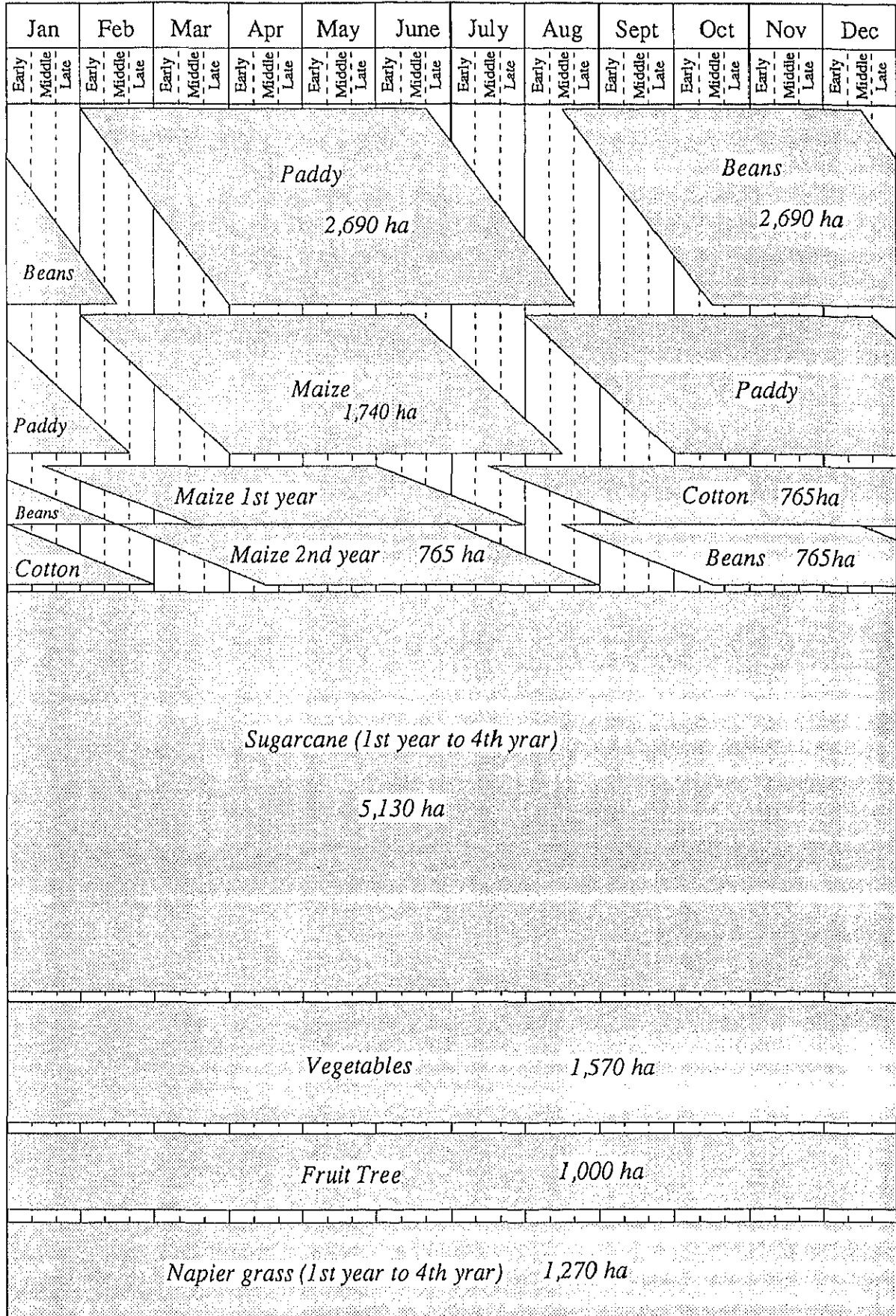
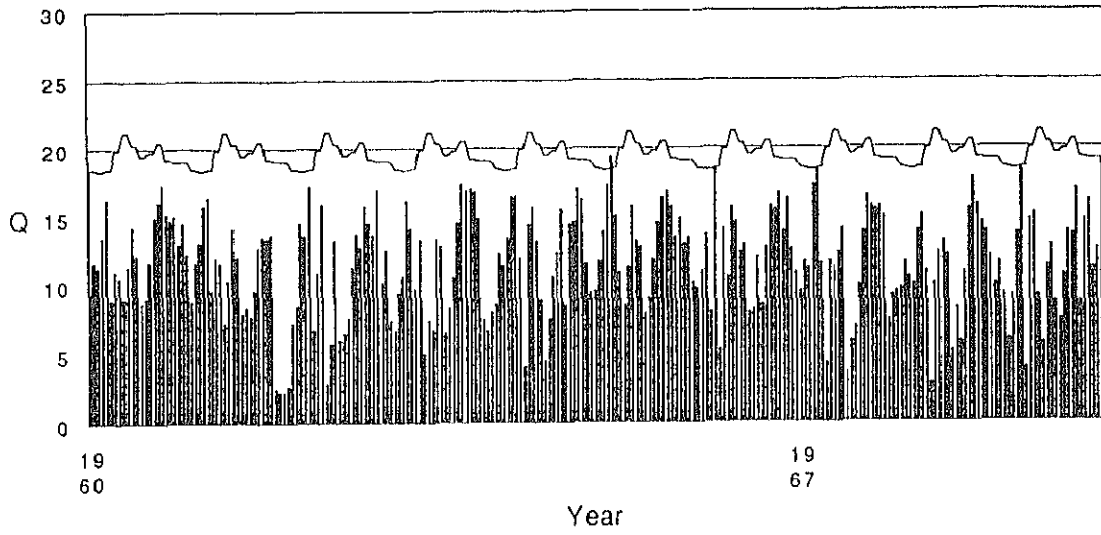


