〔資　料　編〕

資料編

1．調査団員氏名・所属

(1) 基本設計現地調査時（1999年4月10日～5月19日）

担当	氏名	所属
1) 総括	今井 伸	農林水産省構造改善局建設部設計課 海外土地改良技術室課長補佐
2) 計画管理	山目 克巳	国際協力事業団無償資金協力調査部調査一課
3) 業務主任／灌漑農業計画	天野 常雄	太陽コンサルタンツ株式会社
4) 灌漑排水計画	仲田 茂	太陽コンサルタンツ株式会社
5) 灌漑排水施設計画	大里 安	太陽コンサルタンツ株式会社
6) 水理地質	安田 正	北海道開発コンサルタント株式会社
7) 積算／施工計画	西 元孝	太陽コンサルタンツ株式会社
8) PCMモデレータ	伊藤 毅	アイ・シー・ネット株式会社

(2) 基本設計ﾄﾞﾗﾌﾄﾌｧｲﾅﾙﾚﾎﾟｰﾄ説明時（1999年8月19日～8月25日）

担当	氏名	所属
1) 総括	稲本 暁	農林水産省関東農政局計画部資源課 地質官
2) 計画管理	山目 克巳	国際協力事業団無償資金協力調査部調査一課
3) 業務主任／灌漑農業計画	天野 常雄	太陽コンサルタンツ株式会社
4) 灌漑排水計画	仲田 茂	太陽コンサルタンツ株式会社

2．調査日程

(1)　基本設計現地調査時（1999 年 4 月 10 日～5 月 19 日）

月日・曜日			調　査　内　容	宿泊先
4	10	土	①②③④⑥:成田→ｼﾞｬｶﾙﾀ	ｼﾞｬｶﾙﾀ
	11	日	①②③④⑥:団内会議、⑧：成田→ｼﾞｬｶﾙﾀ	ｼﾞｬｶﾙﾀ
	12	月	日本大使館・JICA 表敬 水資源総局、技術指導局・東部建設局・地下水部打合せ	ｼﾞｬｶﾙﾀ
	13	火	BAPENAS、地下水部打合せ	ｼﾞｬｶﾙﾀ
	14	水	地下水部打合せ ⑤⑦：成田→ｼﾞｬｶﾙﾀ、⑧ｼﾞｬｶﾙﾀ→ﾏﾅﾄﾞ→ｺﾀﾓﾊﾞｸﾞ	①～⑦ ｼﾞｬｶﾙﾀ ⑧ ｺﾀﾓﾊﾞｸﾞ
	15	木	①～⑦：ｼﾞｬｶﾙﾀ→ﾏﾅﾄﾞ→現地調査(4)(5)→ｺﾀﾓﾊﾞｸﾞ ⑧：PCM ﾜｸｼｮｯﾌﾟ開催準備	ｺﾀﾓﾊﾞｸﾞ
	16	金	①②③④⑦⑧：PCM ﾜｰｸｼｮｯﾌﾟ、⑤⑥：現地調査(4)(5)	ｺﾀﾓﾊﾞｸﾞ
	17	土	①②③④⑦⑧：PCM ﾜｰｸｼｮｯﾌﾟ、⑤⑥：現地調査(4)(5)	ｺﾀﾓﾊﾞｸﾞ
	18	日	①②③：ｺﾀﾓﾊﾞｸﾞ→ﾏﾅﾄﾞ→ｼﾞｬｶﾙﾀ ④～⑧：PCM ﾜｰｸｼｮｯﾌﾟの結果討論	①②③ ｼﾞｬｶﾙﾀ ④～⑧ ｺﾀﾓﾊﾞｸﾞ
	19	月	①②③：ミニッツ協議 ④～⑦：現地調査(4)(5)、⑧：PCM ﾜｰｸｼｮｯﾌﾟまとめ	①②③ ｼﾞｬｶﾙﾀ ④～⑧ ｺﾀﾓﾊﾞｸﾞ
	20	火	①②：ミニッツ協議・署名、ｼﾞｬｶﾙﾀ→成田 ③：ミニッツ協議 ④～⑦：ｺﾀﾓﾊﾞｸﾞ→ｺﾞﾛﾝﾀﾛ、⑧：ｺﾀﾓﾊﾞｸﾞ→ﾏﾅﾄﾞ→ｼﾞｬｶﾙﾀ→成田	①②⑧ 機中泊 ③ ｼﾞｬｶﾙﾀ ④～⑦ ｺﾞﾛﾝﾀﾛ
	21	水	③：ｼﾞｬｶﾙﾀ→ﾏﾅﾄﾞ ④～⑦：現地調査(1)(2)(3)	③ ﾏﾅﾄﾞ ④～⑦ ｺﾞﾛﾝﾀﾛ
	22	木	③：潅漑事務所打合せ、データ収集 ④～⑦：現地調査(1)(2)(3)	③ ﾏﾅﾄﾞ ④～⑦ ｺﾞﾛﾝﾀﾛ
	23	金	③：データ収集、④～⑦：ｺﾞﾛﾝﾀﾛ→ｺﾀﾓﾊﾞｸﾞ→ﾏﾅﾄﾞ	ﾏﾅﾄﾞ
	24	土	団内打合せ、潅漑事務所打合せ、ﾏﾅﾄﾞ→ｳｼﾞｭﾝﾊﾟﾝﾀﾞﾝ	ｳｼﾞｭﾝﾊﾟﾝﾀﾞﾝ
	25	日	ｳｼﾞｭﾝﾊﾟﾝﾀﾞﾝ→ｸﾝﾀﾞﾘ	ｸﾝﾀﾞﾘ
	26	月	地下水事業所・潅漑事務所打合せ、現地調査(6)(7)	ｸﾝﾀﾞﾘ
	27	火	現地調査(8)(9)(10)	ｸﾝﾀﾞﾘ
	28	水	現地調査(6)(7)	ｸﾝﾀﾞﾘ
	29	木	現地調査(8)(9)(10)	ｸﾝﾀﾞﾘ
	30	金	データ整理	ｸﾝﾀﾞﾘ
5	1	土	ｸﾝﾀﾞﾘ→ﾃﾞﾝﾊﾟｻｰﾙ	ﾃﾞﾝﾊﾟｻｰﾙ
	2	日	ﾃﾞﾝﾊﾟｻｰﾙ→ﾏｳﾒﾚ、地下水事業所打合せ	ｳｳﾒﾚ
	3	月	ﾏｳﾒﾚ→現地調査(13)(14)→ﾓﾆ	ﾓﾆ
	4	火	ﾓﾆ→現地調査(15)→ﾝﾍﾞｲ	ﾝﾍﾞｲ
	5	水	ｲﾍﾞｲ→現地調査(16)(17)→ﾏｳﾒﾚ	ﾏｳﾒﾚ
	6	木	③⑦：地下水事業所打合せ、現地調査(13) ④⑤⑥：ﾏｳﾒﾚ→ﾃﾞﾝﾊﾟｻｰﾙ	③⑦ ﾏｳﾒﾚ ④⑤⑥ ﾃﾞﾝﾊﾟｻｰﾙ
	7	金	③⑦：地下水事業所打合せ、現地調査(14) ④⑤⑥：ﾃﾞﾝﾊﾟｻｰﾙ→ﾜｲﾝｶﾞﾌﾟ	③⑦ ﾏｳﾒﾚ ④⑤⑥ ﾜｲﾝｶﾞﾌﾟ
	8	土	③⑦：データ整理 ④⑤⑥：現地調査(12)	③⑦ ﾏｳﾒﾚ ④⑤⑥ ﾜｲﾝｶﾞﾌﾟ
	9	日	③⑦：ﾏｳﾒﾚ→ｸﾊﾟﾝ ④⑤⑥：ﾜｲﾝｶﾞﾌﾟ→ﾜｲｶﾌﾞﾊﾞｸ、現地調査(11)	③⑦ ｸﾊﾟﾝ ④⑤⑥ ﾜｲｶﾌﾞﾊﾞｸ

月日・曜日	調　査　内　容	宿泊先
5　10　月	③⑦：地下水事業所打合せ、データ収集 ④⑤⑥：現地調査(11)	③⑦ ｸﾊﾟﾝ ④⑤⑥ ﾜｲｶﾌﾞﾊﾞｸ
11　火	③⑦：地下水事業所打合せ、データ収集 ④⑤⑥：ﾜｲｶﾌﾞﾊﾞｸ→ﾜｲﾝｶﾞﾌﾟ	③⑦ ｸﾊﾟﾝ ④⑤⑥ ﾜｲﾝｶﾞﾌﾟ
12　水	③⑦：ｸﾊﾟﾝ→ｼﾞｬｶﾙﾀ ④⑤⑥：現地調査(12)	③⑦ ｼﾞｬｶﾙﾀ ④⑤⑥ ﾜｲﾝｶﾞﾌﾟ
13　木	データ整理	③⑦ ｼﾞｬｶﾙﾀ ④⑤⑥ ﾜｲﾝｶﾞﾌﾟ
14　金	③⑦：地下水部打合せ、④⑤⑥：ﾜｲﾝｶﾞﾌﾟ→ｼﾞｬｶﾙﾀ	ｼﾞｬｶﾙﾀ
15　土	現地再委託業者打合せ、データ整理	ｼﾞｬｶﾙﾀ
16　日	データ整理	
17　月	データ収集、地下水部打合せ（現地調査報告） ⑤⑦：ｼﾞｬｶﾙﾀ→成田	③④⑥ ｼﾞｬｶﾙﾀ ⑤⑦ 機中泊
18　火	③④⑥：日本大使館・JICA 報告、ｼﾞｬｶﾙﾀ→成田	機中泊
19　水	③④⑥：成田着	

（調査団員）

①：今井　伸　　②：山目　克巳　　③：天野　常雄

④：仲田　茂　　⑤：大里　安　　⑥：安田　正

⑦：西　元孝　　⑧：伊藤　毅

（調査対象地区）

(1)　ボンゴ I、北スラウェシ州

(2)　ボンゴ II、北スラウェシ州

(3)　ボンゴ III、北スラウェシ州

(4)　テンポック、南東スラウェシ州

(5)　パラペ、南東スラウェシ州

(6)　ラノオハ、南東スラウェシ州

(7)　ラノメト、南東スラウェシ州

(8)　ラプル、南東スラウェシ州

(9)　モロインダ、南東スラウェジ州

(10)　ランブディジャヤ、南東スラウェシ州

(11)　カレムブカハ、NTT 州スンバ

(12)　パラカヘンビ、NTT 州スンバ

(13)　ナマンゲワ、NTT 州フローレス

(14)　マゲパンダ、NTT 州フローレス

(15)　ラナコロ、NTT 州フローレス

(16)　ダワ、NTT 州フローレス

(17)　トトマラ、NTT 州フローレス

(2) 基本設計ドラフトファイナルレポート説明時（1999年8月19日～8月25日）

月日・曜日	調査内容	宿泊先
8 19 木	成田→ジャカルタ	ジャカルタ
20 金	水資源総局、技術指導局・東部建設局・地下水部打合せ 日本大使館表敬	ジャカルタ
21 土	団内会議	ジャカルタ
22 日	団内会議	ジャカルタ
23 月	水資源総局打合せ、ミニッツ協議	ジャカルタ
24 火	ミニッツ署名 日本大使館・JICA報告、ジャカルタ→成田	機中泊
25 水	成田着	

3．相手国関係者リスト

Ministry of Public Works

- Bureau of International Cooperation
  - Mr. Darminto — Section Chief of Administration for Bilateral Cooperation
- Directorate General of Water Resources Department (DGWRD)
  - Mr. Budiman Arif — Director General
  - Mr. Susilo Soekardi — Secretary
- Directorate of Planning and Programming, DGWRD
  - Mr.Soenarno — Director
  - Mr. Her Wiryanto — Head, Sub Dir. of Foreign Aid and Administration
  - Mr. Yayat Hidayat — Foreign Aid and Administration Division
  - Mr. Sutardi — Chief of Section for Priority Setting
  - Mr. Minoru Nakano — JICA Expert
- Directorate of Technical Guidance, DGWRD
  - Mr. M. Napitupulu — Director
  - Mr. Wahyu Hartomo — Head of Sub Dir. of Groundwater
  - Mr. Djoko Santoso — Chief of Eastern Region, Sub-Dir. of Groundwater
  - Mr. Rochhadi — Chief of Dissemination, Sub-Dir. of Groundwater
  - Mr. Willy A Firdaus — Stuff of Central Region, Sub-Dir. of Groundwater
  - Mr. Nagata Satoshi — JICA Expert
- Directorate of Implementation Guidance for East Region, DGWRD
  - Mr. Meduk Suebiyanto — Director
- Irrigation Engineering Service Center, DRWRD
  - Mr. A. Tommy M. Sitompul — Project Manager
  - Mr. Masayuki Shimizu — Project Team Leader (JICA Expert)
- North Sulawesi Irrigation Project Office in Manado
  - Mr. Bambang Hargono — Manager
  - Mr. Nus Mokodongan — Sub Project Manager (for Surface Irrigation)
  - Mr. Aya Lahida — Chief of Construction Guidance
- North Sulawesi Groundwater Development Sub Project Office in Kotamobagu
  - Mr. Mar`I — Sub-project Maneger
  - Mr. Djidon R. Watania — Chief of Administration
  - Mr. Sujatno — Hydrogeologist
  - Mr. Zaenal Arifin — Stuff of O/M, P2AT
  - Mr. Basarudin — Mechanical Engineer
  - Mr. Rukani Be — Irrigation Enginner
- Southeast Sulawesi Irrigation Project Office in Kendari
  - Mr. Hudan Karyoso — Director

- Southeast Sulawesi Groundwater Development Sub-Project Office in Kendari
  - Mr. Edy Sanusi — ex-Sub Project Manager (Sub Project Manager for Surface Irrigation Project Office)
  - Mr. K. Tambunan — Sub Project Manager
  - Mr. Mr. Muh Tahir — Chief of Drilling Section
- Flores Irrigation Project Office in Ruteng
  - Mr. Obet Sabetu — Director
- Flores Groundwater Development Sub-Project Office in Maumere
  - Mr. Tjahjo Widiyanto — Sub Project Manager
  - Mr. Nuwa Videlis — Chief of Administration
  - Mr. Asdin Julaidy — Chief of Planning
- Timor Irrigation Project Office in kupang
  - Mr. A. Hasanudin — Director
- Timor Groundwater Development Sub-Project Office in Kupang
  - Mr. Suhartono — Sub Project Manager
  - Mr. I. Ketut Suardita — Chief of Administration
  - Mr. Mardono P. AMd — Chief of Planning
  - Mr. Subadinoto — Chief of Driling
- North Sulawesi Water Resources Institutional Development Project
  - Ms Ghislaine Larouche — Canadian Team Leader
- Rumbia Groundwater Irrigation Sub Project, Central Sulawesi, SSIMP-III
  - Mr. Untung Subagio — Sub Project Leader (Nippon Koei)

NATIONAL DEVELOPMENT PLANNING AGENCY (BAPPENAS)

- Mr. H. Koensatwanto Inpasihardjo — Chief, Bureau for Water Resources and Irrigation

MINISTRY OF HOME AFFAIRS

- North Sulawesi Provicial Public Works
  - Mr. Kambei — Head
- North Sulawesi Provicial Public Works
  - Mr. Bambang Sapto — Head

MINISTRY OF AGRICULTURE

- North Sulawesi Sub-Directorate of Land Development and Rehabilitation, Food Crop and Horticulture Services, North Sulawesi
  - Mr. Wemoie Uguy — Chief
  - Mr. H. Montolalu — Sub Project Manager

日本大使館

河内　幸男	一等書記官

JICA インドネシア事務所

庵原　宏義	所長
米田　一弘	次長
吉成　幸恵	所員

THE OVERSEAS ECONOMIC COOPERATION FUND OF JAPAN (OECF), JAKARTA OFFICE

Mr. Tanimoto	Resident Representative

MINUTES OF DISCUSSIONS
ON
BASIC DESIGN STUDY ON THE PROJECT
FOR
CONSTRUCTION OF FACILITY FOR IRRIGATION IN EASTERN AREA
IN
THE REPUBLIC OF INDONESIA

In response to a request from the Government of the Republic of Indonesia, the Government of Japan decided to conduct a Basic Design Study on the Project for Construction of Facility for Irrigation in the Eastern Area (hereinafter referred to as "the Project") and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Indonesia a Basic Design Study Team (hereinafter referred to as "the Team"), which is headed by Mr. Shin IMAI, Deputy Director, Overseas Land Improvement Cooperation Office, Design Division, Construction Department, Agricultural Structure Improvement Bureau, Ministry of Agriculture, Forestry and Fisheries, and is scheduled to stay in the country from April 10 to April 20, 1999.

The team held discussions with the officials concerned of the Government of Indonesia and conducted field surveys at the study area.

In the course of discussions and field surveys, both parties have confirmed the main items described on the attached sheets. The team will proceed to further work and prepare the Basic Design Study Report.

Jakarta, April 20, 1999

Shin IMAI

Leader
Basic Design Study Team
JICA

for

Budiman Arif

Director General
Water Resources Development
Ministry of Public Works
The Republic of Indonesia

ATTACHMENT

1. Objective

The objective of the Project is to improve living conditions of inhabitants in three provinces in the Eastern Area by construction of small scale groundwater irrigation system in compliance with the national development plan of the Republic of Indonesia.

2. Project Site

The project sites are located in North Sulawesi, South-east Sulawesi and East Nusa Tenggara.

3. Responsible and Executing Agency

The Directorate General of Water Resources Development (hereinafter referred to as "DGWRD"), the Ministry of Public Works is responsible for the administration and execution of the Project.

The executing agencies are the Provincial Irrigation Project Offices in North Sulawesi, South-east Sulawesi and East Nusa Tenggara.

4. Items agreed by the Government of Indonesia

After discussions with the Team, 17 sites with the System were finally agreed by Indonesian side, even though the Government of Indonesia had requested 25 sites (See Annex-1,Annex-2). JICA will assess the appropriateness of the request and will recommend to the Government of Japan for approval.

5. Japan's Grant Aid System

(1) The Government of Indonesia has understood the system of Japan's Grant Aid explained by the Team. (See Annex-3)

(2) The Government of Indonesia will take necessary measures described in Annex-4 for smooth implementation of the Project on condition that the Grant Aid Assistance by the Government of Japan is extended to the Project.

6. Schedule of the Study

(1) The Team will proceed to further studies in Indonesia until May 18, 1999.

(2) JICA will prepare a draft report in English and dispatch a mission in order to explain

its contents around August 1999.

(3) In the case that the contents of the report is accepted in principle by the Government of Indonesia, JICA will complete the final report and send it to the Government of Indonesia by the end of December 1999.

7. Other Relevant Issues

(1) The public security is deteriorated around the districts, namely Irian Jaya and West Timor in East Nusa Tenggara, and the proper execution of the study seems to be difficult there. Therefore, even though the Government of Indonesia had requested 25 sites, the Team confirmed 17 sites excluding 8 sites in the aforementioned proposed districts.

The Team suggested that Indonesian side could request the excluded projects in the rest 8 sites when it comes the study could execute properly in the better security condition.

Indonesia side understood it.

(2) The Team explained that the Project should be formulated with the provision of utilization of the drilling rigs with necessary equipment which had been provided under the past three Japan's Grant Aid Schemes, namely "The Project for Supply of Equipment for Irrigation in Eastern Area (1/2 : 1996) and (2/2 : 1997)" and "Urgent Supply (1997)". Consequantly, the Team requested the proper maintenance of the drilling rigs in order to keep good condition for their smooth execution.
Indonesian side understood it.

(3) The Team inquired the number of existing drilling rigs and their usability. Indonesian side answered and showed the table as follows.

List of Drilling Rigs under Japan's Grant Aid Schemes

Provinces	The Project for Supply of Equipment for Irrigation in Eastern Area						Total (set)	Remarks
	(1/2) 1996		(2/2) 1997		Urgent 1997			
	set	Model	set	Model	set	Model		
North Sulawesi	2	Top150T	-	-	-	-	2	usable
South-east Sulawesi	2	Top150T	1	FSW-5T	-	-	3	"
East Nusa Tenggara (Sumba)	1	Top150T	-	-	1	Top 150T	2	"
East Nusa Tenggara (Flores)	-	-	1	FSW-5T	-	-	1	"
Total	5		2		1		8	

* Drilling Rigs are together with mud pumps, air compressors, logging test equipment, etc.

(4) The Team stressed the importance of the following matters:
a) establishment of the Water User's Association (hereinafter referred to as "WUA")

in connection with the Project

b) O/M of the irrigation facilities by WUA and overall water management including collection of water charge

c) making the farmers in the proposed sites master farming technology with groundwater irrigation

Indonesian side understood it and promised the establishment of and sufficient official support to WUA.

