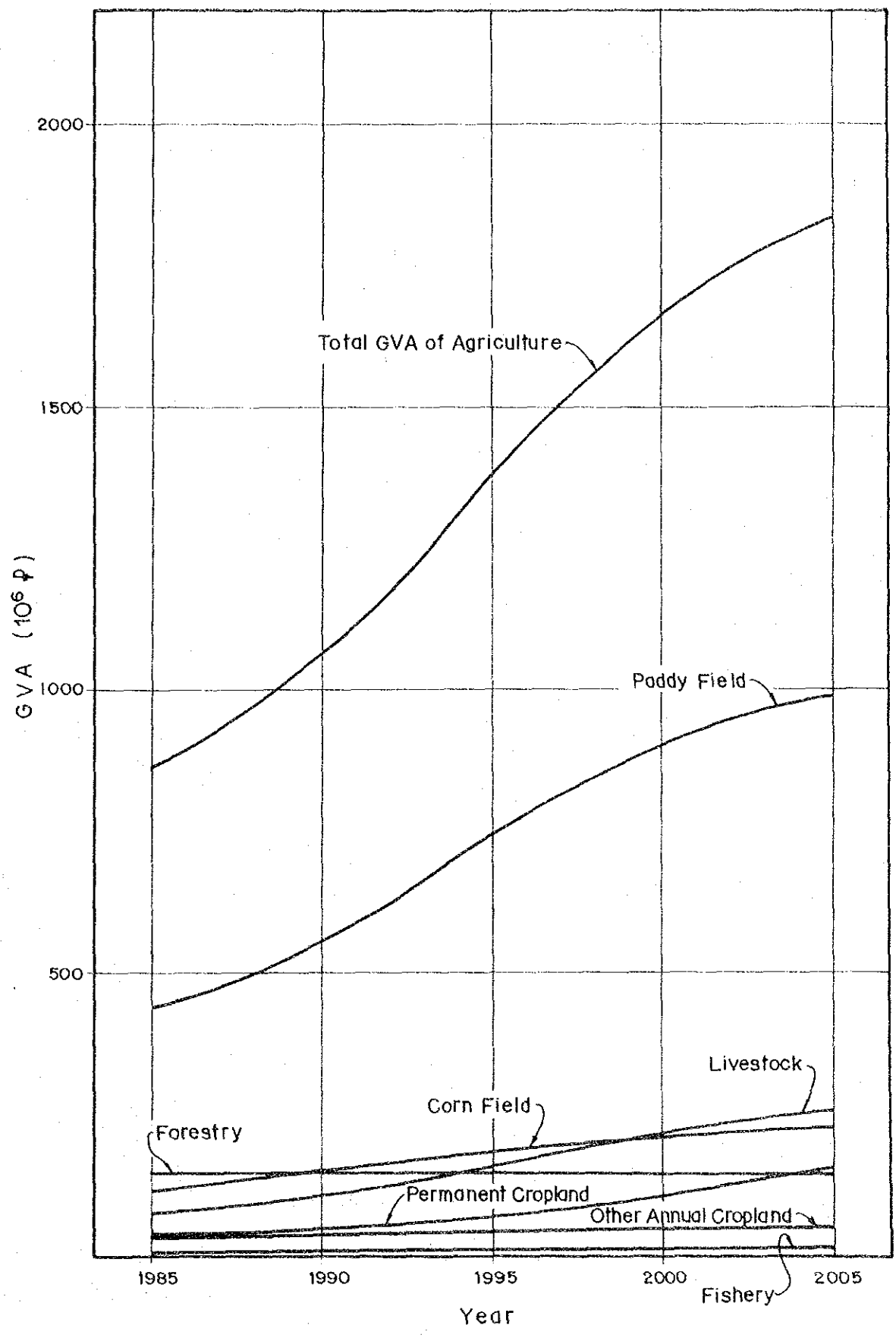


Fig. 8.1 GROWTH OF AGRICULTURAL GVA

Attachment A. List of Collected Data

Ref. No.	Title	Author	Date of Issue
AG-101	Census of Agriculture, Special Report No. 2	NCSO	1981
AG-102	Handbook on Production Costs of Selected Crops, Backyard Poultry, Livestock and Aquaculture Enterprices in the Philippines, 1982-84	BAECON	Jan.1986
AG-103	Agro-Meteorological Field Stations Data	CIADP	1985
AG-104	General Information of Cagayan Valley Experiment Station in Isabela	BPI Isabela	1985
AG-105	New Seed Boad Rice Varieties	BPI Isabela	1985
AG-106	Guideline for Seed Certification		1985
AG-107	Characteristics and Varieties for Crops Bread by BPI	BPI Ilagan	1985
AG-108	Memorandum, MAF-IRRI Technology Transfer Workshops	MAF	1985
AG-109	Results of Experimental Works and Field Trials including Fertilizer Test, Planting Density Test, Agricultural Chemical Test, Seasonal Test	BPI Ilagan	1985
AG-110	Data on Annual Regional Research Review (13-15 May, 1985)	BPI Ilagan	1985
AG-111	Mungbean-Rice Cropping Pattern Successful in Rainfed Area	ISWCRDS	1985
AG-112	Technology Verification and Component Technology Trials in Region II	ISWCRDS	1985
AG-113	Soil Description for Soil Series	MAF/BS	1985
AG-114	The Philippines Recommends for Soil Conservation	MAF/BS	1984
AG-115	Land Capability Map, North Luzon (1/250,000)	BS	1984
AG-116	Slope Map, North Luzon (1/250,000)	BS	1984

(to be continued)

(continuation)

Ref. No.	Title	Author	Date of Issue
AG-117	Land Use Map, North Luzon (1/250,000)	BS	1984
AG-118	Land Use Opportunity Map, North Luzon (1/250,000)	BS	1984
AG-119	Reconnaissance Soil Map, Cagayan (1/250,000)	BS	1984
AG-120	Reconnaissance Soil Map, Isabela (1/250,000)	BS	1984
AG-121	Reconnaissance Soil Map, Kalinga-Aayao(1/250,000)	BS	1984
AG-122	Reconnaissance Soil Map, Mountain (1/250,000)	BS	1984
AG-123	Reconnaissance Soil Map, Ifugao (1/250,000)	BS	1984
AG-124	Reconnaissance Soil Map, Quirino (1/250,000)	BS	1984
AG-125	Reconnaissance Soil Map, Nueva Vizcaya(1/250,000)	BS	1984
AG-126	Soil Map, Textural Classification (1/250,000)	NWRC	1984
AG-127	Detail Soil Survey and Classification, Tuguegarao (1/20,000)	MAF/BS	1984
AG-128	Detail Soil Survey and Classification, Iguig (1/20,000)	MAF/BS	1984
AG-129	Detail Soil Survey and Classification, Alcala (1/20,000)	MAF/BS	1984
AG-130	Detail Soil Survey and Classification, Amulung (1/20,000)	MAF/BS	1984
AG-131	Detail Soil Survey and Classification, Solana (1/20,000)	MAF/BS	1984
AG-132	Detail Soil Survey and Classification, Enrile (1/20,000)	MAF/BS	1984
AG-133	Detail Soil Survey and Classification, Tuao (1/20,000)	MAF/BS	1984
AG-134	Detail Soil Survey and Classification, Piat (1/20,000)	MAF/BS	1984
AG-135	Detail Soil Survey and Classification, Sto. Niño (1/20,000)	MAF/BS	1984

(to be continued)

(continuation)

Ref. No.	Title	Author	Date of Issue
AG-136	Detail Soil Survey and Classification, Peñablanca (1/20,000)	MAF/BS	1984
AG-137	Detail Soil Survey and Classification, Baggao (1/20,000)	MAF/BS	1984
AG-138	Detail Soil Survey and Classification, Gattaran (1/20,000)	MAF/BS	1984
AG-139	Detail Soil Survey and Classification, Allacapan (1/20,000)	MAF/BS	1984

Attachment B. List of Collected Project Reports

Ref. No.	Title	Author	Date of Issue
AG-201	Cagayan Integrated Agricultural Development Project, Main Report	JICA	Apr.1976
AG-202	Perspective Plan for the Cagayan Region 1978-2000	Regional Development Council II, NEDA	Nov.1976
AG-203	Philippine Agricultural Economics Review: Vol. III, No. 1	BAECON	Jun.1980
AG-204	The Philippines: Irrigation Program Review	WB	Dec.15,1982
AG-205	Five-Year Development Plan CY-1983-1987, Cagayan Valley Region	BFAR	1983
AG-206	Wet and Dry Analysis for the Cagayan Valley, the Philippines in Southeast Asia Studies, Vol. 20, No. 4	University of Kyoto	Mar.1983
AG-207	Annual Report on Cagayan Integrated Agricultural Development Project	CIADP	1983
AG-208	Annual Report on Cagayan Integrated Agricultural Development Project	CIADP	1984
AG-209	Cagayan Valley Agro-Industrial Development Project	NEDA	-
AG-210	Five-Year Comprehensive and Integrated Regional Research and Development Program of Cagayan Valley 1983-1987	Ilagan Experimental Station	Apr.16,1984
AG-211	Cagayan Integrated Agricultural Development Project (Irrigation Componet) Camalaniugan, Cagayan Monthly Progress Report	NIA	Nov.1985
AG-212	Agrarian Reform Plan Year 2000	MAR	1975
AG-213	Billingand Collection Manual on Irrigation Service Fee	NIA	Sep.21,1982

