

ANNEXES

**THE STUDY
ON
GROUNDWATER DEVELOPMENT
IN
WANGDUEPHODRANG DISTRICT OF BHUTAN**

FINAL REPORT

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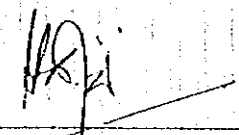
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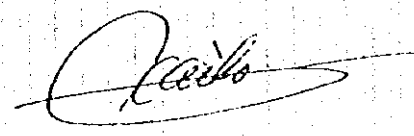
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SCOPE OF WORK
FOR
THE STUDY
ON
GROUNDWATER DEVELOPMENT
IN
WANGDUEPHODRANG DISTRICT
OF
BHUTAN

AGREED UPON BETWEEN
MINISTRY OF AGRICULTURE
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

THIMPHU, AUGUST 18, 1993


DASHO KINZANG DORJI
DIRECTOR GENERAL
DEPARTMENT OF AGRICULTURE
MINISTRY OF AGRICULTURE
ROYAL GOVERNMENT OF BHUTAN


MR. SEIJI KAIHO
LEADER,
PREPARATORY STUDY TEAM,
JAPAN INTERNATIONAL
COOPERATION AGENCY

I. INTRODUCTION

In response to the request of the Royal Government of Bhutan, the Government of Japan has decided to conduct a study on groundwater development project in Wangduephodrang District of Bhutan (hereinafter referred to as "the Study") in accordance with the relevant laws and regulations in force in Japan.

Accordingly, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programs of the Government of Japan, will undertake the Study in close cooperation with the authorities concerned of the Royal Government of Bhutan.

The present document sets forth the scope of work with regard to the Study.

II. OBJECTIVE OF THE STUDY

The objective of the Study is to conduct a study on water resources development plan with an emphasis on groundwater in Wangduephodrang District of Bhutan.

III. STUDY AREA

The Study will cover the area of Wangduephodrang District.

IV. SCOPE OF THE STUDY

The Study shall include followings:

PHASE I :

(1) Data Collection and Review

- 1) socio-economic conditions
- 2) relevant ongoing and planned projects
- 3) data on existing wells and water supply system
- 4) data on water demand
- 5) topographical, geological and hydrogeological maps
- 6) aerial photos
- 7) data on land use
- 8) data on meteorology, hydrology and hydrogeology
- 9) environmental conditions
- 10) law, regulation policies and customary practices
- 11) institutions, organizations and administrations

(2) Basic Study

- 1) topographic and geological reconnaissance
- 2) meteorological and hydrological investigations
- 3) topographic survey
- 4) electrical prospectings
- 5) survey on cross sections and profiles of rivers
- 6) survey on water demand and existing water supply system
- 7) selection of test boring sites
- 8) initial environmental examination

PHASE II :

(1) Detailed Study

- 1) test boring
- 2) pumping test
- 3) hydrological survey
- 4) survey on water quality
- 5) surface water survey

(2) Study and Analysis

- 1) hydrogeological analysis
- 2) design of experimental facilities

PHASE III :

(1) Formulation of Water Resources Development Plan

- 1) installation and operation of experimental facilities
- 2) evaluation of water resources potential
- 3) formulation of water resources development plan
- 4) facility planning and cost estimation
- 5) operation and maintenance planning
- 6) implementation planning

(2) Project Evaluation

- 1) socio-economic evaluation
- 2) environmental impact analysis

V. STUDY SCHEDULE

The Study, in principle, shall be carried out in accordance with the tentative schedule shown in the attached sheet.

VI. REPORT

JICA shall prepare and submit following reports in English to the Royal Government of Bhutan.

- (1) Inception Report (IC/R)
Twenty (20) copies at the commencement of the work in Bhutan.
- (2) Progress Report(1) (P/R1)
Twenty (20) copies within six (6) months after the commencement of the Study.
- (3) Interim Report (IT/R)
Twenty (20) copies within thirteen (13) months after the commencement of the Study.
- (4) Progress Report(2) (P/R2)
Twenty (20) copies within seventeen (17) months after the commencement of the Study.
- (5) Draft Final Report (DF/R)
Twenty (20) copies within twenty-six (26) months after the commencement of the Study.
The Royal Government of Bhutan shall submit their comments within thirty (30) days after the receipt of the Draft Final Report.
- (6) Final Report (F/R)
Thirty (30) copies within thirty (30) days after the receipt of the comments on the Draft Final Report.

VII. UNDERTAKINGS OF THE ROYAL GOVERNMENT OF BHUTAN

1. To facilitate smooth conduct of the Study, the Royal Government of Bhutan shall take necessary measures:
 - (1) to secure the safety of the Japanese study team,
 - (2) to permit the members of the Japanese study team to enter, leave and sojourn in Bhutan for the duration of their assignment therein, and exempt team from alien registration requirements and consular fees,
 - (3) to exempt the members of the Japanese study team from taxes, duties and any other charges on equipment, machinery and other materials brought into Bhutan for the conduct of the Study,
 - (4) to exempt the members of the Japanese study team from income tax and charges of any kind imposed on or in connection with any emolument or allowance paid to the members of the Japanese study team for their services in connection with the implementation of the Study,
 - (5) to provide necessary facilities to the Japanese study team for remittance as well as utilization of the funds introduced into Bhutan from Japan in connection with the implementation of the Study,

- (6) to secure permission for entry into private properties or restricted areas for the conduct of the Study,
 - (7) to secure permission for the Japanese study team to take all data and documents (including photographs and maps) related to the Study out of Bhutan to Japan, and
 - (8) to provide medical services as needed. Its expenses will be chargeable on the members of the Japanese study team.
2. The Royal Government of Bhutan shall bear claims, if any arises against the members of the Japanese study team resulting from, occurring in the course of, or otherwise connected with the discharges of their duties in the implementation of the Study, except willful misconduct on the part of the members of the Japanese study team.
 3. Ministry of Agriculture, the Royal Government of Bhutan (hereinafter referred to as "MOA") shall act as counterpart agency to the Japanese study team and also coordinating body in relation with other governmental and non-governmental organizations concerned for the smooth implementation of the Study.
 4. MOA shall, at its own expense, provide the Japanese study team with the following, in cooperation with other relevant organizations:
 - (1) available data and information related to the Study,
 - (2) counterpart personnel,
 - (3) suitable office spaces with necessary equipment in the study areas and Thimphu,
 - (4) credential or identification cards, and
 - (5) vehicles with drivers and fuels.

VIII. UNDERTAKINGS OF JICA

For the implementation of the Study, JICA shall take the following measures;

- (1) to dispatch, at its own expense, Japanese study team to Bhutan and
- (2) to pursue technology transfer to the Bhutanese counterpart personnel in the course of the Study.

IX. CONSULTATION

JICA and MOA shall consult with each other in respect of any matter that may arise from or in connection with the Study.

APPENDIX 1 TENTATIVE STUDY SCHEDULE

MONTH	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
WORK IN BHUTAN																												
WORK IN JAPAN																												
REPORTS																												

△
IC/R

△
P/R1

△
IT/R

△
P/R2

△
DF/R

△
F/R

MINUTES OF MEETING
FOR
THE STUDY
ON
GROUNDWATER DEVELOPMENT
IN
WANGDUEPHODRANG DISTRICT
OF
BHUTAN

The Preparatory Study Team was organized by Japan International Co-operation Agency (JICA) and dispatched to Bhutan from 5th August to 25th August, 1993. The team conducted field reconnaissance in Wangduephodrang district as well as Lhuntee district respectively and had a series of discussions with the officers and engineers of the Department of Agriculture (DOA). List of officers and engineers is as shown in annex 1.

Through exchange of opinions and discussions, both JICA team and DOA agreed upon the scope of work as per hereto attached in annex 2. The major points discussed in connection with the scope of work are the following.

1. Study Area

As to the study area, both the parties agreed to carry out the study on water resources potential for the specified coverage of the terrain in Wangduephodrang as shown in the attached map, and formulating water resources development plan in Rubeyssa, Phangyul, Lobeyssa and Bajo for irrigation and Wangduephodrang town water supply.

As to Tangmachu project in Lhuntshe District, JICA team pointed out that in view of JICA's past study in the area in connection with integrated agricultural development in Lhuntshe and Mongar, it was agreed not to take up the District in the present study.

2. Study Schedule

Both the parties agreed to conduct the study in accordance with the study schedule as attached to the Scope of Work. However, in view of the reduction in size of the project area, DOA requested the mission to consider shortening the study period. It is, however, noted that due to the topographic conditions of the study area it may be necessary to consult each other on the modification of the study period.



3. Relevant Organizations

Both the parties agreed that DOA should make necessary arrangements for co-ordinating the inter ministerial/departmental co-operations at various occasions during the course of the study.

4. Equipment

DOA requested to JICA to provide any additional equipment, to those which have been retained in custody, which may be required for the study, either due to the possible defects occurred on those procured for long time custody, or due to the change of the study area from Gaylegphug to Wangduephodrang.

5. Experimental Work

With reference to the item 1)-(i)- phase iii-iv in the scope of work, both the parties agreed that experimental facility construction be made to ensure outcoming water development plan in the study. Therefore, DOA secure the land for the work.

6. Undertakings of the Government of Bhutan

With reference to the item 4-vii in the scope of work, DOA stressed that efforts will be made as much as possible to secure office space both in Thimphu and in Wangduephodrang, counterpart personnel assignment etc. The responsibility of maintenance of the vehicles provided for the study will be borne by the MOA. However, on the request of the MOA, JICA may consider bearing the operation and maintenance cost of the vehicles while the study team is in the country.