圖 6-2 計画作付曆





Water Balance in the Project

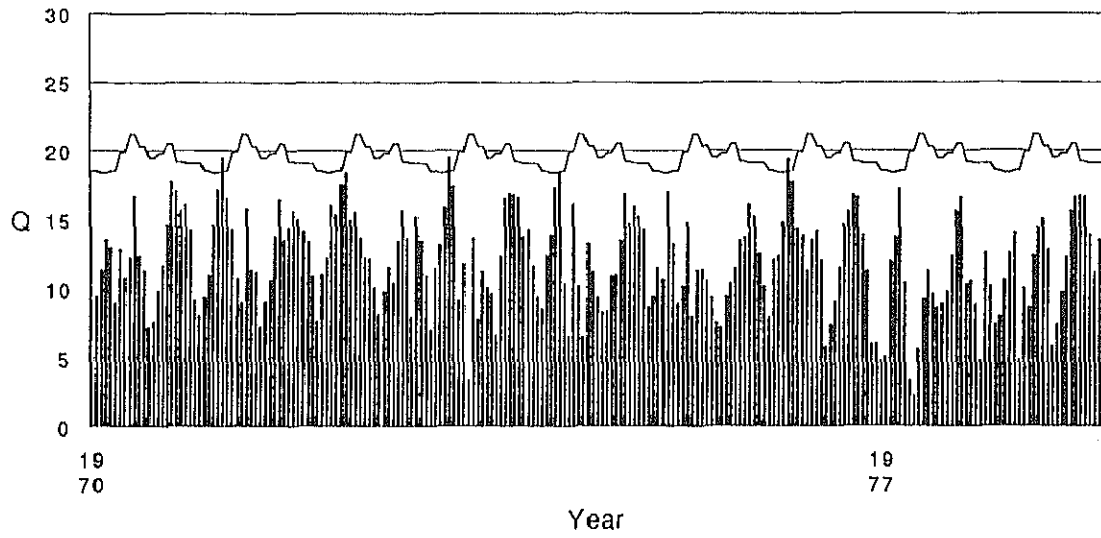
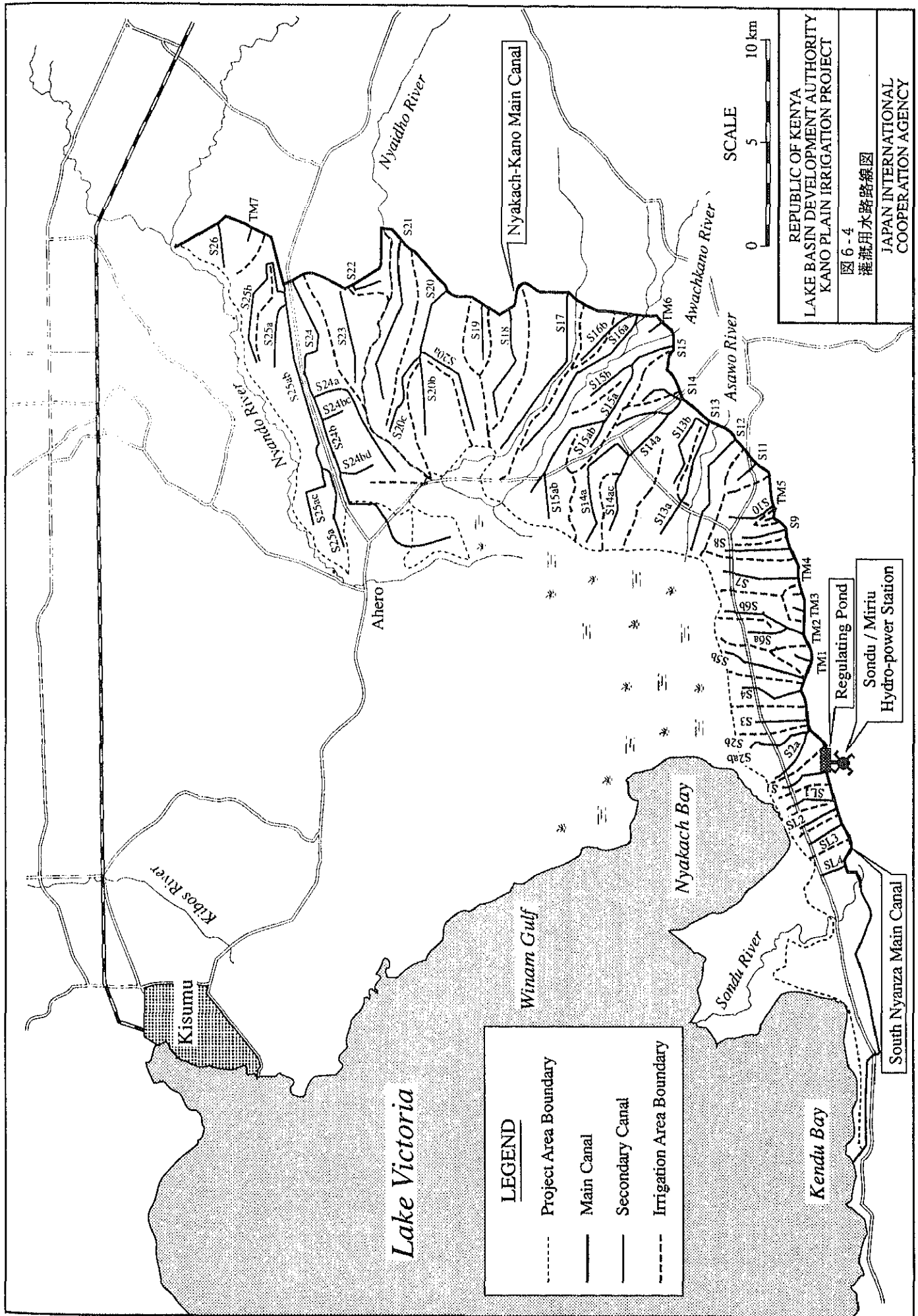
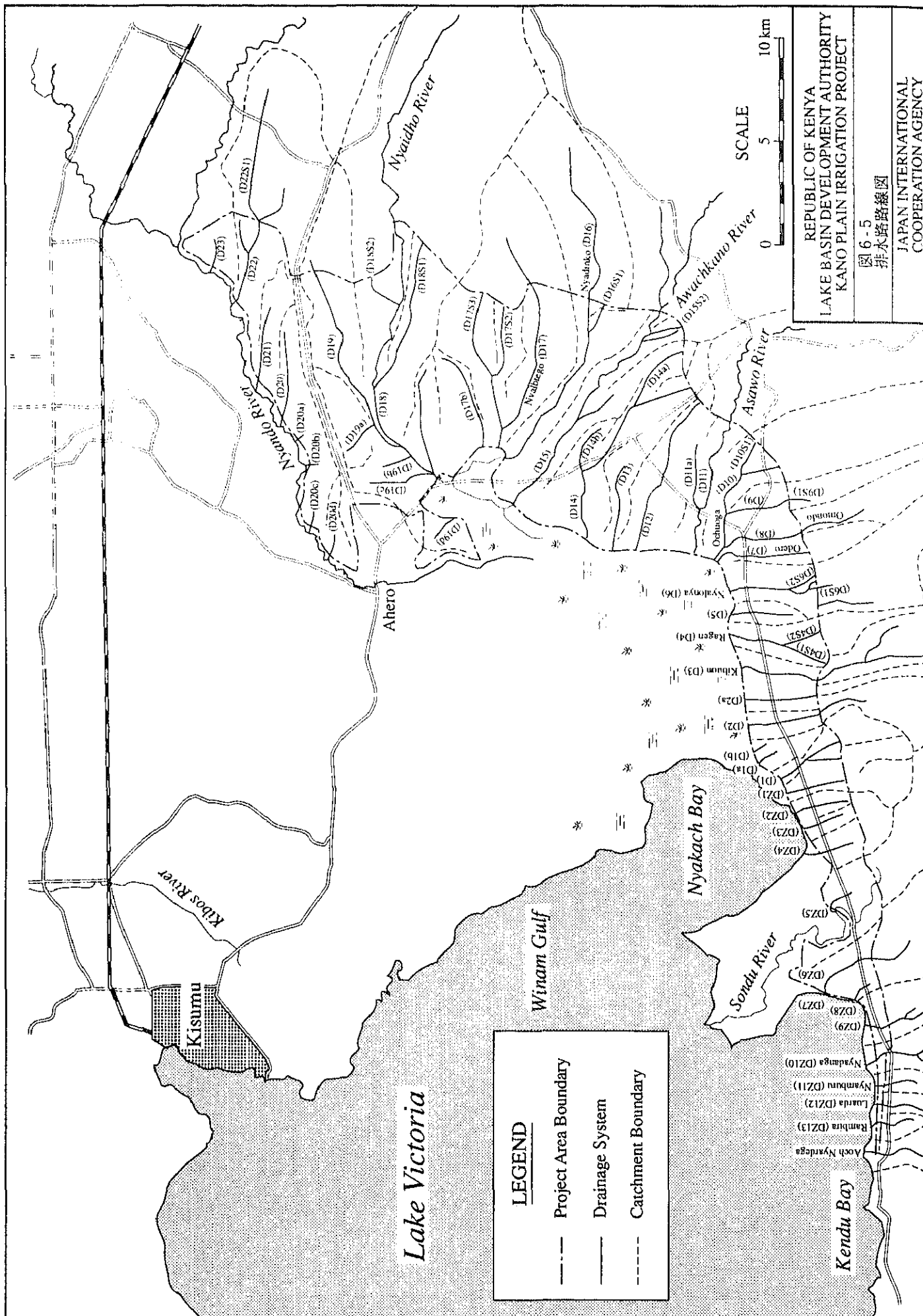


図6-3 1960年～1978年の水収支

| | |
|--|---|
| REPUYBLIC OF KENYA | : |
| KANO PLAIN IRRIGATION PROJECT | : |
| JAPAN INTERNATIONAL COOPERATION AGENCY | |





