

NATIONAL IRRIGATION ADMINISTRATION (NIA)  
REPUBLIC OF THE PHILIPPINES

**THE STUDY  
FOR  
THE MAINTENANCE, REHABILITATION AND IMPROVEMENT  
PLANNING METHODOLOGY  
OF  
NATIONAL IRRIGATION SYSTEMS**

MAIN REPORT  
NOVEMBER 2006

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)  
SANYU CONSULTANTS INC.

## PREFACE

In response to a request from the Government of the Republic of the Philippines, the Government of Japan decided to conduct a study for the maintenance, rehabilitation and improvement planning methodology of national irrigation systems and entrusted the study to Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Takeuchi of Sanyu Consultants Inc. and consists of Sanyu Consultants Inc. between September, 2005 and September, 2006.

The team held discussions with the officials concerned of the Government of the Republic of the Philippines and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of the Philippines for their close cooperation extended to the study.

November 2006

Ariyuki Matsumoto,  
Deputy Vice President  
Japan International Cooperation Agency

Mr. Ariyuki Matsumoto  
Deputy Vice President,  
Japan International Cooperation Agency

November, 2006

Dear Mr. Ariyuki Matsumoto

Letter of Transmittal

We are pleased to submit to you the Final Report on the Study for the Maintenance, Rehabilitation and Improvement Planning Methodology of National Irrigation Systems (NISs) at the termination of the Study. The Report presents the study results of the Study, which has been implemented since September 2005, in close collaboration with the National Irrigation Administration (NIA), Republic of the Philippines.

The NIA constructed a number of irrigation facilities since its establishment in 1963. At present it manages 205 irrigation systems covering a total area of about 634,020 ha being called as the NIS. According to the survey undertaken by the System Management Department (SMD) of NIA, currently in 193 irrigation systems, only 22.4 percent of main canals and 17.9 percent of secondary canals are functioning properly. In this situation, maintenance, rehabilitation and improvement works for the NISs are considered to be the highest priority subjects for the irrigation policy in the Philippines.

Under the circumstances, the Study was implemented aiming at i) preparation of a manual for formulation and management of NISs inventory survey, ii) preparation of a manual for maintenance, rehabilitation and improvement planning methodology of NISs, and iii) carrying out technology transfer to the Philippine counterpart personnel through on-the job training in the course of the Study. Therefore, we expect this Report will contribute to develop capacity building of the NIA staff in formulating plans for the maintenance, rehabilitation and improvement of NISs..

We wish to take this opportunity to express our sincere gratitude to your Agency, the Ministry of Foreign Affairs, Ministry of Agriculture, Forestry and Fisheries of the Government of Japan, especially for Advisory Committee, which gave useful advice to the Study Team from time to time so as to smoothen the Study. We also wish to express our deep gratitude to the NIA, and related agencies of the Government of the Philippines for the close cooperation and assistance extended to us during our study period.