(5) Indonesian side assured that DGWRD would be responsible for the followings:

a) establishment of WUA and its proper management

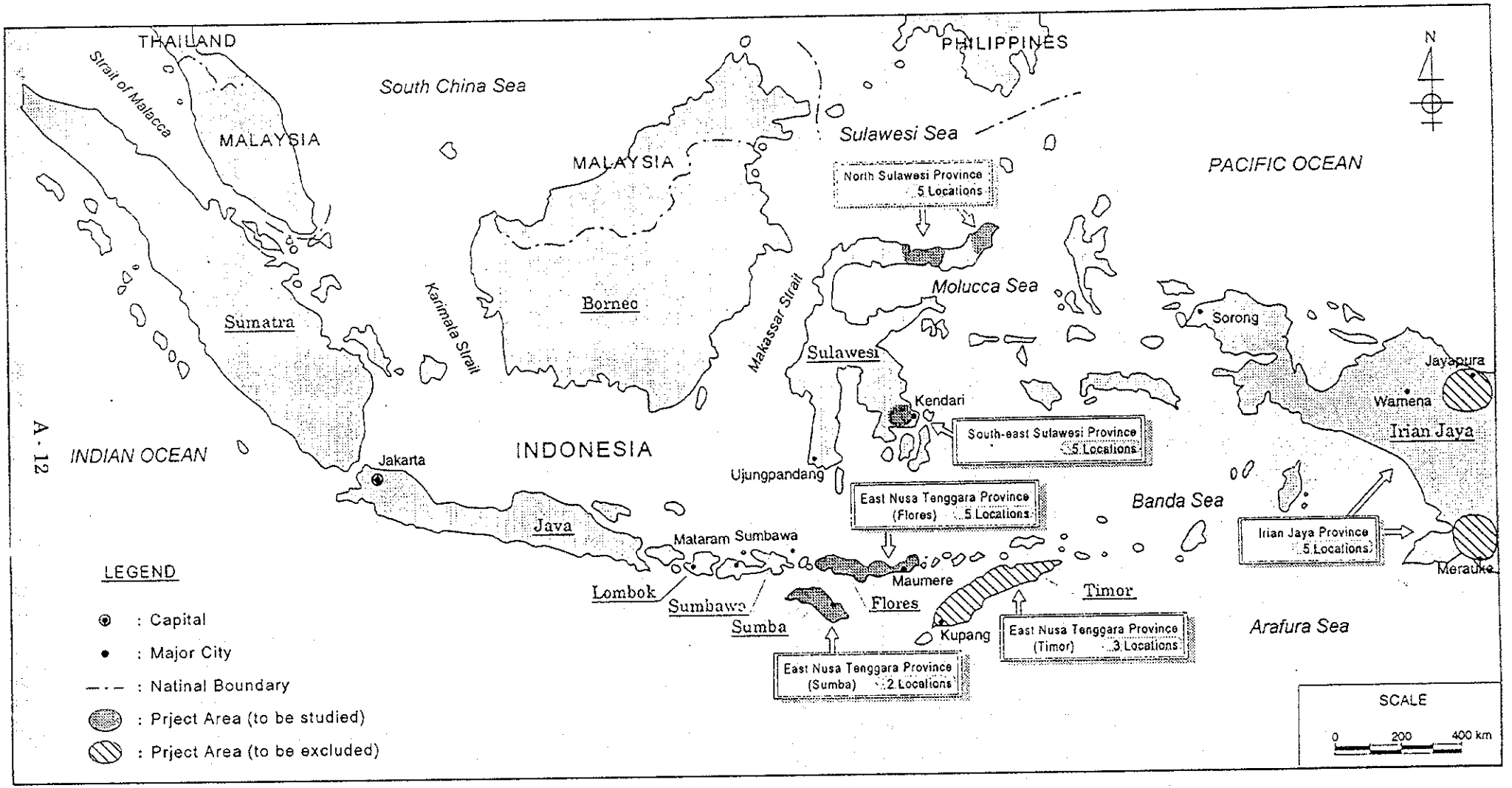
b) guiding WUA's ultimate management of the System

c) assistance to the farmers in the proposed sites with the Cross-Related Agencies

(6) Indonesia side assured that he would be responsible for organization and staff etc. required for smooth implementation of the Project.

(7) Indonesia side assured that he would be responsible for the land preparation needed for construction.

Both side confirmed that the request items would be changeable due to the result of the Study.



Location Map

Annex-1

Annex-2

List of 17 Proposed Sites

	Driling			Area
	Daia (inch)	Depth (m)	Well Number	(ha)
1. North Sulawesi				
(1) -Desa Bongo I	10 - 6	100	1	25
(2) -Desa Bongo II	10 - 6	100	1	25
(3) -Desa Bongo III	10 - 6	100	1	25
(4) -Desa Tempok	10 - 6	100	1	25
(5) -Desa Parepe	10 - 6	100	1	25
Sub-total		500	5	125
2. South East Sulawesi				
(6) -Desa Pamandati	12 - 8	110	1	20
(7) -Desa Ranometo	12 - 8	110	1	20
(8) -Desa Lapulu	12 - 8	110	1	20
(9) -Desa Moolo Inda	12 - 8	110	1	20
(10) -Desa UPT Lapoa Indah	12 - 8	110	1	20
Sub-total		550	5	100
3. East Nusa Tenggara (Sumba)				
(11) -Desa Kalembukaka	14 - 8	70	1	20
(12) -Ds Palakahembi	14 - 8	70	1	20
Sub-total		140	2	40
4. East Nusa Tenggara (Flores)				
(13) -Ds Namangkewa	12 - 8	75	1	10
(14) -Desa Magepanda	12 - 8	75	1	12
(15) -Desa Ranakolo	12 - 8	75	1	10
(16) -Desa Dawa	12 - 8	75	1	10
(17) -Desa Toto Mala	12 - 8	75	1	10
Sub-total		375	5	52
Total		1,565	17	317

Remarks: The figures described in the Table are tentatively proposed by DGERD, and they may be altered after the Study.

Annex 3

Japan's Grant Aid Scheme

1. *Grant Aid Procedures*

1) Japan's Grant Aid Program is executed through the following procedures.

Application	(Request made by a recipient country)
Study	(Basic Design Study conducted by JICA)
Appraisal & Approval	(Appraisal by the Government of Japan and Approval by Cabinet)
Determination of Implementation	(The Notes exchanged between the Governments of Japan and the recipient country)

2) Firstly, the application or request for a Grant Aid project submitted by a recipient country is examined by the Government of Japan (the Ministry of Foreign Affairs) to determine whether or not it is eligible for Grant Aid. If the request is deemed appropriate, the Government of Japan assigns JICA (Japan International Cooperation Agency) to conduct a study on the request.

Secondly, JICA conducts the study (Basic Design Study), using (a) Japanese consulting firm(s).

Thirdly, the Government of Japan appraises the Project to see whether or not it is suitable for Japan's Grant Aid Program, based on the Basic Design Study report prepared by JICA, and the results are then submitted to the Cabinet for approval.

Fourthly, the project, once approved by the Cabinet, becomes official with the Exchange of Notes signed by the Governments of Japan and the recipient country.

Finally, for the implementation of the Project, JICA assists the recipient country in such matters as preparing tenders, contracts and so on.

2. *Basic Design Study*

1) Contents of the Study

The aim of the Basic Design Study (hereafter referred to as "the Study"), conducted by JICA on a requested project (hereinafter referred to as "the Project") is to provide a basic document necessary for the appraisal of the Project by the Japanese Government. The contents of the Study are as follows:

a) Confirmation of the background, objectives, and benefits of the requested Project and also institutional capacity of agencies concerned of the recipient country necessary for Project's implementation.

b) Evaluation of the appropriateness of the Project to be implemented under the Grant Aid Scheme from a technical, social and economic point of view.

c) Confirmation of items agreed on by both parties concerning the basic concept of the Project.

d) Preparation of a basic design of the Project.

e) Estimation of costs of the Project.

The contents of the original request are not necessarily approved in their initial form as the contents of the Grant Aid project. The Basic Design of the Project is confirmed considering the guidelines of Japan's Grant Aid Scheme.

The Government of Japan requests the Government of the recipient country to take whatever measures are necessary to ensure its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization in the recipient country actually implementing the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country through the Minutes of Discussions.

2) Selection of Consultants

For smooth implementation of the Study, JICA uses (a) registered consultant firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms. The firm(s)

selected carry(ies) out a Basic Design Study and write(s) a report, based upon terms of reference set by JICA.

The consultant firm(s) used for the Study is(are) recommended by JICA to the recipient country to also work on the Project's implementation after the Exchanges of Notes, in order to maintain technical consistency and also to avoid any undue delay in implementation should the selection process be repeated.

3. *Japan's Grant Aid Scheme*

1) What is Grant Aid?

The Grant Aid Program provides a recipient country with non-reimbursable funds to procure facilities, equipment and services (engineering services and transportation of the products, etc.) for economic and social development of the country under principles in accordance with the relevant laws and regulations of Japan. Grant Aid is not supplied through the donation of materials as such.

2) Exchange of Notes (E/N)

Japan's Grant Aid is extended in accordance with the Notes exchanged by the Governments concerned, in which the objectives of the Project, period of execution, conditions and amount of the Grant Aid, etc. are confirmed.

3) "The period of the Grant Aid" means the one fiscal year which the Cabinet approves the Project for. Within the fiscal year, all procedures such as exchanging of the Notes, concluding contracts with (a) consultant firm(s) and (a) contractor(s) and a final payment to them must be completed.

However in case of delays in delivery, installation or construction due to unforeseen factors such as weather, the period of the Grant Aid can be further extended for a maximum of one fiscal year at most by mutual agreement between the two Governments.

4) Under the Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased.

When the two Governments deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country.

However the prime contractors, namely, consulting, contracting and procurement firms, are limited to "Japanese nationals". (The term "Japanese nationals" means persons of Japanese nationality or Japanese corporations controlled by persons of Japanese nationality.)

5) Necessity of the "Verification"

The Government of recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be verified by the Government of Japan. This "Verification" is deemed necessary to secure accountability to Japanese taxpayers.

6) Undertakings required of the Government of the Recipient Country

In the implementation of the Grant Aid project, the recipient country is required to undertake such necessary measures as the following:

(1) To secure land necessary for the sites of the Project and to clear, level and reclaim the land prior to commencement of the construction.

(2) To provide facilities for distribution of electricity, water supply and drainage and other incidental facilities in and around the sites.

(3) To secure buildings prior to the procurement in case the installation of the equipment.

(4) To ensure all the expenses and prompt execution for unloading, customs clearance at the port of disembarkation and internal transportation of the products purchased under the Grant Aid.

(5) To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which will be imposed in the recipient country with respect to the supply of the products and services under the Verified Contracts.

(6) To accord Japanese nationals whose services may be required in connection with the supply of the products and services under the Verified Contracts, such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work.

(7) Proper Use

The recipient country is required to maintain and use facilities constructed and equipment purchased under the Grant Aid properly and effectively and to assign staff necessary for this operation and maintenance as well as to bear all the expenses other than those covered by the Grant Aid.

(8) Re-export

The products purchased under the Grand Aid should not be re-exported from the recipient country.

(9) Banking Arrangement (B/A)

a) The Government of the recipient country or its designated authority should open an account in the name of the Government of the recipient country in a bank in Japan (hereinafter referred to as "the Bank"). The Government of Japan will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the verified contracts.

b) The payments will be made when payment requests are presented by the Bank to the Government of Japan under an authorization to pay issued by the Government of the recipient country or its designated authority.

Annex - 4

Necessary measures to be taken by the Government of the Republic of Indonesia in case Japan's Grant Aid is extended

1. To provide data and information necessary for the Project.

2. To secure the land necessary for the execution of the Project.

3. To clear the sites prior to the commencement of the construction, if required.

4. To make passable all roads and bridges leading to the Projects sites before the commencement of inland transportation of materials and equipment, if required.

5. To bear commissions to the Japanese foreign exchange bank for its banking services based upon the Banking Arrangement, namely the advising commission of the "Authorization to Pay" and payment commission.

6. To ensure prompt unloading, tax exemption, customs clearance at the port of disembarkation in the Republic of Indonesia and prompt internal transportation of the materials and equipment for the Project purchased under the Grant Aid.

7. To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which will be imposed in the recipient country with respect to the supply of the products and services under the verified contracts.

8. To accord Japanese nationals whose services may be required in connection with the supply of products and the services under the verified contract such facilities as may be necessary for their entry into the Republic of Indonesia and stay therein for the performance of their work.

9. To provide necessary permissions, licenses and other authorizations for implementing the Project, if necessary.

10. To maintain and use properly and effectively the facilities constructed under the Project.

11. To coordinate and solve any issues related to the Project which may be raised from third parties or inhabitants in the Project area during implementation of the Project.

MINUTES OF DISCUSSIONS
ON
THE BASIC DESIGN STUDY ON THE PROJECT
FOR
THE CONSTRUCTION OF FACILITY FOR IRRIGATION IN EASTERN AREA
IN
THE REPUBLIC OF INDONESIA
(EXPLANATION ON THE DRAFT BASIC DESIGN)

In April 1999, the Japan International Cooperation Agency (JICA) dispatched the Basic Design Study Team on the Project for the construction of facility for Irrigation in the East Area (hereinafter referred to as "the Project") to the Republic of Indonesia. After the assessment of the data and information obtained through the study, JICA has prepared the Draft Basic Design on the Project.

In order to explain and consult with the officials concerned of the Government of Indonesia on the components of the Draft Basic Design, JICA sent to the Republic of Indonesia a Study Team (hereinafter referred to as "the Team") headed by Mr. Akira INAMOTO, Geologist, Resources Division, Planning Department, Kwanto Regional Agricultural Administration Office, Ministry of Agriculture, Forestry and Fisheries, which is scheduled to stay in the country from August 19 to 24, 1999.

As a result of the discussions held between the Team and the officials concerned of the Government of Indonesia, both parties have confirmed the main items described on the attached sheets.

Jakarta, August 24, 1999

Mr. Akira Inamoto

Team Leader,
Draft Report Explanation Team,
JICA

Mr. M. Napitupulu

Director
Directorate of Technical Guidance
Directorate General of Water Resources Development
Ministry of Public Works
The Republic of Indonesia

ATTACHMENT

1. Components of the Draft Report

The Government of Indonesia has agreed and accepted in principle the components of the Draft Report proposed by the Team.

2. Japan's Grant Aid System

(1) The Government of Indonesia has understood the system of Japanese Grant Aid on Annex II as explained by the team.

(2) The Government of Indonesia will take the necessary measures, described in Annex III, for smooth implementation of the Project, on condition that the Grant Aid assistance by the Government of Japan is extended to the Project.

3. Schedule of the Study

JICA will complete the final report and send it to the Government of Indonesia by the end of December 1999.

4. Other Relevant Issues

(1) The Team explained the Indonesian side the results of the Basic Design Study and confirmed the following.

a) The sites No. 10, 15 and 16, which are considered to be inappropriate as Japan's Grant Aid Scheme due to the results of the hydro-geological survey, shall be excluded from the Projects.

b) Design areas of the sites No. 8, 11, 12 and 14 shall be decreased from the requested areas in accordance with the proper groundwater yields derived from the results of the hydro-geological survey.

Therefore, the team explained the Indonesian side that among 17sites, 14 sites were selected and the groundwater irrigation development project were planned for these sites, and the Indonesian side understood it.

(2) The Indonesian side requested as follows.

a) The drilling diameter of wells shall be 17- ½" for the whole length of the bore hole in accordance with the Indonesian standard.

b) The brief report concerning the PCM workshop held at North Sulawesi shall be attached to the Final Report with photos.

The Team understood it.

(3) The Team requested the Indonesian side again the proper maintenance of the drilling rigs with necessary equipment, which had been provided under the past two Japan's Grant Aid Schemes, namely "The Project for Supply of Equipment for Irrigation in Eastern Area (1/2) and (2/2)", in order to keep them good conditions for their smooth use. The Indonesian side assured to fully maintain them.

(4) The Team reconfirmed the items confirmed in the Minutes of Discussions signed between the Indonesian side and the Team dated on the 20th April 1999, and the reconfirmed items are as follows.

"7. Other Relevant Issues (3) number and usability of the existing drilling rigs;

7. (4) establishment of WUA and O/M of the irrigation facilities by WUA and overall water management including collection of irrigation service fees;

7. (5) responsibility of DGWRD;

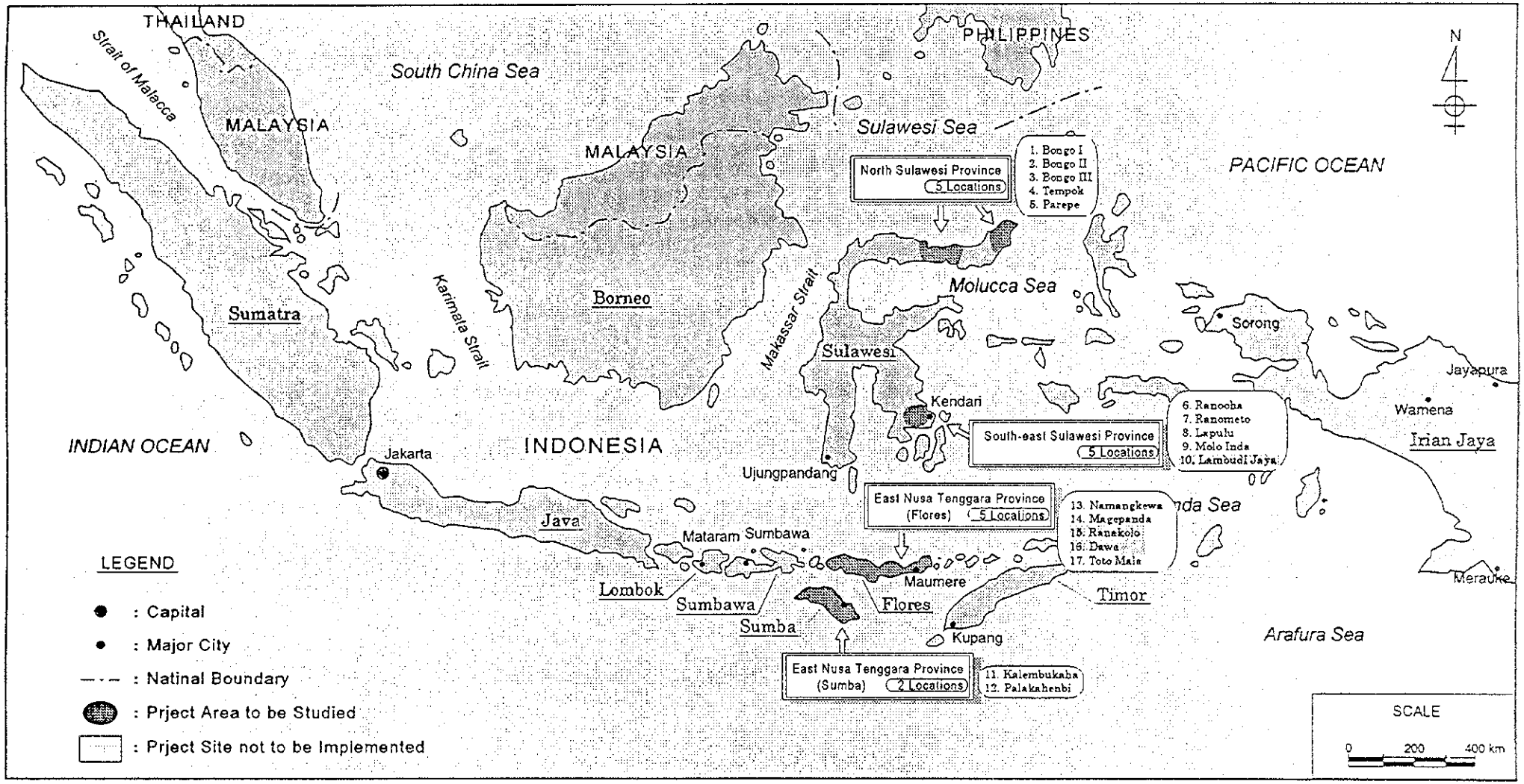
7. (6) responsibility of the Indonesian side for the organization, staff, etc. for the Project;

7. (7) responsibility of the Indonesian side for the land preparation needed for construction"

in the Minutes of Discussions.

The Indonesian side assured them again.

The Indonesian side assured that he would fully understand the contents of the Draft Report, and he especially assured establishment of WUA by the completion of facilities construction in order to realize effective and smooth water management soon after commencement of their operation.



Location Map

Annex- I-2

Summary of Consideration on 17 Sites

No.	Site	Hydro-geological Conditions	Access Conditions	Operation & Maintenance Conditions	Overall Evaluation	Remarks
1	Bongo I	A	A	A	A	
2	Bongo II	A	A	A	A	
3	Bongo III	A	A	A	A	
4	Tempok	A	A	A	A	
5	Parepe	A	A	A	A	
6	Ranooha	B	A	A	A	
7	Ranometo	B	A	A	A	
8	Lapulu	C／B	A	B	B	decrease of area
9	Molo Inda	B	A	A	A	
10	Lambodi Jaya	D	C	A	D	inappropriate
11	Kalenbukaha	C／B	A	B	B	decrease of area
12	Palakahembi	C／B	A	B	B	decrease of area
13	Nawangkewa	A	A	B	B	
14	Magepanda	C／B	A	B	B	decrease of area
15	Ranakolo	D	A	B	D	inappropriate
16	Dawa	D	B	B	D	inappropriate
17	Toto Mala	A	B	B	B	

* A: Appropriate
B: Small problems
C: Some problems/counter measure or design modification
D: Serious problems/impossible to judge

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b) The payments will be made when payment requests are presented by the Bank to the Government of Japan under an authorization to pay issued by the Government of the recipient country or its designated authority.