(to be continued)

(continuation)

Ref. No.	Title	Author	Date of Issue
AG-214	Guidelines for the Preparation, Evaluation and Ranking of Flood Control and Drainage Projects	MPWH	Feb.26,1982
AG-215	Appraisal for the Agro-Processing and Marketing Project in the Republic of the Philippines	ADB	Nov.1982
AG-216	Food Map of Region II (Cagayan Valley Region)	Regional Development Council, Region II	1983
AG-217	Recommendation of the Board of Directors and Appraisal on A Proposed Loan to the Republic of the Philippines for an Agricultural Inputs Program	ADB	Mar.6,1984
AG-218	Economic Profile: Crop Production in the Philippines, A Lecture/Discussion paper presented during the Seminar in Manila	Moises L. Sardido	Jun.1984
AG-219	The Philippines: An Agenda for Adjustment and Growth	WB	Nov.30,1984
AG-220	Office Memorandum: Half Year Revision of Commodity Price Forecasts and Quarterly Review of Commodity Markets for June 1985	WB	Jul.31,1985
AG-221	Kalinga-Apayao Socio-Economic and Physical Profile 1985	Office of the Provincial Governor	1985
AG-222	Quirino Socio-Economic and Physical Profile 1985	Office of the Provincial Governor	1985
AG-223	Isabela Socio-Economic and Physical Profile 1985	Office of the Provincial Governor	1985
AG-224	Ifugao Socio-Economic and Physical Profile 1985	Office of the Provincial Governor	1985

(to be continued)

(continuation)

Ref. No.	Title	Author	Date of Issue
AG-225	Nueva Vizcaya Socio-Economic and Physical Profile 1985	Office of the Provincial Governor	1985
AG-226	Cagayan Socio-Economic Profile	Office of the Provincial Governor	
AG-227	Socio-Economic Study of the Iguig Leading Extension Area in 1982	CIADP/JICA	
AG-228	Socio-Economic Impact of Technology Diffusion by APC on Project Villages	JICA	
AG-229	Annual Report CY-1985, Bureau of Forest Development Region 2	BFD	1985
AG-230	The Operation Land Transfer Program of the Philippines Process and Impact	MAR	Feb.1983
AG-231	An Analysis of Rice Production in Central Luzon	BAECON	1984
AG-232	Sources of Growth in the Livestock Industry	BAECON	1985
AG-233	Economic Assessment of Rice Production in the Philippines	BAECON	1985
AG-234	Primer, Agro-Processing & Marketing Project	ADB	1985
AG-235	Patterns and Levels of Fertilizer and Pesticide Use in Philippine Rice and Corn Farms	BAECON	Aug.1984
AG-236	Design, Operation and Ecocomics of a Small-Scale Hatchery for the Larval Rearing of Sugpo, Penaeus Monodon Fab. (Aquaculture Extension Manual No. 1)	SEAFDEC	Jul.1978
AG-237	The Present Prawn Culture in the Philippines	SEAFDEC	May 1979
AG-238	Pond Culture of Sugpo, P. Monodon (Fabricius)	SEAFDEC	-
AG-239	A Summary of the Experiments on the Culture of Penaeus Monodon		

(to be continued)

(continuation)

Ref. No.	Title	Author	Date of Issue
AG-240	Conversion Table of Selected Agricultural Crops and Inputs	BAECON	1978
AG-241	Area Resources Survey Product Monographs Parts I & II	AITTP	Sep.1984
AG-242	The Philippines Recommends for Tobacco	PCARR	Dec.1979
AG-243	The Philippines Recommends for Forage and Pasture Crops	PCARR	1983
AG-244	The Philippines Recommends for Potato	PCARR	1979
AG-245	The Philippines Recommends for Carabao Production	PCARR	1978
AG-246	Landforms in the Rice Growing Areas of the Cagayan River Basin	IRRI	Aug.1981
AG-248	Agronomic Potential of Potato (Solanum Spp.) in Cagayan Valley, Philippines (Research Results from 1980-1985)	CIADP	1985

Attachment C. List of Collected Publications

Ref. No.	Title	Author	Date of Issue
AG-301	Cagayan Technoguide; Peanut	CIADP	1981
AG-302	Cagayan Technoguide; Rice	CIADP	1983
AG-303	Cagayan Technoguide; Monggo	CIADP	1981
AG-304	Cagayan Technoguide; Corn	CIADP	1983
AG-305	Cagayan Technoguide; Cigar Filler Tobacco	CIADP	1983
AG-306	State of the Art; Rice Research	PCARR	1984
AG-307	The Philippines Recommends for Dairy Cattle Production	PCARR	1981

ANNEX IR

IRRIGATION

ANNEX IR

Table of Contents

List of Tables

List of Figures

List of Attachment

I PROFILE OF PRESENT IRRIGATION SYSTEMS

1.1 Classification of Irrigation Systems

In the Cagayan river basin (the Basin), there are numerous irrigation systems with various sizes of commanding area ranging from less than one (1) ha to more than 10,000 ha. These irrigation systems are classified, by the National Irrigation Administration (NIA), into four (4) categories; i.e., National Irrigation System (NIS), Communal Irrigation System (CIS), Pump Irrigation System (PIS) and Private Irrigation System.

(1) National Irrigation System

The NIS generally commands an irrigation service area of more than 1,000 ha. Construction of its irrigation and drainage facilities as well as its operation and maintenance is carried out by the NIA.

Farmers benefited from the system are obligated to pay an irrigation service fee for each crop. Standard rates of the irrigation service fee for rice crop in all NISs are prescribed as follows (Ref. IR-309).

i) For gravity irrigation system
   2 cavans of paddy per hectare for the wet season crop;
   3 cavans of paddy per hectare for the dry season crop; and
   3 cavans of paddy per hectare for the third crop.

ii) For pump irrigation system
   3 cavans of paddy per hectare for the wet season crop;
   5 cavans of paddy per hectare for the dry season crop; and
   5 cavans of paddy per hectare for the third crop.

The benefited farmer, however, whose lot has an average actual harvest of only 2.0 ton/ha or less due to water shortage, calamities such as typhoon, flood, fire, etc. beyond the control of the farmer, could be exempted from payment of the irrigation fees on the damaged lot.

(2) Communal Irrigation System

The CIS is a small scale gravity irrigation system with an irrigation service area of not more than 1,000 ha. A water users association such as Irrigators Association and Irrigators Service Association is tasked with the operation and maintenance of the CIS.

There are two (2) types of the CIS in the Basin. The first type is constructed by farmers themselves without any financial assistance from the Government agencies. The second type is constructed by the Government agencies such as the Presidential Arm Community Development (PACD), the Bureau of Public Works (BPW), the NIA and the Farmers System Development Corporation (FSDC), and eventually turned over to the water users association for its operation and maintenance. Most of the CISs established during the current decade fall under the second type.

The CISs which had been constructed by the Government agencies before 1974, were doled out to the water users associations. As for the CISs constructed from 1974 onward, however, direct construction cost of the system has been being amortized by benefited farmers with a maximum term of redemption of 50 years.

(3) Pump Irrigation System

The PIS, a small scale pump irrigation system constructed by the FSDC, is operated and maintained by the water users association under the technical assistance of the FSDC. The direct construction cost of the system including the cost for pump equipment has to be amortized with a 6% interest by the benefited farmers within 16 years.

Although development of irrigation area by the PIS was initiated in 1975 aiming at rapid magnification of irrigated farming, this was discontinued in 1984 due to high operation and maintenance costs borne by the farmers.

(4) Private Irrigation System

The private irrigation system, generally having an irrigation service area of less than 10 ha, is constructed and maintained by an individual. The private irrigation systems in the Basin consist of two (2) different types in view of intake method namely, pump irrigation systems and gravity ones.

Aiming at facilitating irrigation development of sporadic minor farmlands, the NIA had distributed small pump units to individuals on condition that the cost for pump unit was to be amortized by the individual concerned. In 1980, however, the NIA stopped issuing the new pump unit due to high costs required for operation and maintenance.

1.2 Existing Irrigation Systems

1.2.1 General

The Basin comprising some 27,300 km^2 has a large number of existing irrigation systems inclusive of on-going projects which cover a total irrigation service area of about 224,000 ha, which is further broken down into 150,800 ha commanded by the NISs, 58,300 ha by the CISs, 2,800 ha by the PISs and 12,100 ha by the private pump irrigation systems.