7. Technology Transfer

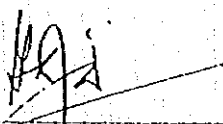
DOA requested the team that technology transfer pursued during the course of the study and specific stress be put on the field of ground water development as this exercise has not been conducted in the country.



8. Others

Both the parties confirmed that the scope of work formerly concluded on November 28 1989 for the Ground Water Project is superseded.

Thimphu, August 18, 1993



DASHO KINZANG DORJI
DIRECTOR GENERAL
DEPARTMENT OF AGRICULTURE
MINISTRY OF AGRICULTURE
ROYAL GOVERNMENT OF BHUTAN



MR. SEIJI KAIHO
LEADER,
PREPARATORY STUDY TEAM,
JAPAN INTERNATIONAL
COOPERATION AGENCY

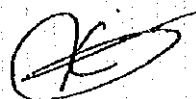
GROUND WATER STUDY TEAM MEMBERS

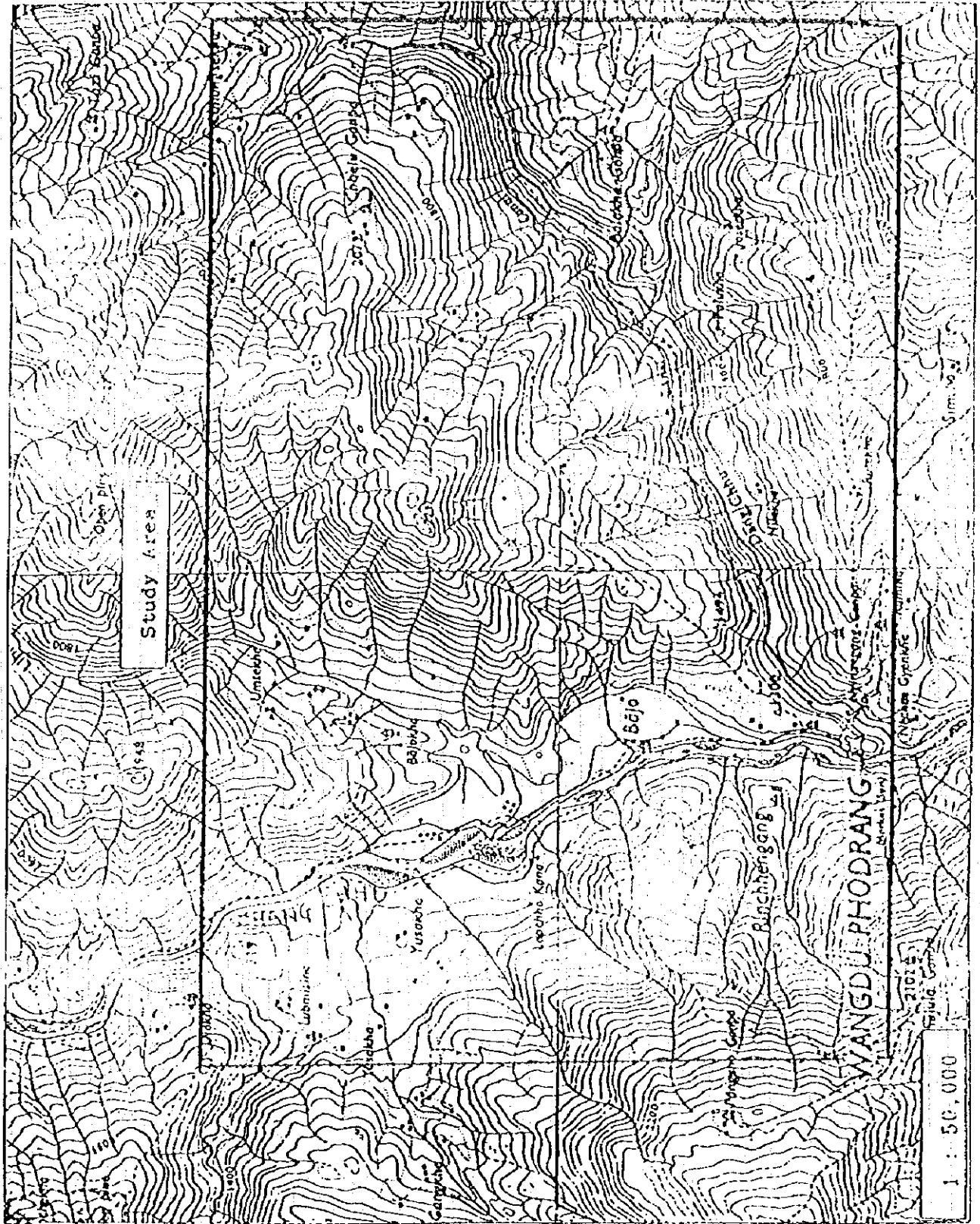
JICA:

- | | | |
|----|------------------------|-------------------|
| 1. | Mr. Seiji Kaiho | Team Leader |
| 2. | Mr. Kiyotaka Otsuki | Study Planner |
| 3. | Mr. Keiji Tokuda | Hydrogeologist |
| 4. | Mr. Shinichi Yoshikawa | Drilling Engineer |

DEPARTMENT OF AGRICULTURE:

- | | | |
|----|-----------------------|-------------------------|
| 1. | Dashe Kinzang Dorji | Director General |
| 2. | Mr. Kinzang Wangchuk | Superintending Engineer |
| 3. | Mr. Kaylzang Tshering | Dy. Executive Engineer |
| 4. | Mr. Rinchen Wangdi | Junior Engineer |






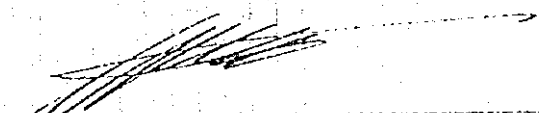
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MINUTES OF MEETING
ON
THE INCEPTION REPORT
FOR
THE STUDY
ON
GROUNDWATER DEVELOPMENT
IN
WANGDUEPHODRANG DISTRICT
OF
BHUTAN

THIMPHU, FEBRUARY 15, 1994


DASHO DR. KINZANG DORJI
JOINT SECRETARY
MINISTRY OF AGRICULTURE
ROYAL GOVERNMENT OF
BHUTAN


DR. SHOJI KANATSU
TEAM LEADER
STUDY TEAM
JAPAN INTERNATIONAL
COOPERATION AGENCY

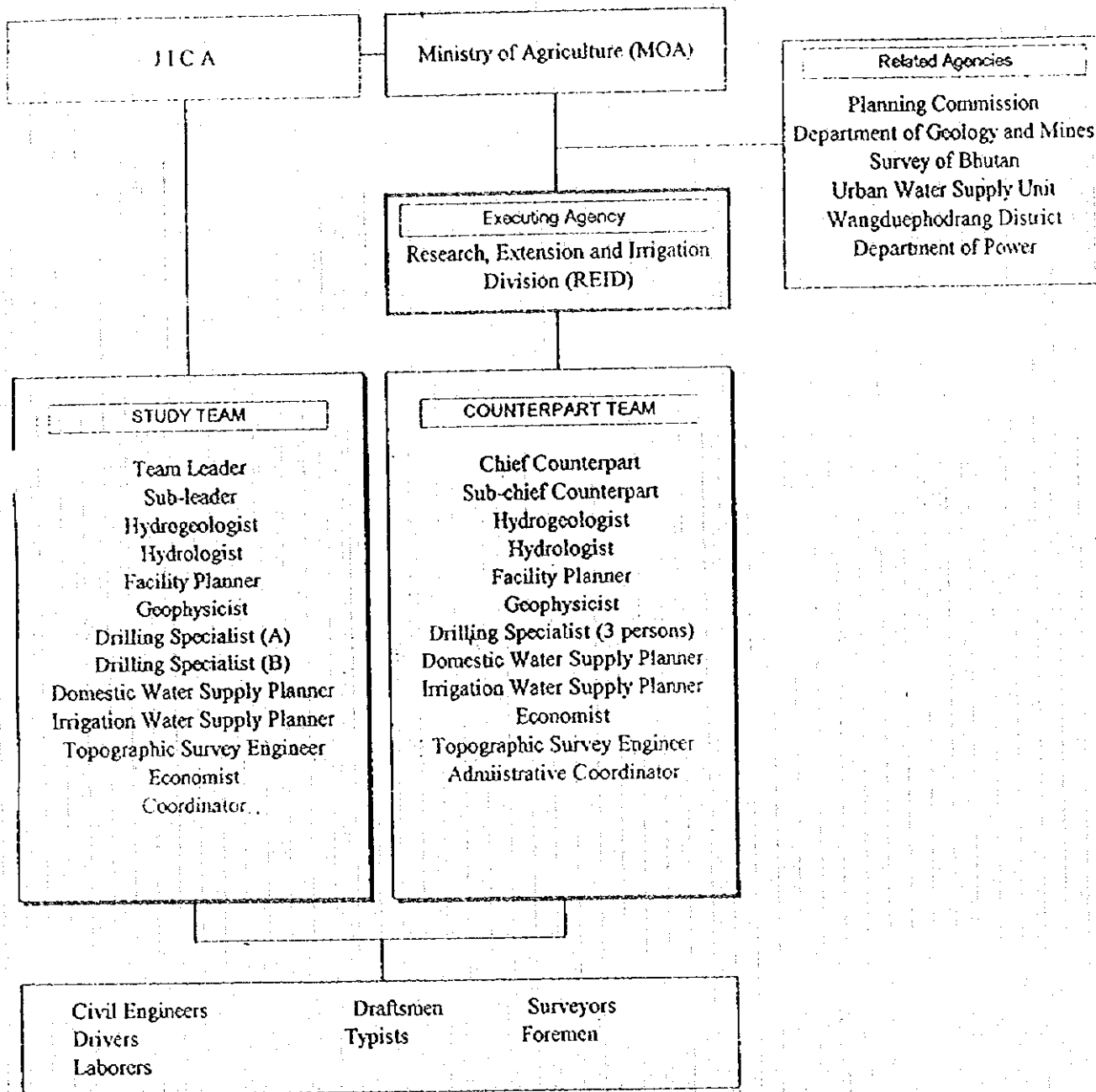
In accordance with the Scope of Work signed on August 18, 1993 between the Ministry of Agriculture (MOA) and Japan International Cooperation Agency (JICA), a Study Team arrived in Bhutan on February 10, 1994.