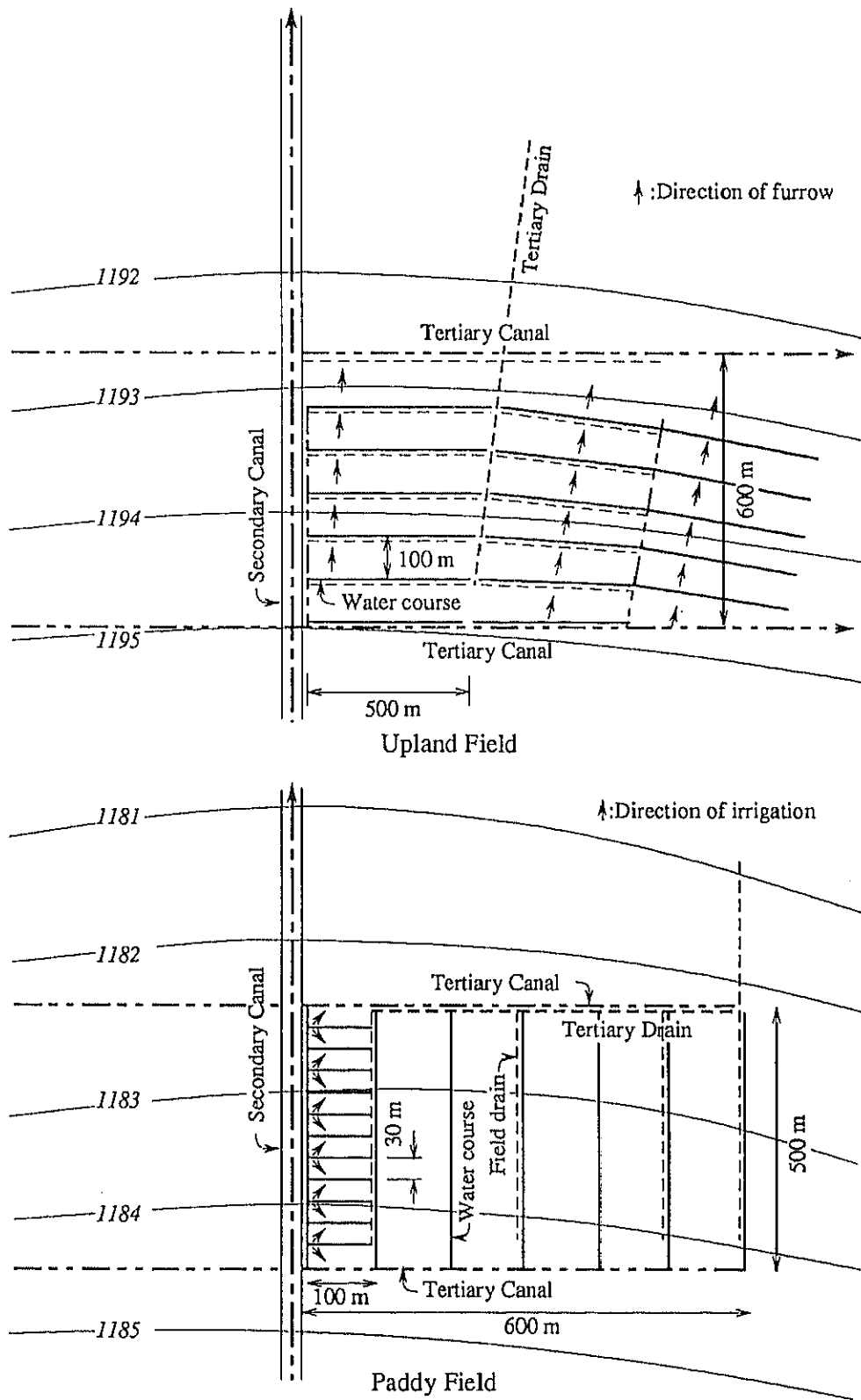


図 6 - 6 3 次水路組織の模式図

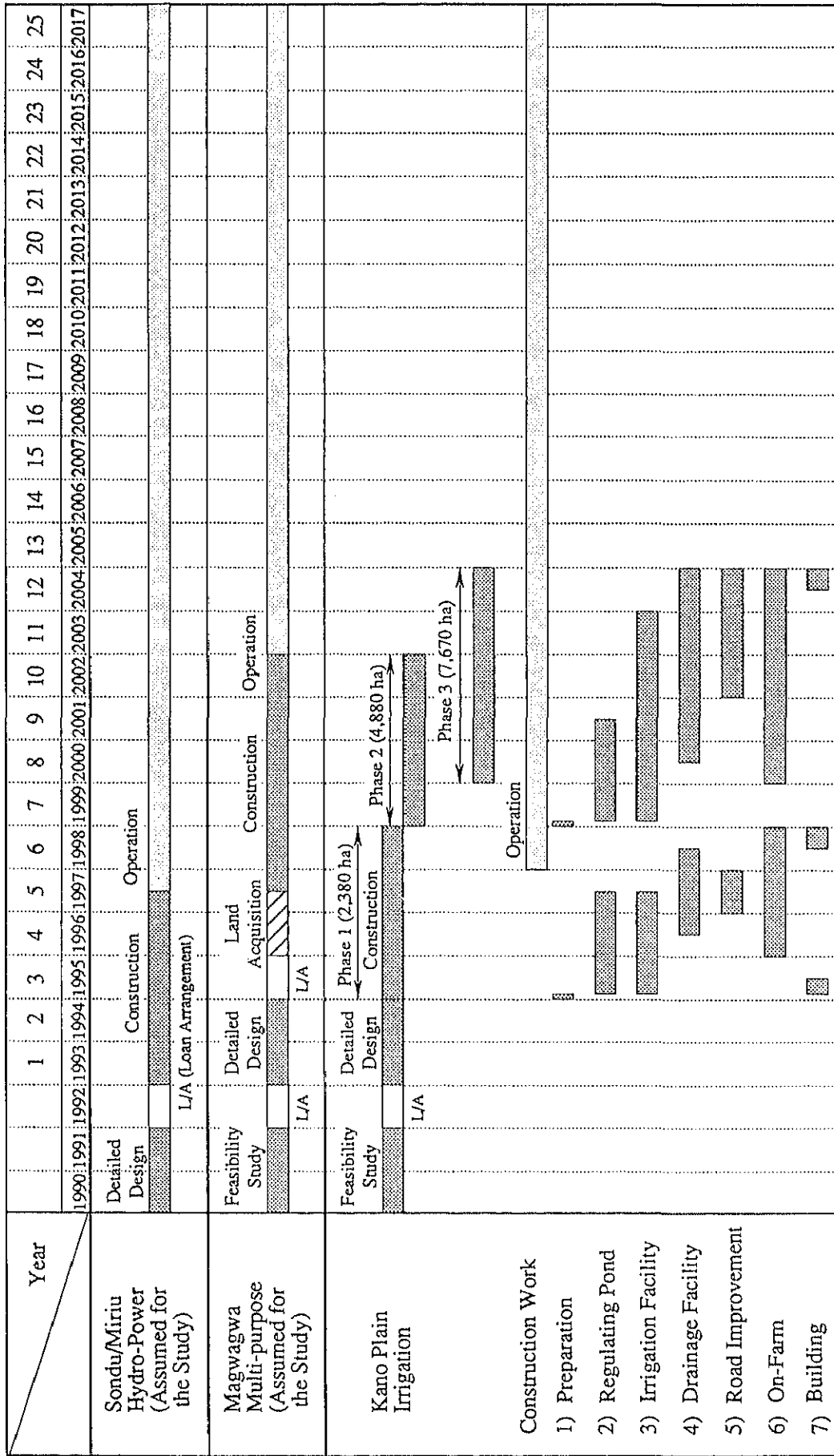
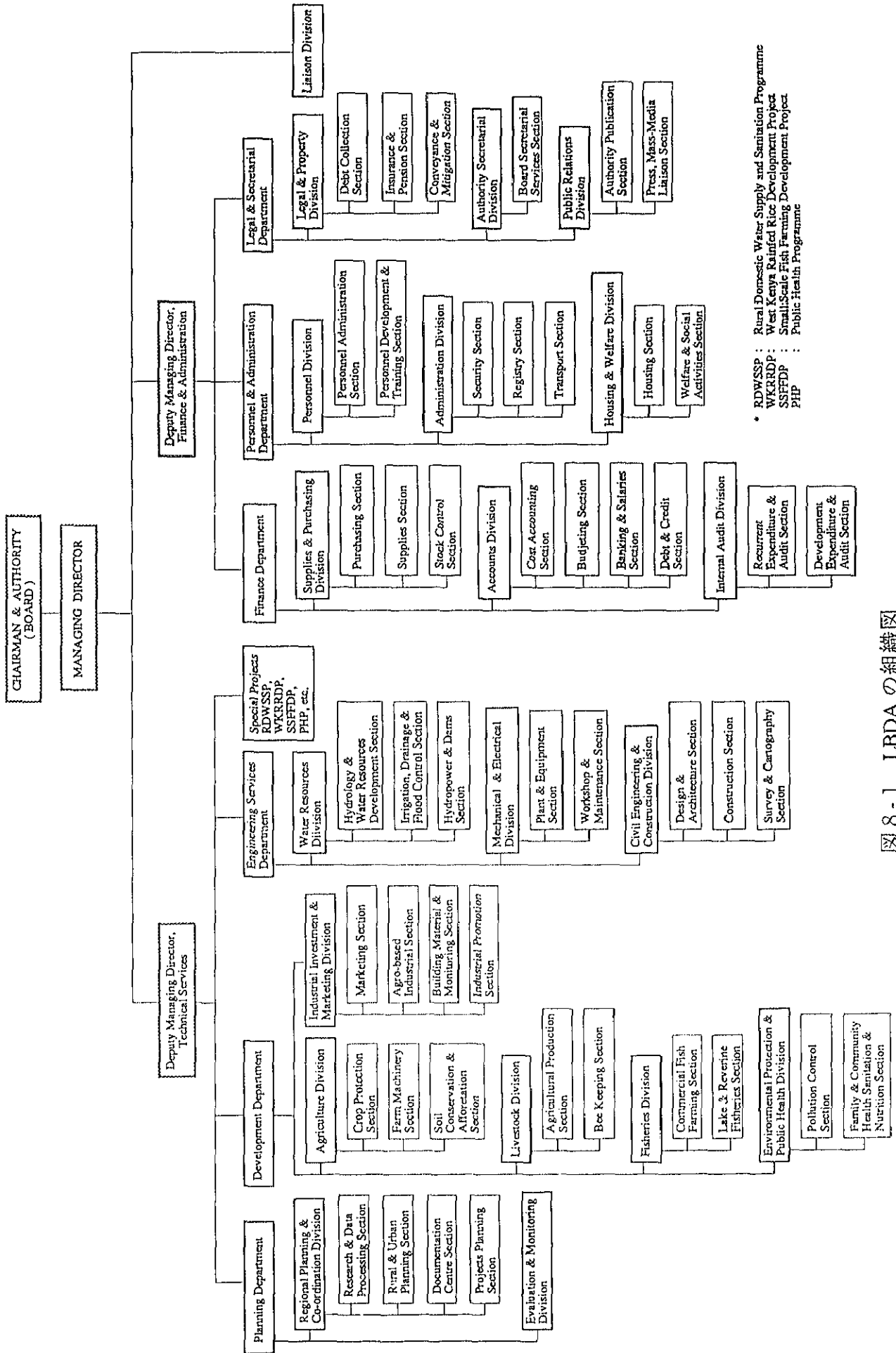


図 7 - 1 事業実施計画



* RDWSSP : Rural Domestic Water Supply and Sanitation Programme
 WKRRDP : West Kenya Rainfed Rice Development Project
 SSFFDP : Small-Scale Fish Farming Development Project
 PHP : Public Health Programme