Since the irrigation service area of the private gravity irrigation systems is insignificant and the data on these systems are not available, their service areas are excluded from the above.

The irrigation service areas in the Basin are schematically shown in Fig. 1.1.

1.2.2 National Irrigation Systems/Projects

As of December 1986, there exist eight (8) NISs, while three (3) national irrigation projects (NIP) are under construction. The aggregate irrigation service areas of the NISs and the on-going NIPs comprise

131,480 ha and 19,317 ha, respectively.

Fig. 1.2 shows location of these systems/projects, the respective service areas of which are tabulated below.

Name of System/Project	Service Area (ha)	Time Completed
1. Existing System	131,480	
(1) Dummun River Irrigation System	2,070	Dec. 1982
(2) Zinundungan River Irrigation System	1,760	Jun. 1983
(3) Baggao Irrigation System	1,812	Jun. 1983
(4) Solana-Tuguegarao Irrigation System	3,143	Dec. 1979
(5) Pinacanauan River Irrigation System	1,200	1980
(6) Tumauini Irrigation System	3,987	Dec. 1983
(7) Chico River Irrigation System	20,108	Jun. 1986
(8) Magat River Integrated Irrigation System	97,400	Jun. 1986
2. On-going Project	19,317	Anticipated Completion ime
(1) San Pablo-Cabagan Irrigation Project	2,890	May 1986
(2) Mallig River Irrigation Project	2,427	Jun. 1986
(3) Cagayan Integrated Agricultural Development Project	14,000	Dec. 1988
Total	150,797	

(1) Existing National Irrigation Systems

There are six (6) existing NISs constructed by using local fund and two (2) NISs materiarized with financial assistance by IBRA and/or ADB. The former ones are the Dummun River, Zinundungan River, Baggao, Solana-Tuguegarao, Pinacanauan River, and Tunauini Irrigation Systems. While, the Chico River Irrigation System, Stage I and the Magat Integrated Irrigation System are those of the latter ones.

i) Locally Funded NISs

Among the six (6) locally funded NISs, the Tumauini Irrigation System (IS) is located in the province of Isabela, while other five (5) existing NISs concentrate in the province of Cagayan.

Except for the Solana-Tuguegarao Irrigation Systems (IS) which is presently served by the unregulated flow of the Cagayan river through two (2) pumping stations, other existing NISs are fed by the unregulated flow of the tributaries of the Cagayan river through respective gravity irrigation systems. Principal features of these existing NISs are summarized in Table 1.1.

Construction of these systems was initiated in the middle of 1970s by using local fund and completed in early part of 1980s. Although their respective irrigation service areas are as small as 2,300 ha on an average, it took five (5) to ten (10) years for construction due mainly to fund limitation. The following table shows construction period of each system.

	Name of System	Commencement Time	Completion Time	Period (years)
(1)	Zinundungan RIS	May 1974	Jun. 1983	9
(2)	Dummun RIS	Jan. 1975	Dec. 1982	7
(3)	Baggao IS	Jan. 1973	Jan. 1983	10
(4)	Solana-Tuguegarao IS	1974	Dec. 1979	5
(5)	Pinacanauan RIS	1977	1980	3
(6)	Tumauini IS	Oct. 1974	Dec. 1983	9

Following the completion, the system came into full swing operation. However, actually irrigated areas of the Dummun RIS, Baggao IS, Solana-Tuguegarao IS, Pinacanauan RIS and Tumauini IS were always lesser than their irrigation service areas not only during the dry season cropping but also the wet season cropping as shown in Table 1.2. The inventory survey

revealed that deterioration and insufficiency of the facilities are common problems of these systems (See Table 1.1). Generally, existing intake works have sufficient design capacity for respective service areas and are located properly. As for the Solana-Tuguegarao IS, however, the pump capacity has been aggravated seriously (Ref. IR-218), which limits possible irrigation area to a considerable extent eventually. Main and lateral canals are well aligned as a whole in any of the NISs. However, since all canals are of unlined earth canal regardless of soil texture and topographic condition, erosion, siltation and deterioration have occurred at many places. And canal embankment is generally insufficient in its width and height for the commanding area, which causes shrinkage of actual irrigation area.

Sufficient number of turnouts, structures to divert irrigation water from a main, lateral or sublateral canal to rotation areas, are adequately located in any of the systems. However, these turnouts consist only of a precast concrete pipe with an inlet box and are equipped with neither control gate nor measuring device. Farm ditches are provided for in all the systems, but its density varies from system to system ranging from 10 to 60 m/ha, more than 50% of which are poor in condition in general due to lack of maintenance works. Streams and creeks function well for drainage. No farm drains have been constructed in general.

ii) Chico River Irrigation System, Stage I (Ref. IR-208, 209)

The Chico River Irrigation System Stage I with a total irrigation service area of 20,108 ha, extends over Tabuk and Pinukpuk municipalities in the province of Kalinga Apayao, Tuao municipality in the province of Cagayan, and Quezon and Mallig municipalities in the province of Isabela.

The system covers; (i) development of farmlands for a year-round irrigation by using the unregulated flow of the Chico river, and (ii) improvement of provincial roads with a total length of 65 km. The irrigation component comprises:

a. construction of a diversion dam and intake facilities on the Chico river,

b. construction of a catch dam and intake facilities on the Talaca creek,
c. rehabilitation and improvement of the existing irrigation and drainage facilities for rice lands of 1,624 ha, and
d. construction of new irrigation and drainage facilities for rainfed farmlands of 18,484 ha.

General layout of the project is shown in Fig. 1.3.

The project has been implemented since March 1976 with financial assistance by IBRD. Improvement works of the provincial roads were completed in 1981. And the Chico diversion dam as well as the intake facilities were constructed by 1983. As of December 1986, irrigation and drainage facilities have been provided for 99 % of the service area. And hence, it is regarded as the existing system although its target completion date is set in December 1987 (Ref. IR-322).

Partial operation were commenced in November 1983 for an area of 4,700 ha and were reportedly extended in 1985 for an area of 7,000 ha for the wet season cropping and 11,200 ha for the dry season cropping.

iii) Magat River Integrated Irrigation System (Ref. IR-210)

The Magat River Integrated Irrigation System (MRIIS), which is the irrigation component of the Magat River Multipurpose Project (MRMP), is located in the province of Isabela. The irrigation area occupies 97,400 ha of rice lands, extending over alluvial terrace in the flood plain of the Cagayan, Magat and Siffu rivers.

The MRMP aimed at introducing a year-round irrigation of paddy over an area of 102,000 ha and hydroelectric power generation. The proposed principal project components were:
a. upgrading and rehabilitation of 40,000 ha of existing Magat River Irrigation System (MARIS);
b. upgrading and rehabilitation of 12,000 ha of existing Siffu River Irrigation System (SIFRIS);

c. expansion of irrigation system for an area of 49,800 ha;
d. construction of Magat dam with a reservoir of a gross storage capacity of $1,254 \times 10^6$ m^3; and
e. installation of a hydroelectric plant with a capacity of 360 MW.

General map of the MRMP is shown in Fig. 1.4.

Because of the physical size, large estimated cost and long construction period, a staged implementation was scheduled as follows:

a. Stage IA; consisting of upgrading and rehabilitation of 40,000 ha of MARIS;
b. Stage IB; consisting of the upgrading and rehabilitation of 12,200 ha of SIFRIS and expansion of the irrigation system for an area of 22,800 ha; and
c. State II; consisting of the construction of the Magat dam and power plant and extension of the irrigation system for an area of 27,000 ha.

Stage IA was implemented with the financial assistance by the Asian Development Bank (ADB) during the period of April 1976 - December 1978, while Stage IB was constructed with the help of a loan from the IBRD during the period of March 1975 - December 1983. The implementation of Stage II were commenced in January 1979 with a financial aid by the IBRD. The construction of the Magat dam was completed in October 1982, while extension of the irrigation system of Stage II were completed in December 1986. By completion of Stage II, the service area of the MRIIS totalled to 97,400 ha eventually, instead of the proposed area of 102,000 ha.

At the initial stage of the implementation of the MRMP, irrigation by the existing systems was limited to 40,000 ha in the wet season and 19,000 ha in the dry season. After completion of the Magat dam in 1982, however, irrigation area increased drastically. In 1984/85, irrigated area reached about 70,000 ha for the dry season crop and 75,000 ha for the wet season crop, respectively.

(2) On-going National Irrigation Projects

Two (2) locally funded and one (1) foreign assisted irrigation projects are now under construction (as of December, 1985). The locally funded projects are the San Pablo-Cabagan Irrigation Project and Mallig River Irrigation Project. The foreign assisted one is the Cagayan Integrated Agricultural Development Project.

i) San Pablo-Cabagan Irrigation Project (Ref. IR-221)

The San Pablo-Cabagan Irrigation Project covers farmlands of 2,890 ha extending over left bank of the Pinacanauan River. The project works comprise intake facilities on the Pinacanauan river, a catch dam and a canal system including main and supplementary farm ditches.