The Inception Report was submitted by the Study Team. A series of discussions was held and views were exchanged between the Study Team headed by Dr. SHOJI KANATSU and Ministry of Agriculture represented by Dasho Dr. KINGANG DORJI.

As a result of the discussions, both sides reconfirmed and agreed as stated below:

The Inception Report submitted by the Study Team to the Ministry of Agriculture of Bhutan on February 14, 1994 was accepted by MOA.

2. Both sides reconfirmed the Scope of Work for the Study agreed upon between the JICA Preliminary Study Team and MOA on August 18, 1993.
3. The requests stated in the Inception Report were generally accepted by MOA with the following conditions.
 - Fuel and maintenance costs of the vehicles provided by JICA will be born by the Study Team during the study period.
 - One station wagon being repaired will be ready for the use of the Study Team as early as possible.
4. Both sides will take best efforts so that the truck with crane which is requested in the Inception Report would be arranged as soon as possible.
5. Both sides confirmed that the technology transfer to counterparts will be carried out on the job in Bhutan. In addition, the Royal Government of Bhutan expressed their wish to send counterpart(s) to Japan in order to receive the technology transfer.
6. Due to recent shuffling of the organization of MOA, the present Research, Extension and Irrigation Division (REID) will take the responsibilities for the Study instead of the former Department of Agriculture.



ORGANIZATION CHART FOR EXECUTING THE STUDY

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LIST OF ATTENDANTS

1. MINISTRY OF AGRICULTURE

Dasho Dr. Kinzang Dorji
Mr. Kinzang Wangchuk

Joint Secretary
Chief Irrigation Officer,
Research, Extension and Irrigation
Division
Irrigation Engineer,
Research, Extension and Irrigation
Division

Mr. Phuntsho Wangdi

2. JICA Head Office

Mr. Kiyotaka Otsuki

Staff,
Head Quarter,
Japan International Cooperation Agency

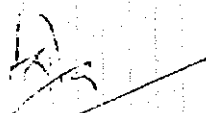
3. JICA Study Team

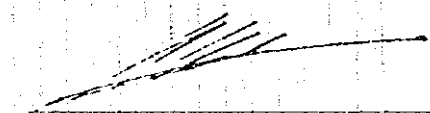
Dr. Shoji Kanatsu
Dr. Mutsumi Motegi
Mr. Soichiro Yumoto
Mr. Takao Sakamoto
Mr. Kazuo Uchida
Mr. Toshihiko Kogo
Mr. Yoshito Kimura

Team Leader
Sub-leader/Hydrogeology
Hydrology/Water Quality
Facility Planning/Experimental Facilities
Electric Prospecting
Test boring(Planning)
Test Boring(Operation)

MINUTES OF MEETING
ON
THE PROGRESS REPORT (1)
FOR
THE STUDY
ON
GROUNDWATER DEVELOPMENT
IN
WANGDUEPHODRANG DISTRICT
OF
BHUTAN

THIMPHU, JULY 19, 1994


DASHO DR. KINZANG DORJI
SECRETARY
MINISTRY OF AGRICULTURE
ROYAL GOVERNMENT OF
BHUTAN


DR. SHOJI KANATSU
TEAM LEADER
STUDY TEAM
JAPAN INTERNATIONAL
COOPERATION AGENCY

In accordance with the Scope of Work signed on August 18, 1993 between the Ministry of Agriculture (MOA) and Japan International Cooperation Agency (JICA), a Study Team arrived in Bhutan on February 10, 1994, a minutes of meeting was signed between MOA and the Study Team on February 15, 1994.

Based on the above minutes of meeting, the Study Team has conducted the field survey and investigation so far, and submitted MOA twenty (20) copies of Progress Reports (1) (hereinafter referred to as the Report) as stated in the Scope of Work. The report presents the results of the field survey, investigation and preliminary studies. A series of discussions was held and views were exchanged between the Study Team headed by Dr. SHOJI KANATSU and Ministry of Agriculture represented by Dasho Dr. KINZANG DORJI.

As a result of the discussions, both sides agreed as stated below.

1. The MOA accepted and agreed the contents of the Report submitted by the Study Team.
2. Both sides confirmed that the Study Team would not conduct the test borings in Phangyul, Rubeyisa and Bajo subareas due to the difficulty in their access and the unnecessary found through the field surveys having been conducted in the Study Area so far.
3. The MOA understood and agreed to the concept of the proposed plan of the experimental facilities as per the Report, and requested the Team to realize all of the proposed facilities in the next phase.
4. The MOA agreed that at least two (2) counterparts and one (1) surveyor who have worked together with the Team since the beginning would be assigned for the works to be conducted during the absence of the Team from the site, because they mutually understood that such requirement would facilitate the transfer of knowledge as stated in the signed Scope of Work.
5. The MOA requested that the Study during the next phase should be carried out focusing more on irrigation aspect.

LIST OF ATTENDANTS

1. MINISTRY OF AGRICULTURE

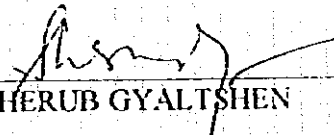
Dasho Dr. Kinzang Dorji	Secretary, Ministry of Agriculture
Mr. Kinzang Wangchuk	Chief Irrigation Officer, Research, Extension and Irrigation Division, MOA
Mr. Wangdi Gyaltshen	Deputy Executive Engineer, Research, Extension and Irrigation Division, MOA
Mr. Kesang Jamtsho,	Deputy Executive Engineer, Research, Extension and Irrigation Division, MOA
Mr. Phuntsho Wangdi	Section Officer, Research, Extension and Irrigation Division, MOA
Mr. Karchung	Section Officer, Research, Extension and Irrigation Division, MOA
Mr. H. R. Ghalley	Junior Engineer, Research, Extension and Irrigation Division, MOA
Mr. Mani Tapa	Planning Officer, MOA

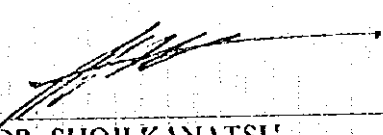
2. JICA Study Team

Dr. Shoji Kanatsu	Team Leader
Dr. Mutsumi Motegi	Sub-leader/Hydrogeology
Mr. Soichiro Yumoto	Hydrology/Water Quality
Mr. Takao Sakamoto	Facility Planning/Experimental Facilities
Mr. Eizaburo Furutani	Domestic Water Supply Planning
Mr. Yutaka Nozaki	Regional Economy/Project Evaluation

**MINUTES OF MEETING
ON
THE INTERIM REPORT
FOR
THE STUDY
ON
GROUNDWATER DEVELOPMENT
IN
WANGDUEPHODRANG DISTRICT
OF
BHUTAN**

THIMPHU, NOVEMBER 8, 1994


MR. SHERUB GYALTSHEN
HEAD
RESEARCH, EXTENSION AND
IRRIGATION DIVISION
MINISTRY OF AGRICULTURE
ROYAL GOVERNMENT OF BHUTAN


DR. SHOJI KANATSU
TEAM LEADER
STUDY TEAM
JAPAN INTERNATIONAL
COOPERATION AGENCY

In accordance with the Scope of Work signed on August 18, 1993 between the Ministry of Agriculture (MOA) and Japan International Cooperation Agency (JICA), the JICA Study Team submitted MOA twenty (20) copies of Interim Report (hereinafter referred to as the Report) on November 7, 1994. The report have been prepared through the home office work in Japan based on the Progress Report (1). A series of discussions were held and views were exchanged on November 8, 1994 between Ministry of Agriculture represented by Mr. SHERUB GYALTSHEN and the Study Team headed by Dr. SHOJI KANATSU.

As a result of the discussions, both sides agreed as stated below;

1. The MOA accepted and agreed the contents of the Report submitted by the Study Team.
2. The MOA understood and agreed to the concept of the additional surveys for the irrigation component on the Phase 2 study.
3. The MOA will request Ministry of Communication to give comments on domestic water supply section of the Report.
4. For the construction of the experimental facilities, the MOA shall take necessary measures,
 - 1) to exempt taxes, duties and any other charges on equipment, machinery and other materials brought into Bhutan for the construction work,
 - 2) to secure necessary permissions for the construction work,
 - 3) to secure the lands required for the construction work,
 - 4) to provide electric power supply line for the river pumping station in the CARD farm.