Necessary measures to be taken by the Government of the Republic of Indonesia in case Japan's Grant Aid is extended

1. To provide data and information necessary for the Project.
2. To secure the land necessary for the execution of the Project.
3. To clear the sites prior to the commencement of the construction, if required.
4. To make passable all roads and bridges leading to the Projects sites before the commencement of inland transportation of materials and equipment, if required.
5. To bear commissions to the Japanese foreign exchange bank for its banking services based upon the Banking Arrangement, namely the advising commission of the "Authorization to Pay" and payment commission.
6. To ensure prompt unloading, tax exemption, customs clearance at the port of disembarkation in the Republic of Indonesia and prompt internal transportation of the materials and equipment for the Project purchased under the Grant Aid.
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9. To provide necessary permissions, licenses and other authorizations for implementing the Project, if necessary.
10. To maintain and use properly and effectively the facilities constructed under the Project.
11. To coordinate and solve any issues related to the Project which may be raised from third parties or inhabitants in the Project area during implementation of the Project.

国名	インドネシア共和国
	Republic of Indonesia

一般指標

政体	共和制	*1	首都	ジャカルタ	*1
元首	President General SOEHARTO	*1	主要都市名	ｽﾗﾊﾞﾔ、ｿﾗﾝ、ﾊﾞﾝﾄﾝ	*1
独立年月日	1945年8月17日	*1	経済活動可人口	89,000 千人 (1995 年)	*4
人種(部族)構成	ｼﾞｬﾜ族45%、ｻﾝﾀﾞ族14%、他41%	*1	義務教育年数	6 年間 (1997 年)	*5
			初等教育就学率	97.0 % (1994 年)	*5
言語・公用語	ｲﾝﾄﾞﾈｼｱ語、英語、蘭語、ｼﾞｬﾜ語	*1	初等教育終了率	% (年)	*6
宗教	回教87%、他13%	*1	識字率	83.8 % (1995 年)	*7
国連加盟	1950年09月	*2	人口密度	113.12人/Km^2 (1996 年)	*1
世銀加盟	1967年04月	*3	人口増加率	1.5 % (1996 年)	*1
ＩＭＦ加盟	1988年05月	*3	平均寿命	平均61.64 男59.51 女63.88	*1
面積	1,919.44 千Km^2	*1	5歳児未満死亡率	71/1000(1996 年)	*7
人口	206,611.600千人(1996 年)	*1	カロリー供給量	2,699.0 cal/日/人(1995 年)	*7

経済指標

通貨単位	ルピア	*1	貿易量	(1997 年)	*8
為替(1US$)	1US$=14,900.00 (1998年06月)	*8	輸入	41,694.0 百万ﾄﾞﾙ	*8
会計年度	4月～3月	*1	輸出	53,443.0 百万ﾄﾞﾙ	*8
国家予算	(1996年)	*9	輸入カバー率	3.0月 (1995 年)	*10
歳入	38,551.0 百万ドル	*9	主要輸出品目	工業製品、石油、燃料、食品 (1994 年)	*1
歳出	33,285.2 百万ドル	*9	主要輸入品目	工業製品、燃料、天然資源 (1994 年)	*1
国際収支	-7,189.00 百万ドル(1997年)	*9	日本への輸出	14,624.3 百万ﾄﾞﾙ(1997 年)	*11
ODA受取額	1,121.00 百万ドル(1996年)	*7	日本からの輸入	10,167.8 百万ﾄﾞﾙ(1997 年)	*11
国内総生産(GDP)	198,079.00 百万ドル(1995年)	*4			
一人当たりGNP	980.0ドル (1995年)	*4	外貨準備総額	17,950.0百万ﾄﾞﾙ(1998年6月)	*8
GDP産業別構成	農業 17.0 % (1995年)	*4	対外債務残高	21,459.0百万ﾄﾞﾙ(1996 年)	*10
	鉱工業 42.0 % (1995年)		対外債務返済率	36.8 % (1996 年)	*10
	ｻｰﾋﾞｽ業 41.0 % (1995年)		インフレ率	8.7 % (1995 年)	*7
産業別雇用	農業 55.0 % (1990年)	*7			
	鉱工業 14.0 % (1990年)				
	ｻｰﾋﾞｽ業31.0 % (1990年)		国家開発計画	第6次経済開発5ヵ年計画 (94～99年)	*12
経済成長率	7.6 % (1995年)	*4			

気象(1961 ～1990年平均) 場所 :Jakarta (標高 8 m)

月	1	2	3	4	5	6	7	8	9	10	11	12	平均 / 計	
最高気温	29.0	29.0	30.0	31.0	31.0	31.0	31.0	31.0	31.0	31.0	30.0	29.0	30.3 ℃	*13
最低気温	23.0	23.0	23.0	24.0	24.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.2 ℃	*13
平均気温	26.3	26.5	26.9	27.5	27.7	27.3	27.1	27.1	27.5	27.7	27.4	26.8	27.2 ℃	*14
降水量	300	300	211	147	114	97	64	43	66	112	142	203	1,799 mm	*13
雨期乾期														

*1 CIA World Fact Book 1997-1998
*2 Member States of United Nations
*3 The World Bank Public Information Center, International Financial Statistics Yearbook 1998
*4 World Development Report 1997
*5 UNESCO Statistical Yearbook 1997
*6 Status and Trends 1997
*7 Human Development Report 1998
*8 International Financial Statistics August 1998
*9 International Financial Statistics Yearbook 1997
*10 Global Development Finance 1998
*11 世界の国一覧表 1998年版
*12 最新世界各国要覧 98年版
*13 The Times Book World Weather Guide,Update Edition
*14 理科年表, 国立天文台(1997)

国名	インドネシア共和国
	Republic of Indonesia

*15

我が国におけるODAの実績　（資金協力は約束ベース、単位：億円）

項目＼年度	1993	1994	1995	1996
技術協力	2,892.93	3,087.67	3,256.28	3,461.48
無償資金協力	2,244.22	2,456.48	2,796.65	2,606.79
有償資金協力	3,939.97	4,352.21	3,878.11	3,025.02
総額	9,077.12	9,896.36	9,931.04	9,093.29

*15

当該国に対する我が国ODAの実績

項目＼年度	1993	1994	1995	1996
技術協力	157.93	177.69	203.67	163.31
無償資金協力	67.61	72.28	66.46	64.41
有償資金協力	923.35	636.20	622.28	737.81
総額	1,148.89	886.17	892.41	965.53

*16

OECD諸国の経済協力実績　（支出純額、単位：百万ドル）

	贈与 (1)	有償資金協力 (2)	政府開発援助 (ODA) (1)+(2)=(3)	その他政府資金及び民間資金 (4)	経済協力総額 (3)+(4)
二国間援助	541.80	520.10	1,061.90		1,061.90
（主要供与国）					
1.日本	277.70	737.80	1,015.50		1,015.50
2.オーストラリア	84.90	0.00	84.90		84.90
3.オーストリア	1.00	63.60	64.60		64.60
4.フランス	0.20	42.20	42.40		42.40
多国間援助	59.90	12.20	72.10		72.10
（主要援助機関）					
1. ASDB					
2. CEC					
その他	0.10	-14.10	-14.00		-14.00
合計	601.80	518.20	1,120.00		1,120.00

*17

援助受入れ窓口機関	
技術	関係各省庁機関→対外経済関係省
無償	
協力隊	

*15 Japan's ODA Annual Report 1997
*16 Geographical Distribution of Financial Flows to Aid Recipients 1992-1996
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6．資料収集リスト

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- 南東スラウェシ（組織図、予算、井戸実績、気象データ、井戸資料他）
- フローレス（組織図、予算、井戸実績、気象データ、井戸資料他）
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7．井戸計画

電気探査データ：図 A-1-1 ～ 図 A-1-17
揚水試験データ：図 A-2-1 ～ 図 A-2-14
井戸計画の検討計算書
地下水収支

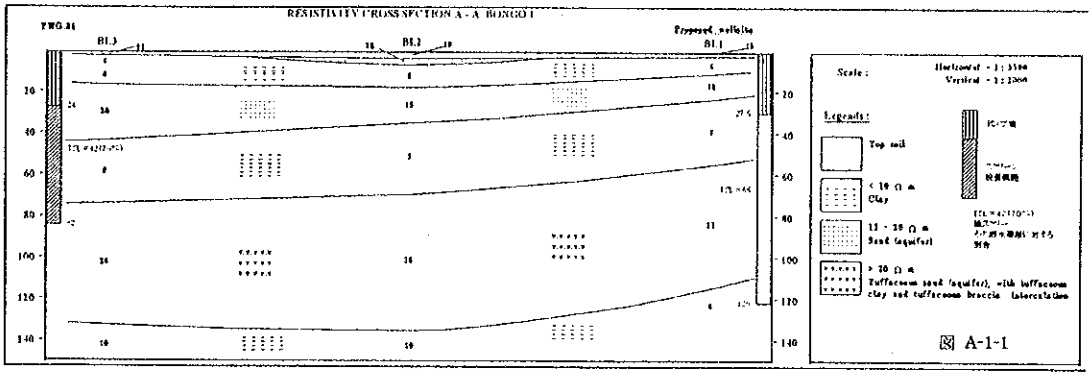
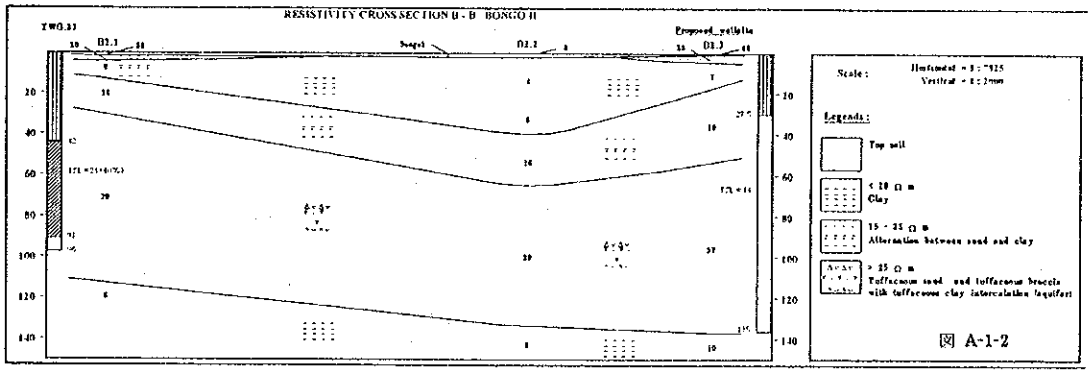


図 A-1-1



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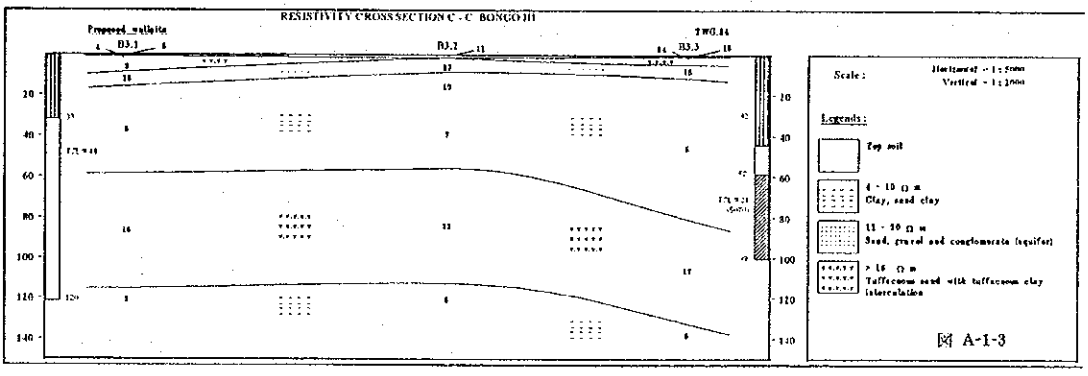

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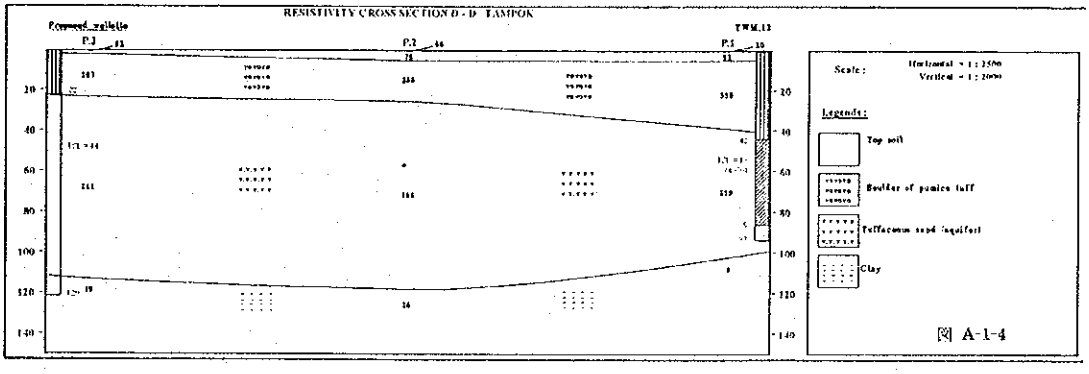

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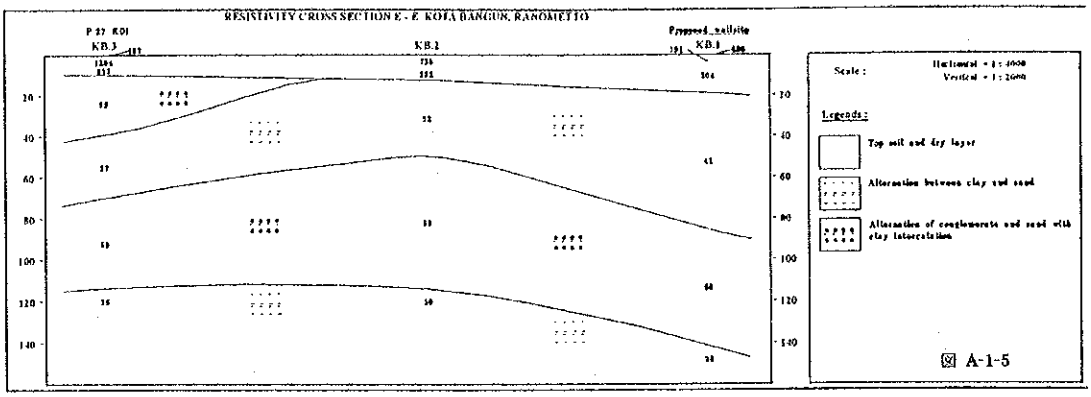

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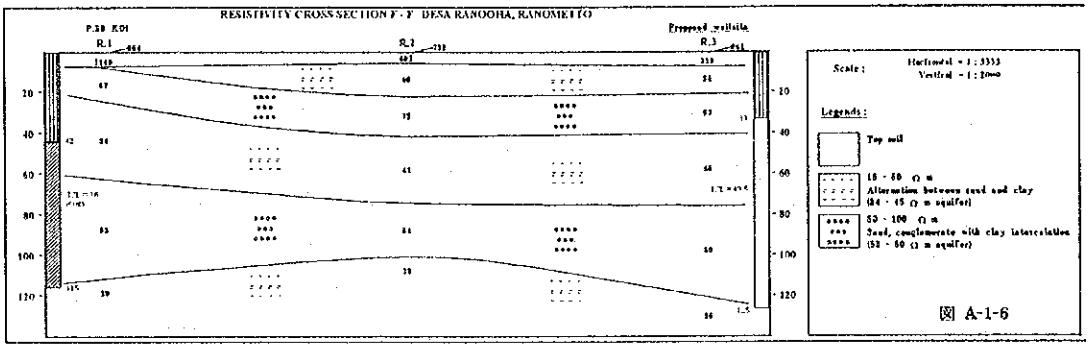

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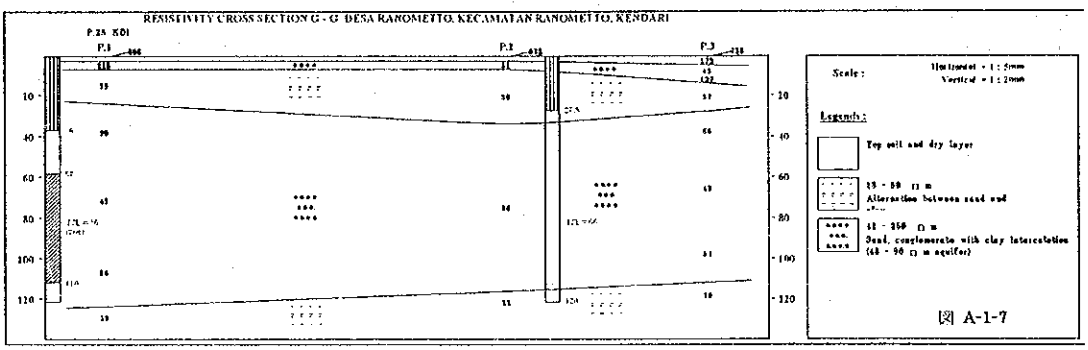

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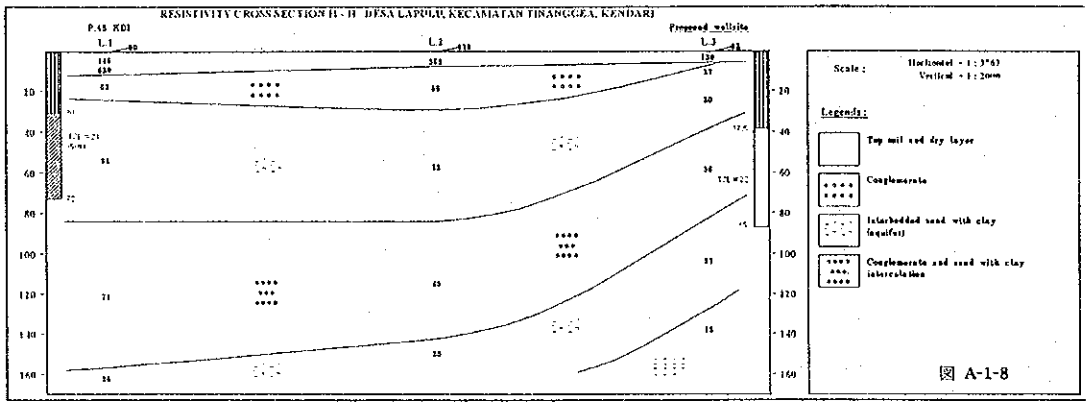

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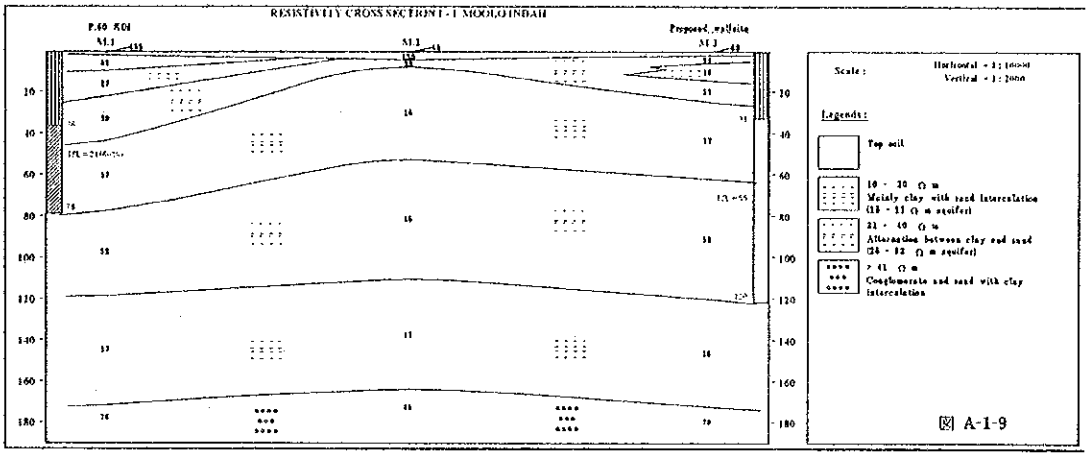

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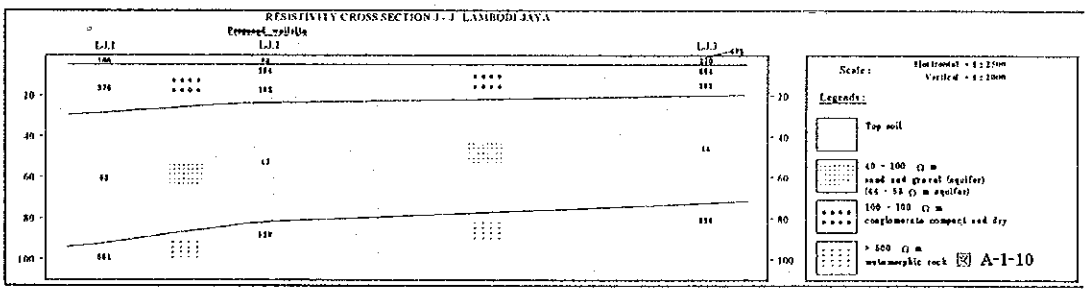