図 8-1 LBDA の組織図

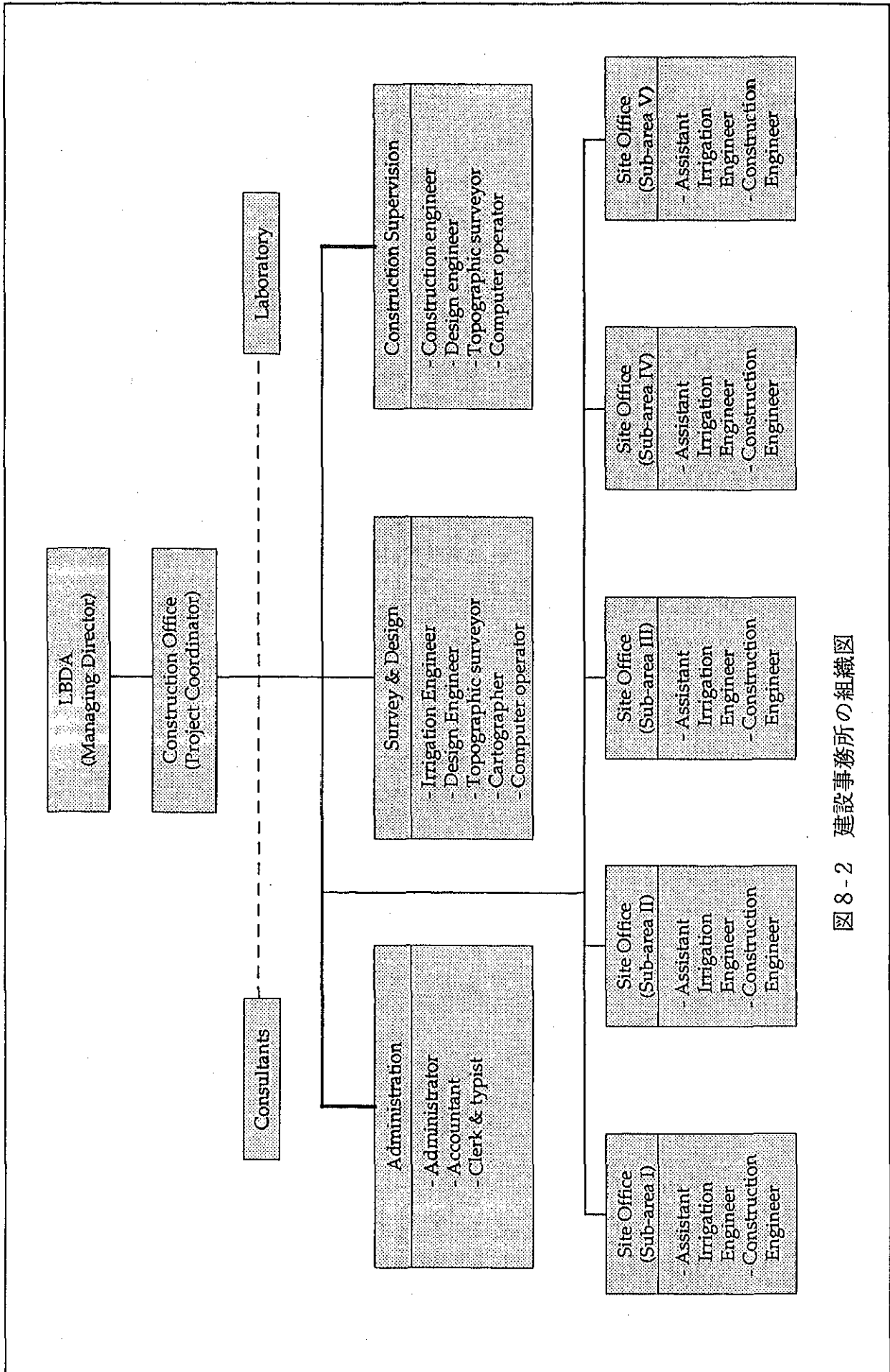


図 8-2 建設事務所の組織図

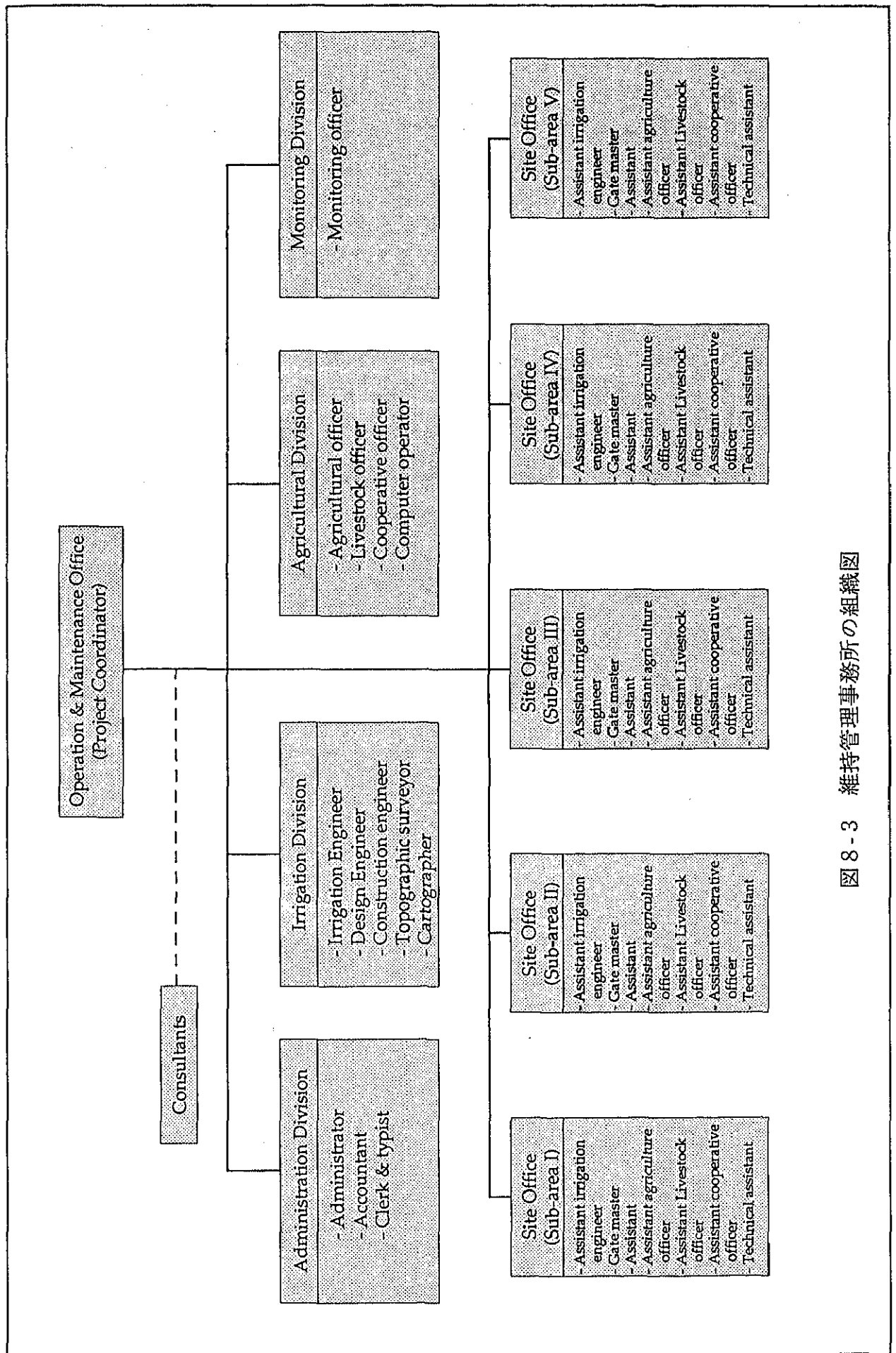
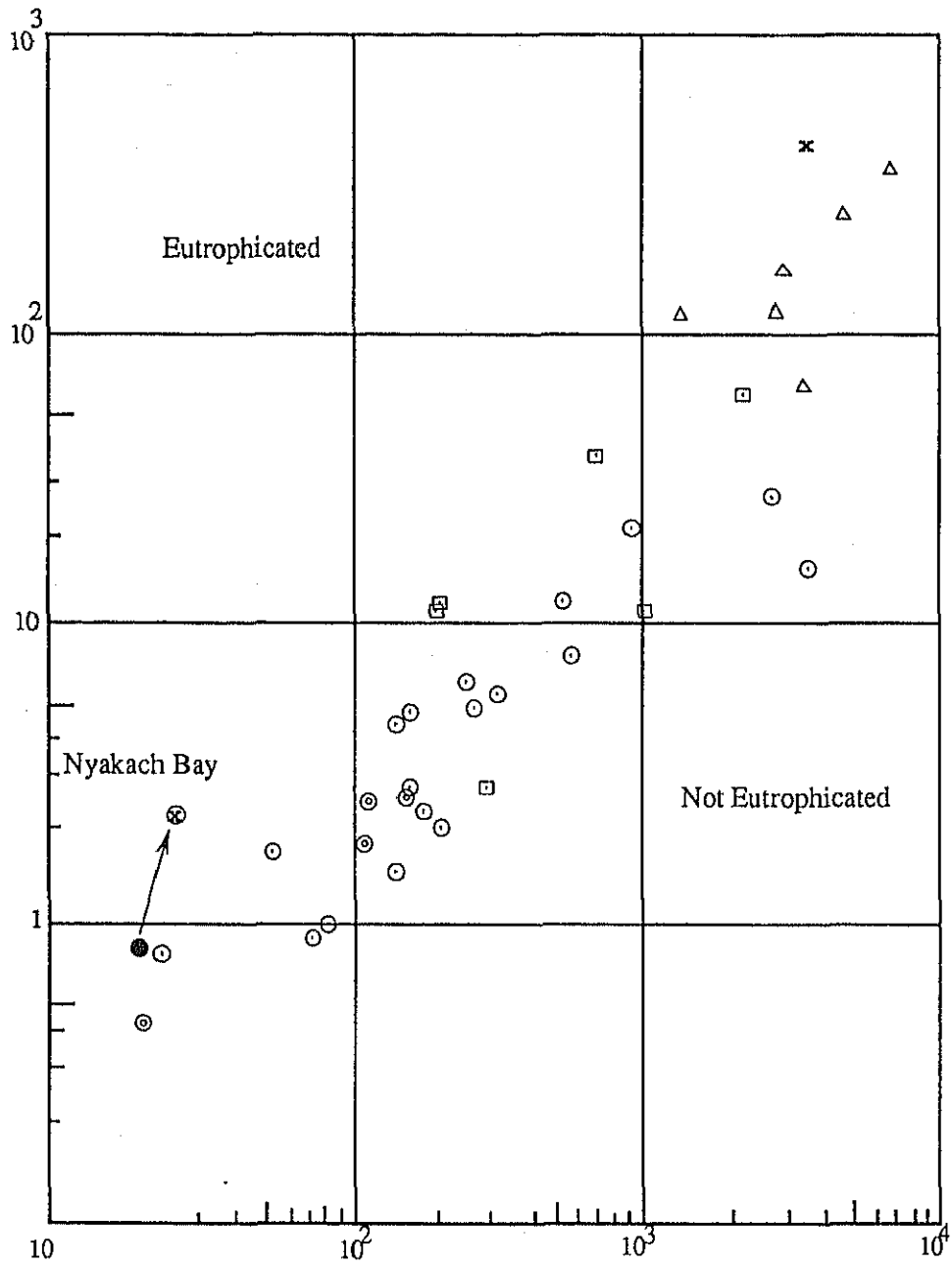


図 8-3 維持管理事務所の組織図



LEGEND

- Existing condition
- ⊗ With project condition
- ⊙ Not eutrophicated water body
- Slightly eutrophicated
- Moderately eutrophicated
- △ Eutrophicated
- × Heavily eutrophicated

Note: The background data in this figure are the cases in Japan quoted from the report prepared by the Japan Electric Power Research Institute.