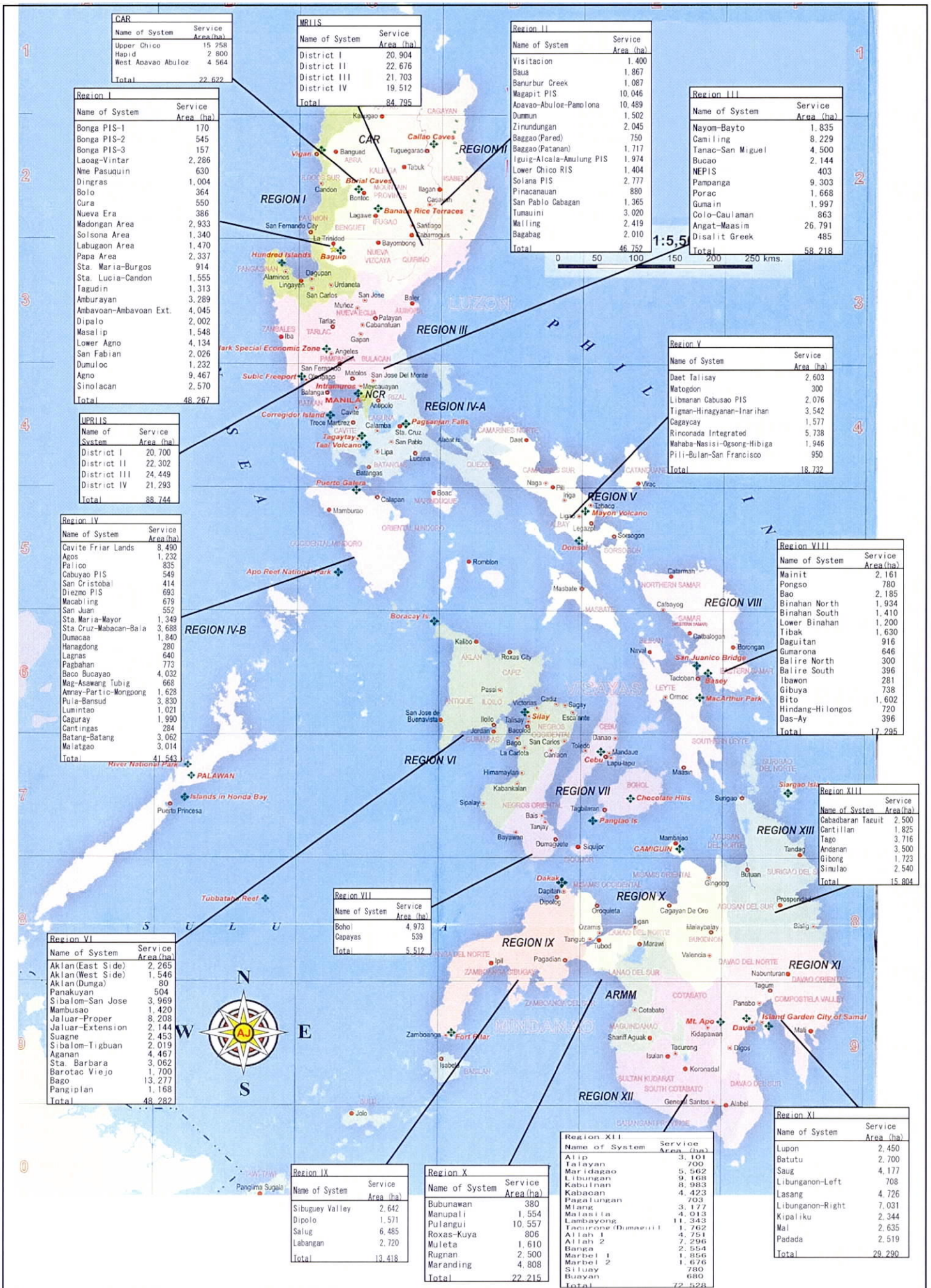
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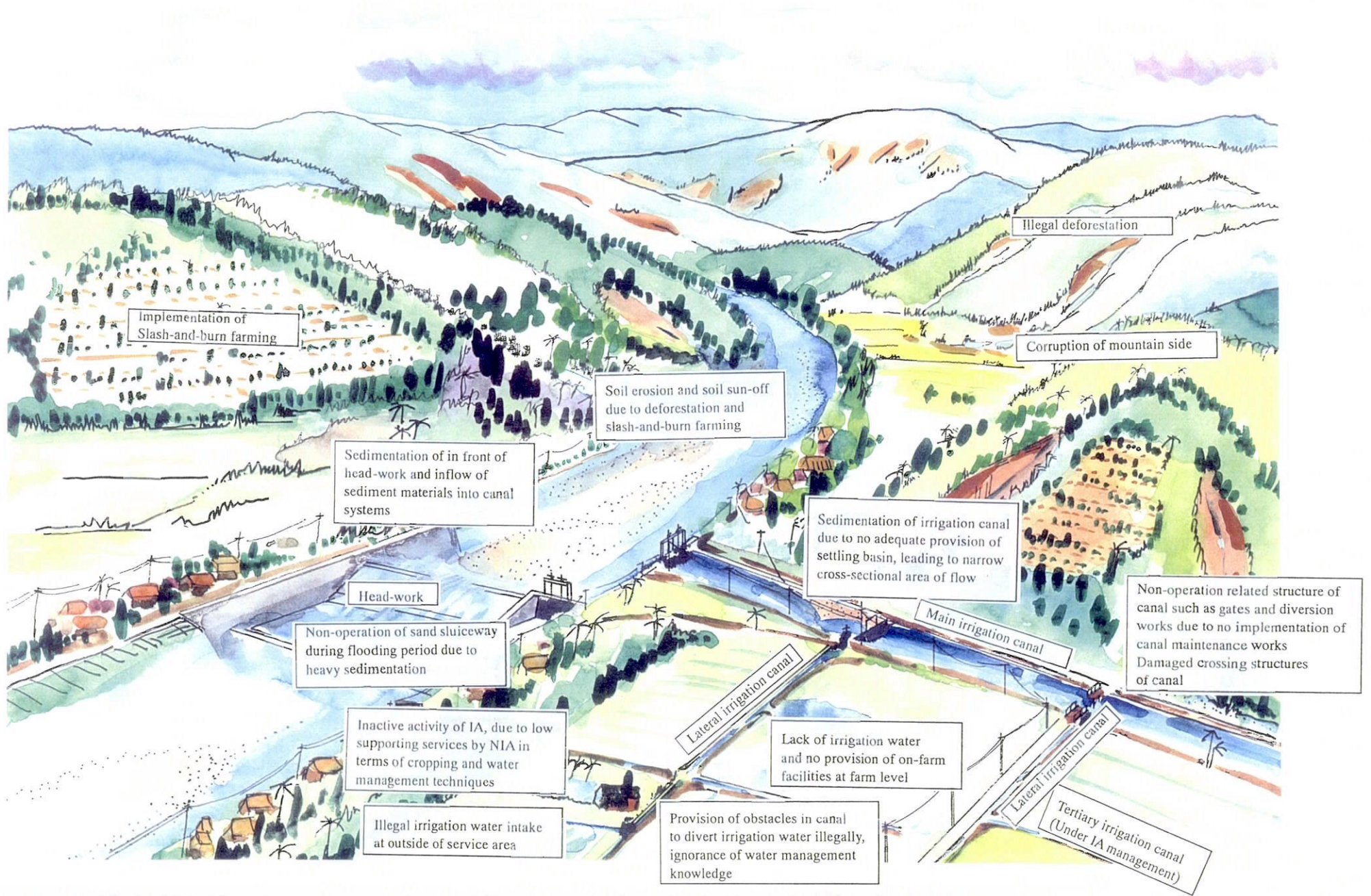
Seiji Takeuchi  
Team Leader of the Study