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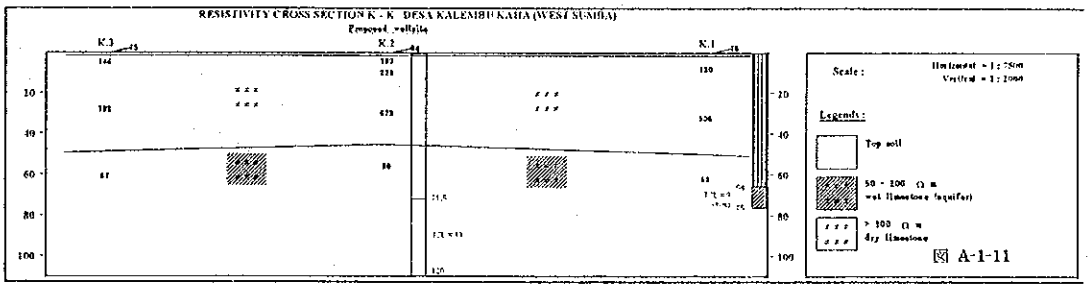

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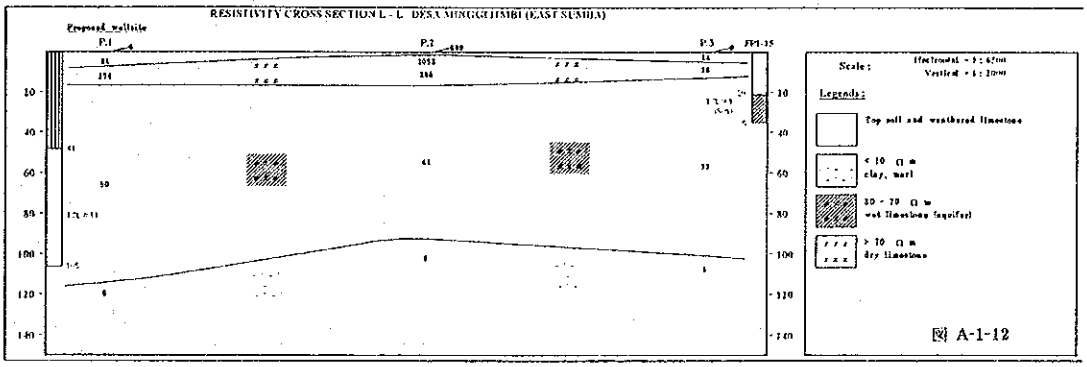

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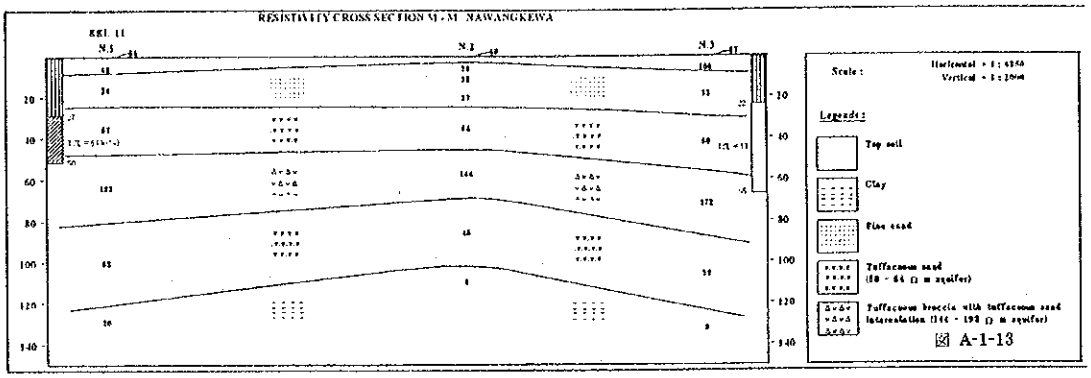

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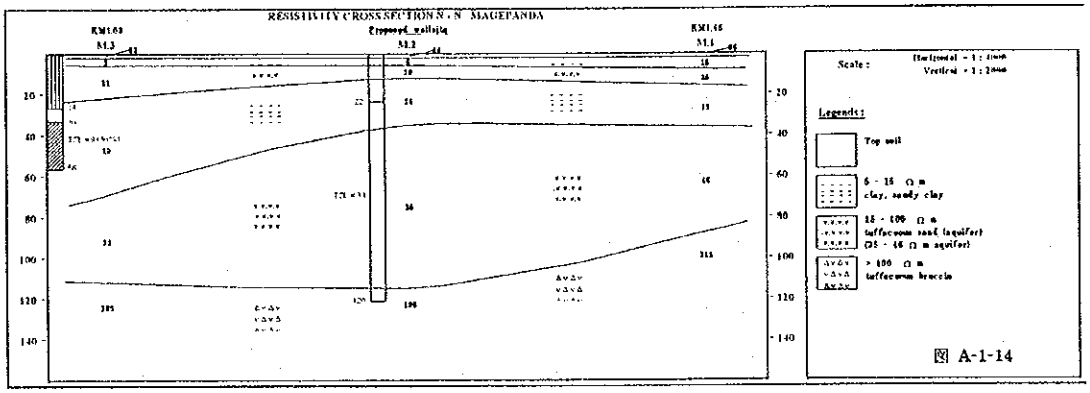

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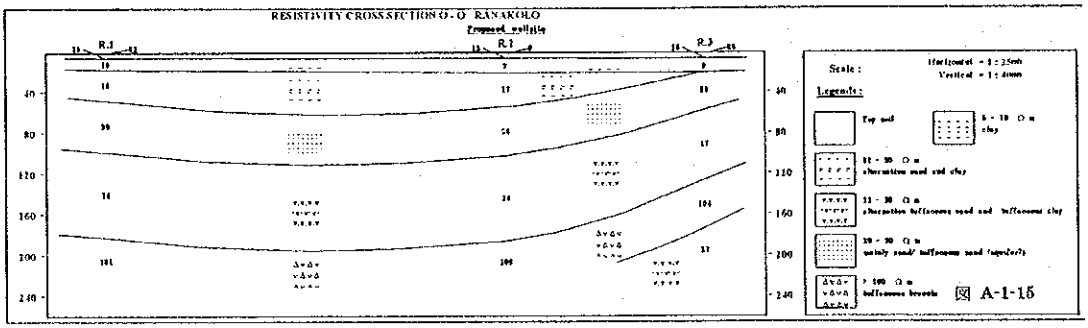

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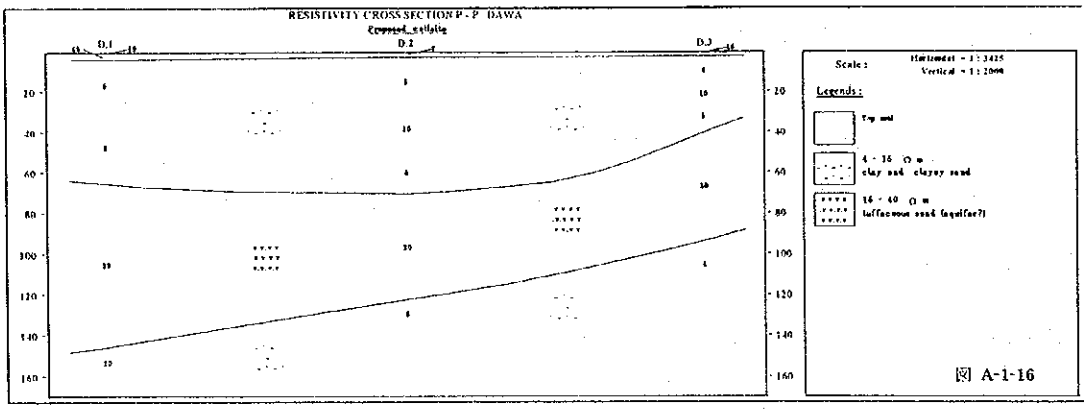
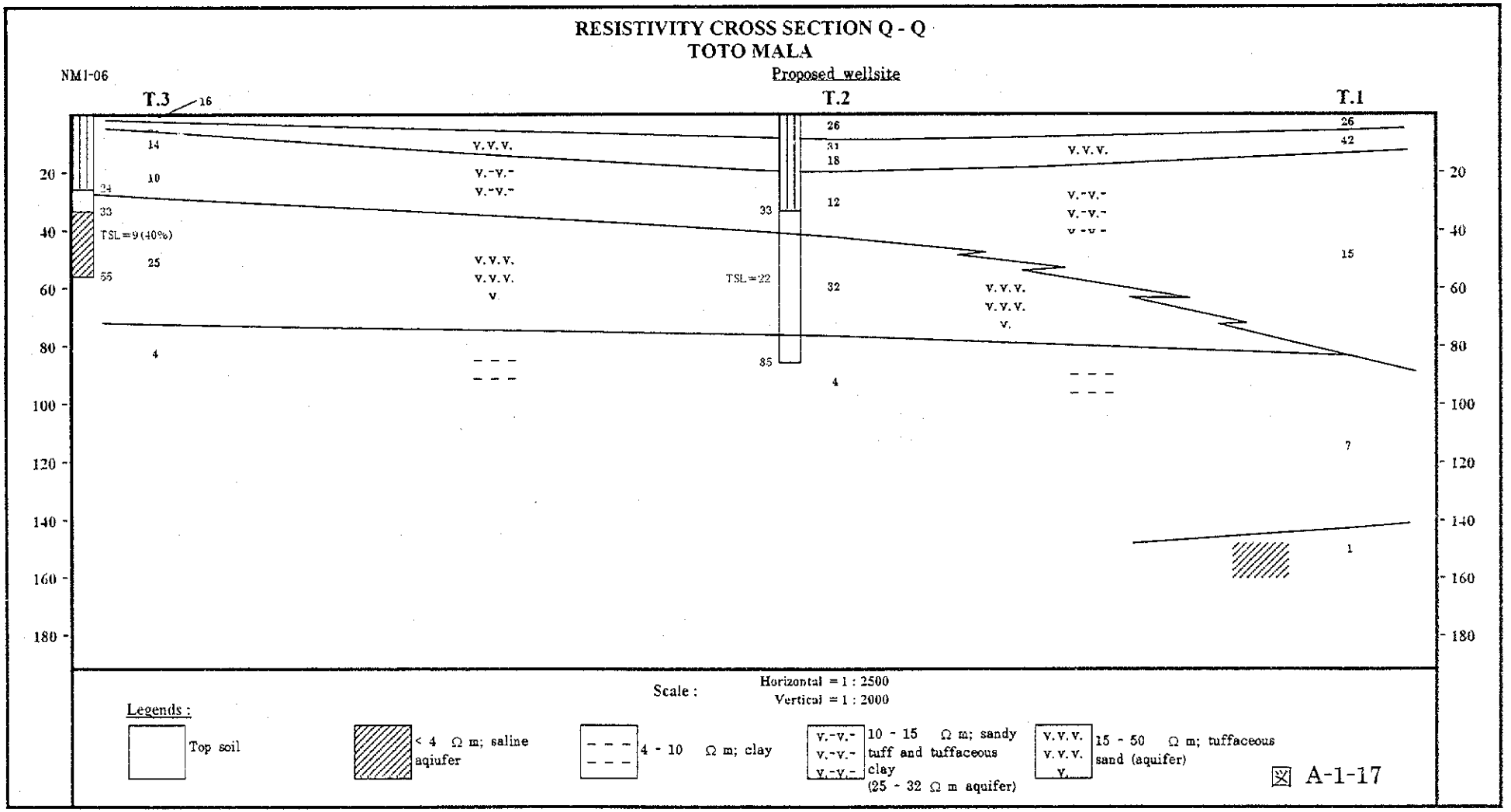