図 10-1 ニヤカチ湾の水の富栄養化

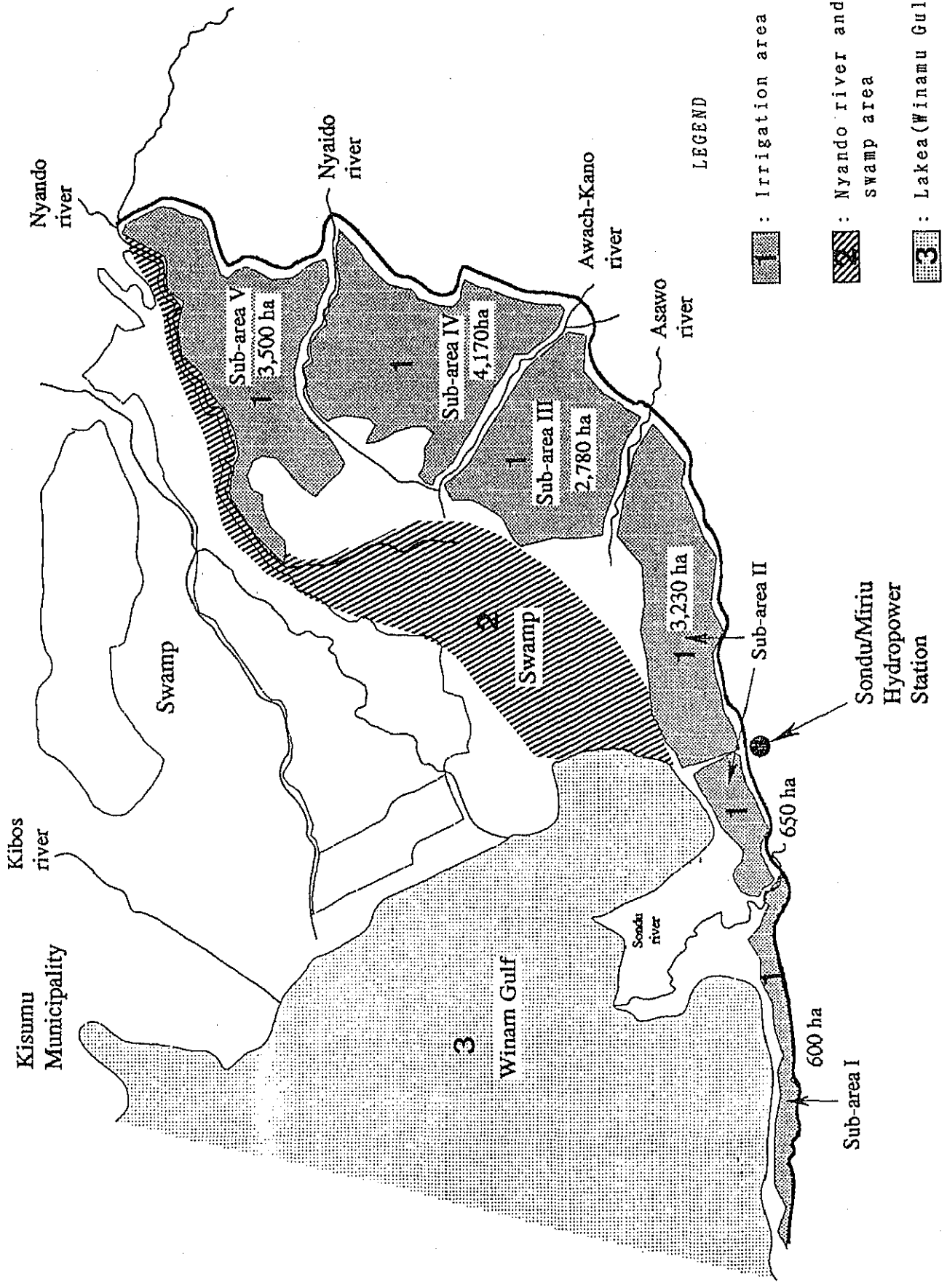


图 10-2 环境影响地域图

添付資料

MINUTES OF MEETING

ON

SCOPE OF WORK

FOR

THE FEASIBILITY STUDY


ON

KANO PALIN IRRIGATION PROJECT

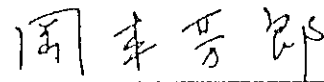
IN

THE REPUBLIC OF KENYA

KISUMU 4TH AUGUST, 1989



MR. S. B. OBURA
MANAGING DIRECTOR
LAKE BASIN DEVELOPMENT
AUTHORITY (LBDA)



MR. YOSHIRO OKAMOTO
LEADER OF CONTACT MISSION
JAPAN INTERNATIONAL COOPERATION
AGENCY (JICA)

MINUTES OF MEETING

The Japanese Contact Mission (hereinafter referred to as "The Team") sent by the Japan International Cooperation Agency headed by Y. OKAMOTO visited the Republic of Kenya from July 28th to August 5th, 1989 for the purpose of discussion on the scope of work for the Feasibility Study on the Kano Plain Irrigation Project in the Republic of Kenya (hereinafter referred to as "The Study").

The Team had a series of discussions with representatives from Lake Basin Development Authority (hereinafter referred to as "the LBDA") and the Ministries concerned, and carried out satisfactory field inspection in the study area.

Both sides discussed on the draft Scope of Work attached in Annex I.

The main items of mutual understanding are as follows:-

1. STUDY AREA

The study is located in Kisumu and South Nyanza Districts of Nyanza province in Western Kenya and covers about 60,000 ha in the Kano and Nyakach Plains delineated by Kibos River up to Kendu Bay.

2. IRRIGABLE AREAS

The Project area will be selected from the study area. In the proposed project it is expected that 26,000 ha net will be irrigated in the Kano and Nyakach plains.

The earlier studies identified six sub-areas as follows:-

- | | | | | | |
|-----|------------|---|------------|---|-----------|
| (1) | Kendu Bay | - | Sondu |) | |
| (2) | Sondu | - | Asawo |) | 8540 ha |
| (3) | Asawo | - | Awach Kano |) | |
| (4) | Awach Kano | - | Nyaidho |) | |
| (5) | Nyaidho | - | Nyando |) | 17070 ha. |
| (6) | Nyando | - | Kibos |) | |

From the field inspection the Team confirmed the six-sub areas which will be considered as the irrigable area utilizing the tailrace water from hydro-power schemes in the upstreams of the Sondu River and the waters of the Nyando river.

3. STUDY SCHEDULE

It is scheduled to implement the study in accordance with the tentative work schedule attached draft Scope of Work.

The Work - I for the topographic mapping work will be commenced on January 1990.

The Work - II and III for the full scale study will be carried out from August, 1990 to January, 1992.

4. PREPARATION OF TOPOGRAPHIC MAPS

The team stated that the mapping area is to cover the expected irrigable area of about 26,000 ha.

5. THE SCOPE OF WORK

The contact mission and the LBDA discussed and agreed with the contents of the draft scope of work. The two teams understood that on acceptance of the draft scope of work by JICA headquarters and express authority will be conveyed to Kenya for the scope of work to be signed by the JICA representative in Nairobi and the Managing Director LBDA.

6. The study team agreed to take into account the environmental aspects in the study based on available data

7. The team was requested and promised to convey the following to JICA HDQ for consideration.

- (i) to provide necessary equipment for the study.
- (ii) to provide vehicles for the JICA study team. It is requested that these vehicles and equipments will be handed over to LBDA at the completion of the study.

7. (iii) to accept a few counterpart personnel for training in Japan.
8. It is agreed that the final report be submitted 100 copies and the other report will be prepared 50 copies.

A MEETING BETWEEN THE LBDA AND JICA TO DISCUSS
THE DRAFT SCOPE OF WORK ON KANO PLAINS IRRIGATION
PROJECT ON 4TH AUGUST 1989

IN ATTENDANCE - LBDA TEAM:

- | | | | |
|----|--------------------|---|---------------------------------|
| 1. | Mr. S. B. Obura | - | Managing Director |
| 2. | Mr. S. M. Machooka | - | Deputy Managing Director (T.S.) |
| 3. | Mr. J. O. Oduk | - | Irrigation Drainage Engineer |
| 4. | Mr. P. A. Kabok | - | |
| 5. | Mr. J. A. Ojuok | - | Surveyor |
| 6. | Mr. J. Magudha | - | Marketing Expert |
| 7. | Mr. M. Lihemo | - | Industrial Economicst |
| 8. | Mr. G. M. Odoyo | - | Liaison Officer |

JICA TEAM:


- | | | | |
|----|-----------------|---|-------------|
| 1. | Mr. Y. Okamoto | - | Team Leader |
| 2. | Mr. Y. Okazaki | - | Member |
| 3. | Mr. K. Iwata | - | Member |
| 4. | Mr. K. Takemori | - | Member |

SCOPE OF WORK
FOR
THE FEASIBILITY STUDY
ON
KANO PLAIN IRRIGATION PROJECT
IN
THE REPUBLIC OF KENYA

AGREED UPON BETWEEN
THE LAKE BASIN DEVELOPMENT AUTHORITY
AND
THE JAPAN INTERNATIONAL COOPERATION AGENCY

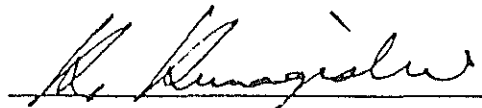
NAIROBI, KENYA

16TH NOVEMBER, 1989



MR. S. B. OBURA

MANAGING DIRECTOR,
THE LAKE BASIN DEVELOPMENT AUTHORITY



MR. KENJI KUMAGISHI

RESIDENT REPRESENTATIVE OF JAPAN
INTERNATIONAL COOPERATION AGENCY
IN KENYA

I . INTRODUCTION

In response to the request of the Government of the Republic of Kenya (hereinafter referred to as "the Government of Kenya "), the Government of Japan decided to conduct the feasibility study on the Kano Plain Irrigation Project(hereinafter referred to as "the Study") in accordance with the relevant laws and regulations in force in Japan.

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

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

II . OBJECTIVE OF THE STUDY

The objective of the study is to formulate an optimum development plan and to conduct the feasibility study on the Kano Plain Irrigation Project in connection with the hydropower development schemes in the Sondu River.

III . OUTLINE OF THE STUDY

1. Study Area:



The study area covers about 60,000 ha in the Kano and Nyakach Plains Nyanza Province in Western Kenya.

2. Scope of the Study:

The Study will be divided into the following three works:

Work - I : Preparation of the topographic map on the scale of 1:5,000 covering the selected area.

Work - II : Data collection, survey, investigation and formulation of basic concept of the project.

Work - III : Formulation of a development plan.

Major work items of each stage are:

1. Work - I

(1) Topographic Mapping

(A) Aerial Photography of the area of about 600Km² on the scale of 1/20,000.

(B) Conduct ground control survey necessary for mapping.

(C) Preparation of topographic maps on the scale of 1/5,000.

2. Work - II

(1) Collect and review the existing data and information relevant to



the project.

(A) Natural condition

- (a) Topography
- (b) Meteorology and Hydrology
- (c) Geology and soil
- (d) Flooding and drought damages
- (e) Vegetation

(B) Agriculture

- (a) Land use and tenure
- (b) Cropping pattern
- (c) Crop and Rice yielding
- (d) Farmers' income productivity
- (e) Price and marketing system
- (f) Agro-economy and institution
- (g) Agricultural support system
- (h) Livestock
- (i) Existing institutions and organizations for farming and project implementation

(C) Agricultural infrastructure

- (a) Irrigation and drainage
- (b) Farm road
- (c) Land reclamation

(D) Social condition

- (a) Population
- (b) Socio-economy and social institution
- (c) Farmer's intention
- (d) Infrastructure



(E) Programmes

- (a) Regional and national development plans relevant to the project

(F) Others

- (2) Conduct survey and investigations necessary for formulating a development plan of the project.

- (a) Meteorology and hydrology
- (b) Soil and land use
- (c) Agricultural survey
- (d) Irrigation and drainage survey
- (e) Farm road
- (f) Soil mechanics and geology
- (g) Agro-economic survey
- (h) Socio-institutional survey
- (i) Construction material and cost survey
- (j) Farmer's intention
- (k) Environmental Impact Assessment
- (l) Others

- (3) Formulate basic concept of the project

- (a) Delineation of the project area
- (b) Outline of agricultural development plan
- (c) Outline of irrigation and drainage plan
- (d) Basic layout of major facilities
- (e) Outline of water management



PLD

(1) Formulate the development plan of the project on the basis of the results of the study on data and information collected through field survey and investigation in work -II .