Construction works started in May 1979 and it was scheduled, as of December 1985, to be completed in May 1986.

Partial operation were commenced in May 1984 following the completion of the intake facilities. However, irrigated area is still limited only to some 50 ha.

ii) Mallig River Irrigation Project

The Mallig River Irrigation Project, having an irrigation service area of 2,427 ha, is located in the municipality of Mallig of the province of Isabela.

The project works consist of a run-of-the river diversion dam, intake facilities and a canal system, which is served by the Mallig river.

Construction works were commenced in January 1976 and is being continued at present, and it was scheduled to be completed in June 1986. Pertial operation started in October 1980. As of December 1985, substantial works have been completed and rice fields of about 1,500 ha have been developed.

Actual irrigation area has gradually increased from 50 ha in 1980 to 1,260 ha for the wet season paddy in 1985.

iii) Cagayan Integrated Agricultural Development (Ref. IR-213, -214)

The Cagayan Integrated Agricultural Development Project (CIADP) aimed at development of water supply system for a year-round irrigation to rice lands of 14,000 ha, rural electrification for five (5) municiparities and establishment of processing facilities and marketing facilities.

The project area of 14,000 ha consists of three (3) separate areas: Iguig area of 775 ha; Alcala-Amulung area of 2,350 ha; and Lower Cagayan area of 10,875 ha, all of which are located in the province of Cagayan.

The irrigation component of the project covers:

a. construction of three (3) pumping stations on the Cagayan river with the following principal features.

Description	Unit	Iguig PS	Amulung PS		Magapit PS
Pump type		Vertical mixed flow	Vertical mixed flow		Vertical mixed flow
Nos. of unit	set	3	1	3	4
Bore	mm	600 x 500	800x800	600x800	1,800x1,500
Unit capacity	m^3/min	37.6	80.0	70.5	340
Total head	m	13.7	13.6	20.5	14.6

b. construction of three (3) irrigation and drainage systems for respective Iguig, Alcala-Amulung and Lower Cagayan areas.

c. improvement of existing farm roads and construction of new main farm and feeder roads.

General map of CIADP is shown in Fig. 1.5.

Implementation of the project was commenced in April 1977 with the financial assistance by Overseas Economic Cooperation Fund (OECF), Japan,

and it is scheduled to be completed in December 1988.

Following the completion of the pumping stations, irrigation water have been supplied to part of the project area as tabulated below;

P.I.S.	Service Area(ha)	Irrigated Area (ha)					
		1983		1984		1985	
		DS	WS	DS	WS	DS	WS
Iguig	775	-		-	202	403	417
Alcala-Amulung	2,350	-	522	604	576	1,184	1,162
Lower Cagayan	10,875	-	-	-	-	57	270

1.2.3 Communal Irrigation Systems

Irrigation development by the CIS in the Basin was initiated by the farmers in the Spanish regime and continued until 1960s. In 1950's, the Government agencies started the construction of the CISs. As of December 1985, there exist 1,156 of the CISs with an aggregate service area of 58,290 ha.

Generally, the CIS is served by the unregulated flow of small rivers and streams. An intake without diversion weir is the most common diversion system. The canal system consists of main and lateral canals. Provision of farm ditches is limited to those constructed recently by the NIA.

The salient features of the CISs are incorporated in the Data Book, and their locations are shown in Fig. 1.2. The number of CISs and their respective aggregate areas for each province in 1985 are summarized below;

	Name of Province	No. of System	Service Area(ha)	Ratio of Irrigated Area		
				Wet Season	Dry Season	Annual
1.	Cagayan	37	6,347	0.91	0.98	1.89
2.	Kalinga-Apayao	103	5,998	0.59	0.42	1.01
3.	Isabela	34	5,560	0.89	0.18	1.07
4.	Ifugao	170	6,473	0.43	0.52	0.95
5.	Nueva Vizcaya	233	25,871	0.87	0.78	1.65
6.	Quirino	36	4,871	0.31	0.27	0.58
7.	Mountain	543	3,170	0.68	0.97	1.65
	Total	1,156	58,290	0.73	0.63	1.36

An irrigation intensity, a ratio of irrigated area to service area, varies year to year depending upon fluctuation of river discharges and other reasons. The annual irrigation intensity of the whole CISs in the Basin in 1985 is estimated to be 1.36 comprising 0.73 for the wet season crop and 0.63 for the dry season crop. It also widely ranges among the provinces from 1.89 in the province of Cagayan to 0.58 in the province of Quirino.

As shown in the list of the salient features of CISs in Data Book, the actual irrigation area is much smaller than the service area in many CISs, which is reportedly attributed to the following reasons solely or compositely.

i) Service area is excessively demarcated in view of river discharge.

ii) Part of the service area is left undeveloped after establishment of canal system.

iii) Once part of the system has been deteriorated, the area being served by which is abonduned due to insufficiency of fund for operation and maintenance which should be borne by the water users association.

1.2.4 Pump Irrigation System

The PISs have been constructed since the middle of 1970's by the FSDC. As of end 1985, 40 PISs have been completed and one (1) PIS is under construction. An aggregate irrigation service area of these PISs is about 2,800 ha in the whole Basin. Due to high costs for operation and maintenance, however, these areas are not always served. Main features of the PISs are listed in Table 1.3. The composition and total area of the PISs for each province is tabulated below;

	Name of Province	Number of PIS	Service Area (ha)
1.	Cagayan	11	788
2.	Kalinga-Apayao	1	30
3.	Isabela	21	1,652
4.	Ifugao	3	130
5.	Nueva Vizcaya	1	32
6.	Quirino	3	210
7.	Mountain	0	-
	Total	40	2,842

1.2.5 Private Irrigation System

A small number of gravity type private irrigation systems have been constructed and operated by individuals in the Basin. Since the data on those systems are not available, their locations and irrigation service areas could not be identified.

Pump units issued to individual farmers by the NIA from 1973 to 1979 reached to 3,365 units, whose aggregate irrigation service area totalled 30,872 ha. As of December 1985, however, operational pump units were reduced to 1,825 in number due to deterioration, loss, diversion of pump units, etc. thereby resulting in reduction of irrigation service areas to about 12,000 ha. Distribution of these pump units serving the irrigation areas for each province is shown below;

Private Pump Irrigation System

Name of Province	Pump Issued System		Operation System	
	No. of System	Service Area(ha)	No. of System	Irrigated Area(ha)
Cagayan	889	7,802	456	3,783
Kalinga-Apayao	236	1,741	92	419
Isabela	1,791	17,375	962	4,800
Ifugao	112	708	75	568
Nueva Vizcaya	162	1,996	146	1,849
Quirino	171	1,220	90	629
Mountain	4	30	4	30
Total	3,365	30,872	1,825	12,078

II PRESENT IRRIGATION PRACTICES

2.1 Present Irrigation Practices of NISs

Operation and maintenance of the NIS are conducted by the system office (O & M Office) under the NIA from headworks to turnouts on sublateral canals. Operation and maintenance of farm ditches are carried out by farmers with the technical assistance of the system office. One gate keeper is assigned for gate operation, and water masters are appointed for gate operation of the turnouts on the main to the sublateral canals. One water master is responsible for an irrigation area of 500-700 ha.

Generally, simultaneous irrigation is applied to the whole irrigation area, and rotational irrigation is occasionally conducted when water shortage takes place during the dry season. Present water supply, which is limited to rice cultivation, is practised in accordance with the water requirement calculated on the monthly basis by the following manner.

i) Land soaking/land preparation requirement

$$WR_{LS/LP} = \frac{Sn + S + (Ev + P)(t - 7)}{t} \times \frac{A_1}{8.64}$$

$$Sn = \frac{(SC-MC) \times Bd}{100} \times Drz$$

where, $WR_{LS/LP}$: Land soaking/land preparation requirement (L/s)

Sn : Land soaking water requirement (mm/day)

S : Depth of ponding (50 mm)

Ev : Evaporation (mm/day)

P : Percolation rate (mm/day)

t : Total number of days for land soaking and land preparation

A_1 : Area under land soaking/preparation (ha)

Sc : Soil saturation capacity (%)

Mc : Soil moisture content (%)

Bd : Bulk density

Drz : Depth of root zone (300 mm)

In the above equation, evaporation is assumed to be constant throughout a cropping season or sometimes throughout a year.

ii) Crop water requirement

$$WR_{cm} = \frac{(Et + P)\ A2}{8.64}$$

where, WR_{cm} : Crop water requirement after transplanting (L/s)

Et : Evapotranspiration (mm/day)

A2 : Area under crop maintenance (ha)

The evapotranspiration is generally determined to be constant throughout a cropping season regardless of the growing stage of the crop.

iii) Farm water requirement

$$WR_T = WR_{LS/LP} + WR_{cm} - Re\ \frac{A_1 + A_2}{8.64}$$

where, WR_T : Farm water requirement (L/s)

Re : Monthly mean daily effective rainfall (mm/day)

The monthly mean daily effective rainfall used in the above equation is an average effective rainfall during the last 5 - 10 years except extraordinarily wet or dry year(s). In case daily rainfall is equal to or less than 50 mm, all rainfall is regarded as effective rainfall. And in case daily rainfall exceeds 50 mm, 50 mm is considered to be effective rainfall.

iv) Diversion water requirement

$$IDR = \frac{WR_T + FW + DL}{1 - \frac{CTL}{100}}$$

where, IDR : Diversion water requirement (L/s)

FW : Farm waste

DL : Distribution loss

$FW + DL = 0.3\ WR_T$

CTL : Conveyance loss (%)

2.2 Present Irrigation Practices of CISs and PISs

Operation and maintenance of both the CISs and the PISs are carried out by the water users association. Only the peak unit diversion water requirement has standard figure of 1.5 - 2.5 L/s/ha, and all the irrigation practices are dependent on farmer's experiences.