図 A-1-16

RESISTIVITY CROSS SECTION Q - Q
TOTO MALA



A-1-17

図 A-2-1 Bongo I (TWG-14)のs/Q-Qグラフ

■ : Test Well

Q	11.13	14.91	20.19
Sw/Q	0.431	0.453	0.504

○ : Constant Rate Test

Q	20.46
Sw/Q	0.024

● : Proposed Well

Q	30.00
Sw/Q	0.333

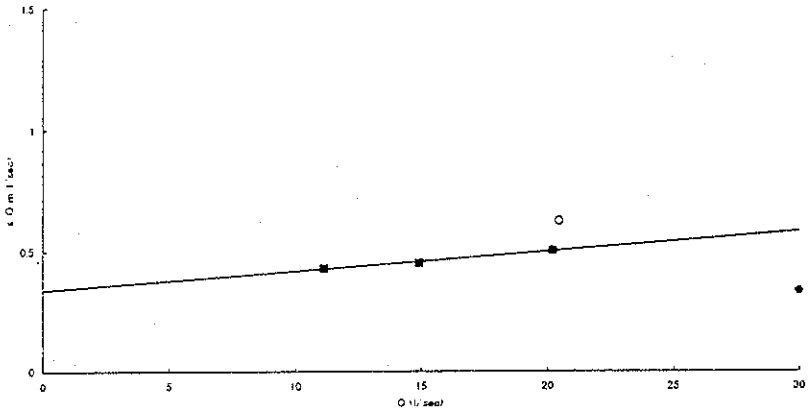


図 A-2-2 Bongo II (TWG-31)のs/Q-Qグラフ

■ : Test Well

Q	10.19	15.37	20.46
Sw/Q	0.246	0.258	0.308

○ : Constant Rate Test

Q	21.02
Sw/Q	0.303

● : Proposed Well

Q	30.00
Sw/Q	0.333

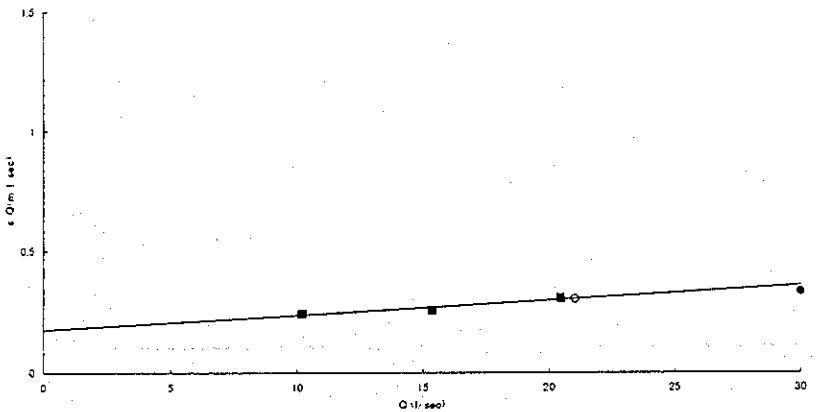


図 A-2-3 Bongo III (TWG-30)のs/Q-Qグラフ

■ : Test Well

Q	11.13	15.14	20.19
Sw/Q	0.16	0.15	0.197

○ : Constant Rate Test

Q	20.46
Sw/Q	0.305

● : Proposed Well

Q	30.00
Sw/Q	0.333

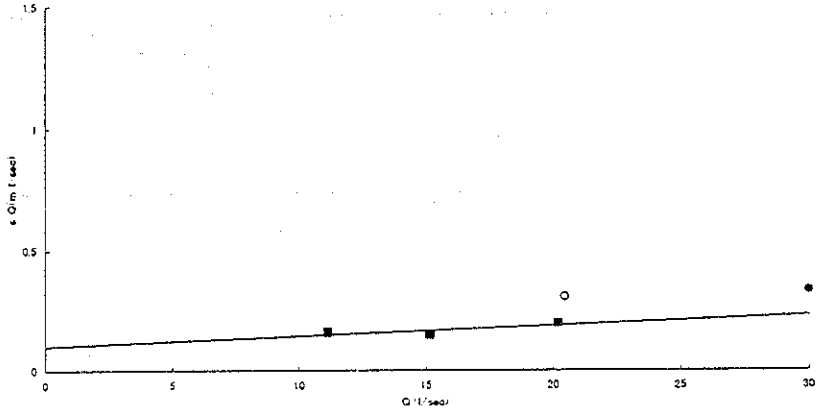


図 A-2-4 Tempok (TWG-12)のs/Q-Qグラフ

■ : Test Well

Q	11.13	15.37	20.19
Sw/Q	0.177	0.189	0.192

○ : Constant Rate Test

Q	21.9
Sw/Q	0.201

● : Proposed Well

Q	30.00
Sw/Q	0.167

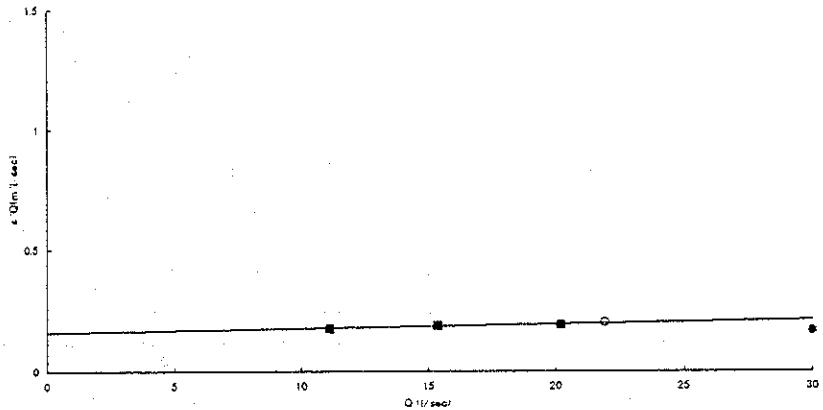


図 A-2-5 Parepe (TWM-03)のs/Q-Qグラフ

■ : Test Well

Q	10.19	15.37	20.48
Sw/Q	0.359	0.382	0.427

○ : Constant Rate Test

Q	19.11
Sw/Q	0.522

● : Proposed Well

Q	30.00
Sw/Q	0.3

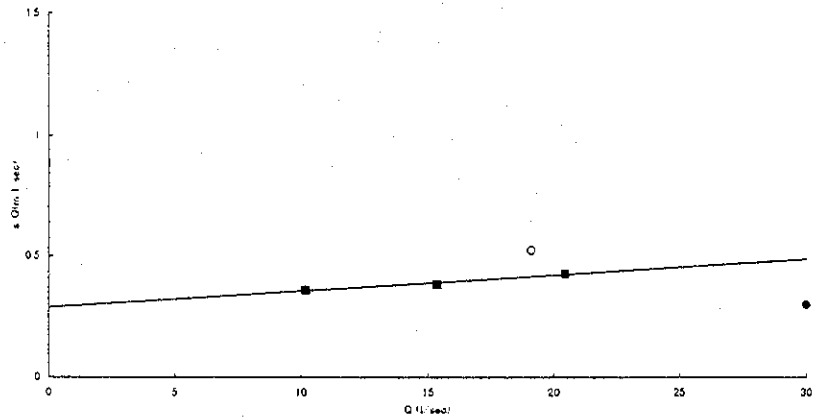


図 A-2-6 Ranooha (P.39.KDI)のs/Q-Qグラフ

■ : Test Well

Q	5	6.2	6.9
Sw/Q	1.056	1.098	1.117

○ : Constant Rate Test

Q	6.04
Sw/Q	1.351

● : Proposed Well

Q	24.00
Sw/Q	0.958

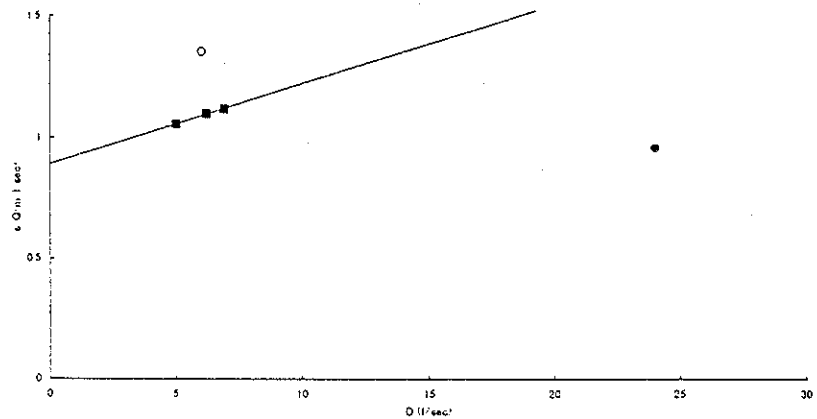


図 A-2-7 Ranometo (P.28.KDI)のs/Q-Qグラフ

■ : Test Well

Q	4.4	8.5	12.11
Sw/Q	0.948	1.002	1.067

○ : Constant Rate Test

Q	8.47
Sw/Q	1.312

● Proposed Well

Q	24.00
Sw/Q	0.583

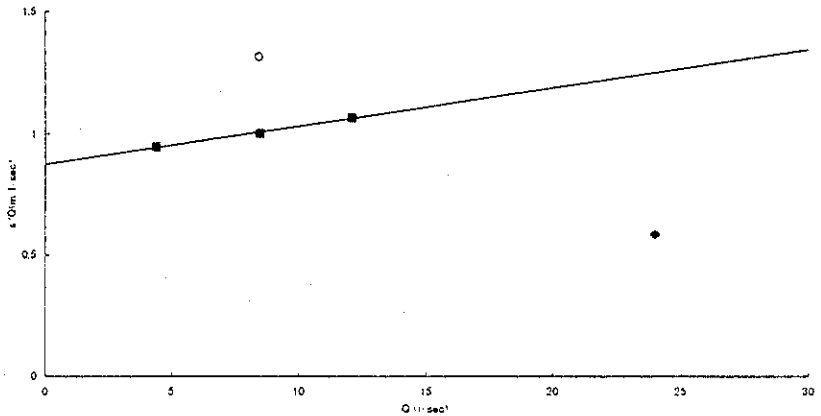


図 A-2-8 Lapulu (P.48.KDI)のs/Q-Qグラフ

■ : Test Well

Q	3.52	6.51	8.23
Sw/Q	0.955	0.945	1.021

○ : Constant Rate Test

Q	5.58
Sw/Q	1.611

● Proposed Well

Q	12.00
Sw/Q	2.083

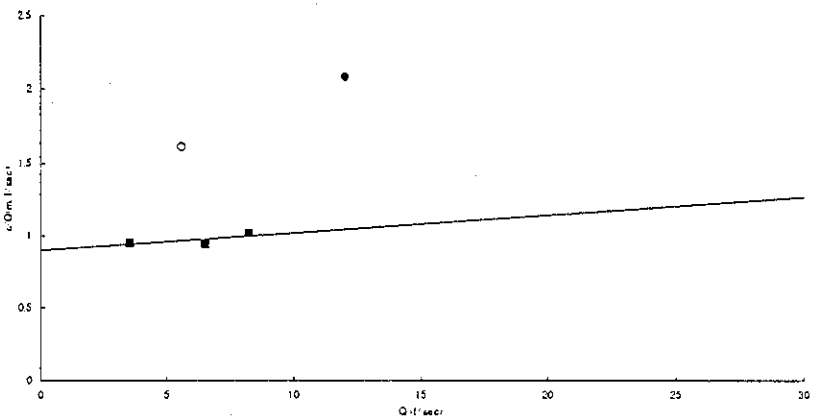


図 A-2-9 Moolo Indaha (P.60.KDI)のs/Q~Qグラフ

■ : Test Well

Q	6.93	8.96	11.12
Sw. Q	0.519	0.627	0.638

○ : Constant Rate Test

Q	8.47
Sw. Q	0.673

● : Proposed Well

Q	24.00
Sw. Q	0.833

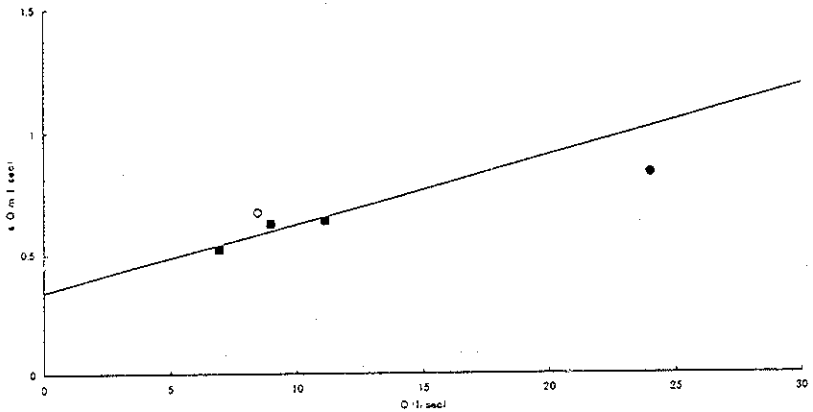


図 A-2-10 Kalembukaka (WKKI-30)のs/Q~Qグラフ

■ : Test Well

Q			
Sw. Q			

○ : Constant Rate Test

Q	0.44
Sw. Q	0.386

● : Proposed Well

Q	24.00
Sw. Q	0.25

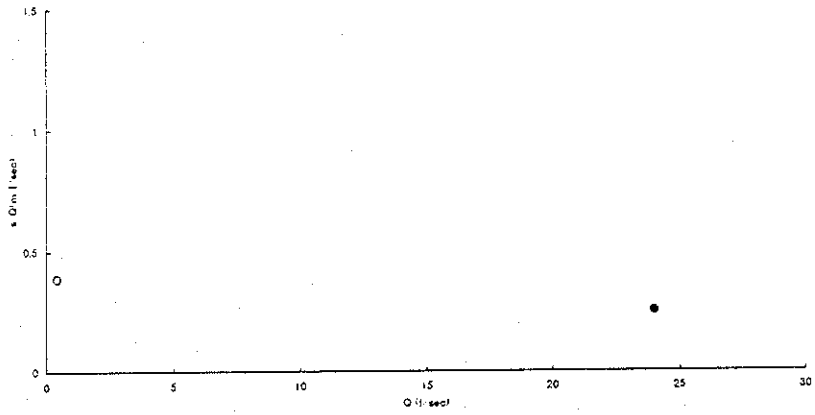


図 A-2-11 Palakahembi (EPI-15)のs/Q~Qグラフ

■ : Test Well

Q	4.2	8.1	12.01
Sw. Q	0.398	0.373	0.473

○ : Constant Rate Test

Q	12.01
Sw. Q	0.505

● : Proposed Well

Q	24.00
Sw. Q	0.657

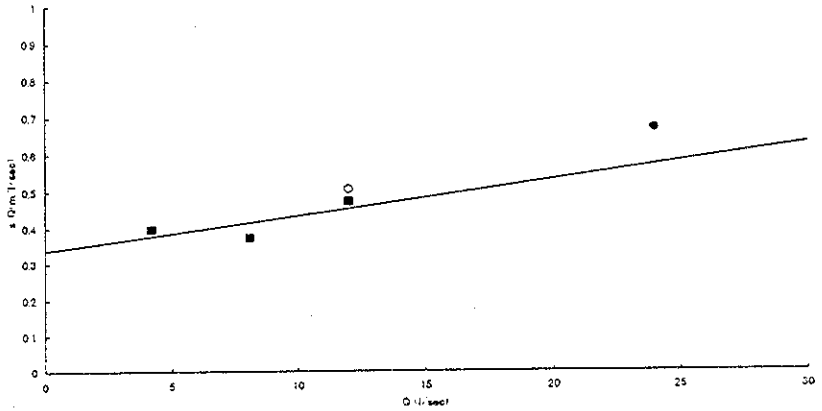


図 A-2-12 Namangkewa (KKI-11)のs/Q~Qグラフ

■ : Test Well

Q	2.68	5.58	7.28
Sw. Q	0.246	0.279	0.297

○ : Constant Rate Test

Q	7.53
Sw. Q	0.294

● : Proposed Well

Q	11.00
Sw. Q	0.182

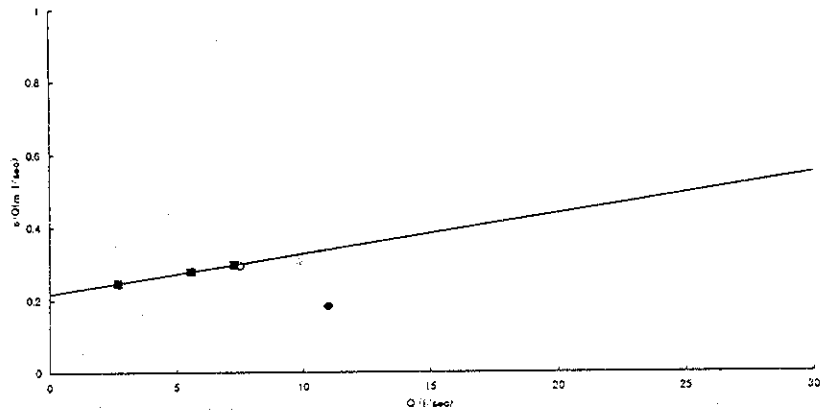


図 A-2-13 Magepanda (KMI-59)のs/Q-Qグラフ

■ : Test Well

Q	3.9	6.7	8.9
Sw-Q	0.832	1	1.065

○ : Constant Rate Test

Q	7.68
Sw-Q	1.044

● : Proposed Well

Q	15.00
Sw-Q	0.933

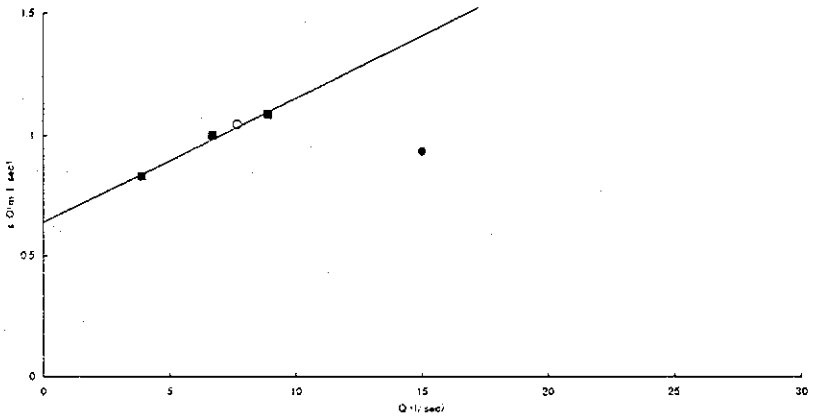


図 A-2-14 Toto Mala (NMI-06)のs/Q-Qグラフ

■ : Test Well

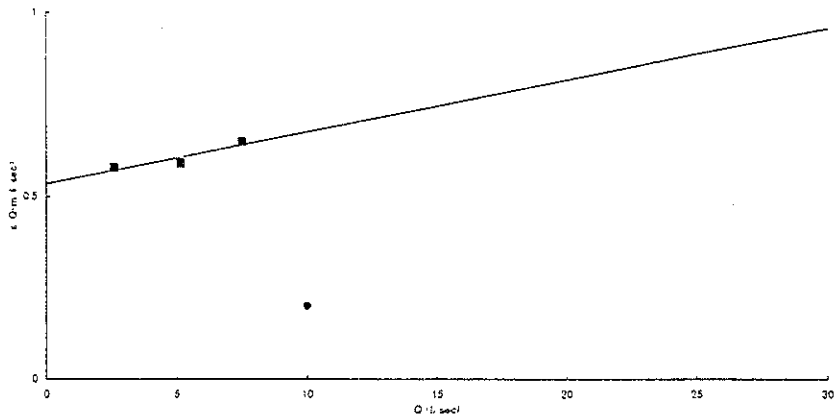
Q	2.6	5.13	7.5
Sw-Q	0.579	0.591	0.648

○ : Constant Rate Test

Q	7.5
Sw-Q	0.651

● : Proposed Well

Q	10.00
Sw-Q	0.2



井戸計画の検討計算書

1．　計算式、条件

井戸計画の検討はタイスの非平衡式による降下水位の検討によって行う。タイスの非平衡式は、降下水位の検討する上では、最も一般的で基本的な式である。

1）計画揚水量（Q:m^3/sec）

2）連続揚水時間（t:sec）

3）降下水位（s:m）＝（Q・W(u)）／（4π・T）……（タイスの非平衡式）

4）井戸関数（W(u)）＝∫　$((e^{-u})/u)$ ・du、　$u = r^2 \cdot S / 4 \cdot T \cdot t$

u、W(u)の関係は標準曲線で求める。

5）透水量係数（T:m^2/sec）

6）計画井戸の半径（r:m）

7）貯留係数（S）

貯留係数は透水量係数（m^2/sec 単位）の１オーダー小さな値を仮定。

また、揚水井戸から（R: m）地点での水位降下量（x: m）は、次式となる。

（s - x）＝　（Q・ln (R/r)）／２π・T

2．計算

1）ボンゴ I

T = 4.80×10^{-3}（ボンゴ地区３井戸の平均）、S = 5.00×10^{-4}、Q = 30×10^{-3} 、t = 5.76×10^{4}、r = 10×10^{-2}

s ＝(30×10^{-3}) ・W(u) ／4π ・ (4.80×10^{-3}) ＝ (4.97×10^{-1}) ・W(u)……(1)

u = $(10 \times 10^{-2})^2$ ・ (5.00×10^{-4}) ／4 ・ (4.80×10^{-3}) ・ (5.76×10^{4})

＝ 4.52×10^{-9}　これに対するW(u) = 18.5（標準曲線より）……(2)

したがって、(1)、(2)式から

s ＝ (4.97×10^{-1}) ・18.5 = 9.19（約 10 m）

動水位深度（運転水位深度）＝ 静水位 ＋ 動水位 ＝7.52 + 9.19 = 16.71

乾季最低水位を現水位よりも-1 m として、16.71+ 1 = 17.71（約 18 m）

500 m 地点への影響

（9.19 - x）＝(30×10^{-3})・2.3・3.70／２π・ (4.80×10^{-3}) ＝8.46

x = 0.73 (m)

2）ボンゴII

T = 4.80 x 10^{-3}（ボンゴ地区３井戸の平均）、S = 5.00 x 10^{-4}、Q = 30 x 10^{-3} 、t = 5.76 x 10^{4}、r = 10 x 10^{-2}

s =(30 x 10^{-3}) ・W(u) ／4π・ (4.80 x 10^{-3}) = (4.97 x 10^{-1}) ・W(u).....(1)

u = (10 x 10^{-2})^2・ (5.00 x 10^{-4}) ／4・ (4.80 x 10^{-3}) ・ (5.76 x 10^{4})

= 4.52 x 10^{-9} これに対するW(u) = 18.5（標準曲線より）.....(2)

したがって、(1)、(2)式から

s = (4.97 x 10^{-1}) ・18.5 = 9.19（約 10 m）

動水位深度（運転水位深度）= 6.50+ 9.19 = 15.69

乾季最低水位を現水位よりも-1 m として、15.69 + 1 = 16.69（約 17m）

500 m 地点への影響

(9.19 - x) =(30 x 10^{-3})・2.3・3.70／２π・ (4.80 x 10^{-3}) = 8.46

x = 0.73 (m)

3）ボンゴIII

T = 4.80 x 10^{-3}（ボンゴ地区３井戸の平均）、S = 5.00 x 10^{-4}、Q = 30 x 10^{-3} 、t = 5.76 x 10^{4}、r = 10 x 10^{-2}

s =(30 x 10^{-3}) ・W(u) ／4π・ (4.80 x 10^{-3}) = (4.97 x 10^{-1}) ・W(u).....(1)

u = (10 x 10^{-2})^2・ (5.00 x 10^{-4}) ／4・ (4.80 x 10^{-3}) ・ (5.76 x 10^{4})

= 4.52 x 10^{-9} これに対するW(u) = 18.5（標準曲線より）.....(2)

したがって、(1)、(2)式から

s = (4.97 x 10^{-1}) ・18.5 = 9.19（約 10 m）

動水位深度（運転水位深度）=10.78 + 9.19 = 19.9 7

乾季最低水位を現水位よりも-1 m として、19.97 + 1 = 20.97（約 21m）

500 m 地点への影響

(9.19 - x) =(30 x 10^{-3})・2.3・3.70／２π・ (4.80 x 10^{-3}) = 8.46

x = 0.73 (m)

4）テンポック

$T = 1.00 \times 10^{-2}$、$S = 1.00 \times 10^{-3}$、$Q = 30 \times 10^{-3}$ 、$t = 5.04 \times 10^{4}$、$r = 10 \times 10^{-2}$

$s = (30 \times 10^{-3}) \cdot W(u) / 4\pi \cdot (1.00 \times 10^{-2}) = (2.39 \times 10^{-1}) \cdot W(u)$.....(1)

$u = (10 \times 10^{-2})^2 \cdot (1.00 \times 10^{-3}) / 4 \cdot (1.00 \times 10^{-2}) \cdot (5.04 \times 10^{4})$

$= 4.96 \times 10^{-9}$ これに対する$W(u) = 18.5$（標準曲線より）.....(2)

したがって、(1)、(2)式から

$s = (2.39 \times 10^{-1}) \cdot 18.5 = 4.42$（約 5 m）

動水位深度（運転水位深度）=3.30 + 4.42 = 7.70

乾季最低水位を現水位よりも-1 m として、7.70 + 1 =8.70（約 9 m）

500 m 地点への影響

$(4.42 - x) = (30 \times 10^{-3}) \cdot 2.3 \cdot 3.70 / 2\pi \cdot (1.00 \times 10^{-3}) = 4.06$

$x = 0.36$ (m)

5）パレペ

$T = 5.10 \times 10^{-3}$、$S = 5.00 \times 10^{-4}$、$Q = 30 \times 10^{-3}$ 、$t = 5.04 \times 10^{4}$、$r = 10 \times 10^{-2}$

$s = (30 \times 10^{-3}) \cdot W(u) / 4\pi \cdot (5.10 \times 10^{-3}) = (4.68 \times 10^{-1}) \cdot W(u)$.....(1)

$u = (10 \times 10^{-2})^2 \cdot (5.00 \times 10^{-4}) / 4 \cdot (5.10 \times 10^{-3}) \cdot (5.04 \times 10^{4})$

$= 4.86 \times 10^{-9}$ これに対する$W(u) = 18.5$（標準曲線より）.....(2)

したがって、(1)、(2)式から

$s = (4.68 \times 10^{-1}) \cdot 18.5 = 8.66$（約 9 m）

動水位深度（運転水位深度）=0.96 + 8.66 = 9.62

乾季最低水位を現水位よりも-1 m として、9.62 + 1 = 10.62（約 11 m）

500 m 地点への影響

$(8.66 - x) = (30 \times 10^{-3}) \cdot 2.3 \cdot 3.70 / 2\pi \cdot (5.10 \times 10^{-3}) = 7.97$

$x = 0.69$ (m)

6）ラノオハ

$T = 1.61 \times 10^{-3}$、$S = 1.00 \times 10^{-4}$、$Q = 24 \times 10^{-3}$ 、$t = 5.04 \times 10^{4}$、$r = 10 \times 10^{-2}$

$s = (24 \times 10^{-3}) \cdot W(u) / 4\pi \cdot (1.61 \times 10^{-3}) = (1.19 \times 10^{-1}) \cdot W(u)$.....(1)

$u = (10 \times 10^{-2})^2 \cdot (1.00 \times 10^{-4}) / 4 \cdot (1.61 \times 10^{-3}) \cdot (5.04 \times 10^{4})$

$= 3.08 \times 10^{-9}$ これに対する$W(u) = 18.5$（標準曲線より）.....(2)

したがって、(1)、(2)式から

s =1.19 x 18.5 = 22.02（約 23 m）

動水位深度（運転水位深度）=0 + 22.02 = 22.02

乾季最低水位を現水位よりも-1 m として、22.02 + 1 = 23.02（約 24 m）

500 m 地点への影響

$(22.02 - x) = (24 \times 10^{-3}) \cdot 2.3 \cdot 3.70 / 2\pi \cdot (1.61 \times 10^{-3}) = 20.19$

$x = 1.83$ (m)

7）ラノメト

$T = 2.71 \times 10^{-3}$、$S = 1.00 \times 10^{-4}$、$Q = 24 \times 10^{-3}$ 、$t = 5.04 \times 10^{-4}$、$r = 10 \times 10^{-2}$

$s = (24 \times 10^{-3}) \cdot W(u) / 4\pi \cdot (2.71 \times 10^{-3}) = (7.05 \times 10^{-1}) \cdot W(u)$.....(1)

$u = (10 \times 10^{-2})^2 \cdot (1.00 \times 10^{-4}) / 4 \cdot (2.71 \times 10^{-3}) \cdot (5.04 \times 10^{-4})$

$= 1.83 \times 10^{-9}$ これに対する W(u) =19（標準曲線より）.....(2)

したがって、(1)、(2)式から

$s = (7.05 \times 10^{-1}) \cdot 19 = 13.40$（約 14 m）

動水位深度（運転水位深度）=0 + 13.40 = 13.40

乾季最低水位を現水位よりも-1 m として、13.40 + 1 = 14.40（約 15 m）

500 m 地点への影響

$(13.40 - x) = (24 \times 10^{-3}) \cdot 2.3 \cdot 3.70 / 2\pi \cdot (2.71 \times 10^{-3}) = 11.99$

$x = 1.41$ (m)

8）ラプル

$T = 7.15 \times 10^{-4}$、$S = 5.00 \times 10^{-5}$、$Q = 12 \times 10^{-3}$ 、$t = 5.04 \times 10^{-4}$、$r = 10 \times 10^{-2}$

$s = (12 \times 10^{-3}) \cdot W(u) / 4\pi \cdot (7.15 \times 10^{-4}) = 1.34 \cdot W(u)$.....(1)

$u = (10 \times 10^{-2})^2 \cdot (5.00 \times 10^{-5}) / 4 \cdot (7.15 \times 10^{-4}) \cdot (5.04 \times 10^{-4})$

$= 3.47 \times 10^{-9}$ これに対する W(u) =18.5（標準曲線より）.....(2)

したがって、(1)、(2)式から

s =1.34 x 18.5 = 24.79（約 25 m）

動水位深度（運転水位深度）=0 + 24.79 = 24.79

乾季最低水位を現水位よりも-1 m として、24.79 + 1 =25.79（約 26 m）

500 m 地点への影響

$(24.79 - x) = (12 \times 10^{-3}) \cdot 2.3 \cdot 3.70 / 2\pi \cdot (7.15 \times 10^{-4}) = 22.73$

$x = 2.06 > 2.0$ (m)