(A) Formulation of the following plans

(a) Final delineation of the project area

(b) Land use and classification

(c) Selection of crops, cropping pattern and farming

(d) Agricultural infrastructure

-Irrigation and drainage facilities

-Farm road

-Land reclamation

(e) Farmer's training

(f) Water Management

(g) Environmental management plan

(h) Others

(B) Preliminary design of the major structure

(C) Implementation schedule of the project

(D) Organization and institutional plan for operation and maintenance

(E) Estimation of the project cost and benefit

(F) Project evaluation

IV . STUDY SCHEDULE

The Study shall be executed in accordance with the attached tentative work schedule.



V. REPORTS

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

(1) Inception Report :

Fifty (50) copies within one month after the commencement of the work.

(2) Interim Report :

Fifty (50) copies at the end of the work- II .

(3) Draft Final Report :

Fifty (50) copies at the end of the work-III .

(4) Final Report :

One hundred (100) copies within two (2) months after receiving the comments from Kenyan side on the Draft Final Report.

VI. UNDERTAKING OF THE GOVERNMENT KENYA

1. To facilitate smooth conduct of the Study, the Government of Kenya will take necessary measures:

(1) to secure the safety of the Study team,

(2) to permit the members of the Japanese study team to enter, leave and sojourn in Kenya for the duration of their assignment therein, and exempt them from alien registration requirements during the period of the study and consular fees,

(3) to exempt the members of the Japanese study team from taxes, duties, fees and other charges on equipment, machinery and other materials brought into Kenya for the conduct of the Study.

- (4) to exempt the members of the Japanese study team from income tax and charges of any kind imposed on or in connection with any emoluments or allowances paid to the members of the Japanese study team for their services in connection with the implementation of the Study,
 - (5) to provide necessary facilities to the Japanese study team for remittances as well as utilization of the funds introduced into Kenya from Japan in connection with the implementation of the Study,
 - (6) to secure permission for entry into private properties or restricted areas for the conduct of the Study,
 - (7) To secure permission for the Japanese study team to take all data documents related to the Study including photographs out of Kenya to Japan,
 - (8) to provide medical services as needed. Its expenses will be chargeable to members of the Japanese study team.
2. The Government of Kenya shall bear claims, if any arises against the members of the Japanese study team resulting from, occurring in the course of, or otherwise connected with the discharge of their duties in the implementation of the Study, except when such claims arise from gross negligence or wilful misconduct on the part of the members of the Japanese study team.
 3. The Lake Basin Development Authority (hereinafter referred to as "LBDA") shall act as counterpart agency to the Japanese study team and also as coordinating body in relation with other governmental and non-governmental organization concerned for smooth implementation of the Study.
 4. LBDA shall, at its own expense, provide the Japanese study team with the following in cooperation with other agencies concerned:



- (1) available data and information related to the Study,
- (2) additional survey related to the Study, if necessary,
- (3) counterpart personnel to participate in the various activities for the Study,
- (4) suitable office space with necessary furniture in Nairobi and the Project site,
- (5) credentials or identification cards to the members of the study team.

VII. UNDERTAKING OF JICA

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

1. to dispatch, at its own expense, study team to Kenya,
2. to pursue technology transfer to the Kenyan counterpart personnel in the course of the Study.



VIII. OTHERS






























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



SBC

TENTATIVE WORK SCHEDULE

 : Activities in Kenya
 : Activities in Japan

| Description | Month In order | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-----------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | |
| (1) WORK- I |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |
| (2) WORK- II | | | | | | |  | | | | | | | | | | | | | | | | | | | | | | |
| (3) WORK- III | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (4) REPORT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A) Inception Report | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| B) Interim Report | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C) Draft Final Report | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| D) Final Report | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

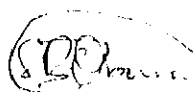


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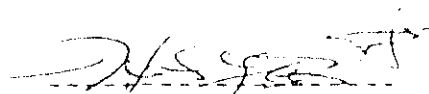
MINUTES OF MEETING
ON
THE FEASIBILITY STUDY
OF
THE KANO PLAIN IRRIGATION PROJECT

AGREED UPON BETWEEN
THE LAKE BASIN DEVELOPMENT AUTHORITY
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

KISUMU - 09TH AUGUST, 1990



S. B. OBURA
MANAGING DIRECTOR
LAKE BASIN DEVELOPMENT AUTHORITY



H. YAMAMOTO
LEADER
JICA STUDY TEAM

MINUTES OF MEETING
ON
THE FEASIBILITY STUDY
OF
THE KANO PLAIN IRRIGATION PROJECT

DATE: 6th August and 7th August 1990
PLACE: Boardroom of LBDA - Kisumu
OBJECTIVE: The meeting was held to discuss the Inception Report on the Feasibility Study of the Kano Plain Irrigation Project.

INCEPTION REPORT:

Fifty copies of the Inception Report were submitted to the LBDA through JICA - Nairobi Office.

ATTENDANCE:

The list of attendance is as shown in Annex I and II.

OPENING REMARKS

Mr S M Machooka, Deputy Managing Director, Technical Services, and Chairman of the meeting, welcomed the Study Team and the representatives from JICA, Tokyo. He stated that the purpose of the meeting was to discuss the Inception Report prior to the commencement of the Feasibility Study.

BRIEFING BY STUDY TEAM LEADER

The Team Leader of the JICA Study Team, Mr H Yamamoto, briefed the meeting on the Inception Report and highlighted the following:

1. The objective of the Study is to formulate an optimal development plan of the Kano Plain Irrigation Project taking into account the development of Sondu/Miriu Hydropower and Magwagwa Dam projects.

SL:

2. The Inception Report deals with the plan of operation for the entire work of the feasibility study. It was also noted by the Team Leader that all figures and ideas described in the Inception Report were tentative because they were conceived based on the information in the pre-feasibility study done in May 1985.

COMMENTS AND REQUEST ON INCEPTION REPORT

The following comments and requests were raised:

1. LBDA mentioned that the final result of the feasibility study should be accepted to both LBDA and JICA as it is a collective responsibility.
 - JICA Study Team agreed.
2. LBDA mentioned training in Japan for Counterpart personnel as essential for the transfer of technology. In this connection, LBDA will select the personnel to send to Japan.
 - JICA representative has agreed to receive one person this year for training in Japan.
3. LBDA is still requesting that JICA submits 200 copies of the Final Report to LBDA.
 - JICA representative said that it was impossible to send 200 copies of the Final Report, because submission of 100 copies was agreed to in the Scope of Work between LBDA and JICA on 16th November 1989. The request, however, will be sent to JICA Headquarters.
4. LBDA agreed to provide Counterpart personnel for each expert of the JICA Study Team. In this connection LBDA requested JICA Study Team to provide curriculum vitae of their experts.
 - JICA Study Team accepted.
5. LBDA stated that the right bank of the Nyando River was part of the 26,000 ha and should be studied together with the rest of the project. In this connection the topographic mapping with a Scale of 1:5,000 should be produced for the said area.
 - The irrigable area will be preliminarily selected in the First Field Work. Based on the above

832

selection, the area for mapping will be determined in Japan.

6. LBDA requested JICA to send all reports to LBDA Headquarters in Kisumu.

- JICA Study Team agreed.

7. LBDA agreed to prepare official letters to the authorities concerned to secure permission for entry into private properties or restricted areas during the course of the feasibility study. LBDA also agreed to prepare introductory letters for the JICA Study Team members.

- JICA Study Team appreciated.

OTHERS

1. Comments on the Reports:

LBDA and JICA Study Team agreed that comments on the Reports which will be submitted to the LBDA shall be sent to JICA Office in Nairobi within two weeks after submission of the Reports except for the draft final which should be submitted after one month.

2. Up-dating of Information:

LBDA and JICA Study Team agreed that information in the Inception Report will be up-dated in future reports.

3. Vehicles and Equipments:

As agreed in the Scope of Work signed in August 1989 JICA will provide two vehicles for the Study Team and some equipments which at the end of the Study will be handed over to LBDA.

4. After discussions between both parties the Inception Report was basically accepted by LBDA.

GL

PL

ANNEX I

HANDING OVER OF THE INCEPTION REPORT TO LBDA

LIST OF PARTICIPANTS 6TH AUGUST 1990

LBDA TEAM

1. Mr S B Obura Managing Director
2. Mr S M Machooka Deputy Managing Director
(Technical Services)
3. Mr Rautta-Athiambo Deputy Managing Director
(Finance & Administration)
4. Dr Onyango-Ogembo Water Resources Engineer/
Hydrologist
5. Mr James O Oduk Irrigation/Drainage
Engineer
6. Mr M O K'Oniala Chief Engineer
7. Mr George A Odingo Agronomist
8. Mr Solomon Kipsang' Agronomist
9. Mr Godfrey M Mwangi Civil Engineer
10. Mr George A Lusui Ag. Surveyor
11. Mr John W Mburu Civil Engineer

JICA F/S TEAM

1. Mr H Yamamoto Team Leader, JICA Study
Team
2. Mr M Kodama Co-Team Leader,
Irrigation/Drainage
Engineer
3. Dr G Wada Agronomist
4. Mr A Honda Trainee

SC

ANNEX II

MEETING ON THE INCEPTION REPORT

LIST OF PARTICIPANTS

7TH AUGUST 1990

LBDA TEAM:

1. Mr S M Machooka Deputy Managing Director
(Technical Services)
2. Mr M O K'Oniala Chief Engineer
3. Mr D L Mshila Regional Planner
4. Mr J O Oduk Irrigation/Drainage Engineer
5. Mr George A Odingo Agronomist
6. Dr Onyango-Ogembo Water Resources Engineer/
Hydrologist
7. Mr Mburu J Wainaina Civil Engineer
8. Mr Kabok P Aguko Irrigation/Drainage Engineer
9. Miss R Mkok Legal Officer
10. Miss B Munyendo Bio-Chemist
11. Mr G A Lusui Ag. Surveyor
12. Mr J M Okello Civil Engineer
13. Mr Rautta-Athiambo Deputy Managing Director
(Finance & Admin.)