LIST OF ATTENDANTS

1. MINISTRY OF AGRICULTURE

Mr. Sherub Gyaltsen	Head, Research, Extension and Irrigation Division, MOA
Mr. Kinzang Wangchuk	Chief Irrigation Officer, Research, Extension and Irrigation Division, MOA
Mr. Wangdi Gyaltsen	Deputy Executive Engineer, Research, Extension and Irrigation Division, MOA
Mr. Ugyen Tshewang	Assistant Engineer, Research, Extension and Irrigation Division, MOA
Mr. Y.N. Sharma	Geotechnical Engineer, Research, Extension and Irrigation Division, MOA
Mr. Phuntsho Wangdi	Section Officer, Research, Extension and Irrigation Division, MOA
Mr. Karchung	Section Officer, Research, Extension and Irrigation Division, MOA
Mr. Dorji Khaudu	Section Officer, Research, Extension and Irrigation Division, MOA

2. JICA Head Office

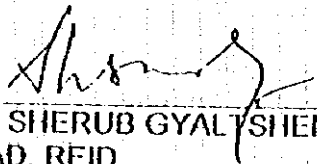
Mr. Satoshi Kimura	Staff Head Quarter JICA
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3. JICA Study Team

Dr. Shoji Kanatsu	Team Leader
Mr. Takao Sakamoto	Facility Planning/Experimental Facilities
Mr. Yujiro Itakura	Irrigation Engineer
Mr. Daigo Yano	Coordinator

MINUTES OF MEETING
ON
THE PROGRESS REPORT (2)
FOR
THE STUDY
ON
GROUNDWATER DEVELOPMENT
IN
WANGDUEPHODRANG DISTRICT
OF
BHUTAN

THIMPHU, MARCH 21, 1995



MR. SHERUB GYALTSHEN
HEAD, REID
MINISTRY OF AGRICULTURE
ROYAL GOVERNMENT OF
BHUTAN



DR. SHOJI KANATSU
TEAM LEADER
STUDY TEAM
JAPAN INTERNATIONAL
COOPERATION AGENCY

In accordance with the Scope of Work signed on August 18, 1993 between the Ministry of Agriculture (MOA) and Japan International Cooperation Agency (JICA), the JICA Study Team submitted MOA twenty (20) copies of Progress Report (2) (hereinafter referred to as the Report). The report have been prepared through the field work in Bhutan based on the Interim Report. A series of discussions was held and views were exchanged between the Study Team headed by Dr. SHOJI KANATSU and Ministry of Agriculture represented by Mr. Sherub Gyaltshen.

As a result of the discussions, both sides agreed as stated below;

1. The MOA accepted and agreed the contents of the Report submitted by the Study Team.
2. For the monitoring of the experimental facilities, the MOA shall take necessary measures as stated below;
 - 1) to assign the following staff of MOA during the absence of the Study Team
 - Three (3) counterpart staff (2 Section Officers and 1 Surveyor) (Full time at the site in Wangduephodrang)
 - Three (3) staff of the RNR-RC in Bajo (Full time at the site in Wangduephodrang)
 - 2) The support from AMC in Bajo is required for maintenance and repair of the facilities.
 - 3) The MOA will allow the above counterpart staff assigned for monitoring works to use all the vehicles provided by JICA during the absence of the Study Team
 - 4) The MOA duly understands that the counterpart staff assigned for the above monitoring works would have to continue the on-going meteo-hydrological observation also.

A - 23

LIST OF ATTENDANTS

1. MINISTRY OF AGRICULTURE

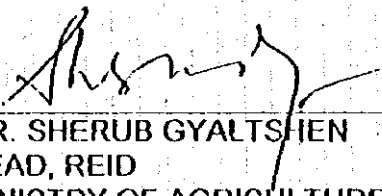
Mr. Sherub Gyaltshen	Head, Research, Extension and Irrigation Division, MOA
Mr. Kinzang Wangchuk	Chief Irrigation Officer, Research, Extension and Irrigation Division, MOA
Mr. Wangdi Gyaltshen	Deputy Executive Engineer, Research, Extension and Irrigation Division, MOA
Mr. Karchung	Section Officer, Research, Extension and Irrigation Division, MOA


2. JICA Study Team

Dr. Shoji Kanatsu	Team Leader
Dr. Mutsumi Motegi	Sub-leader/Hydrogeology
Mr. Takao Sakamoto	Facility Planning/Experimental Facilities
Mr. Soichiro Yumoto	Hydrology/Water Quality
Mr. Yujiro Itakura	Irrigation Improvement Planning
Mr. Daigo Yano	Coordinator

**MINUTES OF MEETING
FOR
THE STUDY
ON
GROUNDWATER DEVELOPMENT
IN
WANGDUEPHODRANG DISTRICT
OF
BHUTAN**

THIMPHU, SEPTEMBER 5, 1995


MR. SHERUB GYALTSHIEN
HEAD, REID
MINISTRY OF AGRICULTURE
ROYAL GOVERNMENT OF
BHUTAN

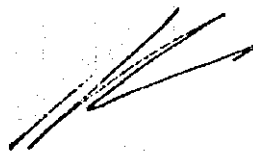

DR. SHOJI KANATSU
TEAM LEADER
STUDY TEAM
JAPAN INTERNATIONAL
COOPERATION AGENCY

In accordance with the Scope of Work signed on August 18, 1993 between the Ministry of Agriculture (MOA), Bhutan and Japan International Cooperation Agency (JICA), the JICA Study Team has conducted the field surveys and investigations, and completed all of its necessary field works. Based on the results obtained through such field works, a series of discussions was held and views were exchanged between the Study Team headed by Dr. SHOJI KANATSU and Ministry of Agriculture represented by Mr. Sherub Gyaltshen.

As a result of the discussions, both sides agreed on the basic concepts on the water resources master plan and the further schedules as stated below;

1. The MOA accepted and agreed the basic concepts for formulating the water resources master plan of the area as per the attached figures and tables.
2. The MOA agreed that the target year of the master plan would be set at 2002 and 2007 considering the period of its five-year plan.
3. The MOA agreed that the Final Report, which will be prepared during the home office work after the field work, will include the following volumes.
 - Volume I: Executive Summary
 - Volume II: Main Report
 - Volume III: Supporting Report
 - Volume IV: Drawings
 - Volume V: Data Book

The contents of the above Volume II to V are agreed as per the attached, and MOA understood that the attached contents is subjected to change depending upon the results of the Study. The Draft Final Report will be submitted to MOA in the middle of December 1995 as scheduled.



LIST OF ATTENDANTS

1. MINISTRY OF AGRICULTURE

Mr. Sherub Gyaltshen	Head, Research, Extension and Irrigation Division, MOA
Mr. Kinzang Wangchuk	Chief Irrigation Officer, Research, Extension and Irrigation Division, MOA
Mr. Karchung	Section Officer, Research, Extension and Irrigation Division, MOA
Mr. Phuntsho Wangdi	Section Officer, Research, Extension and Irrigation Division, MOA
Mr. Homraj Ghalay	Junior Engineer, Research, Extension and Irrigation Division, MOA

2. JICA Study Team

Dr. Shoji Kanatsu	Team Leader
Dr. Mutsumi Motegi	Sub-leader/Hydrogeology
Mr. Takao Sakamoto	Facility Planning/Experimental Facilities
Mr. Soichiro Yumoto	Hydrology/Water Quality
Mr. Yujiro Itakura	Irrigation Improvement Planning



DRAFT CONTENTS OF DRAFT FINAL REPORT

VOLUME II: MAIN REPORT

- | | |
|---|---|
| 1. INTRODUCTION | 7. WATER RESOURCES |
| 2. COUNTRY BACKGROUND | 8. WATER RESOURCES DEVELOPMENT
MASTER PLAN |
| 3. THE STUDY AREA | 9. URBAN WATER SUPPLY PLAN FOR
WANGOUEPHODRANG |
| 4. WATER RESOURCES | 10. IRRIGATION IMPROVEMENT PLAN |
| 5. IRRIGATION WATER MANAGEMENT AND
WATER REQUIREMENT | 11. CONCLUSIONS AND RECOMMENDATIONS |
| 6. URBAN AND RURAL WATER SUPPLY
DEMAND | |