2.3 Intake Discharge Record

Each system office (O & M Office) of the NIS maintains daily intake discharge record. However, the records are fragmentary and unreliable in the absence of measuring device. It is, therefore, hardly possible to examine based on those discharge records whether the present water use is sufficient. Intake discharge records collected are compiled in the Data Book. As for the CIS, PIS and the Private Irrigation System, no intake discharge records are available.

III EXISTING IRRIGATION DEVELOPMENT PLAN

3.1 Nationwide Development Plan (Ref. IR-308)

The NIA issued Corporate Plan 1983-1992 Version 3.1/1983 in May 1983, which presents thrusts, program and strategies of the agency during the period 1983-1992 and an indicative irrigation development program up to 2000.

Irrigation development during the period 1983-1992 are physically programmed to develop and rehabilitate the total areas of 581,120 ha and 405,060 ha, respectively. New areas to be developed under National Irrigation Projects (NIP) and Communal Irrigation Projects (CIP) are estimated to be 424,490 ha and 156,630 ha, respectively.

From 1993-2000, emphasis on irrigation development would be focused on CIPs at relatively modest scale compared to the next decade plan, and rehabilitation of systems. In this period, physical area target for new development is programmed to be 123,300 ha in total consisting of 45,300 ha for NISs and 78,000 ha for CISs, while that for rehabilitation totals up to 167,150 ha comprising 56,750 ha for NISs and 110,400 ha for CISs.

Annual physical target for the plan period are shown in Table 3.1 and 3.2. Annual fund requirement for the corresponding period is shown in Table 3.3.

3.2 National Irrigation Project

There are three (3) major irrigation development and one O & M improvement plans in the Basin and one (1) nationwide irrigation support program, which all of the existing NISs as well as on-going NISs in the Basin are involved in. The former ones are the Chico River Irrigation Project Stage II, the Matuno River Development Project, the Dabubu River Irrigation Project and The Improvement Project of the O & M of Magat River Integrated Irrigation System. The latter one is the Irrigation Operation

Support Program.

(1) Chico River Irrigation Project, Stage II (Ref. IR-207, -208, & -209)

The feasibility report on the Chico River Irrigation Project prepared by the NIA in 1975, proposes the development of agricultural lands of 49,000 ha in two (2) stages. Stage I, being implemented at present and to be completed in June 1986, is dependent on the unregulated flow of the Chico river. The Stage I works consist of construction of a run-of-the river diversion weir on the Chico river and construction of an irrigation system for an area of 21,000 ha.

Stage II, which is expected to rely on dependable water generated by the Chico IV storage dam to be constructed at about 20 km upstream from the existing diversion weir on the Chico river, involves the establishment of irrigation systems for an additional area of 28,000 ha. The project area is located near the provincial boundaries of Isabela, Cagayan and Kalinga-Apayao.

At full development, double cropping of rice a year with a cropping intensity of 190% is proposed to introduce to the whole commanding area of 49,000 ha. The economic rate of return of the project (Stage I & Stage II) is expected to be about 15%.

As the Stage II was planned to be dependent on regulated flow from the Chico IV dam for hydro-power generation, and the feasibility study of the Chico IV project were underway when the feasibility report on the Chico River Irrigation Project was prepared, the project features of the Stage II were preliminarily drawn for economic evaluation of the project as a whole. It was intended, therefore, the feasibility study for the Stage II be carried out in coordination with a result of the feasibility study of the Chico IV dam and the availability of a regulated water supply.

Owing to the political reason, however, the Chico IV Dam Project was officially cancelled by the Government in December 1986. Consequently, the Stage II should be reformulated on the basis of another water source.

(2) Matuno River Development (Ref. IR-201 & -202)

The proposed Matuno River Development Project with a gross area of 20,700 ha is located in the center of northern part of Nueva Vizcaya Province. The municipalities involved are Bagabag, Villa Verde, Solano, Bayombong and Bambang.

The feasibility study of the Matuno River Development Project was conducted during January 1872 - February 1984 by the NIA with the technical assistance of the Japan International Cooperation Agency (JICA).

Formulated as multipurpose project, it calls for the development of agriculture, hydropower and flood control. The agricultural development plan proposes to introduce a year-round irrigation to the entire project area with the provision of two (2) diversion weirs on the Matuno and Magat rivers and irrigation and drainage facilities for an area of 12,680 ha.

The hydropower development plan involves the construction of a storage dam of 147 m high with a 6 km pressure tunnel on the Matuno river and installation of 180 MW power plant. It is expected that the proposed reservoir would ensure stable water supply for irrigation in periods of severe drought which would occur twice in a 20-year period, and would reduce design flood at the damsite from 10,300 to 6,800 m^3/s.

Since flood control by the Matuno dam would not be sufficient to completely protect the project area from flood damage, a flood protection dike is proposed to be constructed along a 13.5 km portion on the left bank of the Magat river.

The economic rate of return is estimated to be 18.9% for the agricultural development plan and 15.7% for the multipurpose development plan.

(3) Dabubu Irrigation Project (Ref. IR-219)

The Dabubu Irrigation Project is one of the sub-projects of the Communal Irrigation Development Project (CIDP). The feasibility study of the Dabubu irrigation project was conducted by the NIA Region II office.

The project area, having net irrigation area of 1,000 ha, is located in the municipality of San Agustin, province of Isabela.

The project aims at introducing a year-round irrigation with a cropping intensity of 200% to the whole project area, most of which consist presently of rainfed farmlands.

Proposed works include a run-of-the river diversion weir on the Dabubu river which is one of the tributaries of the Cagayan river, a irrigation canal system and on-farm facilities.

Economic internal rate of return (EIRR) is estimated to be 34% according to the feasibility report prepared by the NIA Region II office.

(4) Irrigation Operation Support Program (Ref. IR-220)

The Irrigation Operation Support Program (IOSP) is a program aiming to provide adequate and timely funds for operation and maintenance of all national irrigation systems in the country which are operated and maintained by the NIA.

The IOSP includes: i) restoration and upgrading works of the existing systems; ii) procurement of operation and maintenance (O & M) equipment including necessary spare parts; iii) training of regional staff, systems O & M staff, institutional development workers, farmer leaders and trainers; iv) establishment of Barangay Action Center; v) development of Irrigators Association (IA); and vi) systems level financing of recurrent O & M expenditures.

Since the project component are of various aspects including time consuming works such as item iii) and iv) above and the project covers all the NISs in the country, the IOSP is planned to be implemented in three (3) packages over a nine-year period. Major work items in each package is summarized in Table 3.4.

(5) Improvement Project of the O & M of Magat River Integrated Irrigation System (Ref. IR-222 & -223)

As mentioned precedently, the Magat River Integrated Irrigation System (MRIIS) had been developed since April 1976 and was completed for the net irrigation service area of 97,400 ha in December 1986. With a view to undertaking integrated operation and maintenance (O & M) of the MRIIS including the Magat reservoir, an organization for the O & M was established in 1984, by which the O & M works for the MRIIS have been conducted since then. Through the O & M works, however, unexpected problems such as; i) less actual irrigation area than designed one, ii) inproper water allocation to the service area, iii) low production yield and high production cost, iv) insufficient activities of O & M organization, etc. have emerged recently.

In order to overcome these problems radically, the NIA commenced the master plan study on the Improvement Project of the O & M of Magat River Integrated Irrigation System in March 1986 with the technical assistance of the JICA. It is scheduled to complete in July 1987.