# ADMINISTRATIVE REGIONS AND NATIONAL IRRIGATION SYSTEMS (NIS)







NIS VARIOUS PROBLEMS CAUSED BY COLLAPSE OF CATCHMENT AREA AND INSUFFICIENT O&M WORKS

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## ABBREVIATION AND GLOSSARIES

### 1. Related Agencies

ADB	: Asian Development Bank
CAR	: Cordillera Autonomous Region
CO	: Central Office
CORPLAN	: Corporate Planning
DA	: Department of Agriculture
DAR	: Department of Agrarian Reform
EMD	: Equipment Management Department
DENR	: Department of Environment and Natural Resources
DPWH-BRS	: Department of Public Works and Highway-Bureau of Research and Standard
FMB	: Forest Management Bureau
IA	: Irrigators' Association
IDD	: Institutional Development Department
JBIC	: Japan Bank for International Cooperation
JICA	: Japan International Cooperation Agency
LGU	: Local Government Unit
NAFC	: National Agriculture and Fishery Council
NAMRIA	: National Mapping and Resources Information Authority
NIA CO	: National Irrigation Administration Central Office
NISO	: National Irrigation System Office
NWRB	: National Water Resources Board
PAGASA	: Philippine Atmospheric, Geophysical and Astronomical Service Administration
PIMO	: Provincial Irrigation Management Office
PIO	: Provincial Irrigation Office
PDD	: Project Development Department
PMO	: Project Management Office
PO	: Project Office
RC	: Responsibility Center
RIO	: Regional Irrigation Office
SEC	: Securities and Exchange Committee
SMD	: System Management Department

### 2. Glossaries

AFMA	: Agriculture and Fisheries Modernization Act
AMRIS	: Angat-Maasim River Irrigation System
ASBRIS	: Aganan-Sta. Barbara River Irrigation Systems
CBFM	: Community Based Forest Management
CIS	: Communal Irrigation System
CY	: Crop Year
GDP	: Gross Domestic Product
GIS	: Geographical Information System
I/A	: Implementing Arrangement
IDP	: Institutional Development Program
IS	: Irrigation Superintendent
IDO	: Irrigation Development Officer
IMIS	: Irrigation Management Information Systems
IMT	: Irrigation Management Transfer
ISF	: Irrigation Service Fee
ISFP	: Integrated Social Forestry Program
ISOP	: Irrigation Operations Support Project
ISIP	: Irrigation Systems Improvement Project
MAP	: Management Action Plan
MOOE	: Maintenance, Operation and Other Expenses

MRI	: Maintenance, Rehabilitation and Improvement
MRIIS	: Magat River Integrated Irrigation System
MTPDO	: Medium-Term Philippine Development Plan
NIS	: National Irrigation System
PD	: Provincial Degree
PERECOM	: Performance Evaluation/Commitment Report
RRIDFPS	: Repair, Rehabilitation and Improvement of Drainage and Flood Protection System
RRCFMR	: Repair, Rehabilitation and Construction of Farm-to-Market Roads
PIDP	: Participatory Irrigation Development Project
PIS	: Private Irrigation System
PoW	: Program of Works
RA	: Republic Act
R/I	: Rehabilitation and Improvement
RRENIS	: Repair and Rehabilitation of Existing National Irrigation Systems
SCRIS	: Sta. Cruz River Irrigation System
SEC	: Securities and Exchange Commission
SOEM	: System Operation and Equipment Management
SSA	: Sustainable System Agriculture
SWRFT	: Supervising Water Resources Facility Technician
UPRIIS	: Upper Pampanga River Integrated Irrigation System
WRDP	: Water Resources Development Project