VOLUME III: SUPPORTING REPORT

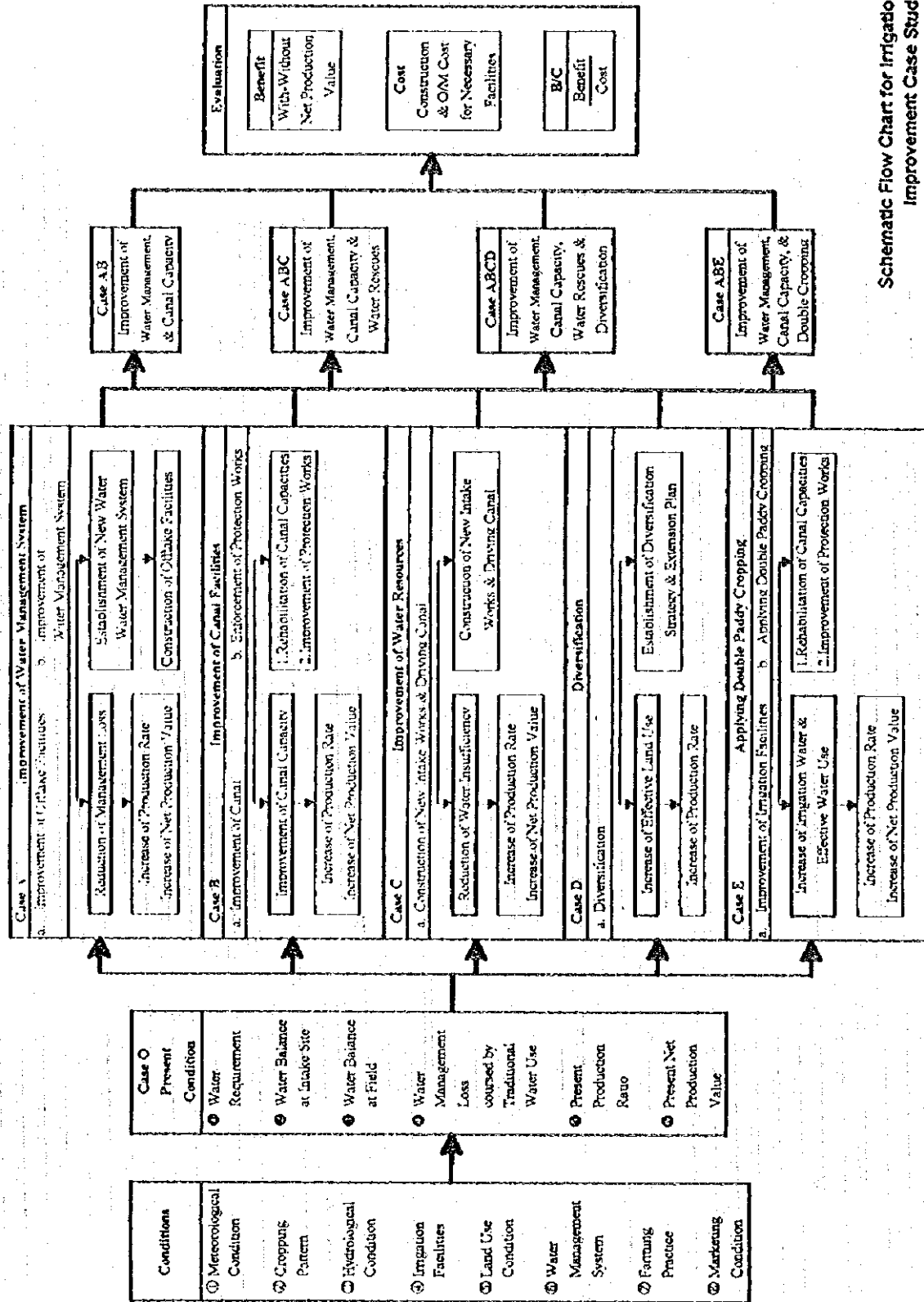
- | | |
|------------|--|
| APPENDIX-A | TOPOGRAPHIC SURVEY |
| APPENDIX-B | SOCIO-ECONOMIC SITUATION |
| APPENDIX-C | GEOPHYSICAL SURVEY AND TEST BORING |
| APPENDIX-D | GEOLOGY AND HYDROGEOLOGY |
| APPENDIX-E | METEOROLOGY AND HYDROLOGY |
| APPENDIX-F | GEOLOGICAL HAZARDS ASSESSMENT |
| APPENDIX-G | DOMESTIC WATER SUPPLY SYSTEM |
| APPENDIX-H | AGRICULTURE IMPROVEMENT STUDY |
| APPENDIX-I | EXPERIMENTAL FACILITIES AND MONITORING |
| APPENDIX-J | ALTERNATIVE STUDIES FOR WATER RESOURCES DEVELOPMENT MASTER
PLAN |
| APPENDIX-K | IMPLEMENTATION PLAN AND COST ESTIMATE |
| APPENDIX-L | FINANCIAL AND ECONOMIC EVALUATION |

VOLUME IV: DRAWINGS

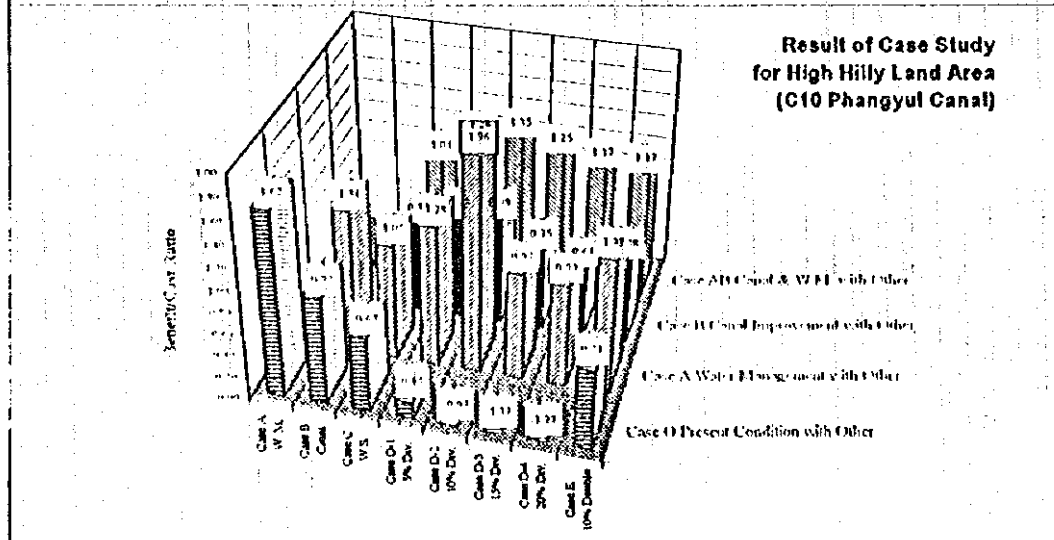
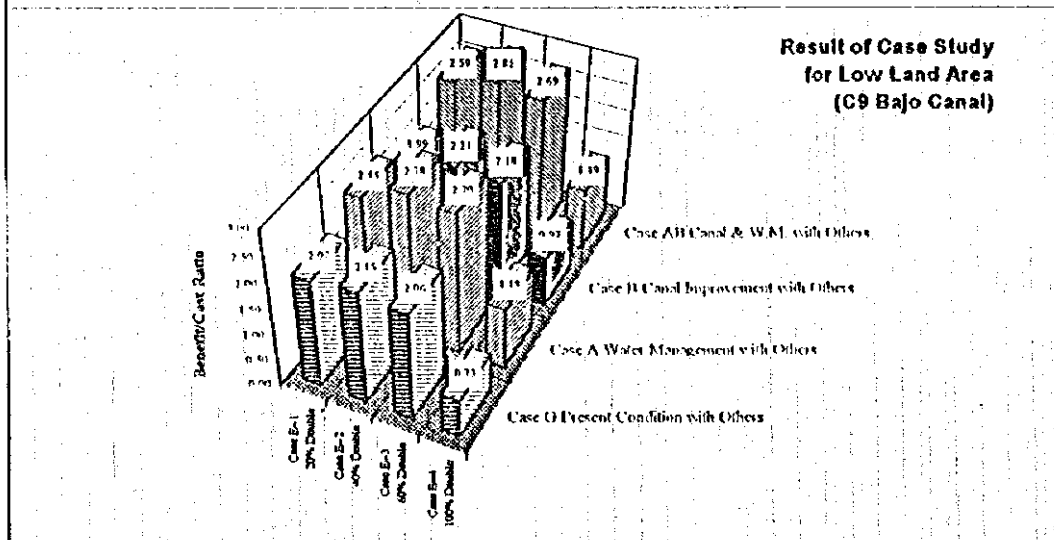
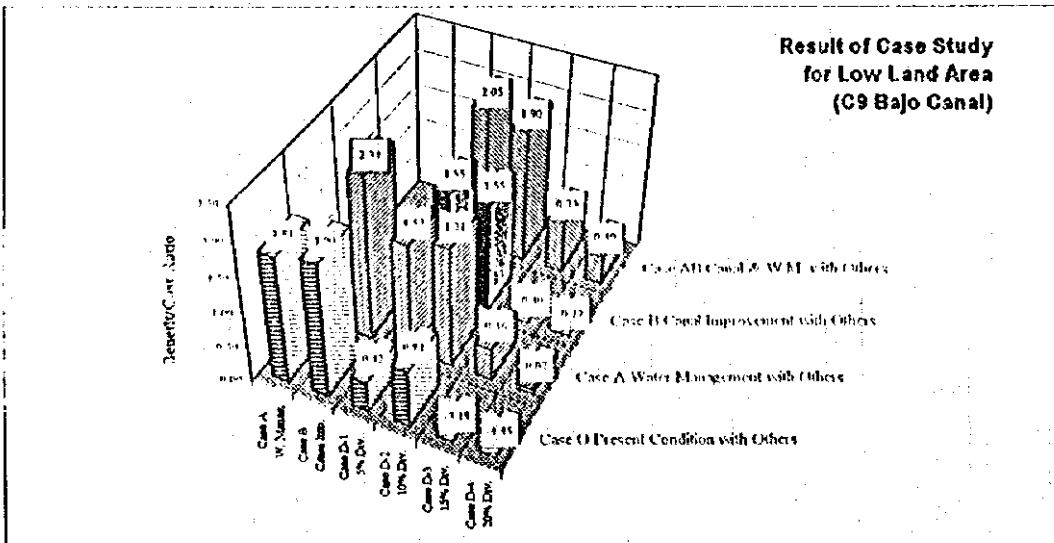
- | | |
|--|--------------------------------|
| I. DRAINAGE SYSTEM MAPS | IV. GEOLOGICAL PROFILES |
| II. GEOMORPHOLOGICAL LAND
CLASSIFICATION MAPS | V. HYDROGEOLOGICAL MAPS |
| III. GEOLOGICAL MAPS | VI. GROUNDWATER INVENTORY MAPS |
| | VII. LAND USE MAPS |

VOLUME V: DATA BOOK

- | | |
|-----------------------------|------------------------------|
| I. TOPOGRAPHIC DATA | III. GEOPHYSICAL SURVEY DATA |
| II. METEO-HYDROLOGICAL DATA | IV. MONITORING DATA |