The master plan study recommends the following to achieve the largest possible paddy production, to keep and utilize the system as long as possible, and to increase the farmers' income and stabilize the regional economy and peoples' livlihood:

- Expansion of actual irrigation area to 97,400 ha,
- Improvement of water management,
- Improvement of system facilities,
- Improvement of on-farm facilities,
- Reinforcement of O & M organization,

- Assurance in financial viability of the O & M office,
- Improvement of paddy cultivation,
- Reinforcement of farmers' institution, and
- Improvement of governmental supporting services.

Implementation of the MRIIS O/M improvement works, consisting of two categories classified largely such as improvement of system facilities and water management in the Service Area and strengthening of farmers' institution, are planned to be a five-year program from 1988 to 1992.

The required costs for the improvement works are estimated at 1,060 million pesos, 705 million pesos of foreign currency and 355 million of local currency.

IV POTENTIAL IRRIGATION AREA

4.1 Land Resources for Agricultural Development

The potentially cultivable area is defined to lands with slope less than 18%, which occupies 58% of the Basin area or 15,800 km^2 gross. It is further classified into several categories in respect of land suitability for paddy and diversified crops and summarized below (Ref. Chapter V of ANNEX AG):

(Unit: km^2)

Suitability	For Paddy	For Diversified Crop
1. Highly suitable	3,110	490
2. Moderately suitable	660	2,270
3. Marginally suitable	530	5,220
4. Limitedly Arable	460	2,820
5. Non-Arable	11,040	5,000
Total	15,800	15,800

On the basis of the above land classification, potential area for agricultural development in the Basin is estimated to be 10,800 km^2, which is broadly divided into a lowland area with a land slope less than 8% of 4,760 km^2 and a upland area with a slope between 8% and 18% of 6,040 km^2. Irrigation development is proposed to be concentrated in the lowland area, while the upland area is contemplated to be developed under rainfed condition (Ref. Chapter V of ANNEX AG).

4.2 Potential Irrigation Area

Lowlands area suitable for irrigated agriculture in the Basin is estimated to be 476,000 ha, of which the existing irrigation service area occupies 224,000 ha in total, and a potentially irrigable area of 252,000 ha, corresponding to 53% of the total area, still remains

undeveloped in view of irrigation.

Of the potential irrigable area, an aggregate area of 82,400 ha are identified as promising irrigable area. Identification of the promising irrigable areas are based on the topographic maps on a scale of 1:50,000 with the aid of the topographic maps of 1:25,000 scale and field reconnaissance. Macro and micro topographic conditions with respect to slopes are the main factors used in the identification of the areas. Other factors considered are present land use, soil conditions and river areas proposed in the flood control plan in the present study. The lands identified as the promising irrigable area are those that meet with the following conditions:

i) lands with slope less than 3%;
ii) a land area more than 100 ha each;
iii) soils suitable for paddy and/or diversified crops; and
iv) present land use of paddy, diversified crops or grass lands.

Thus identified promising irrigable areas, shown in Fig. 4.1, are further classified into two (2) categories taking its area extent and each location into account, i.e., an aggregate area of 53,800 ha to be developed under National Irrigation Project (NIP) and a total area of 28,600 ha to be developed under Communal Irrigation Project (CIP).

Existing communal irrigation areas of 11,500 ha out of total area of 58,300 ha are enclosed by or adjacent to the promising irrigable area to be developed under NIP. It is, therefore, considered that those areas should be integrated into the NIPs when the NIPs are formulated.

V CRITERIA FOR PRELIMINARY STUDY ON CANDIDATE SCHEMES

5.1 Concept of Irrigation Development

The principal objectives of irrigation development are to increase agricultural products and to secure stable agricultural production by means of providing adequate irrigation systems, drainage systems and operation and maintenance (O & M) facilities.

Basic requirement of the irrigation system is to supply stable perennial irrigation water to a service area and to assure equitable and timely distribution of water to fields, which deems to be essential for introducing modernized irrigation farming.

Since paddy is the main crop of the candidate schemes, only the surface drainage system is considered in the present study. Basic requirement of the drainage system is to avoid excessive and prolonged submergence of crops by excess water caused by storm runoff or over application and to expedite drying practices whenever needed.

The O & M facilities are prerequisite to operate the irrigation system effectively in response to desirable farming practice and to maintain function of the irrigation and drainage systems properly.

5.2 Criteria for Preliminary Study

As the preliminary study primarily aims at setting forth a priority ranking of each candidate scheme for its implementation, unified methodology and criteria are employed for formulating development plan of the scheme so that all the schemes could be evaluated on the same basis. The methodology and criteria employed are worked out in such a way that the development plan fulfill the above-mentioned basic concept in the most effective and economical manner, and are discussed in succeeding sections.

For the preliminary study, two (2) types of the cropping patterns for paddy are considered. One is established giving priority over the profit, while the other is formulated putting emphasis on water saving, leading to cost reduction. The proposed cropping patterns for each of the candidate schemes are discussed in Chapter VI of ANNEX AG. The preliminary study on each candidate scheme is conducted for the both types of the cropping pattern.

5.2.1 Irrigation Water Requirement

Methodology and calculation basis of the irrigation water requirement is discussed in Chapter IX.

5.2.2 Irrigation and Drainage System

Facilities required for irrigated agriculture are broadly divided into: i) irrigation system, ii) drainage system, and iii) operation and maintenance (O & M) facilities.

(1) Irrigation System

The irrigation system consists of intake facilities, main and lateral/sublateral canals, main and supplementary farm ditches and structures related to those canals.

A gravity irrigation system is the first consideration. A pump irrigation system is taken into account only when a gravity type intake is not economically viable.

A main canal is to convey irrigation water from an intake site to a service area. Irrigation water in the main canal is diverted to lateral canals at strategic points or directly to rotation areas through turnouts on the main canal where provision of the lateral canal is not economical. A lateral canal, branching off from the main canal, is to distribute irrigation water to rotation areas through turnouts on the lateral canal or to divert it to sublateral canals. The sublateral canals, diverging from

the lateral canal, are provided to supply irrigation water to the rotation areas where the service area is undulating or irregularly dissected by creeks and streams.

The service area is subdivided into the rotation areas with a standard area of 50 ha. The rotation area is delineated to be rectangular in shape with 1,000 m in length and 500 m in width as much as possible. Other factors to be considered in delineating the rotation areas are route of main, lateral/sublateral canals, existing roads, natural drains, topography, etc.

On-farm canals consisting of main and supplementary farm ditches, are provided within the rotation area. In the preliminary study, only typical layout is considered as shown in Fig. 5.1. The main farm ditch conveys water from the turnout on the main, lateral or sublateral canal to supplementary farm ditches, while the supplementary farm ditch supply water through division boxes on the main farm ditch to paddy fields. Based on the typical layout, the standard density of the main and supplementary farm ditches is assumed to be 20 m/ha and 50 m/ha, respectively.

Structures related to the irrigation canals are those for conveyance, regulation and measurement of irrigation water and protection of the canals.

(2) Drainage System

The drainage system comprises farm drains, collector drains, main drains and structures related to those canals.

The farm drains including main and supplementary farm drains are a small drainage canals to collect excess water on the fields and convey it to the collector drain or natural drain. They are provided within the rotation area. The standard density of the main and supplementary farm drains is assumed at 16 m/ha and 50 m/ha, respectively based on Fig. 5.1. The collector drain is a channel to convey drainage water to the main drain or natural drain. The main drain is a channel to discharge water fed by

the collector drains to the natural drain.

Related structures of the drainage canals are mainly of conveyance structures such as siphons and culverts.

(3) O & M Facilities

O & M facilities considered in the preliminary study are O& M roads and their related structures.

As a rule, O & M roads are provided along the whole reaches of the irrigation canals. O & M roads for the main and lateral/sublateral canals are all-weather road and wide enough for passage of vehicles and equipment for maintenance works. O & M roads for the main and supplementary farm ditches are for pedestrian.

5.2.3 Preliminary Design of Irrigation Facilities

(1) Design Discharge

The unit design discharge for the preliminary design of intake facilities, the main and lateral/sublateral canals and related structures is determined to be peak unit diversion water requirement which corresponds to that with a 5-year return period. While that for the on-farm facilities is determined so as to meet land soaking requirement including farm application loss.

The design discharge of each irrigation facilities is obtained by multiplying the unit design discharge by its commanding area.

The unit designs discharge thus calculated for respective alternative schemes are shown in Table 5.1.

(2) Design of Canals

In general, all the irrigation canals are of unlined trapezoidal earth canal and lined canal is limitedly provided to the portions where construction of the earth canal is impossible or unfeasible due to engineering and/or environmental reasons.

Preliminary design of the canals is based on the Manning's formula with the following conditions.