### 3. Unit of Measurements

mm	: millimeter
cm	: centimeter
m	: meter
km	: kilometer
sq.m	: square meter
sq.km	: square kilometer
ha	: hectare
lit	: liter
cu.m	: cubic meter
MCM	: million cubic meter
cu.m/day	: cubic meter per day
lit/sec	: liter per second
cu.m/sec	: cubic meter per second
ppm	: parts per million
pH	: potential of hydrogen
g	: gram
kg	: kilogram
t, ton	: metric ton
sec.	: second
min.	: minute
hr.	: hour
yr.	: year
ave.	: average
min.	: minimum
max.	: maximum
kcal	: kilocalories
kw	: kilowatt
kwh	: kilowatt-hour

%	: percent
No.	: number
°C	: degree centigrade
cap.	: capita
md	: man-day
pers.	: person
msl	: meters above mean sea level
N	: nitrogen
P	: phosphorus
K	: potassium
US\$	: US Dollar
PhP	: Philippines Peso
cavan	: weight of paddy (1cavan = 50 kg)
peso	: Philippine currency (1US\$ =52.0pesos, as of August 2006)

## SUMMARY





# **1. Introduction**

## **1.1 Background of the Study**

The National Irrigation Administration (NIA) of Republic of the Philippines has constructed a number of irrigation facilities since its establishment in 1963. At present it manages 205<sup>1</sup> irrigation systems covering a total area of about 634,020 ha being called as National Irrigation Systems (NIS). According to the survey undertaken by the System Management Department (SMD) of NIA, currently in 193 irrigation systems, only 22.4 percent of main canals and 17.9 percent of secondary canals are functioning properly. In this situation, maintenance, rehabilitation and improvement works for the NISs are considered to be the highest priority subjects for the irrigation policy in the Philippines.

Under this situation, the Government of Republic of the Philippines requested the Government of Japan to undertake a developmental study for capacity building of NIA staff, particularly for formulating an efficient improvement plan of NISs, focusing on water resources conditions in the basin.

## **1.2 Objectives of the Study**

The objectives of the Study are to develop capacity building of the NIA staff in formulating plans for maintenance, rehabilitation and improvement (MRI) of national irrigation systems (NISs) through the following activities:

- Preparation of a manual for formulation and management of NISs Inventory Survey
- Preparation of a manual for maintenance, rehabilitation and improvement planning methodology of NISs,
- Carrying out technology transfer to the Philippine counterpart personnel through on-the-job training in the course of the Study.

## **1.3 Study Areas**

Target Study Areas are 205 NISs in the country. In addition to these Study Areas, following three Pilot NISs areas were selected within NISs to test the inventory survey format and formulate the plan for maintenance, rehabilitation and improvement planning methodology of NISs.

- Angat-Maasim River Irrigation System (AMRIS) (Region-III)
- Sta. Cruz River Irrigation System (RIS) (Region-IV)
- Aganan RIS (Region-VI)

## **1.4 Implementation of the Study**

The Study was carried out with two stages, Stage-I and Stage-II with the following activities:

---

<sup>1</sup> At the beginning of the first field works, the total number of NISs were 193, but increased to 195 NISs at the end of the first field works. However, these numbers finally increased to 205 NISs by the end of the second field works.

### Stage-I Study

- Preparation Works of the Inventory Survey
  - Selection of Pilot NIS Areas
  - Preparation and Examination of the Inventory Survey Format
- Holding of Workshop Seminars
- Implementation of the Inventory Survey

### Stage-II Study

- Tabulation of Inventory Survey Data
- Evaluation of the Data
- Identification of Problems in the Inventory Survey Contents
- Finalization of the Inventory Survey Format
- Formulation of Planning Methodology for NISs Operation, Maintenance, Rehabilitation and Improvement (MRI) Works
- Preparation of Manual for the NIS Inventory Survey and its Maintenance Methodology
- Preparation of Manual for Formulation of MRI Planning Methodology of NISs
- Holding of Workshop Seminars for Draft Final Report Presentation

## **2. General NISs Conditions and Problems**

### **2.1 Present NISs Number and Related Areas**

According to the Inventory Survey implemented in this Study, it was proved that the total number of NISs are 205 systems and their total firm-ed-up service areas (FUSA) are about 634,070 ha as shown below.