したがって、$Q = 10 \times 10^{-3}$ とすれば、

$s = 1.11 \times 18.5 = 20.53$（約 21m）

動水位深度（運転水位深度）$= 0 + 20.53 = 20.53$（約 21 m）

乾季最低水位を現水位よりも-1 m として、$20.53 + 1 = 21.53$（約 22 m）

500 m 地点への影響（再）

$(20.53 - x) = (10 \times 10^{-3}) \cdot 2.3 \cdot 3.70 / 2\pi \cdot (7.15 \times 10^{-4}) = 18.94$

$x = 1.59$ (m)

海岸への影響

$(20.53 - x) = (10 \times 10^{-3}) \times 2.3 \times 4.08 / 2\pi \times (7.15 \times 10^{-4}) = 20.09$

$x = 0.44$ (m)

9）モロインダ

$T = 1.81 \times 10^{-3}$、$S = 1.00 \times 10^{-4}$、$Q = 24 \times 10^{-3}$ 、$t = 5.04 \times 10^{4}$、$r = 10 \times 10^{-2}$

$s = (24 \times 10^{-3}) \cdot W(u) / 4\pi \cdot (1.81 \times 10^{-3}) = 1.06 \cdot W(u)$.....(1)

$u = (10 \times 10^{-2})^2 \cdot (1.00 \times 10^{-4}) / 4 \cdot (1.81 \times 10^{-3}) \cdot (5.04 \times 10^{4})$

$= 2.74 \times 10^{-9}$ これに対する $W(u) = 18.5$（標準曲線より）.....(2)

したがって、(1)、(2)式から

$s = 1.06 \times 18.5 = 19.61$（約 20 m）

動水位深度（運転水位深度）$= 0 + 19.61 = 19.61$

乾季最低水位を現水位よりも-1 m として、$19.61 + 1 = 20.61$（約 21 m）

500 m 地点への影響

$(19.61 - x) = (24 \times 10^{-3}) \cdot 2.3 \cdot 3.70 / 2\pi \cdot (1.81 \times 10^{-3}) = 17.95$

$x = 1.66$ (m)

海岸への影響

$(19.61 - x) = (24 \times 10^{-3}) \times 2.3 \times 4.08 / 2\pi \cdot (1.81 \times 10^{-3}) = 19.80$

$x = -0.19$ (m)

10) ランボディジャヤ

$T = 4.52 \times 10^{-4}$ (m^2/sec = 39.01 m^2/day)、 $S = 5.00 \times 10^{-5}$、 $Q = 24 \times 10^{-3}$、 $t = 4.32 \times 10^{4}$、 $r = 10 \times 10^{-2}$

$s = (24 \times 10^{-3}) \cdot W(u) / 4\pi \cdot (4.52 \times 10^{-4}) = 4.23 \cdot W(u)$.....(1)

$u = (10 \times 10^{-2})^2 \cdot (5.00 \times 10^{-5}) / 4 \cdot (4.52 \times 10^{-4}) \cdot (4.32 \times 10^{4})$

$= 6.40 \times 10^{-9}$ これに対する W(u) = 18.5 （標準曲線より）.....(2)

したがって、(1)、(2)式から

$s = 4.23 \times 18.5 = 78.26$（約 78 m）

動水位深度（運転水位深度） = 1.50 + 78.26 =79.76

乾季水位を現水位よりも-1 m として、79.76+ 1 =80.76（約 81 m）

$Q = 12 \times 10^{-3}$ とすれば、

$s = (12 \times 10^{-3}) \cdot W(u) / 4\pi \cdot (4.52 \times 10^{-4}) = 2.11 \cdot W(u)$.....(1)

$u = (10 \times 10^{-2})^2 \cdot (5.00 \times 10^{-5}) / 4 \cdot (4.52 \times 10^{-4}) \cdot (4.32 \times 10^{4})$

$= 6.40 \times 10^{-9}$ これに対する W(u) = 18.5 （標準曲線より）.....(2)

したがって、(1)、(2)式から

$s = 2.11 \times 18.5 = 39.04$（約 39 m）

動水位深度（運転水位深度） = 1.50 + 39.04 = 40.54

乾季水位を現水位よりも-1 m として、40.54+ 1 = 41.54（約 42 m）

500 m 地点への影響

$(39.04 - x) = (12 \times 10^{-3}) \cdot 2.3 \cdot 3.70 / 2\pi \cdot (4.52 \times 10^{-4}) = 35.96$

$x = 3.08 > 2.0$ m

$Q = 10 \times 10^{-3}$ とすれば、

$s = (10 \times 10^{-3}) \cdot W(u) / 4\pi \cdot (4.52 \times 10^{-4}) = 1.76 \cdot W(u)$.....(1)

$u = (10 \times 10^{-2})^2 \cdot (5.00 \times 10^{-5}) / 4 \cdot (4.52 \times 10^{-4}) \cdot (4.32 \times 10^{4})$

$= 6.40 \times 10^{-9}$ これに対する W(u) = 18.5 （標準曲線より）.....(2)

したがって、(1)、(2)式から

$s = 1.76 \times 18.5 = 32.56$（約 33 m）

動水位深度（運転水位深度） = 1.50 + 33.00 = 34.50

乾季水位を現水位よりも-1 m として、34.50+ 1 =35.50（約 36 m）

500 m 地点への影響

$(32.56 - x) = (6 \times 10^{-3}) \cdot 2.3 \times \cdot 3.70 / 2\pi \cdot (4.52 \times 10^{-4}) = 29.96$ $x = 2.60$ (m)

11) カレンブカハ

$T = 7.05 \times 10^{-3}$、$S = 5.00 \times 10^{-4}$、$Q = 24 \times 10^{-3}$ 、$t = 5.76 \times 10^{4}$、$r = 10 \times 10^{-2}$

$s = (24 \times 10^{-3}) \cdot W(u) / 4\pi \cdot (7.05 \times 10^{-3}) = (2.71 \times 10^{-1}) \cdot W(u)$.....(1)

$u = (10 \times 10^{-2})^2 \cdot (5.00 \times 10^{-4}) / 4 \cdot (7.05 \times 10^{-3}) \cdot (5.76 \times 10^{4})$

$= 3.08 \times 10^{-9}$ これに対する$W(u) = 18.5$（標準曲線より）.....(2)

したがって、(1)、(2)式から

$s = (2.71 \times 10^{-1}) \cdot 18.5 = 5.01$（約 6 m）

動水位深度（運転水位深度）= 51.00 +5.01 =56.01

乾季最低水位を現水位よりも-1 m として、56.01 + 1 = 57.01（約 58 m）

500 m 地点への影響

$(5.01 - x) = (24 \times 10^{-3}) \cdot 2.3 \cdot 3.70 / 2\pi \cdot (7.05 \times 10^{-3}) = 4.61$

$x = 0.40$ (m)

12) パラカヘンビ

$T = 2.33 \times 10^{-3}$、$S = 1.00 \times 10^{-4}$、$Q = 24 \times 10^{-3}$ 、$t = 4.32 \times 10^{4}$、$r = 10 \times 10^{-2}$

$s = (24 \times 10^{-3}) \cdot W(u) / 4\pi \cdot (2.33 \times 10^{-3}) = (8.20 \times 10^{-1}) \cdot W(u)$.....(1)

$u = (10 \times 10^{-2})^2 \cdot (1.00 \times 10^{-4}) / 4 \cdot (2.33 \times 10^{-3}) \cdot (4.32 \times 10^{4})$

$= 2.48 \times 10^{-9}$ これに対する$W(u) = 19$（標準曲線より）.....(2)

したがって、(1)、(2)式から

$s = (8.20 \times 10^{-1}) \cdot 19 = 15.58$（約 16 m）

動水位深度（運転水位深度）= 14.74 +15.58 = 30.32

乾季最低水位を現水位よりも-1 m として、30.32 + 1 = 31.32（約 32 m）

500 m 地点への影響

$(15.58 - x) = (24 \times 10^{-3}) \cdot 2.3 \cdot 3.70 / 2\pi \cdot (2.33 \times 10^{-3}) = 13.95$

$x = 1.63$ (m)

海岸への影響

$(15.58 - x) = (24 \times 10^{-3}) \cdot 2.3 \cdot 4.24 / 2\pi \cdot (2.33 \times 10^{-3}) = 15.99$

$x = -0.41$ (m)

13) ナワンゲワ

$T = 1.42 \times 10^{-2}$、$S = 1.00 \times 10^{-3}$、$Q = 11 \times 10^{-3}$ 、$t = 4.32 \times 10^{-4}$、$r = 10 \times 10^{-2}$

$s = (11 \times 10^{-3}) \cdot W(u) / 4\pi \cdot (1.42 \times 10^{-2}) = (6.16 \times 10^{-2}) \cdot W(u)$.....(1)

$u = (10 \times 10^{-2})^2 \cdot (1.00 \times 10^{-3}) / 4 \cdot (1.42 \times 10^{-2}) \cdot (4.32 \times 10^{-4})$

$= 4.08 \times 10^{-9}$ これに対する$W(u) = 18$（標準曲線より）.....(2)

したがって、(1)、(2)式から

$s = (6.16 \times 10^{-1}) \cdot 18 = 1.11$（約 2 m）

動水位深度（運転水位深度）= 8.09 +1.11 = 9.20

乾季最低水位を現水位よりも-1 m として、9.20 + 1 = 10.20（約 11 m）

500 m 地点への影響

$(1.11 - x) = (11 \times 10^{-3}) \cdot 2.3 \cdot 3.70 / 2\pi \cdot (1.42 \times 10^{-2}) = 1.05$

$x = 0.06$ (m)

海岸への影響

$(1.11 - x) = (11 \times 10^{-3}) \cdot 2.3 \cdot 3.93 / 2\pi \cdot (1.42 \times 10^{-2}) = 1.14$

$x = -0.03$ (m)

14) マゲパンダ

$T = 1.70 \times 10^{-3}$、$S = 1.00 \times 10^{-4}$、$Q = 15 \times 10^{-3}$ 、$t = 4.32 \times 10^{4}$、$r = 10 \times 10^{-2}$

$s = (15 \times 10^{-3}) \cdot W(u) / 4\pi \cdot (1.70 \times 10^{-3}) = (7.02 \times 10^{-1}) \cdot W(u)$.....(1)

$u = (10 \times 10^{-2})^2 \cdot (1.00 \times 10^{-4}) / 4 \cdot (1.70 \times 10^{-3}) \cdot (4.32 \times 10^{4})$

$= 4.08 \times 10^{-9}$ これに対する$W(u) = 19$（標準曲線より）.....(2)

したがって、(1)、(2)式から

$s = (7.02 \times 10^{-1}) \cdot 19 = 13.33$（約 14 m）

動水位深度（運転水位深度）= 0.00 +13.33 =13.33

乾季最低水位を現水位よりも-1 m として、13.33 + 1 =14.33（約 15 m）

最寄りの 300 m 地点への影響

$(13.33 - x) = (15 \times 10^{-3}) \cdot 2.3 \cdot 3.48 / 2\pi \cdot (1.70 \times 10^{-3}) = 11.24$

$x = 2.09 > 2.0$ (m)

したがって、<u>$Q = 10 \times 10^{-3}$ とすれば</u>、

$s = (4.68 \times 10^{-1}) \cdot 19 = 8.89$（約 9 m）

動水位深度（運転水位深度）= 0 + 8.89 =8.89（約 9 m）

乾季最低水位を現水位よりも-1 m として、8.89 + 1 = 9.89（約 10 m）

最寄りの 300 m 地点への影響（再）

$(8.89 - x) = (10 \times 10^{-3}) \cdot 2.3 \cdot 3.48 / 2\pi \cdot (1.70 \times 10^{-3}) = 7.49$

$x = 1.40$ (m)

海岸へ影響

$(8.89 - x) = (10 \times 10^{-3}) \cdot 2.3 \cdot 4.13 / 2\pi \cdot (1.70 \times 10^{-3}) = 8.89$

$x = 0.00$ (m)

15）、16）省略

17）トトマラ

$T = 8.01 \times 10^{-3}$、$S = 5.00 \times 10^{-4}$、$Q = 10 \times 10^{-3}$ 、$t = 4.32 \times 10^{4}$、$r = 10 \times 10^{-2}$

$s = (10 \times 10^{-3}) \cdot W(u) / 4\pi \cdot (8.01 \times 10^{-3} = (9.93 \times 10^{-2}) \cdot W(u)$.....(1)

$u = (10 \times 10^{-2})^2 \cdot (5.00 \times 10^{-4}) / 4 \cdot (8.01 \times 10^{-3}) \cdot (4.32 \times 10^{-4})$

$= 3.61 \times 10^{-9}$ これに対する $W(u) = 18.5$（標準曲線より）.....(2)

したがって、(1)、(2)式から

$s = (9.93 \times 10^{-2}) \cdot 18.5 = 1.84$（約 2 m）

動水位深度（運転水位深度）= 18.42 +1.84 = 20.26

乾季最低水位を現水位よりも-1 m として、20.26 + 1 = 21.26（約 22 m）

500 m 地点への影響

$(1.84 - x) = (10 \times 10^{-3}) \cdot 2.3 \cdot 3.70 / 2\pi \cdot (8.01 \times 10^{-3}) = 1.69$

$x = 0.15$ (m)

海岸への影響

$(1.84 - x) = (10 \times 10^{-3}) \cdot 2.3 \cdot 4.08 / 2\pi \cdot (8.01 \times 10^{-3}) = 1.86$

$x = -0.02$ (m)

地下水収支

今回の井戸を掘削することによる、対象地区周辺の水収支を試みた。
今回の調査対象地区で、比較的良く地下水が開発されている、（１）北ｽﾗｳｪｼ・ボンゴ地区、（２）北ｽﾗｳｪｼ・テンポクーパレペ地区、（３）南東ｽﾗｳｪｼ・ラノメトーラノオハ地区で水収支を試みた。

（１）北ｽﾗｳｪｼ・ボンゴ地区

年間降水量、1,200 mm（「気象」の項参照）、年間を通じて、その 1/3 が地下水として涵養されるとすれば（インドネシアにおける水収支の例を適用）年間涵養量は 400 mm ,したがって、1.10 mm/day 、単位面積量では 1,100 m^3/day/km^2
一方、１井戸平均の揚水量を（既存および計画井戸も含む）20lit/sec とし、平均日運転時間を 8 時間運転とすれば約 600 m^3/day　となる。
井戸が集中している部分だけの井戸密度を考えてみると、14 本/ 40km^2 ,したがって 1 本/ 2.86km^2
この地区での 1 井戸の涵養量は 1,100 x 2.86 = 3,140 m^3/day＞600 m^3/day となる。

（２）北ｽﾗｳｪｼ・テンポクーパレペ地区

年間降水量、1,900 mm（「気象」の項参照）、年間を通じて、その 1/3 が地下水として涵養されるとすれば)、年間涵養量は 630 mm ,したがって、1.73 mm/day 、単位面積量では 1,730 m^3/day/km^2
一方、１井戸平均の揚水量を（既存および計画井戸も含む）20 lit/sec とし、平均日運転時間を 8 時間運転とすれば約 600 m^3/day　となる。
井戸が集中している部分だけの井戸密度は、7 本/ 40 km^2 ,したがって 1 本/5.71km^2
1 井戸の涵養量は 1,730 x 5.71 = 9,800 m^3/day＞600 m^3/day となる。

（３）南東ｽﾗｳｪｼ・ラノメトーラノオハ地区

年間降水量、1,650 mm（「気象」の項参照）、年間を通じて、その 1/3 が地下水として涵養されるとすれば、年間涵養量は 550 mm ,したがって、1.51 mm/day 、単位面積量では 1,510 m^3/day/km^2
一方、１井戸平均の揚水量を（既存および計画井戸も含む）15 lit/sec とし、平均日運転時間を 8 時間運転とすれば約 450 m^3/day　となる。
井戸が集中している部分だけの井戸密度は、8 本/ 25 km^2 ,したがって 1 本/3.13km^2

1 井戸の涵養量は 1,510 x 3.13 = 4,700 m^3/day＞450 m^3/day となる。

上記収支検討の中で、井戸密度は地下水の集水域を考えれば、もっと小さなものとなり、また、ポンプの運転時間は 1 日 8 時間にしても年間を通して稼働するわけではないので、全体としては、もう少し余裕が出来ると思われる。

8．潅漑計画

潅漑用水計算書：表 A-1-1 ～ 表 A-1-10

表 A-1-1 Water Requirement for Bongo I, II, III

Month		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Annual
		I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	
days		15	16	14	14	15	16	15	15	15	16	15	15	15	16	15	16	15	15	15	16	15	15	15	16	365
1. Evapotranspiration (Eto)	mm/day	4.7	4.7	5.3	5.3	5.4	5.4	5.3	5.3	5.0	5.0	4.6	4.6	4.9	4.9	5.5	5.5	5.7	5.7	5.4	5.4	4.8	4.8	4.9	4.9	
	mm	71	75	74	74	81	86	80	80	75	80	69	69	74	78	83	88	86	86	81	86	72	72	74	78	1,872
2. Cropping Pattern		Rainy Season Paddy				Semi-Rainy Season Paddy						Dry Season Upland Crops (Green Beans, Maize, Soybeans)												Rainy Season Paddy				
3. Crop Coefficient (k)																										
(1) P-1 + P-2 + UC		1.05	0.95		LP	1.10	1.10	1.10	1.10	1.05	0.95				0.50	0.64	0.89	0.95	0.88		LP	1.10	1.10	1.10	1.10	
(2) P-1 + P-2 + UC		1.10	1.05	0.95		LP	1.10	1.10	1.10	1.10	1.05	0.95			0.50	0.59	0.96	1.05	1.02	0.95		LP	1.10	1.10	1.10	
(3) P-1 + P-2 + UC		1.10	1.10	1.05	0.95		LP	1.10	1.10	1.10	1.10	1.05	0.95			0.50	0.75	1.00	1.00	0.82	0.45		LP	1.10	1.10	
4. Crop Evapotranspiration (ETc)																										
(1) P-1 + P-2 + UC	mm	75	71			89	95	88	88	79	76				39	53	78	82	76			79	79	81	86	1,314
(2) P-1 + P-2 + UC	mm	78	79	70			95	88	88	83	84	66			39	49	84	90	88	77			79	81	86	1,404
(3) P-1 + P-2 + UC	mm	78	83	78	70			88	88	83	88	72	66			42	66	86	86	66	39			81	86	1,346
5. Land Preparation (Puddling: 200 mm)																										
(1) P-1 + P-2	mm				200																200					400
(2) P-1 + P-2	mm					200																200				400
(3) P-1 + P-2	mm						200																200			400
6. Percolation (2 mm)																										
(1) P-1 + P-2	mm	23	24			23	24	23	23	23	24											23	23	23	24	
(2) P-1 + P-2	mm	23	24	21			24	23	23	23	24	30											23	23	24	
(3) P-1 + P-2	mm	23	24	21	21			23	23	23	24	23	23											23	24	
7. Effective Rainfall (ER)																										
Paddy (P)	mm	30	34	32	15	35	42	42	34	62	25	32	35	31	25	19	15	5	10	18	36	56	39	41	29	742
Upland Crops (UC)	mm	36	41	38	18	42	50	50	41	74	29	37	42	37	29	22	18	6	12	22	42	66	46	49	34	881
8. Net Water Requirements (NWR)																										
(1) P-1 + P-2 + UC	mm	68	61		185	77	77	69	77	40	75				10	31	60	76	64		164	46	63	63	81	1,387
(2) P-1 + P-2 + UC	mm	71	69	59		165	77	69	77	44	83	64			10	27	66	84	76	55		144	63	63	81	1,447
(3) P-1 + P-2 + UC	mm	71	73	67	76		158	69	77	44	87	63	54			20	48	80	74	44	0		161	63	81	1,410
Average	mm	70	68	42	87	81	104	69	77	43	82	42	18		7	26	58	80	71	33	55	63	96	63	81	1,416
9. Irrigation Efficiency (IE)																										
Paddy (P)		0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	
Upland Crops (UC)		0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	
10. Gross Water Requirements (GWR)																										
	mm	74	72	44	92	85	109	73	81	45	86	44	19	0	7	27	61	84	75	35	58	66	101	66	85	1,489
	m3/ha	740	720	440	920	850	1,090	730	810	450	860	440	190	0	70	270	610	840	750	350	580	660	1,010	660	850	14,890
	l/sec/ha	0.57	0.52	0.36	0.76	0.66	0.79	0.56	0.63	0.35	0.62	0.34	0.15	0.00	0.05	0.21	0.44	0.65	0.58	0.27	0.42	0.51	0.78	0.51	0.61	
11. GWR with 16 hours Pump Operation	l/sec/ha	0.9	0.8	0.6	1.2	1.0	1.2	0.9	1.0	0.6	1.0	0.6	0.3	0.0	0.1	0.4	0.7	1.0	0.9	0.5	0.7	0.8	1.2	0.8	1.0	
12. Irrigation Area	ha	25	25	17	17	17	25	25	25	25	25	17	9	0	9	13	13	13	13	9	13	17	25	25	25	
13. Design Discharge	l/sec	23	20	10	20	17	30	23	25	15	25	10	3	0	1	5	9	13	12	5	9	14	30	20	25	