Roughness coefficient

Canals	Roughness Coefficient
I. Unlined earth canals	
a) Main & lateral canals	0.025
b) Farm ditches	0.030
II. Lined canals	
a) Cast in situ concrete	0.018
b) Pre-cast concrete	0.020

Permissible velocities

Canals	Permissible Velocity (m/s)
1. Main & lateral canals	
a) Earth canal	0.3 - 0.8
b) Concrete lining canal	0.3 - 2.0
2. Farm Ditches	0.3 - 0.6

Side slopes

Canal	Inside slope	Outside slope
1. Main & lateral canals		
a) Earth canal	1.5 : 1	1.5 : 1
b) Concrete lining canal	1 : 1	1.5 : 1
2. Farm Ditches	1 : 1	1 : 1

(3) Related Structures

Relating to the irrigation canals, many kinds and a number of structures are required to effectively and efficiently convey, regulate and measure the discharge in the canal and also to protect the canal from external storm runoff and internal excess water caused mainly by missoperation. Those structures are broadly divided into i) conveyance structures, ii) regulating structures, iii) water measurement structures, iv) protective structures and v) other structures.

In addition to the proposed canal itself, various types of conveyance structures are necessary to convey water across the tributaries, canals, road, etc. They include aqueducts, siphons, culverts and drops.

The regulating structures considered are headgates, turnouts, division boxes and checks. The first three structures are provided for regulating canal discharge. The last one is provided to raise canal water surface when the canal is flowing at less than design capacity. The headgates are placed to divert the required water from a main canal to lateral canal(s) or a lateral canal to sublateral canal(s). The turnouts are installed to divert the required water from a main, lateral or sublateral canal to a rotation area. The division boxes are provided to distribute water in a main farm ditch to supplementary farm ditches. The checks are provided to raise and maintain the canal water surface when the canal is flowing at partial capacity so that the turnout can deliver the required discharge properly. The checks are placed at appropriate intervals along the canal

to fulfill function of all turnouts.

The water measurement structures are indispensable for effective and equitable water distribution. They are provided at strategic points such as upstream end of the main, lateral/sublateral canals and the main farm ditches. A broad crested weir and a parshall flume are those considered for the candidate schemes.

The protective structures are those designed to keep the canal safety against internal excess water caused by storm runoff or incidental missoperation and external storm runoff. The structures proposed are spillways, wasteways, drain inlets and cross drains.

5.2.4 Preliminary Design of Drainage Facilities

(1) Design Discharge

The unit drainage water requirement is estimated with following assumptions and procedure:

i) Daily rainfall data observed at the following four (4) rain gauges are adopted for estimating drainage requirement of respective candidate schemes.

Name of Project	Rain Gauges/1
1. Zinundungan Irrigation Extension Project	Aparri
2. Alcala-Amulung West Irrigation Project	Tuguegarao
3. Chico Millig Irrigation Project	Tuguegarao
4. Tuguegarao Irrigation Project	Tuguegarao
5. Lulutan Irrigation Project	Ilagan
6. Ilagan Irrigation Project	Ilagan
7. Gappal Irrigation Project	Echague

Name of Project	Rain Gauges/1
8. Matuno River Irrigation Project	Ref. IR-202
9. Dabubu River Irrigation Project	Echague

/1 Ref. Chapter I of ANNEX HY.

ii) Design storm rainfall adopted in the present study is a 1-day and a 3-day probable maximum rainfall with a 10-year return period of excess probability.

Rain Gauge	Storm rainfall (mm)	
	1-day	3-day
Aparri	320	439
Tuguegarao	258	338
Ilagan	184	267
Echague	205	377

iii) Unit drainage requirement in the paddy fields: Assuming that retention of rainfall in the paddy fields is allowed up to 100 mm and also taking submergence tolerance of rice into account (Ref. IR-311), the unit design discharge in the paddy fields is calculated by the following equation:

$$q_1 = \frac{R - D}{8.64\ T}$$

where, q_1 : unit design discharge (l/s/ha)

R : 3-day storm rainfall (mm)

D : retention of rainfall in paddy field (100 mm)

T : drainage period (3 days)

iv) Unit drainage requirement in the upland area is determined to remove excess water caused by a 4-hour rainfall with a 10-year return period so that retention of excess water could be limited within four (4) hours.

v) The unit drainage requirement for each alternative scheme, thus calculated, is presented in Table 5.2.

vi) The design discharges of respective canals and structures are calculated from the unit design discharge and their commanding area.

$$Q = q_1 A_1 + q_2 A_2$$

where, Q : design discharge (l/s)
q_1 : unit design discharge in the paddy fields (l/s/ha)
q_2 : unit design discharge in the diversified crop fields (l/s/ha)
A_1 : area of the paddy field (ha)
A_2 : area of the diversified crop field (ha)

(2) Design of Canals and Structures

Design of the drainage canals is carried out based on the Manning's formula with the following conditions.

a. Roughness coefficient: 0.03
b. Permissible velocity : 0.4 - 0.9 m/s
c. Canal type: trapezoidal earth canal with inside slope of 1.5:1

Structures related to the drainage canals are culverts and bridges.

5.2.5 Design of O & M Roads

All-weather gravel road is provided on the service area side bank of the main, lateral and sublateral canals. The width of the O & M road is determined to be:

Canal	O & M road	Top Berm (m)
1. Main canal	5.0(4.0)	1.0
2. Lateral, sublateral canals		
a) $Q > 0.3\ m^3/s$	5.0(4.0)	1.0
b) $Q < 0.3\ m^3/s$	3.5(2.5)	1.0
3. Farm ditches	1.0	0.5

(Figure in parenthesis shows an effective width.)

VI CANDIDATE SCHEMES FOR IRRIGATION DEVELOPMENT

6.1 Objective Area

An objective area of the candidate schemes for irrigation development totals up to 65,300 ha, which comprises whole the promising area of 53,800 ha to be developed under NIP and the existing CIS areas of 11,500 ha (Ref. Chapter IV).

In this objective area, nine (9) candidate schemes were delineated taking topography, location of each potential area, available water source, the existing irrigation development plan, etc. into account as shown in Table 6.1 and Fig. 6.1.

6.2 Irrigation Water Requirement

Irrigation water requirements of each new candidate scheme by proposed cropping patterns (Ref. Chapter VI of ANNEX AG) were calculated on a monthly basis in compliance with the calculation basis discussed in Chapter IX. They are shown in Table 6.2 to 6.11.

6.3 Irrigation and Drainage System

The preliminary planning of the canal system for each of the new candidate schemes were made on the topographic maps on a scale of 1:25,000. The general layouts of the schemes are shown in Fig. 6.2 to 6.11.

6.4 Chico Mallig Irrigation Project

The Chico River Irrigation Project Stage II was formerly formulated to be dependent for its water source on the Chico IV dam, which had been contemplated to construct aiming primarily at generating hydropower at about 20 km upstream from the existing Chico diversion weir (Ref. IR-207). In December 1986, however, the Chico IV dam project had officially been cancelled by the Government due to social circumstances, thereby the

development plan of the Stage II has lost its basis. Further, it would be unavoidable that the Chico siphon, constructed to connect the Chico diversion weir to the main canal system for both the Stage I and II, be limitedly used to serve only the Stage I area. In the present study, therefore, the Stage II were formulated anew with another water source as the Chico Mallig Irrigation Project.

The Chico Mallig Irrigation Project is located near the provincial boundaries of Isabela, Cagayan and Kalinga-Apayao. The net project area is 31,200 ha, which comprises four (4) separate areas; Chico East area of 8,100 ha, Liwan Gadu area of 9,000 ha, Enrile area of 4,100 ha and Magsaysay area of 10,000 ha.

Conceivable water source of the project is dependable water to be exploited by the proposed Mallig No. 2 dam. Since the catchment area of the dam is too small to provide sufficient water for the project, the remainder of the stream flow of the Chico river which is preferentially allocated for the Chico River Irrigation System Stage I (Chico RIS), is proposed to divert to the Mallig river basin through a proposed transbasin diversion channel with a total length of 5.6 km consisting of an open channel of 1.6 km long and a tunnel of 4.0 km long.

The required storage volume of the Mallig No. 2 dam for the irrigation purpose with a 80% dependability is worked out through water balance calculation (Ref. Chapter III of ANNEX WB) as follows:

	Required Storage Volume (10^6m)	
	Cropping Pattern-A	Cropping Pattern-B
1) Chico Mallig Project only	421	334
2) Chico Mallig Project + deficit of Chico RIS	537	480

The water balance calculation revealed that the unregulated flow of the Chico river would not satisfy the water requirement for the Chico RIS

during a drought flow period, and hence the required storage volume for the project is proposed to include that for making up the deficit of the Chico RIS.

The irrigation water released from the Mallig No. 2 dam would be conveyed to four (4) irrigation areas through a diversion canal system with a total length of 34.7 km, which is schematically shown in Fig. 6.12. A total length of the proposed main and lateral/sublateral canals are 135 km and 416 km, respectively.