- No. of NISs	: 205
- Firm-ed-Up Service Areas (FUSA)	: 634,017 ha
- Irrigated Areas in CY 2004-2005	
• Dry Season	: 475,858 ha
• Wet season	: 500949 ha
- Average Benefited Areas	
• Dry Season	: 396,894 ha
• Wet Season	: 428,041 ha

### **2.2 Problems facing NISs**

Out of the total 205 NISs, many have been constructed since the late 1960s, which was the initial stage of the project. Generally, most of those NISs have not reached its targeted irrigation area, and expansion of irrigation areas is retarded with lessening functions of the related facilities. Under these situations of NISs, NIA had made efforts to objectively secure the targeted irrigation areas through rehabilitation of irrigation hardware, as well as improvement of its irrigation efficiency in terms of irrigation management transfer (IMT) to irrigators' associations (IA) in the aspect of software sector.

Major reasons necessarily to be taken place as countermeasures mentioned above are flood damages caused by deforestation in the river catchment area, lessening function of irrigation canals due to heavy sedimentation in canals, etc., aside from the deteriorated irrigation facilities, and inadequate operation and maintenance works.

On the other hand, in order to establish adequate procedures for the fundamental improvement plan of NISs with lessening function, comprehensive NISs improvement plan including the findings of current NISs problems facing and prioritization of improvement works would be essential. However, it could be considered difficult to undertake these works under the severe situations of NIA in terms of limited budgets and manpower resources. The following table indicates financial situations of the selected three Pilot NIS Areas.

Financial Situations of Pilot NISs Areas

Items	Pilot NISs			Average	
	AMRIS	Sta. Cruz RIS	Aganan RIS	(Peso)	(Peso/ha)
Firmed-Up Service Area (ha)	26,791	3,688	7,530	12,670	
Total Income (P' 000)					
ISF	26,606	2,655	4,884	11,382	
Equipment Rental	1,436	342	233	670	
Others	9342	507	86	3,312	
Total	37,384	3,504	5,203	15,364	1,213
Total Experiences (P '000)					
Personal Services	29,104	3,955	4,759	12,606 (75%)	995
MOOE	11,703	340	623	4,222 (25%)	333
Total	40,807	4,295	5,382	16,828 (100%)	1,328

### 2.3 Current Inventory Survey of NISs

Current inventory surveys on NISs periodically undertaken by NIA are listed below.

- NIS Performance Evaluation Report
- NIS Repair / Rehabilitation Status
- NIS Status of Service & Irrigated Area
- IA Profile
- IA O&M Performance Survey
- IA Functionality Survey

On the other hand, inventory surveys undertaken through JICA studies are as follows.

- Inventory Survey undertaken in the Study on Strengthening of NIA's Management Systems, 2001
- Inventory Survey undertaken in the Study on the Irrigators Association Strengthening Project, 2003
- Inventory Survey undertaken through a JICA Short-Term Expert Program, 2004

Major characteristics of these current inventory systems include evaluation of NIS performance, but do not include evaluation of improvement priority of NISs as indicated above. Besides, no decisions on prioritization of improvement projects among NISs could be made integrally, considering available information of facility functionality and water resources. However, in order to implement effectively the improvement works of NISs under the severe financial conditions of NIA, revised inventory works on NISs would be essential not only for comprehensive evaluation of the whole NIS functionality and needs for improvement, but also for identification of the NISs

prioritized projects for improvement. Furthermore, current inventory surveys did not include the factors of required improvement costs and obtained benefits, so that selection of the prioritized NISs for rehabilitation and improvement projects should be made on the basis of these cost and benefit indexes.

### **3. Implementation of the Inventory Survey**

#### **3.1 Preparation Works of the Inventory Survey**

##### **1) Selection of Pilot NIS Areas**

As preparation works of the Inventory Survey, following three Pilot NISs were selected to formulate a preliminary inventory survey formats through field works and necessary data collection.

- Angat-Maasim RIS (AMRIS) (Region-III)
- Sta. Cruz RIS (Region-IV)
- Aganan RIS (Region-VI)

In selecting these Pilot NIS Areas, following selection factors are taken into account.

- Regional classification of the Philippines, such as Luzon, Visayas, and Mindanao
- Climate type of the Philippines and fluctuation of available irrigation water resources during the dry and wet seasons
- Present conditions of major irrigation facilities such as diversion dams and main/lateral canals, and also scale of service areas
- Location of RIO and NISO
- Progress of IMT and IA activities
- Results of discussion with NIA-SMD and their preference

##### **2) Preparation and Examination of the Inventory Survey Format**

###### **Major Survey Items proposed in the Inventory Survey**

Main objectives of the Inventory Survey are to formulate adequate maintenance, rehabilitation and improvement (MRI) plans of NISs, in order to cope with the following requirements, namely i) effective realization of project benefits with limited investments for the MRI works considering severe financial conditions of NIA, ii) sustainable irrigation management to secure the targeted irrigation service areas, iii) reasonable and transparent selection and implementation of prioritized NISs for MRI works, from technical points of view, etc.