表 A-1-2 Water Requirement for Tempok, Parepe

Month		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Annual
		I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	
days		15	16	14	14	15	16	15	15	15	16	15	15	15	16	15	16	15	15	15	16	15	15	15	16	365
1. Evapotranspiration (Eto)	mm/day	4.1	4.1	4.6	4.6	4.6	4.6	4.4	4.4	3.8	3.8	3.9	3.9	4.1	4.1	4.8	4.8	5.0	5.0	4.5	4.5	3.9	3.9	3.9	3.9	
	mm	62	66	64	64	69	74	66	66	57	61	59	59	62	66	72	77	75	75	68	72	59	59	59	62	1,573
2. Cropping Pattern		Rainy Season Paddy				Semi-Rainy Season Paddy						Dry Season Upland Crops (Green Beans, Maize, Soybeans)											Rainy Season Paddy			
3. Crop Coefficient (k)																										
(1) P-1 + P-2 + UC		1.05	0.95		LP	1.10	1.10	1.10	1.10	1.05	0.95				0.50	0.64	0.89	0.95	0.88		LP	1.10	1.10	1.10	1.10	
(2) P-1 + P-2 + UC		1.10	1.05	0.95		LP	1.10	1.10	1.10	1.10	1.05	0.95			0.50	0.59	0.96	1.05	1.02	0.95		LP	1.10	1.10	1.10	
(3) P-1 + P-2 + UC		1.10	1.10	1.05	0.95		LP	1.10	1.10	1.10	1.10	1.05	0.95			0.50	0.75	1.00	1.00	0.82	0.45		LP	1.10	1.10	
4. Crop Evapotranspiration (ETc)																										
(1) P-1 + P-2 + UC	mm	65	63			76	81	73	73	60	58				33	46	69	71	66			65	65	65	68	1,097
(2) P-1 + P-2 + UC	mm	68	69	61			81	73	73	63	64	56			33	42	74	79	77	65			65	65	68	1,176
(3) P-1 + P-2 + UC	mm	68	73	67	61			73	73	63	67	62	56			36	58	75	75	56	32			65	68	1,128
5. Land Preparation (Puddling: 200 mm)																										
(1) P-1 + P-2	mm				200																200					400
(2) P-1 + P-2	mm					200																200				400
(3) P-1 + P-2	mm						200																200			400
6. Percolation (2 mm)																										
(1) P-1 + P-2	mm	30	32			30	32	30	30	30	32											30	30	30	32	
(2) P-1 + P-2	mm	30	32	28			32	30	30	30	32	30											30	30	32	
(3) P-1 + P-2	mm	30	32	28	28			30	30	30	32	30	30											30	32	
7. Effective Rainfall (ER)																										
Paddy (P)	mm	43	50	36	36	43	56	44	42	56	42	44	38	37	29	31	15	10	20	33	34	60	47	36	42	924
Upland Crops (UC)	mm	55	63	47	47	55	72	56	53	72	53	56	49	48	37	40	20	13	25	43	44	76	61	46	54	1,185
8. Net Water Requirements (NWR)																										
(1) P-1 + P-2 + UC	mm	52	45		164	63	57	59	61	34	48				0	6	49	58	41		166	35	48	59	58	1,103
(2) P-1 + P-2 + UC	mm	55	51	53		157	57	59	61	37	54	42			0	2	54	66	52	22		140	48	59	58	1,127
(3) P-1 + P-2 + UC	mm	55	55	59	53		144	59	61	37	57	48	48			0	38	62	50	13	0		153	59	58	1,109
Average	mm	54	50	37	72	73	86	59	61	36	53	30	16		0	3	47	62	48	12	55	58	83	59	58	1,112
9. Irrigation Efficiency (IE)																										
Paddy (P)		0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	
Upland Crops (UC)		0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	
10. Gross Water Requirements (GWR)																										
	mm	57	53	39	76	77	91	62	64	38	56	32	17	0	0	3	49	65	51	13	58	61	87	62	61	1,172
	m^3/ha	570	530	390	760	770	910	620	640	380	560	320	170	0	0	30	490	650	510	130	580	610	870	620	610	11,720
	l/sec/ha	0.44	0.38	0.32	0.63	0.59	0.66	0.48	0.49	0.29	0.41	0.25	0.13	0.00	0.00	0.02	0.35	0.50	0.39	0.10	0.42	0.47	0.67	0.48	0.44	
11. GWR with 14 hours Pump Operation	l/sec/ha	0.8	0.7	0.6	1.1	1.1	1.2	0.9	0.9	0.5	0.8	0.5	0.3	0.0	0.0	0.1	0.6	0.9	0.7	0.2	0.8	0.9	1.2	0.9	0.8	
12. Irrigation Area	ha	25	25	17	17	17	25	25	25	25	25	17	9	0	9	13	13	13	13	9	13	17	25	25	25	
13. Design Discharge	l/sec	20	18	10	19	19	30	23	23	13	20	9	3	0	0	1	8	12	9	2	10	15	30	23	20	

表 A-1-3 Water Requirement for Ranooha. Ranometo

Month		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Annual
		I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	
days		15	16	14	14	15	16	15	15	15	16	15	15	15	16	15	16	15	15	15	16	15	15	15	16	365
1. Evapotranspiration (Eto)	mm/day	4.0	4.0	4.1	4.1	4.4	4.4	4.0	4.0	4.2	4.2	3.9	3.9	4.2	4.2	4.7	4.7	5.4	5.4	5.3	5.3	4.8	4.8	3.9	3.9	
	mm	60	64	57	57	66	70	60	60	63	67	59	59	63	67	71	75	81	81	80	85	72	72	59	62	1,610
2. Cropping Pattern				Rainy Season Paddy							Semi-Rainy Season Paddy							Dry Season Upland Crops (Groundnuts, Maize, Soybeans)								
3. Crop Coefficient (k)																										
(1) P-1 + P-2 + UC		LP	1.10	1.10	1.10	1.10	1.05	0.95		LP	1.10	1.10	1.10	1.10	1.05	0.95			0.50	0.51	0.66	0.85	0.95	0.75		
(2) P-1 + P-2 + UC			LP	1.10	1.10	1.10	1.10	1.05	0.95		LP	1.10	1.10	1.10	1.10	1.05	0.95			0.50	0.59	0.96	1.05	1.02	0.95	
(3) P-1 + P-2 + UC		0.45		LP	1.10	1.10	1.10	1.10	1.05	0.95		LP	1.10	1.10	1.10	1.10	1.05	0.95			0.50	0.75	1.00	1.00	0.82	
4. Crop Evapotranspiration (ETc)																										
(1) P-1 + P-2 + UC	mm		70	63	63	73	74	57			74	65	65	69	70	67			41	41	56	61	68	44		1,121
(2) P-1 + P-2 + UC	mm			63	63	73	77	63	57			65	65	69	74	75	71			40	50	69	76	60	59	1,169
(3) P-1 + P-2 + UC	mm	27			63	73	77	66	63	60			65	69	74	78	79	77			43	54	72	59	51	1,150
5. Land Preparation (Puddling: 200 mm)																										
(1) P-1 + P-2	mm	200								200																400
(2) P-1 + P-2	mm		200								200															400
(3) P-1 + P-2	mm			200								200														400
6. Percolation (2 mm)																										
(1) P-1 + P-2	mm		32	28	28	30	32	30			32	30	30	30	32	30										
(2) P-1 + P-2	mm			28	28	30	32	30	30			30	30	30	32	30	32									
(3) P-1 + P-2	mm				28	30	32	30	30	30			30	30	32	30	32	30								
7. Effective Rainfall (ER)																										
Paddy (P)	mm	42	53	51	39	52	66	65	53	54	67	64	42	61	46	33	37	21	15	16	33	23	42	37	37	1,049
Upland Crops (UC)	mm	52	66	63	48	64	81	81	65	67	83	78	51	75	56	41	45	26	19	20	40	28	51	46	46	1,292
8. Net Water Requirements (NWR)																										
(1) P-1 + P-2 + UC	mm	158	49	40	52	51	40	22		146	39	31	53	38	56	64			22	21	16	33	17	0		948
(2) P-1 + P-2 + UC	mm		147	40	52	51	43	28	34		133	31	53	38	60	72	66			20	10	41	25	14	13	971
(3) P-1 + P-2 + UC	mm	0		149	52	51	43	31	40	36		136	53	38	60	75	74	86			3	26	21	13	5	992
Average	mm	53	65	76	52	51	42	27	25	61	57	66	53	38	59	70	47	29	7	14	10	33	21	9	6	971
9. Irrigation Efficiency (IE)																										
Paddy (P)		0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	
Upland Crops (UC)		0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	
10. Gross Water Requirements (GWR)																										
	mm	56	68	80	55	54	44	28	26	64	60	69	56	40	62	74	49	31	7	15	11	35	22	9	6	1,021
	m^3/ha	560	680	800	550	540	440	280	260	640	600	690	560	400	620	740	490	310	70	150	110	350	220	90	60	10,210
	l/sec/ha	0.43	0.49	0.66	0.45	0.42	0.32	0.22	0.20	0.49	0.43	0.53	0.43	0.31	0.45	0.57	0.35	0.24	0.05	0.12	0.08	0.27	0.17	0.07	0.04	
11. GWR with 14 hours Pump Operation	l/sec/ha	0.8	0.9	1.2	0.8	0.8	0.6	0.4	0.4	0.9	0.8	1.0	0.8	0.6	0.8	1.0	0.6	0.5	0.1	0.3	0.2	0.5	0.3	0.2	0.1	
12. Irrigation Area	ha	10	14	20	20	20	20	20	14	14	14	20	20	20	20	20	14	7	4	7	10	10	10	10	7	
13. Design Discharge	l/sec	8	13	24	16	16	12	8	6	13	11	20	16	12	16	20	8	4	0	2	2	5	3	2	1	

表 A-1-4 Water Requirement for Lapulu

Month		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Annual
		I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	
days		15	16	14	14	15	16	15	15	15	16	15	15	15	16	15	16	15	15	15	16	15	15	15	16	365
1. Evapotranspiration (Eto)	mm/day	4.0	4.0	4.1	4.1	4.4	4.4	4.0	4.0	4.2	4.2	3.9	3.9	4.2	4.2	4.7	4.7	5.4	5.4	5.3	5.3	4.8	4.8	3.9	3.9	
	mm	60	64	57	57	66	70	60	60	63	67	59	59	63	67	71	75	81	81	80	85	72	72	59	62	1,610
2. Cropping Pattern		Rainy Season Paddy						Semi-Rainy Season Paddy						Dry Season Upland Crops (Green Beans, Maize, Groundnuts)										Rainy Season Paddy		
3. Crop Coefficient (kc)																										
(1) P-1 + P-2 + UC		1.10	1.05	0.95		LP	1.10	1.10	1.10	1.10	1.05	0.95				0.50	0.64	0.89	0.95	0.88		LP	1.10	1.10	1.10	
(2) P-1 + P-2 + UC		1.10	1.10	1.05	0.95		LP	1.10	1.10	1.10	1.10	1.05	0.95			0.50	0.59	0.96	1.05	1.02	0.95		LP	1.10	1.10	
(3) P-1 + P-2 + UC		1.10	1.10	1.10	1.05	0.95		LP	1.10	1.10	1.10	1.10	1.05	0.95			0.50	0.51	0.66	0.85	0.95	0.75		LP	1.10	
4. Crop Evapotranspiration (ETc)																										
(1) P-1 + P-2 + UC	mm	66	67	54			77	66	66	69	70	56				36	48	72	77	70			79	65	68	1,106
(2) P-1 + P-2 + UC	mm	66	70	60	54			66	66	69	74	62	56			36	44	78	85	82	81			65	68	1,182
(3) P-1 + P-2 + UC	mm	66	70	63	60	63			66	69	74	65	62	60			38	41	53	68	81	54			68	1,121
5. Land Preparation (Puddling: 200 mm)																										
(1) P-1 + P-2	mm					200																200				400
(2) P-1 + P-2	mm						200																200			400
(3) P-1 + P-2	mm							200																200		400
6. Percolation (2 mm)																										
(1) P-1 + P-2	mm	30	32	28			32	30	30	30	32	30											30	30	32	
(2) P-1 + P-2	mm	30	32	28	28			30	30	30	32	30	30											30	32	
(3) P-1 + P-2	mm	30	32	28	28	30			30	30	32	30	30	30											32	
7. Effective Rainfall (ER)																										
Paddy (P)	mm	57	41	54	45	51	53	57	58	50	48	53	33	38	27	23	20	11	17	17	23	20	28	50	42	916
Upland Crops (UC)	mm	72	51	69	57	64	67	71	73	62	60	66	41	47	34	29	25	14	22	22	29	25	35	64	53	1,152
8. Net Water Requirements (NWR)																										
(1) P-1 + P-2 + UC	mm	39	58	28		149	56	39	38	49	54	33				7	23	58	55	48		180	74	45	58	1,091
(2) P-1 + P-2 + UC	mm	39	61	34	37		147	39	38	49	58	39	53			7	19	64	63	60	52		165	45	58	1,127
(3) P-1 + P-2 + UC	mm	39	61	37	43	42		143	38	49	58	42	59	52			13	27	31	46	52	29		150	58	1,069
Average	mm	39	60	33	27	64	68	74	38	49	57	38	37	17		5	18	50	50	51	35	70	80	80	58	1,098
9. Irrigation Efficiency (IE)																										
Paddy (P)		0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	
Upland Crops (UC)		0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	
10. Gross Water Requirements (GWR)																										
	mm	41	63	35	28	67	72	78	40	52	60	40	39	18	0	5	19	53	53	54	37	74	84	84	61	1,157
	m^3/ha	410	630	350	280	670	720	780	400	520	600	400	390	180	0	50	190	530	530	540	370	740	840	840	610	11,570
	l/sec/ha	0.32	0.46	0.29	0.23	0.52	0.52	0.60	0.31	0.40	0.43	0.31	0.30	0.14	0.00	0.04	0.14	0.41	0.41	0.42	0.27	0.57	0.65	0.65	0.44	
11. GWR with 14 hours Pump Operation	l/sec/ha	0.6	0.8	0.5	0.4	0.9	0.9	1.1	0.6	0.7	0.8	0.6	0.6	0.3	0.0	0.1	0.3	0.8	0.8	0.8	0.5	1.0	1.2	1.2	0.8	
12. Irrigation Area	ha	8	8	8	6	6	6	8	8	8	8	8	6	3	0	3	4	4	4	4	3	4	6	8	8	
13. Design Discharge	l/sec	5	6	4	2	5	5	9	5	6	6	5	4	1	0	0	1	3	3	3	2	4	7	10	6	

表 A-1-5 Water Requirement for Moolo Inda

Month		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Annual
		I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	
days		15	16	14	14	15	16	15	15	15	16	15	15	15	16	15	16	15	15	15	16	15	15	15	16	365
1. Evapotranspiration (Eto)	mm/day	4.0	4.0	4.1	4.1	4.4	4.4	4.0	4.0	4.2	4.2	3.9	3.9	4.2	4.2	4.7	4.7	5.4	5.4	5.3	5.3	4.8	4.8	3.9	3.9	
	mm	60	64	57	57	66	70	60	60	63	67	59	59	63	67	71	75	81	81	80	85	72	72	59	62	1,610
2. Cropping Pattern		Rainy Season Paddy				Semi-Rainy Season Paddy								Dry Season Upland Crops (Green Beans, Maize, Groundnuts)										Rainy Season Paddy		
3. Crop Coefficient (k)																										
(1) P-1 + P-2 + UC		1.10	1.05	0.95		LP	1.10	1.10	1.10	1.10	1.05	0.95				0.50	0.64	0.89	0.95	0.88		LP	1.10	1.10	1.10	
(2) P-1 + P-2 + UC		1.10	1.10	1.05	0.95		LP	1.10	1.10	1.10	1.10	1.05	0.95			0.50	0.59	0.96	1.05	1.02	0.95		LP	1.10	1.10	
(3) P-1 + P-2 + UC		1.10	1.10	1.10	1.05	0.95		LP	1.10	1.10	1.10	1.10	1.05	0.95			0.50	0.51	0.66	0.85	0.95	0.75		LP	1.10	
4. Crop Evapotranspiration (ETc)																										
(1) P-1 + P-2 + UC	mm	66	67	54			77	66	66	69	70	56				36	48	72	77	70			79	65	68	1,106
(2) P-1 + P-2 + UC	mm	66	70	60	54			66	66	69	74	62	56			36	44	78	85	82	81			65	68	1,182
(3) P-1 + P-2 + UC	mm	66	70	63	60	63			66	69	74	65	62	60			38	41	53	68	81	54			68	1,121
5. Land Preparation (Puddling: 200 mm)																										
(1) P-1 + P-2	mm					200																200				400
(2) P-1 + P-2	mm						200																200			400
(3) P-1 + P-2	mm							200																200		400
6. Percolation (2 mm)																										
(1) P-1 + P-2	mm	30	32	28			32	30	30	30	32	30											30	30	32	
(2) P-1 + P-2	mm	30	32	28	28			30	30	30	32	30	30											30	32	
(3) P-1 + P-2	mm	30	32	28	28	30			30	30	32	30	30	30											32	
7. Effective Rainfall (ER)																										
Paddy (P)	mm	57	41	54	45	51	53	57	58	50	48	53	33	38	27	23	20	11	17	17	23	20	28	50	42	916
Upland Crops (UC)	mm	72	51	69	57	64	67	71	73	62	60	66	41	47	34	29	25	14	22	22	29	25	35	64	53	1,152
8. Net Water Requirements (NWR)																										
(1) P-1 + P-2 + UC	mm	39	58	28		149	56	39	38	49	54	33				7	23	58	55	48		180	74	45	58	1,091
(2) P-1 + P-2 + UC	mm	39	61	34	37		147	39	38	49	58	39	53			7	19	64	63	60	52		165	45	58	1,127
(3) P-1 + P-2 + UC	mm	39	61	37	43	42		143	38	49	58	42	59	52			13	27	31	46	52	29		150	58	1,069
Average	mm	39	60	33	27	64	68	74	38	49	57	38	37	17		5	18	50	50	51	35	70	80	80	58	1,098
9. Irrigation Efficiency (IE)																										
Paddy (P)		0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	
Upland Crops (UC)		0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	
10. Gross Water Requirements (GWR)																										
	mm	41	63	35	28	67	72	78	40	52	60	40	39	18	0	5	19	53	53	54	37	74	84	84	61	1,157
	m^3/ha	410	630	350	280	670	720	780	400	520	600	400	390	180	0	50	190	530	530	540	370	740	840	840	610	11,570
	l/sec/ha	0.32	0.46	0.29	0.23	0.52	0.52	0.60	0.31	0.40	0.43	0.31	0.30	0.14	0.00	0.04	0.14	0.41	0.41	0.42	0.27	0.57	0.65	0.65	0.44	
11. GWR with 14 hours Pump Operation	l/sec/ha	0.6	0.8	0.5	0.4	0.9	0.9	1.1	0.6	0.7	0.8	0.6	0.6	0.3	0.0	0.1	0.3	0.8	0.8	0.8	0.5	1.0	1.2	1.2	0.8	
12. Irrigation Area	ha	20	20	20	14	14	13	22	12	14	16	12	8	2	0	1	3	8	8	8	4	10	17	24	16	
13. Design Discharge	l/sec	12	16	10	6	13	13	22	12	14	16	12	8	2	0	1	3	8	8	8	4	10	17	24	16	