JICA F/S TEAM

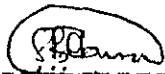
1. Mr S Tukamoto JICA Co-ordinator
2. Mr H Yamamoto Team Leader
3. Mr M Kodama Co-Team Leader, Irrigation
/Drainage Engineer
4. Dr G Wada Agronomist
5. Mr A Honda Trainee



MINUTES OF MEETING
ON
THE PROGRESS REPORT NO.1
OF
THE FEASIBILITY STUDY
OF
THE KANO PLAIN IRRIGATION PROJECT

AGREED UPON BETWEEN
THE LAKE BASIN DEVELOPMENT AUTHORITY
AND
JICA STUDY TEAM

KISUMU - 24TH OCTOBER



S. B. Obura
MANAGING DIRECTOR
LAKE BASIN DEVELOPMENT AUTHORITY



M. KODAMA
DEPUTY TEAM LEADER
JICA STUDY TEAM

MINUTES OF MEETING
ON
THE PROGRESS REPORT NO.1
OF
THE FEASIBILITY STUDY
OF
THE KANO PLAIN IRRIGATION PROJECT

DATE: 24th October, 1990

PLACE: Board room of LBDA - Kisumu

OBJECTIVE: The meeting was held to discuss the Progress Report No.1 on the Feasibility Study of the Kano Plain Irrigation Project

PROGRESS REPORT:

Thirty copies of the Progress Report were submitted to the LBDA by the Study Team.

ATTENDANCE:

The list of attendance is as shown in Annex 1.

OPENING REMARKS:

Mr. Machooka, Deputy Managing Director, Technical Services, and chairman of the meeting, stated that since this was the end of the first field work which was mainly collection and analysis of the data it was only appropriate to request the Deputy Team Leader of the JICA Study Team to explain the progress they have made to date and highlight any difficulties that they may have encountered during this phase of the study.

BRIEFING BY THE DEPUTY TEAM LEADER:

The Deputy Team Leader, Mr. M. Kodama, briefed the meeting on the Progress Report No.1. The LBDA has accepted the Progress Report in general but raised the following points.

POINTS:

- (1) Population growth rate should have been mentioned in the Report.
- (2) Existing health facilities and schools should be clearly recorded to help in accessing future needs of the project.
- (3) Service road in the study area should also be noted and included in the development plan.
- (4) Although flood damage is difficult to quantify, it would

- have been better to include at least the estimated acreage of the areas under water, how many schools closed or destroyed, how many houses are swept, etc.
- (5) Frequency of the floods should have been also considered.
 - (6) How is the extra water brought from Sondu into the Kano Plain controlled particularly during the rainy season when Nyando floods.
 - (7) Crop husbandry practices should have been looked into, what kind of practices that must be adopted (not to depend too much on machinery)
 - (8) The Kano Plains is a water deficit area, hence competition exists between human beings, animals and irrigation. How has this been looked into.
 - (9) Transportation and marketing in the study area is currently not good and with the project will become even more necessary how is this taken care of.
 - (10) What kind of employment exists and what kind of employment will be created by this project.
 - (11) All data from this field work is going to be processed in Japan, how will Kenyan counterparts benefit from such analysis? Where is the technology transfer?
 - (12) Models used for analysis should be given to Kenyans for testing their suitability in Kenya.
 - (13) LBDA had requested JICA to provide overseas training in Japan for four Kenyans in the Inception Meeting, when will this be done?
 - (14) Environmentalist should come to Kenya in the Second Field Work so that environmental aspects will be considered before formulation of the agricultural development plan, which comes immediately after the Second Field Work.

ANSWER BY THE JICA STUDY TEAM:

- (1) The Study Team will mention the population growth rate in the next report.
- (2) The data which was provided by the LBDA on infrastructure and health facilities will be included in the next report.
- (3) Planning of farm road network will also be included in the study.
- (4) The flood control measures which includes quantifying flood damages is recommended to be undertaken by others since it requires a large investment cost. However, improvement of drainage conditions of the farm land will be included in this project.
- (5) Answered in (4).
- (6) The amount of water taken from the Sondu P/S is relatively small in comparison to the flood discharge of the Nyando river. Secondly, some appropriate water control structure will be planned to avoid waste of irrigation water.
- (7) Project will be based on the labour intensive method which will create a lot of employment and the Team will undertake to calculate it.
- (8) The water requirement of the human beings and animals are relatively very small compared to irrigation water requirement. Secondly, washing steps and cattle watering ponds will be provided along the main and secondary canals.

- (9) Answered in (3).
- (10) Answered in (7).
- (11) All data, information, parameters and models which are employed in the analysis in the Study will be described in the report for easy reference.
- (12) Answered in (11).
- (13) JICA representative agreed to receive one person this year for training in Japan as mentioned in the Minutes of Meeting of the Inception Report and further requests will be conveyed to JICA H/Q.
- (14) It was discussed in the former meeting and mutually agreed that the environmental data will be collected by other engineers and that the environmentalist will only process the data in the Third Field Work.

OTHERS:

LBDA confirmed to the JICA Study Team that it wishes to develop the entire 26,000 ha, in order to spread the benefit of irrigation to more people as opposed to another plan of irrigating only 15,000 ha for instance using the same quantity of water from Sondu, but with a higher percentage of paddy fields.

LIST OF ATTENDANCE

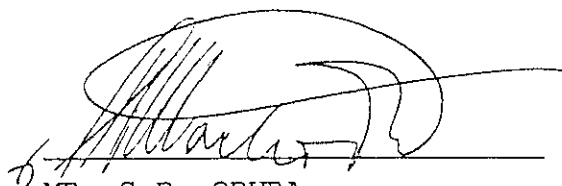
| NAME | POSITION |
|------------------------|---|
| <u>LBDA Team</u> | |
| S.B. Obura | Managing Director, LBDA |
| S.M. Machooka | Deputy Managing Director |
| M.O. Koniala | Chief Engineer/Team Leader |
| J.O. Oduk | Irrigation/Drainage Engineer |
| F. Odera | Geologist |
| L.M. Nyongesa | Hydrologist |
| M.J. Wainaina | Civil Engineer |
| J.O. Amayo | Marketing Officer |
| M.O. Akech | Ecologist |
| <u>JICA Study Team</u> | |
| M. Kodama | Deputy Team Leader, Irrigation/Drainage |
| N. Morioka | Agro-economy and project economy |
| A. Honda | Plan and design Engineer |
| K. Kondo | Meteoro-hydrology |
| A. Honda | Trainee |
| M. Suga | Worked in the field so absent in the meeting |

THE FEASIBILITY STUDY
OF
THE KANO PLAIN IRRIGATION PROJECT

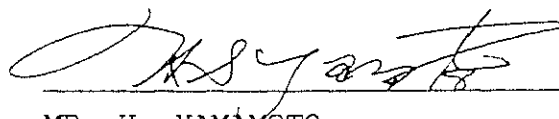
MINUTES OF MEETING
ON
THE INTERIM REPORT
OF
JICA STUDY TEAM

DISCUSSED BETWEEN
THE LAKE BASIN DEVELOPMENT AUTHORITY
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

KISUMU - 4TH MARCH, 1991



MR. S.B. OBURA
MANAGING DIRECTOR
LBDA



MR. H. YAMAMOTO
TEAM LEADER
JICA STUDY TEAM

MINUTES OF MEETING

1. Place of Meeting: LBDA Meeting Room
2. Date and Time: 2:30 thru 5:00 PM, February 28th, 1991, and 2:00 thru 5:00 PM, March 1st, 1991.
3. Attendant: As listed in ATTACHMENT
4. Agenda of Meeting: Briefing of Interim Report and Technical Discussion

On the first day, after the opening address by the Chairman (Deputy Managing Director of LBDA, Mr S.M Machooka), the JICA Study Team officially presented the Interim Report and gave a briefing of the Report. Then, the chairman picked out three(3) major items for discussion, that is the development area, additional mapping area, and the need of a pilot scheme for the project. But, the discussion was suspended until the following day, to allow the LBDA Team to study the report.

On the second day, the following matters were clarified through discussion and mutually agreed upon:

(1) Development area

The LBDA strongly requested that,

- i. the project should be developed to the maximum extent, depending on the available land and water resources endowed in the plain,
- ii. in due consideration of the economic feasibility and financial viability of the Project, the project size should be optimized as far as possible.

The study Team confirmed that the LBDA's view is in conformity to item 5 of the basic development concepts in Chapter 6 of the report. Both parties fully agreed to the concepts on the project formulation as presented in the study.

(2) Mapping area:

LBDA requested additional mapping of the area between the right bank of the Nyando river and the left bank of the Kibos river, as this was an integral part of the irrigable area measuring 26,000 ha.

In response to the request, the JICA officials explained that additional mapping of about 18,000 ha is being carried out based on the Report on Optimization's Study of Irrigation Development Area as prepared by the study team and submitted to LBDA in early January, 1991. Therefore, further additional mapping is not necessary based on this optimization plan as formulated by the Study Team.

LBDA accepted this explanation by the Study Team and noted with appreciation that JICA has already accepted additional mapping of some 18,000 ha over and above the agreed mapping area in the Scope of Work.

(3) Development of Pilot Scheme

LBDA enquired from the JICA officials for the implementation of a pilot scheme of about 1,500 to 2,000 ha in the project area, during the study period.

In response to the enquiry, the JICA officials explained that,

- i. Implementation of a pilot scheme is not included in this study according to the Scope of Work,
- ii. However, the Study Team should prepare a draft pilot scheme development plan, and submit it to the LBDA for discussion after approval by JICA.

(4) Promotion of the Project

With respect to the promotion of the project, the Study Team suggested that,

- i. In order to quickly implement the project in due consideration of the commencement of operation of the Sondu-Miriu Hydropower Station in June 1997, the project should be in the optimal scale and bankable.
- ii taking into account the project size and possible loan arrangements, the project should be stagewise implemented

The LBDA accepted these suggestions and requested the JICA officials to assist in the quick implementation of the 1st phase of the Project.

(5) Title of the Project

LBDA requested that the name of the project should be revised to read "Kano-Nyakach Plain Irrigation Project" in accordance with the delineated project area.

JICA officials explained that the project name was already registered with the Authorities concerned in the Japanese Government as "Kano Plain Irrigation Project", and therefore, the revision of the title of the project may be very difficult. But, the JICA officials promised to take up the matter with Tokyo.

In closing, the Chairman announced the official acceptance of the Interim Report submitted by the JICA Study Team and appreciated efforts made by the JICA officials and the Study Team for the completion of the 2nd field work.