Major subjects to be involved in the Inventory Survey are primarily proposed as shown below.

- Water Resources and Irrigation Water Use Information
- Flood and Drainage Information
- Facility Functionality Information
- O&M Organizations and their Activity Information

###### **Preparation of Inventory Formats and their Contents**

Major contents of the proposed Inventory Survey are itemized as shown below;



- Part-I. General Information
- Part-II. Water Resources and Irrigation Requirement Information
  - 2.1 Available Water Resources
  - 2.2 Irrigation Water Requirement
  - 2.3 Farm Management Conditions
  - 2.4 Balance of Available Water Resources and Irrigation Water Requirement in Average Year
  - 2.5 Evaluation of Water Use
- Part-III. Flood and Drainage Information
  - 3.1 Flood Information
  - 3.2 Drainage Information
  - 3.3 Evaluation of Flood and Drainage Conditions
- Part-IV. Functionality Information of Irrigation and Drainage Facilities
  - 4.1 Diversion Dam
  - 4.2 Canal
- Part-V. Organization and O&M Information
  - 5.1 NISO Information on Management and Facility
  - 5.2 NISO Information on O&M Status of Irrigation Facilities

#### Holding of Workshop Seminar

Study Team in collaboration with NIA-SMD and PDD staff held a workshop seminar to explain and discuss the objectives, contents, survey procedures, compilation of collected data on the Inventory Survey for 195 NISs, especially on inventory survey formats, with attendance of the related government agencies such as DA and DENR-FMB. Major contents of the workshop seminar were as follows.

- Presentation of objectives and output of the Study using a projector
- Presentation of formats of the preliminary Inventory Survey
- Replies and discussions on questions/reaction/comments/suggestions on the presentation

At the explanation and discussion seminar, the Study Team hand on the following data to the RIO representatives participating for requesting them to carry out the Inventory Survey in their region by the end of March 2006.

- Sample data of the actual inventory survey at Aganan RIS in Region VI
- Preliminary inventory survey formats
- Description guidelines for the NIS Inventory Survey
- Floppy diskette for storing the above data indicating contents

### **3.2 Implementation of the Inventory Survey**

NIA implemented the Inventory Survey for 205 NISs by means of NIA responsibility during December 2005 to March 2006. Actual undertakings of the Inventory Survey have been made by the National Irrigation System Office (NISO) in collaboration with the related IA in each Region, under the assistances of NIA Central Office, especially NIA-SMD and PDD, and Regional Irrigation Office (RIO).

Overall accomplishment rates of the Inventory Survey by the end of March 2006 and the beginning of May 2006, which correspond to the targeted closing date of the Inventory Survey and

starting dates of the Phase II Study are 53 percent and 87 percent, respectively. However, since the accomplished data of the Inventory Survey had missing and low qualified data in some items, effective NISs in terms of the Inventory Survey response rate NIS were 99 at this stage of the Study.

### 3.3 Analysis and Evaluation of the Inventory Survey

Detailed analyses were carried out for the three Pilot NIS areas. Based on the result of those analyses, method of analyses for each NIS was formulated. Analysis items and evaluations for each Pilot NIS area are summarized as below.

#### Water Resources, Irrigation Water Use and Flood and Drainage

Item	Analyses and Evaluation		
	AMRIS	Sta. Cruz RIS	Aganan RIS
1) Water Balance Study	Average runoff discharge is mostly big enough against the diverted discharge, because of adjusted/stored water by the Angat Dam.	Most of the average river runoff discharges are diverted on average. But water shortage conditions are considered to be not very severe in this system.	Drastic fluctuation of an average runoff discharge is found between dry and wet seasons.
2) Evaluation of Irrigation and Drainage Condition	Monitoring and coordination with NWRB are essential because water supply from Angat Main Unit is reduced year by year due to a recent rapid increase of domestic water to Metro Manila.	Explanation and enforcement on designed cropping pattern are needed to maximize water use and minimize illegal water take.	Promotion of IA for provision of farm ditches at the on-farm level, which were once constructed, is needed for effective water distribution.

#### Functionality of Irrigation and Drainage Facilities

Based on the present conditions of irrigation and drainage facilities, which were obtained from the inventory survey results and field observation, plans for maintenance and rehabilitation and improvement (R/I) were fabricated. Estimated costs for each work are shown in the table below.

Item	Unit	AMRIS	Sta. Cruz RIS	Aganan RIS	Average
Maintenance					
Amount	Pesos	3,371,000	655,000	790,000	
Unit Amount	Pesos/ha	329	320	180	276
Actual Unit Amount	Pesos/ha	539	266	225	343
R/I					
Amount	Pesos	449,230,000	110,500,000	46,360,000	
Unit Amount	Pesos/ha	17,500	53,400	10,400	27,100
Actual Unit Amount	Pesos/ha	18,100 in 30 years	55,700 in 75 years	11,600 in 25 years	28,466

#### Organizations and O&M

Relevant survey items of the targeted NISO/NISs are analyzed through comparison with the national average. Analyses on major evaluation criteria are tabulated as below.