表 A-1-6 Water Requirement for Kalembukaha

Month		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Annual
		I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	
days		15	16	14	14	15	16	15	15	15	16	15	15	15	16	15	16	15	15	15	16	15	15	15	16	365
1. Evapotranspiration (Eto)	mm/day	4.2	4.2	4.6	4.6	5.6	5.6	6.3	6.3	6.7	6.7	6.3	6.3	6.1	6.1	6.7	6.7	6.8	6.8	6.8	6.8	5.8	5.8	4.6	4.6	
	mm	63	67	64	64	84	90	95	95	101	107	95	95	92	98	101	107	102	102	102	109	87	87	69	74	2,150
2. Cropping Pattern				Semi-Rainy Season Paddy								Dry Season Upland Crops (Green Beans, Maize, Groundnuts)										Rainy Season Paddy						
3. Crop Coefficient (kc)																										
(1) P-1 + P-2 + UC			LP	1.10	1.10	1.10	1.10	1.05	0.95				0.50	0.64	0.89	0.95	0.88		LP	1.10	1.10	1.10	1.10	1.05	0.95	
(2) P-1 + P-2 + UC		0.95		LP	1.10	1.10	1.10	1.10	1.05	0.95			0.50	0.59	0.96	1.05	1.02	0.95		LP	1.10	1.10	1.10	1.10	1.05	
(3) P-1 + P-2 + UC		1.05	0.95		LP	1.10	1.10	1.10	1.10	1.05	0.95			0.50	0.51	0.66	0.85	0.95	0.75		LP	1.10	1.10	1.10	1.10	
4. Crop Evapotranspiration (ETc)																										
(1) P-1 + P-2 + UC	mm			70	70	92	99	100	90				48	59	87	96	94			112	120	96	96	72	70	1,471
(2) P-1 + P-2 + UC	mm	60			70	92	99	105	100	96			48	54	94	106	109	97			120	96	96	76	78	1,596
(3) P-1 + P-2 + UC	mm	66	64			92	99	105	105	106	102			46	50	67	91	97	77			96	96	76	81	1,516
5. Land Preparation (Puddling: 200 mm)																										
(1) P-1 + P-2	mm		200																200							400
(2) P-1 + P-2	mm			200																200						400
(3) P-1 + P-2	mm				200																200					400
6. Percolation (2 mm)																										
(1) P-1 + P-2	mm			21	21	23	24	23	23											22.5	24	23	23	23	24	
(2) P-1 + P-2	mm	23			21	23	24	23	23	30											24	23	23	23	24	
(3) P-1 + P-2	mm	23	24			23	24	23	23	23	24											23	23	23	24	
7. Effective Rainfall (ER)																										
Paddy (P)	mm	90	171	112	124	155	99	105	69	24	15	9	10	16	22	5	20	5	27	18	61	82	93	128	99	1,559
Upland Crops (UC)	mm	103	196	129	142	178	114	120	80	28	17	10	12	18	25	6	23	6	30	21	70	94	107	147	113	1,789
8. Net Water Requirements (NWR)																										
(1) P-1 + P-2 + UC	mm		29	0	0	0	24	18	44				36	41	62	90	71		173	114	83	37	26	0	0	848
(2) P-1 + P-2 + UC	mm	0		88	0	0	24	23	54	102			36	36	69	100	86	91		179	83	37	26	0	3	1,037
(3) P-1 + P-2 + UC	mm	0	0		76	0	24	23	59	105	111			28	25	61	68	91	47		139	37	26	0	6	926
Average	mm	0	10	29	25	0	24	21	52	69	37		24	35	52	84	75	61	73	98	102	37	26	0	3	937
9. Irrigation Efficiency (IE)																										
Paddy (P)		0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	
Upland Crops (UC)		0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	
10. Gross Water Requirements (GWR)																										
	mm	0	11	31	26	0	25	22	55	73	39	0	25	37	55	88	79	64	77	103	107	39	27	0	3	986
	m^3/ha	0	110	310	260	0	250	220	550	730	390	0	250	370	550	880	790	640	770	1,030	1,070	390	270	0	30	9,860
	l/sec/ha	0.00	0.08	0.26	0.21	0.00	0.18	0.17	0.42	0.56	0.28	0.00	0.19	0.29	0.40	0.68	0.57	0.49	0.59	0.79	0.77	0.30	0.21	0.00	0.02	
11. GWR with 16 hours Pump Operation	l/sec/ha	0.0	0.2	0.4	0.4	0.0	0.3	0.3	0.7	0.9	0.5	0.0	0.3	0.5	0.6	1.1	0.9	0.8	0.9	1.2	1.2	0.5	0.4	0.0	0.1	
12. Irrigation Area	ha	7	7	7	10	10	10	10	10	7	4	0	4	5	5	5	5	4	5	7	10	10	10	10	10	
13. Design Discharge	l/sec	0	1	3	4	0	3	3	7	6	2	0	1	3	3	6	5	3	5	8	12	5	4	0	1	

表 A-1-7 Water Requirement for Palakahembi

Month		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Annual
		I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	
days		15	16	14	14	15	16	15	15	15	16	15	15	15	16	15	16	15	15	15	16	15	15	15	16	365
1. Evapotranspiration (Eto)	mm/day	4.2	4.2	4.6	4.6	5.6	5.6	6.3	6.3	6.7	6.7	6.3	6.3	6.1	6.1	6.7	6.7	6.8	6.8	6.8	6.8	5.8	5.8	4.6	4.6	
	mm	63	67	64	64	84	90	95	95	101	107	95	95	92	98	101	107	102	102	102	109	87	87	69	74	2,150
2. Cropping Pattern		Wet Season Upland Crops							Dry Season Upland Crops								Dry Season Upland Crops									
3. Crop Coefficient (k)		(Green Beans, Maize, Sorghum)							(Green Beans, Maize, Sorghum)								(Green Beans, Maize, Sorghum)									
(1) P-1 + P-2 + UC		0.64	0.89	0.95	0.88			0.50	0.64	0.89	0.95	0.88				0.50	0.64	0.89	0.95	0.88				0.50		
(2) P-1 + P-2 + UC		0.59	0.96	1.05	1.02	0.95		0.50	0.59	0.96	1.05	1.02	0.95			0.50	0.59	0.96	1.05	1.02	0.95			0.50		
(3) P-1 + P-2 + UC		0.50	0.75	1.00	1.00	0.82	0.45		0.50	0.75	1.00	1.00	0.82	0.45			0.50	0.75	1.00	1.00	0.82	0.45				
4. Crop Evapotranspiration (ETc)																										
(1) P-1 + P-2 + UC	mm	40	60	61	56			48	65	95	90	84				54	65	91	97	96				37	1,039	
(2) P-1 + P-2 + UC	mm	37	64	67	65	80		48	60	103	100	97	87			54	60	98	107	111	83			37	1,358	
(3) P-1 + P-2 + UC	mm	32	50	64	64	69	41		51	80	95	95	75	44			51	77	102	109	71	39			1,209	
5. Land Preparation (Puddling: 200 mm)																									0	
(1) P-1 + P-2	mm																								0	
(2) P-1 + P-2	mm																								0	
(3) P-1 + P-2	mm																									
6. Percolation (2 mm)																										
(1) P-1 + P-2	mm																									
(2) P-1 + P-2	mm																									
(3) P-1 + P-2	mm																									
7. Effective Rainfall (ER)																										
Paddy (P)	mm	49	62	53	51	51	37	34	10	4	5	2	4	1	2	0	0	1	1	1	1	5	20	43	44	481
Upland Crops (UC)	mm	56	69	59	57	57	41	38	12	5	6	2	4	1	3	0	0	1	1	1	1	5	22	49	49	539
8. Net Water Requirements (NWR)																										
(1) P-1 + P-2 + UC	mm	0	0	2	0				36	60	89	88	80			54	64	90	96	95				0	754	
(2) P-1 + P-2 + UC	mm	0	0	8	8	23			36	55	97	98	93	86		54	59	97	106	110	78			0	1,008	
(3) P-1 + P-2 + UC	mm	0	0	5	7	12	0			46	74	93	91	74	41			50	76	101	108	66	17			861
Average	mm	0	0	5	5	12	0		24	54	87	93	88	53	14		36	58	88	101	104	48	6		0	876
9. Irrigation Efficiency (IE)																										
Paddy (P)		0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	
Upland Crops (UC)		0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	
10. Gross Water Requirements (GWR)																										
	mm	0	0	7	7	18	0	0	36	81	130	139	131	79	21	0	54	87	131	151	155	72	9	0	0	1,308
	m^3/ha	0	0	70	70	180	0	0	360	810	1,300	1,390	1,310	790	210	0	540	870	1,310	1,510	1,550	720	90	0	0	13,080
	l/sec/ha	0.00	0.00	0.06	0.06	0.14	0.00	0.00	0.28	0.63	0.94	1.07	1.01	0.61	0.15	0.00	0.39	0.67	1.01	1.17	1.12	0.56	0.07	0.00	0.00	
11. GWR with 12 hours Pump Operation	l/sec/ha	0.0	0.0	0.2	0.2	0.3	0.0	0.0	0.6	1.3	1.9	2.2	2.1	1.3	0.3	0.0	0.8	1.4	2.1	2.4	2.3	1.2	0.2	0.0	0.0	
12. Irrigation Area	ha	10	10	10	10	7	4	0	4	5	5	5	5	4	2	0	4	5	5	5	5	4	2	0	7	
13. Design Discharge	l/sec	0	0	2	2	2	0	0	2	7	10	11	11	5	1	0	3	7	11	12	12	5	0	0	0	

表 A-1-8 Water Requirement for Nawangkewa

Month		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Annual
		I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	
days		15	16	14	14	15	16	15	15	15	16	15	15	15	16	15	16	15	15	15	16	15	15	15	16	365
1. Evapotranspiration (Eto)	mm/day	6.0	6.0	6.4	6.4	6.9	6.9	6.9	6.9	6.9	6.9	6.8	6.8	6.7	6.7	6.9	6.9	6.9	6.9	6.8	6.8	6.5	6.5	5.8	5.8	
	mm	90	96	90	90	104	110	104	104	104	110	102	102	101	107	104	110	104	104	102	109	98	98	87	93	2,423
2. Cropping Pattern		Wet Season Upland Crops							Dry Season Upland Crops								Dry Season Upland Crops									
3. Crop Coefficient (k)		(Green Beans, Maize, Groundnuts)							(Green Beans, Maize, Groundnuts)								(Green Beans, Maize, Groundnuts)									
(1) P-1 + P-2 + UC		0.64	0.89	0.95	0.88				0.50	0.64	0.89	0.95	0.88				0.50	0.64	0.89	0.95	0.88				0.50	
(2) P-1 + P-2 + UC		0.59	0.96	1.05	1.02	0.95			0.50	0.59	0.96	1.05	1.02	0.95			0.50	0.59	0.96	1.05	1.02	0.95			0.50	
(3) P-1 + P-2 + UC		0.50	0.51	0.66	0.85	0.95	0.75			0.50	0.51	0.66	0.85	0.95	0.75			0.50	0.51	0.66	0.85	0.95	0.75			
4. Crop Evapotranspiration (ETc)																										
(1) P-1 + P-2 + UC	mm	58	85	86	79				52	67	98	97	90				55	67	93	97	96				47	1,167
(2) P-1 + P-2 + UC	mm	53	92	95	92	99			52	61	106	107	104	96			55	61	100	107	111	93			47	1,531
(3) P-1 + P-2 + UC	mm	45	49	59	77	99	83			52	56	67	87	96	80			52	53	67	93	93	74			1,282
5. Land Preparation (Puddling: 200 mm)																										
(1) P-1 + P-2	mm																									0
(2) P-1 + P-2	mm																									0
(3) P-1 + P-2	mm																									0
6. Percolation (2 mm)																										
(1) P-1 + P-2	mm																									
(2) P-1 + P-2	mm																									
(3) P-1 + P-2	mm																									
7. Effective Rainfall (ER)																										
Paddy (P)	mm	38	44	56	58	36	34	21	24	8	6	4	8	5	4	0	1	1	2	2	4	21	37	33	49	496
Upland Crops (UC)	mm	49	57	72	75	46	44	27	31	10	8	5	11	6	5	0	1	1	3	2	5	27	48	43	64	640
8. Net Water Requirements (NWR)																										
(1) P-1 + P-2 + UC	mm	9	28	14	4				21	57	90	92	79				54	66	90	95	91				0	790
(2) P-1 + P-2 + UC	mm	4	35	23	17	53			21	51	98	102	93	90			54	60	97	105	106	66			0	1,075
(3) P-1 + P-2 + UC	mm	0	0	0	2	53	39			42	48	62	76	90	75			51	50	65	88	66	26			833
Average	mm	4	21	12	8	35	13		14	50	79	85	83	60	25		36	59	79	88	95	44	9		0	899
9. Irrigation Efficiency (IE)																										
Paddy (P)		0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	
Upland Crops (UC)		0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	
10. Gross Water Requirements (GWR)																										
	mm	6	31	18	12	52	19	0	21	75	118	127	124	90	37	0	54	88	118	131	142	66	13	0	0	1,342
	m^3/ha	60	310	180	120	520	190	0	210	750	1,180	1,270	1,240	900	370	0	540	880	1,180	1,310	1,420	660	130	0	0	13,420
	l/sec/ha	0.05	0.22	0.15	0.10	0.40	0.14	0.00	0.16	0.58	0.85	0.98	0.96	0.69	0.27	0.00	0.39	0.68	0.91	1.01	1.03	0.51	0.10	0.00	0.00	
11. GWR with 12 hours Pump Operation	l/sec/ha	0.1	0.5	0.3	0.2	0.8	0.3	0.0	0.4	1.2	1.7	2.0	2.0	1.4	0.6	0.0	0.8	1.4	1.9	2.1	2.1	1.1	0.2	0.0	0.0	
12. Irrigation Area	ha	10	10	10	10	7	4	0	4	5	5	5	5	4	2	0	4	5	5	5	5	4	2	0	7	
13. Design Discharge	l/sec	1	5	3	2	6	1	0	2	6	9	10	10	6	1	0	3	7	10	11	11	4	0	0	0	

表 A-1-9 Water Requirement for Magepanda

Month		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Annual
		I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	
days		15	16	14	14	15	16	15	15	15	16	15	15	15	16	15	16	15	15	15	16	15	15	15	16	365
1. Evapotranspiration (Eto)	mm/day	6.0	6.0	6.4	6.4	6.9	6.9	6.9	6.9	6.9	6.9	6.8	6.8	6.7	6.7	6.9	6.9	6.9	6.9	6.8	6.8	6.5	6.5	5.8	5.8	
	mm	90	96	90	90	104	110	104	104	104	110	102	102	101	107	104	110	104	104	102	109	98	98	87	93	2,423
2. Cropping Pattern		Wet Season Upland Crops							Dry Season Upland Crops								Dry Season Upland Crops									
3. Crop Coefficient (k)		(Green Beans, Maize, Rice)							(Green Beans, Maize, Rice)								(Green Beans, Maize, Rice)									
(1) P-1 + P-2 + UC		0.64	0.89	0.95	0.88				0.50	0.64	0.89	0.95	0.88				0.50	0.64	0.89	0.95	0.88				0.50	
(2) P-1 + P-2 + UC		0.59	0.96	1.05	1.02	0.95			0.50	0.59	0.96	1.05	1.02	0.95			0.50	0.59	0.96	1.05	1.02	0.95			0.50	
(3) P-1 + P-2 + UC		1.10	1.10	1.10	1.10	1.05	0.95			1.10	1.10	1.10	1.10	1.05	0.95			1.10	1.10	1.10	1.10	1.05	0.95			
4. Crop Evapotranspiration (ETc)																										
(1) P-1 + P-2 + UC	mm	58	85	86	79				52	67	98	97	90				55	67	93	97	96				47	1,167
(2) P-1 + P-2 + UC	mm	53	92	95	92	99			52	61	106	107	104	96			55	61	100	107	111	93			47	1,531
(3) P-1 + P-2 + UC	mm	99	106	99	99	109	105			114	121	112	112	106	102			114	114	112	120	103	93			1,940
5. Land Preparation (Puddling: 200 mm)																										
(1) P-1 + P-2	mm																									0
(2) P-1 + P-2	mm																									0
(3) P-1 + P-2	mm																									0
6. Percolation (2 mm)																										
(1) P-1 + P-2	mm																									
(2) P-1 + P-2	mm																									
(3) P-1 + P-2	mm																									
7. Effective Rainfall (ER)																										
Paddy (P)	mm	42	54	75	72	30	23	19	15	9	2	5	8	4	6	2	3	3	4	1	12	7	17	39	40	492
Upland Crops (UC)	mm	53	67	94	89	38	28	24	19	11	2	6	10	5	7	3	4	3	5	1	15	9	21	49	49	612
8. Net Water Requirements (NWR)																										
(1) P-1 + P-2 + UC	mm	5	18	0	0				33	56	96	91	80				51	64	88	96	81				0	759
(2) P-1 + P-2 + UC	mm	0	25	1	3	61			33	50	104	101	94	91			51	58	95	106	96	84			0	1,053
(3) P-1 + P-2 + UC	mm	46	39	5	10	71	77			103	119	106	102	101	95			111	109	111	105	94	72			1,476
Average	mm	17	27	2	4	44	26		22	70	106	99	92	64	32		34	78	97	104	94	59	24		0	1,095
9. Irrigation Efficiency (IE)																										
Paddy (P)		0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	
Upland Crops (UC)		0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	
10. Gross Water Requirements (GWR)																										
	mm	25	40	3	6	66	39	0	33	104	158	148	137	96	48	0	51	116	145	155	140	88	36	0	0	1,634
	m^3/ha	250	400	30	60	660	390	0	330	1,040	1,580	1,480	1,370	960	480	0	510	1,160	1,450	1,550	1,400	880	360	0	0	16,340
	l/sec/ha	0.19	0.29	0.02	0.05	0.51	0.28	0.00	0.25	0.80	1.14	1.14	1.06	0.74	0.35	0.00	0.37	0.90	1.12	1.20	1.01	0.68	0.28	0.00	0.00	
11. GWR with 12 hours Pump Operation	l/sec/ha	0.4	0.6	0.1	0.1	1.1	0.6	0.0	0.5	1.6	2.3	2.3	2.2	1.5	0.7	0.0	0.8	1.8	2.3	2.4	2.1	1.4	0.6	0.0	0.0	
12. Irrigation Area	ha	8	8	8	8	6	3	0	3	4	4	4	4	3	2	0	3	4	4	4	4	3	2	0	6	
13. Design Discharge	l/sec	3	5	1	1	7	2	0	2	6	9	10	9	5	1	0	2	7	9	10	8	4	1	0	0	

表 A-1-10 Water Requirement for Ranakolo, Dawa, Toto Mala

Month		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Annual
		I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	
days		15	16	14	14	15	16	15	15	15	16	15	15	15	16	15	16	15	15	15	16	15	15	15	16	365
1. Evapotranspiration (Eto)	mm/day	6.0	6.0	6.4	6.4	6.9	6.9	6.9	6.9	6.9	6.9	6.8	6.8	6.7	6.7	6.9	6.9	6.9	6.9	6.8	6.8	6.5	6.5	5.8	5.8	
	mm	90	96	90	90	104	110	104	104	104	110	102	102	101	107	104	110	104	104	102	109	98	98	87	93	2,423
2. Cropping Pattern			Wet Season Upland Crops								Dry Season Upland Crops								Dry Season Upland Crops							
3. Crop Coefficient (k)			(Green Beans, Maize, Groundnuts)								(Green Beans, Maize, Groundnuts)								(Green Beans, Maize, Groundnuts)							
(1) P-1 + P-2 + UC			0.50	0.64	0.89	0.95	0.88				0.50	0.64	0.89	0.95	0.88				0.50	0.64	0.89	0.95	0.88			
(2) P-1 + P-2 + UC			0.50	0.59	0.96	1.05	1.02	0.95			0.50	0.59	0.96	1.05	1.02	0.95			0.50	0.59	0.96	1.05	1.02	0.95		
(3) P-1 + P-2 + UC				0.50	0.51	0.66	0.85	0.95	0.75			0.50	0.51	0.66	0.85	0.95	0.75			0.50	0.51	0.66	0.85	0.95	0.75	
4. Crop Evapotranspiration (ETc)																										
(1) P-1 + P-2 + UC	mm		48	58	80	99	97				55	65	91	96	94				52	65	97	93	86			1,176
(2) P-1 + P-2 + UC	mm		48	53	86	109	112	99			55	60	98	106	109	99			52	60	105	103	100	83		1,537
(3) P-1 + P-2 + UC	mm			45	46	69	94	99	78			51	52	67	91	99	83			51	56	65	83	83	70	1,282
5. Land Preparation (Puddling: 200 mm)																										
(1) P-1 + P-2	mm																									0
(2) P-1 + P-2	mm																									0
(3) P-1 + P-2	mm																									0
6. Percolation (2 mm)																										
(1) P-1 + P-2	mm																									
(2) P-1 + P-2	mm																									
(3) P-1 + P-2	mm																									
7. Effective Rainfall (ER)																										
Paddy (P)	mm	123	115	96	86	73	75	58	48	17	20	11	6	8	11	1	4	9	19	9	11	47	70	83	78	1,078
Upland Crops (UC)	mm	136	126	105	95	81	83	63	53	19	22	13	7	8	12	1	4	10	21	10	12	51	77	91	85	1,185
8. Net Water Requirements (NWR)																										
(1) P-1 + P-2 + UC	mm		0	0	0	18	14				33	52	84	88	82				31	55	85	42	9			593
(2) P-1 + P-2 + UC	mm		0	0	0	28	29	36			33	47	91	98	97	98			31	50	93	52	23	0		806
(3) P-1 + P-2 + UC	mm			0	0	0	11	36	25			38	45	59	79	98	79			41	44	14	6	0	0	575
Average	mm		0	0	0	15	18	24	8		22	46	73	82	86	65	26		21	49	74	36	13	0	0	658
9. Irrigation Efficiency (IE)																										
Paddy (P)		0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	
Upland Crops (UC)		0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	
10. Gross Water Requirements (GWR)																										
	mm	0	0	0	0	22	27	36	12	0	33	69	109	122	128	97	39	0	31	73	110	54	19	0	0	981
	m^3/ha	0	0	0	0	220	270	360	120	0	330	690	1,090	1,220	1,280	970	390	0	310	730	1,100	540	190	0	0	9,810
	l/sec/ha	0.00	0.00	0.00	0.00	0.17	0.20	0.28	0.09	0.00	0.24	0.53	0.84	0.94	0.93	0.75	0.28	0.00	0.24	0.56	0.80	0.42	0.15	0.00	0.00	
11. GWR with 12 hours Pump Operation	l/sec/ha	0.0	0.0	0.0	0.0	0.4	0.4	0.6	0.2	0.0	0.5	1.1	1.7	1.9	1.9	1.5	0.6	0.0	0.5	1.2	1.6	0.9	0.3	0.0	0.0	
12. Irrigation Area	ha	0	10	10	10	10	10	7	4	0	4	5	5	5	5	4	2	0	4	5	5	5	5	4	2	
13. Design Discharge	l/sec	0	0	0	0	4	4	4	1	0	2	6	9	10	10	6	1	0	2	6	8	5	2	0	0	