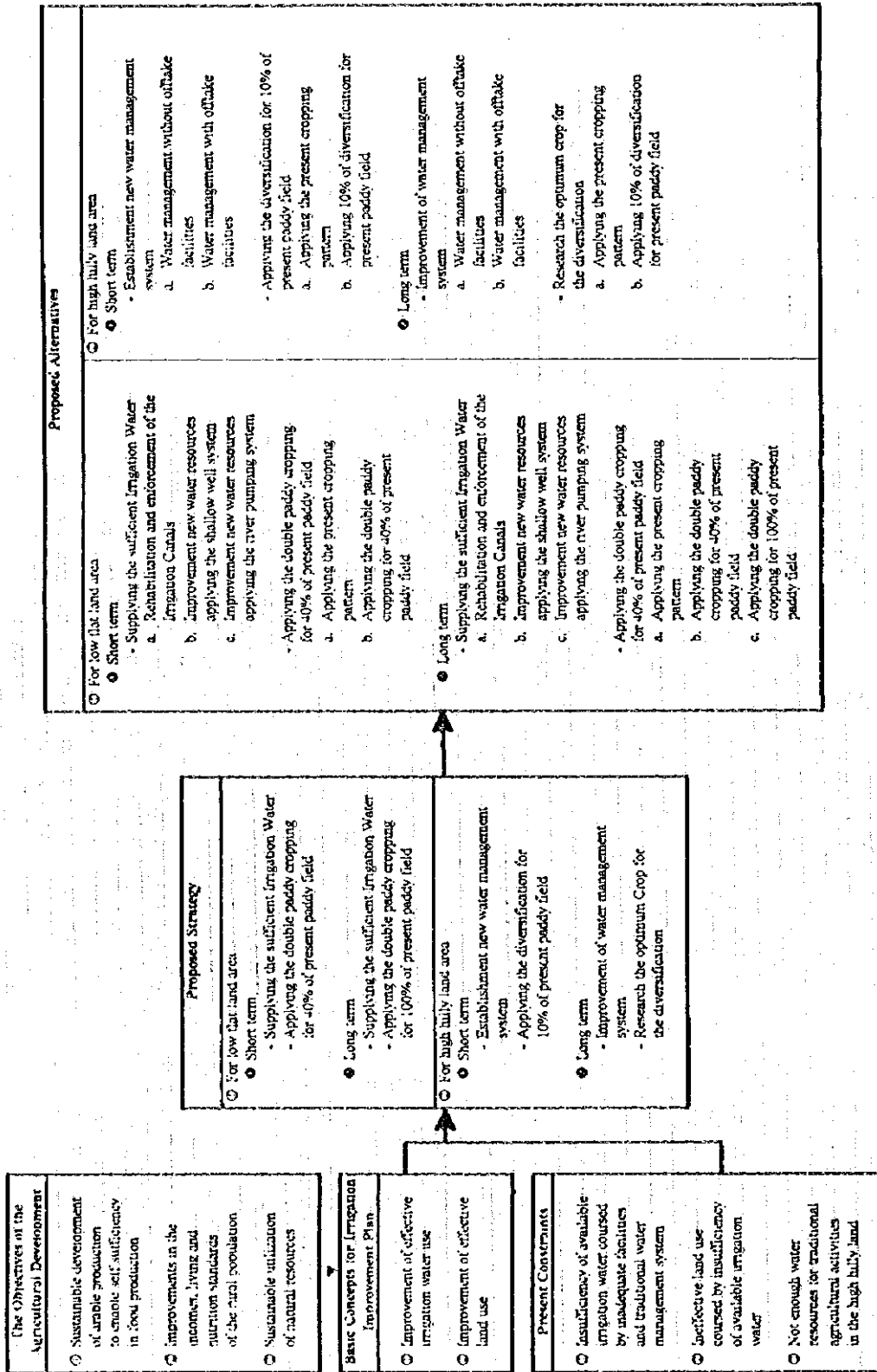


Schematic Flow Chart for Irrigation Improvement Case Study

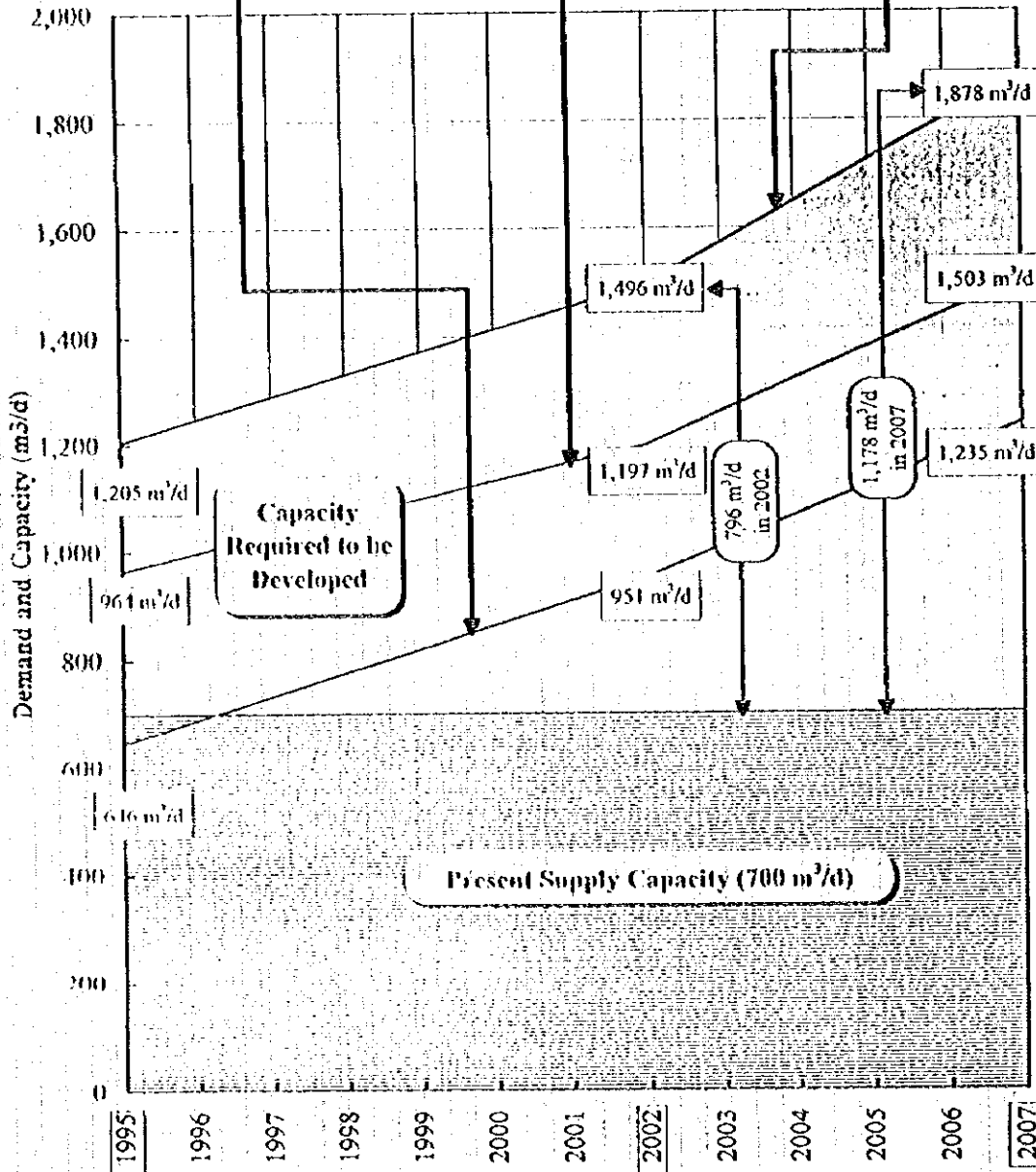


Result of Case Study

Schematic Flow of Alternatives
(based on the result of case study)