Item	Analyses and Evaluation		
	AMRIS	Sta. Cruz RIS	Aganan RIS
1) Area and No. of Personnel	Number of staff is more than the national average.	Number of staff is the almost same as the average.	Number of staff is slightly more than the national average.
2) Viability	Improvement of collection efficiency is strongly expected in all sites.		
3) Past Program of Works (PoW)	Almost same as the average	Slightly lower than the average	Almost a half of the average
4) ISF Collection Efficiency	ISF collection efficiency (C.E.) is lower than the national average in all sites. Following points are important to improve ISF C.E.; explanation of legal power, reduction of ISF collection works, collaboration with LGUs, and dialogue with farmers.		
5) Irrigators Association	Good institutional arrangement in the office should be maintained.	Functionality point is very low, and should be improved.	Effort to support IAs from various aspects are really appreciated and should be maintained.
	Following points are important to improve institutional capacities of IAs; to keep current high membership rate, to secure five percent of the institutional development fund, to secure institutional development officers (IDOs), to reorient water masters as IDO, and to collaborate with local authorities.		

### 3.4 Continuation of the Inventory Survey

From view points of identifying irrigation and drainage facility functionalities in the systems, continuing the Inventory Survey would be essential and prerequisite, and for that necessary administrative and technical countermeasures to implement the survey should be taken with maximum efforts of respective organizations. The NISs without submitting inventory survey data would be precluded from any possibility of MRI planning analysis, of which study results would be reflected to the preparation of “Program of Works (PoWs)”.

#### 1) Updating Procedures of the Inventory Survey

##### Timing and Interval of Implementation of the Inventory Survey

To determine an appropriate timing and interval of the survey implementation, the Study Team and NIA officials concerned had a series of discussions and undertook the “Questionnaire for the Inventory Survey” for the targets of Regional Offices and representative large-scale National Irrigation Systems such as MRIIS and UPRIIS.

Through these discussions and questionnaire surveys, timing and interval of the survey implementation were scheduled as shown below.

##### Timing of Inventory Survey;

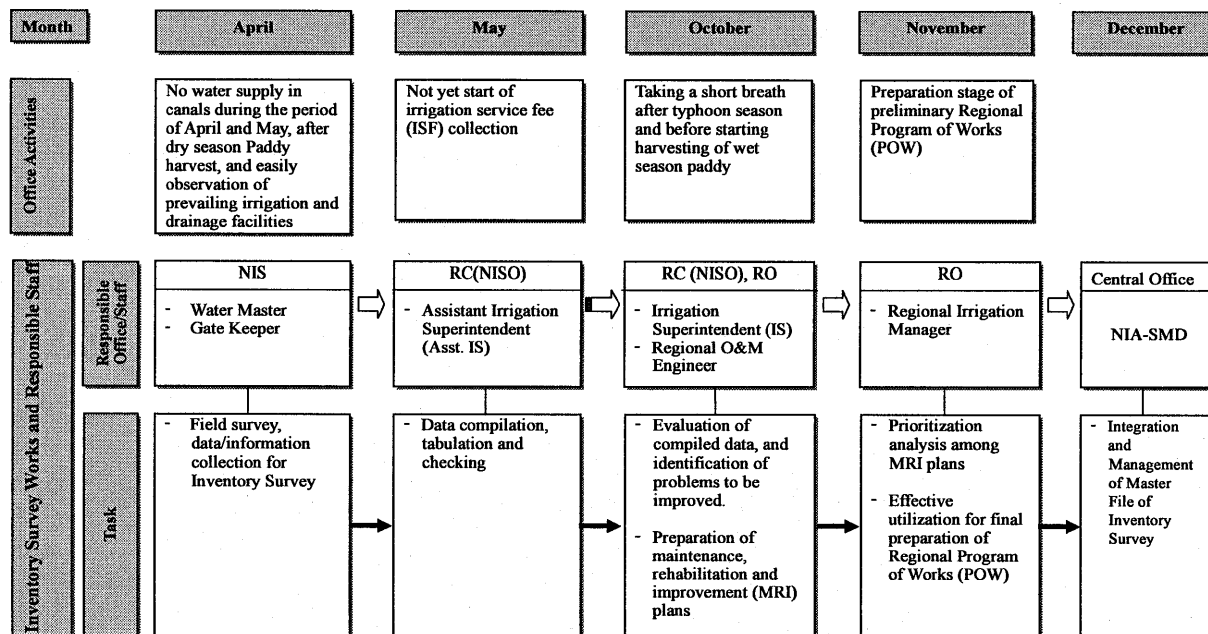
- Field survey, data collection and filing work : April – May
- Tabulation of data/information : April – May
- Data evaluation and identification of problems : October
- Preparation of MRI Plans : November
- Submission of survey results to Regional Office : End of November

Interval of the Inventory Survey; : Every Year

## Procedures of Data Compilations and Report Submission

Procedures of data compilations and report submission after implementing the Inventory Survey are shown below.