The design discharge of the diversion canal is estimated to be 59.3 m^3/s at its head, which consists of 51.8 m^3/s for the project and 7.5 m^3/s for supplemental supply to the Chico RIS, and 28.4 m^3/s at its end. The design discharge of each proposed canal for the cropping pattern-A is shown in Fig. 6.13.

The salient features of the Mallig No. 2 dam is shown in Chapter V of ANNEX DA and those for the irrigation and drainage system is shown in Table 6.12.

6.5 Matuno River Irrigation Project

The Matuno River Irrigation Project with a net irrigation area of 12,680 ha, is located in the center of the northern part of the province of Nueva Vizcaya, extending over the alluvial plain along the left side of the Magat river.

The water source of the project would be the unregulated flow of the Sta Cruz and Sta Fe rivers and release from the proposed Matuno No. 1 dam on the Matuno river at about 17 km upstream from its confluence with the Sta Fe river.

The required storage volume for irrigation with a 80% dependability is estimated to be 66.7 x $10^6 m^3$ for the cropping pattern-A and 45.5 x $10^6 m^3$ for the cropping pattern-B (Ref. Chapter III of ANNEX WB).

Three (3) run-of-the river diversion weirs; Manamtam, Bayombong and Lanog diversion weirs, are newly proposed. The Manamtam diversion weir, which would serve relatively higher area of 1,090 ha, is located on the Matuno river at about 7 km upstream from its confluence with the Sta Fe river. The Bayombong diversion weir is proposed to construct on the Magat river near Bayombong City, and would serve most part (about 11,200 ha) of the project area. The Lanog diversion weir, a kind of catch dam, would be constructed on the Lanog river traversing the project area from south to east.

The existing canals are mostly integrated in the proposed system. The main canals of 90.4 km in total comprises 58.0 km of new canals and 32.4 km of existing ones. The lateral canals reaches 193,4 km in total, of which about 98.6 km are of the existing ones.

Design discharges of the each of proposed canal for the cropping pattern-A are shown in Fig. 6.14. The salient features of the project are summarized in Table 6.13 and those for the Matuno No. 1 dam is given in Chapter V of ANNEX DA.

6.6 Dabubu River Irrigation Project

The Dabubu River Irrigation Project is located at about 40 km southeast of Santiago, the commercial center in the province of Isabela. A net irrigation area of 1,000 ha extends over the right bank of the lower reaches of the Dabubu river, one of the tributaries of the upper Cagayan river.

The project would mainly rely on the unregulated flow of the Dabubu river for its water source. Since it cannot meet the irrigation water requirement by the proposed cropping patterns (Ref. Chapter II of ANNEX WB), dependable water would be generated by a small storage dam on a creek as a supplemental water source. The required storage volume of the dam with a 80% dependability is estimated to be 2.0×10^6 m^3 for the cropping pattern-A and 1.5×10^6 m^3 for the cropping pattern-B (Ref. Chapter III of ANNEX WB). The storage dam would be constructed just mountain side of the

main canal at 8 km downstream from its beginning point.

A run-of-the river diversion weir would be constructed on the Dabubu river at about 14.5 km upstream of its confluence with the Cagayan river. The irrigation water would be diverted through an intake to be constructed on the right side of the Dabubu river at the said diversion weir and would be conveyed to the project area through a main canal of 13.6 km long and lateral canals with a total length of 19.0 km. Neither main nor collector drains are proposed because natural drains such as small streams and creeks are located conveniently to discharge excess water from the project area. Design discharge at the intake is 1.22 m^3/s in case of the cropping pattern-A and 1.15 m^3/s in case of the cropping pattern-B, respectively. The irrigation flow diagram for the cropping pattern-A is given in Fig. 6.15. The salient feature of the project is summarized in Table 6.14 and those for the dam is given in Chapter V of ANNEX DA.

6.7 Zinundungan Irrigation Extension Project

The Zinundungan Irrigation Extension Project is located on the northern rim of the existing Zinundungan RIS, which extends over the left bank of the lower reaches of the Zinundungan river. The net irrigation area of the Zinundungan IEP is 1,750 ha, while the irrigation service area of the existing Zinundungan RIS is 1,760 ha.

The Zinundungan RIS is dependent for its water source on the unregulated flow of the Zinundungan river by which whole the service area is reportedly irrigated throughout a year (See Table 1.2). According to the results of the water balance calculation as shown in Table 6.15, however, it seems that the unregulated flow cannot afford to irrigate entire service area especially during the dry season. The following table shows the possibly maximum irrigation area by the unregulated flow with a 80% dependability.

Cropping Pattern-A		Cropping Pattern-B	
Wet season crop	Dry season crop	Wet season crop	Dry season crop
1,060 ha	810 ha	1,760 ha	780 ha

In order to ensure perennial irrigation to both the existing service area and the extension area, a storage dam is proposed to construct on the Zinundungan river at about 1 km upstream from the existing intake on the Zinundangan river. Required storage volume with a 80% dependability is estimated to be 53.1 x $10^6 m^3$ for the cropping pattern-A and 34.7 x $10^6 m^3$ for the cropping pattern-B (Ref. Chapter III of ANNEX WB).

The irrigation water released from the dam would be taken at the existing intake and conveyed to the extension area through the existing main canal and a new lateral canal with a length of 37.0 km. A new headgate would be provided on the existing main canal at 8 km downstream from its head to divert irrigation water to the new lateral canal.

No enlargement of the existing main canal is needed because it has a flow capacity of 5.89 m^3/s, which is sufficiently big compared with the integrated design discharge of 5.41 m^3/s in case of the cropping pattern-A and 5.60 m^3/s in case of the cropping pattern-B. The maximum design discharge of the new laternal canal is 1.84 m^3/s for both cropping patterns. The design discharges of the proposed canal for the cropping pattern-A is shown in Fig. 6.16.

The salient features of the proposed irrigation and drainage facilities are summarized in Table 6.16 and those for the dam are given in Chapter V of ANNEX DA.

6.8 Alcala Amulung West Irrigation Project

The Alcala Amulung West Irrigation Project is located at about 25 km north-north west of Tuguegarao city. The project area of 6,750 ha net extends over the left bank of the Cagayan river.

The irrigation water would be tapped from the Cagayan river through a proposed pumping station with a total pump head of 29 m, which would be located on the left bank of the Cagayan river at about 1.5 km upstream from the Buntun bridge. No water deficit for this project is expected according to the water balance calculation (Ref. Chapter II of ANNEX WB).

The design discharge at the head of a main canal is 9.38 m^3/s in case of the cropping pattern-A and 9.19 m^3/s in case of the cropping pattern-B. The irrigation water tapped would be conveyed to the project area through the main canal of 27.8 km long. The irrigation flow diagram, showing design discharges and lengths of the proposed canals, is given in Fig. 6.17. The salient features of the project is summarized in Table 6.17.

6.9 Tuguegarao Irrigation Project

The Tuguegarao Irrigation Project, having a net irrigation area of 1,400 ha, is located on the northern fringe of the Tuguegarao city.

The water source of the project would be the unregulated flow of the Pinacanauan de Tuguegarao river, which could afford to irrigate the project area throughout a year according to the result of the water balance calculation (Ref. Chapter II of ANNEX WB).

A pumping station with a total pump head of 23 m would be constructed on the right bank of the Pinacanauan de Tuguegarao river at about 6 km upstream from its confluence with the Cagayan river. Proposed main and lateral canals are 9.5 km and 14.9 km in total, respectively. The design discharge at the head of the main canal is 1.54 m^3/s in case of the cropping pattern-A and 1.43 m^3/s in case of the cropping pattern-B, respectively.

The irrigation flow diagram for the cropping pattern-A is shown in Fig. 6.18, and the salient features of the project are summarized in Table 6.18.

6.10 Lulutan Irrigation Project

The Lulutan Irrigation Project is located about 25 km northward of Cauayan city, extending over the left bank of the Cagayan river.

The project would depend for its water source on the unregulated flow of the Cagayan river. The water balance calculation proved that the stream flow would satisfy the demand even in the dry season (Ref. Chapter II of ANNEX WB).

The project area of 2,950 ha would be irrigated by a pump irrigation system. A pumping station is proposed on the left bank of the Cagayan river at about 10.5 km upstream of the confluence of the Cagayan and the Ilagan rivers. Starting at the pumping station, a main canal of 13.5 km would run to the north along the hills and terminate near the confluence of the Cagayan and the Siffu river. Required total head of the pumping station is 26 m, and its design discharge is 4.19 m^3/s in case of the cropping pattern-A and 4.10 m^3/s in case of the cropping pattern-B, respectively.

The irrigation flow diagram for the cropping pattern-A and the salient features of the project are shown in Fig. 6.19 and Table 6.19, respectively.

6.11 Ilagan Irrigation Project

The Ilagan Irrigation Project with a net irrigation area of 3,200 ha slenderly extends along the lower reaches of the Ilagan river.

Water source of the project would be the unregulated flow of the Ilagan river.