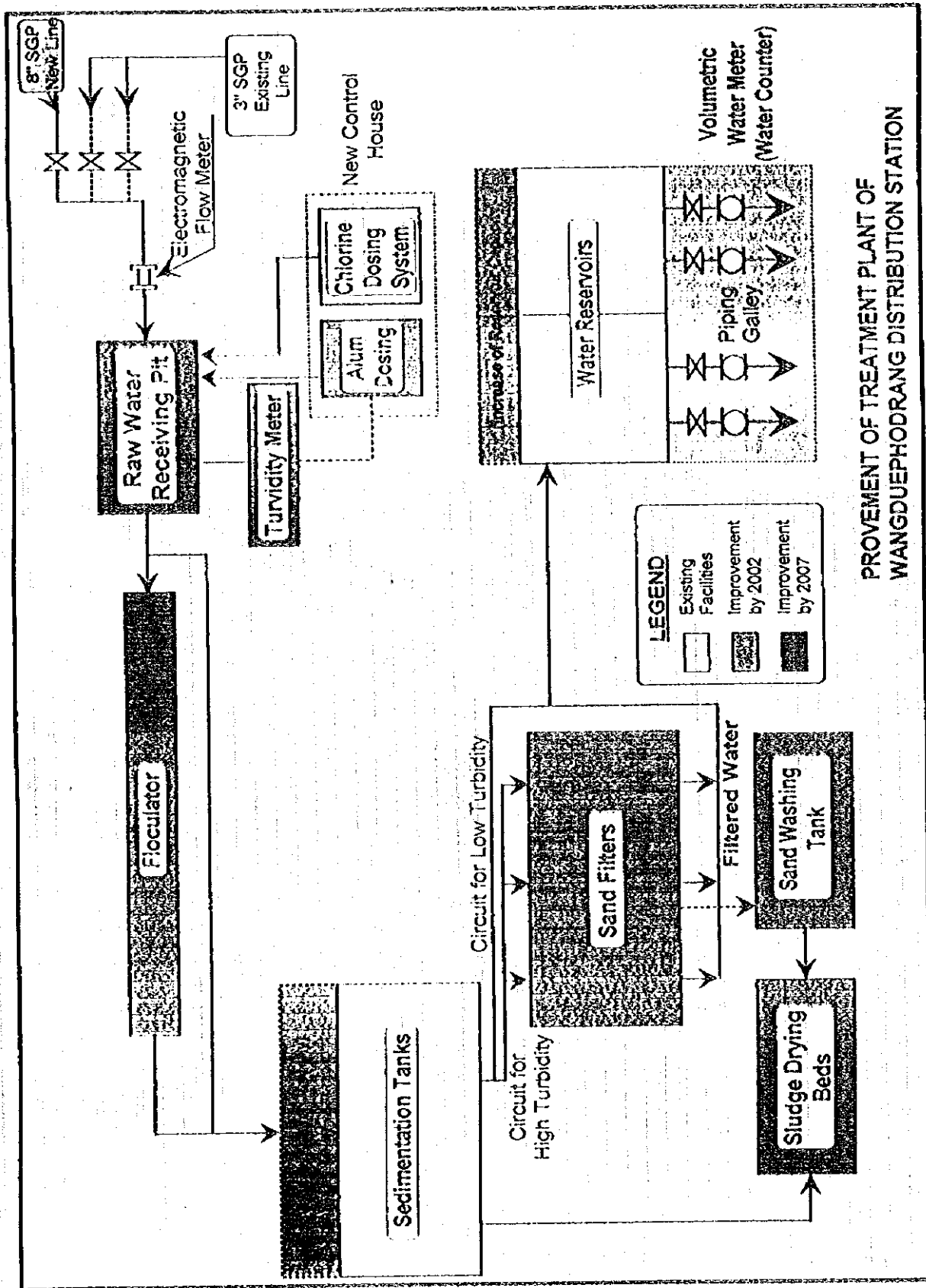
Year	Average Daily Consumption (m ³ /d)	Average Daily Demand (m ³ /d)	Maximum Daily Demand (m ³ /d)
1995	646	964	1,205
2002	951	1,197	1,496
2007	1,235	1,503	1,878



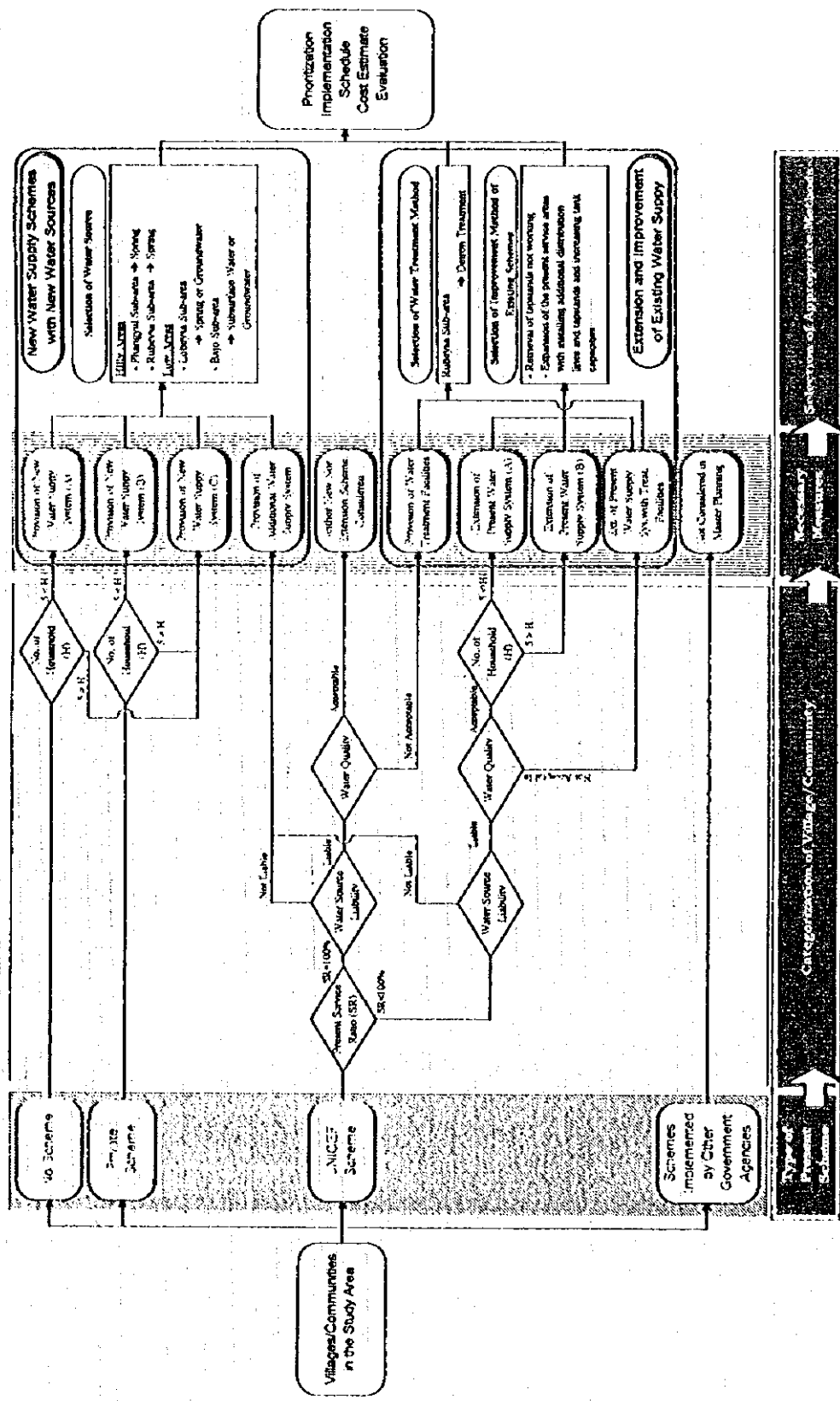
FUTURE WATER REQUIREMENT

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SCHMATIC FLOW FOR SELECTING MEASURES TO BE TAKEN

Sub-areas	Available Water Sources				Water Sources Considered in Alternative Study
	Spring Water	Sub-surface Water	Groundwater	Stream/River Water**	
Lobeysa	⊙	⊙	⊙	×	→ Spring Water & Groundwater
Bajo*	⊙	⊙	⊙	×	→ Sub-surface Water & Groundwater
Phangyul	⊙	×	×	×	→ Spring Water
Rubeysa	⊙	×	×	×	→ Spring Water

Note:

*: Spring water source is considered partly in hilly area

** : Stream and river water is not considered in the study since they may easily contaminated biologically.



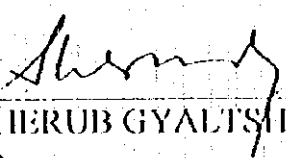
Sub-areas	Item	New Scheme (A)	New Scheme (B)	New Scheme (C)	Additional Scheme	Extension Scheme (A)	Extension Scheme (B)	Extension with Treatment	Water Treatment Scheme
Lobeysa	Population				0		67	0	0
	No. of Village	[L-1]	0	[L-2]	0	0	[S-3] 1	0	0
	Average Population				0		67	0	0
Bajo	Population	[B-1] 184	0	[B-2] 184	[B-1] 184	0	0	0	0
	No. of Village		0	[B-2]	[B-1]	0	0	0	0
	Average Population	184	0	[B-2] 184	[B-1] 184	0	0	0	0
Phangyul	Population	361	49	128	0	227	0	0	0
	No. of Village	3	1	7	0	3	0	0	0
	Average Population	[S-1] 120	49	[S-2] 18	0	[S-3] 76	0	0	0
Rubeysa	Population	186	0	42	0	169	53	0	[T-1] 123
	No. of Village	2	0	2	0	1	[S-4] 2	0	[T-1] 3
	Average Population	93	0	21	0	169	27	0	123
Whole Area	Total Population	1,181	49	282	185	396	120	0	123
	Total No. of Village	9	1	12	1	4	3	0	1
	Average Population	131	49	24	185	99	40	0	123

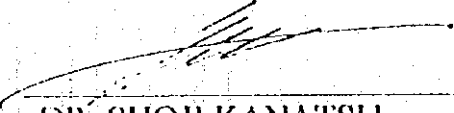
Case S-1:	Spring Development - New (Large)	Case D-1:	Groundwater vs Subsurface Development (Large)
Case S-2:	Spring Development - New (Small)	Case D-2:	Groundwater vs Subsurface Development (Small)
Case S-3:	Spring Development - Extension (Small)	Case L-1:	Spring vs Groundwater Development (Large)
Case S-4:	Spring Development - Extension (Large)	Case L-2:	Spring vs Groundwater Development (Small)
Case T-1:	Water Treatment - Design		

OPTIONS CONSIDERED IN THE ALTERNATIVE STUDY

MINUTES OF MEETING
ON
THE DRAFT FINAL REPORT
FOR
THE STUDY
ON
GROUNDWATER DEVELOPMENT
IN
WANGDUEPHODRANG DISTRICT
OF
BHUTAN

THIMPHU, January 17, 1996


MR. SHERUB GYALTSHIEN
HEAD
RESEARCH, EXTENSION,
AND IRRIGATION DIVISION
MINISTRY OF AGRICULTURE
ROYAL GOVERNMENT OF
BHUTAN

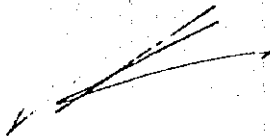
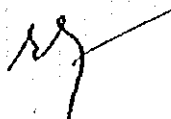

DR. SHOJI KANATSU
TEAM LEADER
STUDY TEAM
JAPAN INTERNATIONAL
COOPERATION AGENCY

In accordance with the Scope of Work for the Study on Groundwater Development in Wangduephodrang District of Bhutan (hereinafter referred to as the Study), the Government of Japan through Japan International Cooperation Agency (JICA) dispatched from January 10 to January 18, 1996 the Study Team headed by Dr. Shoji Kanatsu, Pacific Consultants International and accompanied Mr. Narihito Fujisawa, JICA Head Office for exposition of the Draft Final Report to the officials of the Government of Bhutan concerned with the Study.