### Data Compilation of Inventory Survey and Report Submission Procedure



### 3.5 Integration and Management of Master File Data

#### Related Organization

Related organizations concerning implementation of the Inventory Survey are as follows.

##### Region Level :

- National Irrigation System (NIS)
- Responsibility Center (RC)/National Irrigation System Office (NISO)
- Regional Office (RO)

##### Central Office :

- NIA-System Management Department (SMD)

#### Data Management by Related Organization

The data obtained through the Inventory Survey should be tabulated and stored by each related office, and data contents to be saved at each office are itemized as follows. Updated annual data should be stored under the responsibility of each office manager.

Related Organizations	Managed, Evaluated and Stored Data	Saving Means
NIS	Collected raw data	Paper Filling
RC/NISO	Tabulated and checked/verified data within RC/NISO	Floppy Diskette /CD
RO	Tabulated and evaluated data, and prioritized	CD/Regional Host



	MRI plan data within Region	Computer
NIA-SMD	Integration of tabulated, evaluated and prioritized MRI plans in the country	CD/SMD Host Computer

#### 4. Preparation of Manuals

Following two types of Manuals were formulated in the Study for the purposes of operation, maintenance, rehabilitation and improvement of NISs.

- Manual for the NIS Inventory Survey and its Maintenance Methodology
- Manual for Formulation of Maintenance, Rehabilitation and Improvement (MRI) Planning Methodology of NISs

##### 4.1 Manual for the NIS Inventory Survey and its Maintenance Methodology

###### Inventory Survey Manual

For implementation of the Inventory Survey by NIA, following manuals were prepared by the Study Team.

- Inventory Survey Formats for five parts and their description guidelines (see Form IS-1 and Form IS-2)
- NIS number, location and related areas by Region (Form AR-1)
- Tabulation of Inventory Survey results (see Form TB-1, Form TB-2, Form TB-3, Form Tb-4, Form Tb-5, and Form TB-6)
- Evaluation of Inventory Survey data
  - Monthly average river discharge (see Form PW-1)
  - Monthly average diverted intake discharge (see Form PW-2)
  - Evaluation of development potential for seasonal water resources (see Form PW-3 and Form PW-4)

###### Procedures of Updating the Inventory Survey

- Timing and interval of implementation of the Inventory Survey
- Procedures of data compilations and report submission

##### 4.2 Manual for Formulation of MRI Planning Methodology of NISs

Regarding the Manual for formulation of MRI planning methodology of NISs, Manuals for the following three sectors were prepared.

- Water Resources and Irrigation Water Use
- Irrigation and Drainage Facilities
- Organizations and Operation and Maintenance

###### Water Resources and Irrigation Water Use

- Procedures for canal discharge measurement and water distribution
- Computerization of Operation Plan for water delivery schedule
- Procedures for estimating effective rainfall.

### Irrigation and Drainage Facilities

- Scale of NIS Facilities
- Present Conditions of NIS Facilities

## **5 Suggestions and Recommendations**

Following suggestions and recommendations were raised regarding implementation of the Inventory Survey and formulation of the operation and MRI planning methodology.

### **5.1 NIS Inventory Survey**

- Accomplishment of the Inventory Survey with qualified data
- Continuing implementation of the Inventory Survey
- Observation and collection of discharge data
- Data management of master files in Regional and Central Offices
- Initiative of System Management Department (SMD)
- Creation of appropriate organizations to stop squatters living nearby irrigation premises

### **5.2 Formulation of Operation and MRI Planning Methodology**

- Separating implementation of periodical maintenance works, rehabilitation and improvement works
- Formulation of a suitable maintenance plan aiming at reducing required rehabilitation and improvement costs under the current severe financial situation of NIA
- Formulation of most appropriate maintenance, rehabilitation and improvement (MRI) plan of facilities on the basis of NIA technical design standards
- Prioritization analysis of NIS R/I works
- Capacity building of NIA Regional and Central Office staff
- Strengthening of Irrigators' Association (IA)
- NIA campaigns to farmers for maintaining on-farm facilities in well-functioning conditions
- Institutionalization for implementation of the Inventory Survey and MRI planning methods
- Better water management during drought periods