The explanation and an exchange of opinions on the Draft Final Report was made by the Study Team from January 12 to January 17, 1996.

As a consequence of the said explanation as well as exchange of opinions on the Draft Final Report, the Study Team and the Bhutan side agreed upon as follows:

1. The Bhutan side received from JICA Tokyo Head Office the Draft Final Report which is composed of twenty (20) copies of Executive Summary, Main report and Supporting Report and two (2) copies of Drawings and Data Book on January 10, 1996.
2. The Bhutan side agreed on the contents of the Draft Final Report which has been prepared in due compliance with the stipulations of the Scope of the Work and with the methodology set forth in the Inception Report.
3. Despite the agreement to the report expressed in the numeral 2 above, the Bhutan side will make detailed analysis on the Draft Final Report and will provide the Study Team with their comments and observations on the report within thirty (30) days after receipt of the Draft Final Report, namely, by February 10, 1996.
4. The Study Team shall make a revision of the Draft Final Report, if necessary, based on the comments and observations of the Bhutan side and will submit the Final Report to the Bhutan Government within thirty (30) days after receipt of the comments and observations on the report.
5. The Bhutan side has no objection for the Final Report being open to the public immediately after the Final Report is received by Ministry of Agriculture.



LIST OF ATTENDANTS

1. MINISTRY OF AGRICULTURE

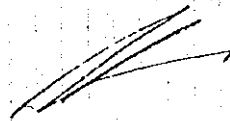
Mr. Sherub Gyaltsen	Head,
Mr. Kinzang Wangchuk	Research, Extension and Irrigation Division, MOA
Mr. Kaylzang Tshering	Project Manager, Paro Valley Development Project
Mr. Kinga Dorji	Chief Irrigation Officer, Research, Extension and Irrigation Division, MOA
Mr. Karchung	Dy. Executive Engineer, Research, Extension and Irrigation Division, MOA
Mr. H. R. Ghalley	Section Officer, Research, Extension and Irrigation Division, MOA
	Junior Engineer, Research, Extension and Irrigation Division, MOA

2. JICA Head Office

Mr. Naohito Fujisawa	Staff JICA Head Office
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3. JICA Study Team

Dr. Shoji Kanatsu	Team Leader
Dr. Mutsumi Motegi	Sub-leader/Hydrogeology
Mr. Takao Sakamoto	Facility Planning/Experimental Facilities



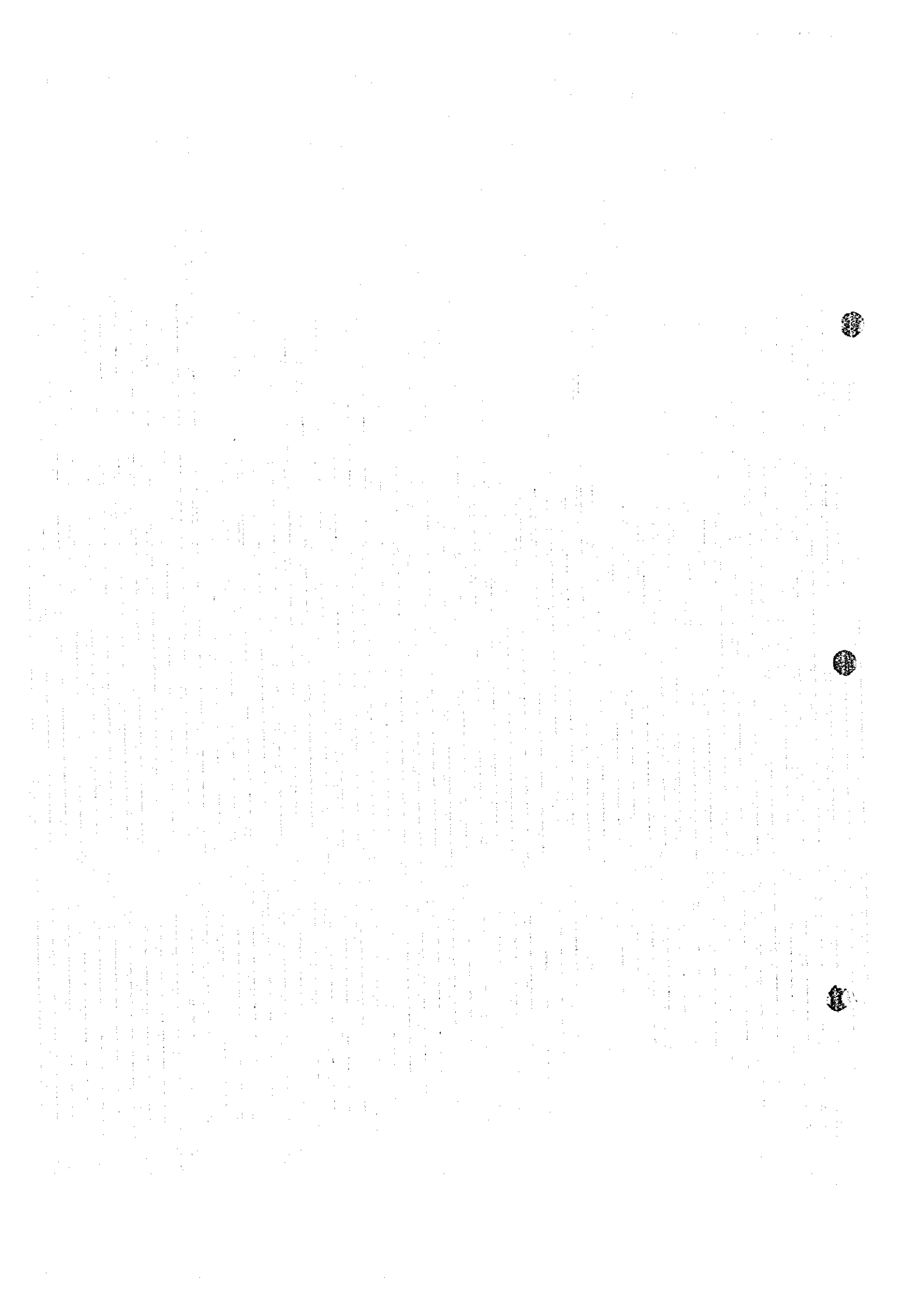
LIST OF THE STUDY TEAM

	NAME	CHARGE
1	Dr. Shoji KANATSU	Team Leader
2	Dr. Mutsumi MOTEGI	Sub-leader/Hydrogeology
3	Mr. Soichiro YUMOTO	Hydrology/Water Quality
4	Mr. Takao SAKAMOTO	Facilities Planning/Experimental Facilities
5	Mr. Kazuo UCHIDA	Electric Prospecting
6	Mr. Toshihiko KOGO	Test Boring
7	Mr. Yoshito KIMURA	Test Boring
8	Mr. Eizaburo FURUTANI	Domestic Water Supply Planning
9	Mr. Isao DOJUN	Irrigation Water Supply Planning
10	Mr. Osamu NOGOSHI	Topographic Survey
11	Mr. Yutaka NOZAKI	Regional Economy/Project Evaluation
12	Mr. Yujiro ITAKURA	Irrigation Improvement Planning
13	Mr. Daigo YANO	Coordinator

LIST OF THE COUNTERPARTS

<u>CHARGE</u>	<u>NAME</u>
1. Chief Counterpart	Dasho (Dr.) Kinzang Dorji Secretary, MOA (Till Oct. 1994) Mr. Sherab Gyaltshen Head, REID, MOA (From Nov. 1994)
2. Sub-chief Counterpart	Mr. Kinzang Wangchuk Chief Irrigation Officer, REID, MOA
3. Hydrogeologist	Mr. Y. N. Sharma Geotechnical Engineer, REID, MOA
4. Hydrologist (A)	Mr. J. N. Sharma Assistant Hydrologist, Hydrology Unit, DOP
5. Hydrologist (B)	Mr. Karchung Section Officer, REID, MOA
6. Facility Planner	Mr. Kinzang Wangchuk Chief Irrigation Officer, REID, MOA
7. Geophysicist	Mr. Santa Bahadur Rai Mechanic, AMC Bajo, MOA
8. Drilling Specialist (A)	Mr. Dorji Khandu Mechanic, PVADP, MOA
9. Drilling Specialist (B)	Mr. Wangchuk Mechanic, PVADP, MOA
10. Drilling Specialist (C)	Mr. Lungten Norbu Mechanic, AMC Paro, MOA
11. Domestic Water Supply Planner	Mr. Prem Rai Work Assistant, Wanduephodrang District
12. Irrigation Water Supply Planner (A)	Sonam Tobgay Project Engineer, PWVDP
13. Irrigation Water Supply Planner (B)	Mr. Homraj Ghaley Junior Engineer, REID, MOA
14. Economist	Mr. Mani Thapa Planning Officer, MOA
15. Topographic Survey Engineer	Mr. Nangay Tshering Surveyor, PWVDP
16. Administrative Coordinator (A)	Mr. Phuntsho Wangdi Section Officer, REID, MOA
17. Administrative Coordinator (B)	Mr. Dorji Khandu Section Officer, REID, MOA





JICA