ATTACHMENT

List of Participants

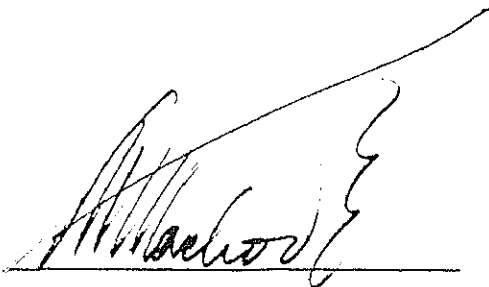
| Name | Organization | Position |
|-------------------|--------------|------------------------------|
| Mr. M. Machooka | LBDA | Deputy Managing Director |
| Mr. M.O. K'Oniala | LBDA | Chief Engineer/Team Leader |
| Mr. J.W. Mburu | LBDA | Civil Engineer |
| Mr. J.O. Oduk | LBDA | Irrigation/Drainage Engineer |
| Mr. Omondi Aketch | LBDA | Ecologist |
| Miss B. Munyendo | LBDA | Bio-chemist |
| Mr. Fred W. Odera | LBDA | Hydro-geologist |
| Mr. H. Yamamoto | JICA Team | Team Leader |
| Mr. M. Kodama | JICA Team | Irrigation Engineer |
| Dr. G. Wada | JICA Team | Agronomist |
| Mr. A. Honda | JICA Team | Structure Engineer |
| Mr. N. Morioka | JICA Team | Agro-economist |
| Mr. S. Tsukamoto | JICA Tokyo | |
| Mr. Y. Takahashi | JICA Nairobi | |

FEASIBILITY STUDY
ON
THE KANO PLAIN IRRIGATION PROJECT

MINUTES OF MEETING
ON
SELECTION OF OPTIMUM DEVELOPMENT AREA

DISCUSSED
BETWEEN
THE LAKE BASIN DEVELOPEMENT AUTHORITY
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

KISUMU - 9TH JULY, 1991



MR. S.M. MACHOOKA
DEPUTY MANAGING DIRECTOR
LBDA



MR. M. KODAMA
DEPUTY LEADER
JICA STUDY TEAM

MINUTES OF MEETING

1. Place of Meeting: LBDA Board Room
2. Date and Time: 10:00 AM thru 1:10 PM, July 9th, 1991
3. Attendant: As listed in the attached annex
4. Agenda of Meeting: Briefing of the Study Result on Selection of Optimum Development Scale and technical discussion

After the opening address by the Chairman (Deputy Managing Director of LBDA, Mr. S.M.Machooka), the JICA Study Team officially presented the Study Result and gave a briefing on the report.

fr The following matters were clarified through discussion and mutually agreed upon:

(1) Crops

Possibility of including Robusta coffee and fruit trees on the higher grounds was raised by the LBDA. Study team agreed to examine this possibility during the next step of the study within the selected development area.

(2) Vegetable

s LBDA wanted to know why the acreage of vegetables was limited to 1,000ha only. They suggested that there were plans for improvement of infrastructures such as processing plant and international airport for export. Study team replied that such plans were not yet conclusive, and that 40,000tons of vegetables will be produced from 1,000ha in a year. This 40,000tons could be marketed in and around Kisumu by the existing structures. LBDA noted that any additional production will find a ready market outside the district on condition that improvement of the market channels and expansion of the agro-based processing of horticultural products will be given.

(3) Dairy

Study team showed the rough calculation of dairy production based on zero grazing. Several issues were raised by the LBDA.

- Yield of milk as estimated by the study team was too low.
- Calculation of dry matters for feeding was based only on the napier grass. While other sources (Barna grass etc.) could have been considered, with better result.
- LBDA felt the lactation period of 106 days was too short and suggested that 280 to 300 days were more appropriate.

ATTACHMENT

LIST OF ATTENDANTS

| <u>Name</u> | <u>Position</u> |
|---------------------|---|
| LBDA | |
| Mr. S.M. Machooka | Deputy Managing Director (Technical service) |
| Mr. J.O. Oduk | Irrigation and drainage engineer (Deputy leader LBDA) |
| Mr. J. Amayo | Marketing officer |
| Mr. L. Nyongesa | Hydrologist |
| Mr. M. Omondi | Environmentalist |
| Mr. O. Bala | Agronomist |
| Mr. J.W. Mburu | Structural engineer |
| Mr. R. Athiambo | Deputy Managing Director (Finance and administration) |
| JICA Nairobi | |
| Mr. Y. Takahashi | Assistant Resident Representative |
| Study Team | |
| Mr. M. Kodama | Irrigation and drainage, (Deputy leader) |
| Dr. G. Wada | Agronomy |
| Mr. N. Morioka | Agro-economy |
| Mr. Y. Iwai | Environmentalist |
| Mr. A. Honda | Structure plan |
| Mr. H. Nozoe | Cost estimate |
| Mr. T. Ujiie | Trainee |

THE FEASIBILITY STUDY
ON
KANO PLAIN IRRIGATION PROJECT

Subject: Confirmation on Crops and Hectarage to be included in the Project for the Feasibility Study

Date: 10:00 AM to 11:30 AM, July 16th, 1991

Place: Office of Mr. S. M. Machooka,
Deputy Managing Director (Technical Service), LBDA

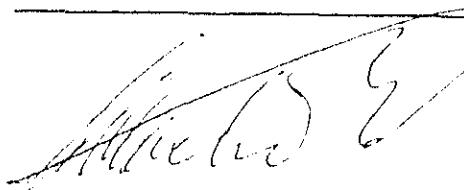
Attendant: LBDA
Mr. S. M. Machooka (Deputy Director TS),
Mr. M. O. K'Oniala (Chief Engineer, Team Leader),
Mr. J. Magudha (Regional Planner)
JICA Study Team
Mr. H. Yamamoto (Team Leader),
Dr. G. Wada (Agronomist),
Mr. N. Morioka (Agro-Economist)

On the basis of the comments on "the Study Result on Selection of Optimal Development Area", the discussion was made between LBDA and JICA study team on crops and hectarage to be included in the project, and the both sides confirmed as follows:

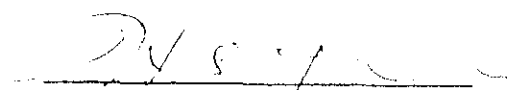
- (1) 770 ha of irrigated pasture (managed forage) is included for dairy farming by zero grazing system in the project, based on the higher return and the target of consumption of milk in the project area.
- (2) Robusta coffee is not included in the project owing to the low net production value.
- (3) 1,100 ha of vegetables is included in the project on the basis of the estimation of the future demand for fresh markets in Kisumu District and the surrounding area.
- (4) 1,200 ha for fruit tree is included in the project on the basis of the higher net production value and the capacity of the processing plant which is currently under promotion by LBDA.

Accordingly, the feasibility study will proceed on the basis of the crops and hectareage in the project area as follows.

| Long rainy season | Short rainy season | Area |
|------------------------|------------------------|------------------|
| Paddy | Beans | 2,270 ha |
| Maize | Paddy | 1,290 ha |
| Maize | Cotton/Beans | 2,430 ha |
| Maize | Groundnuts | 270 ha |
| Sugarcane | Sugarcane | 5,000 ha |
| Vegetables | Vegetables | 1,100 ha |
| Fruit tree | Fruit tree | 1,200 ha |
| Managed forage | Managed forage | 770 ha |
| Pasture (Napier grass) | Pasture (Napier grass) | 500 ha |
| Total | | 14,930 ha |



Mr. S. M. Machooka
Deputy Managing Director
LBDA



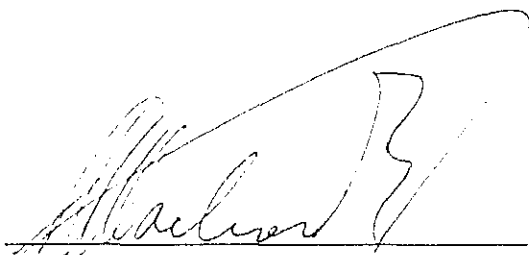
Mr. H. Yamamoto
Team Leader
JICA Study Team

FEASIBILITY STUDY
ON
THE KANO PLAIN IRRIGATION PROJECT

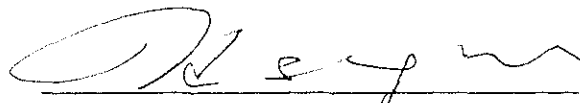
MINUTES OF MEETING
ON
PROGRESS REPORT 2

DISCUSSION
BETWEEN
THE LAKE BASIN DEVELOPMENT AUTHORITY
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

KISUMU - 1ST AUGUST, 1991



Mr. S. M. Machooka
Deputy Managing Director
LBDA



Mr. H. Yamamoto
Team Leader
JICA Study Team

MINUTES OF MEETING

1. Place of Meeting : LBDA Board Room
2. Date and Time : 2:30 PM thru 4:30 PM, August 1st, 1991
3. Attendant : As listed in the attachment
4. Agenda of Meeting : Briefing of Progress Report 2 and technical discussion

The Team Leader of JICA Study Team, Mr. H. Yamamoto presented the Progress Report 2 and discussion was made between LBDA and JICA Study Team as follows:

(1) Drainage

It was confirmed that in order to reduce direct pollution by agricultural inputs from the project the drained water from the irrigation field would not be released directly to the Lake, but into the swamp before reaching the Lake.

(2) Organization

LBDA emphasized that the project has its own identity and no inter-ministerial steering committee is encouraged. It will have a project coordinator who will be responsible to the managing director, LBDA for policy matters, but remains fully in charge of day to day running of the project. Under the project coordinator, a project office would have various sections including engineering services, production activities, marketing, extension, etc.

(3) Water Management

LBDA requested that the study team prepare proper comprehensive water management system to suit water demand of various cropping patterns proposed in the project. The study team suggested that LBDA undertake the training programme for water management for project personnel both local and foreign e.g. Mwea irrigation project in Kenya and Southeast Asian countries.

(4) Crop Combination of farmers

LBDA requested that the study team show return from various crop combination of the typical farmers in the project (model farm).

(5) Environmental Aspects

LBDA requested that the study team give estimated levels of pollution over a long period during the project life, particularly for Nyakach Bay. The team leader replied that the matter will be transferred to the environmental engineer for water quality, but he thinks that the data is not adequate for that kind of assessment. Further data collection is necessary to ascertain and estimate pollution levels over the long period.

LBDA asked the study team to consider the engineering design of facilities and specific measures to be undertaken during operation stage to control malaria and schistosomiasis.

(6) Fishery

LBDA mentioned that although fisheries is one of the important activities in the region, the study has not considered fisheries upto now. LBDA requested the study team to include the fishery in the project in collaboration with LBDA's Fishery Department. In addition to this, the environmental effect of the project on fishery should be studied. The study team replied that collection of data and information on fisheries is being undertaken in collaboration with LBDA.

(7) Additional Comments

It was further agreed that any additional comments from LBDA should be forwarded to JICA Nairobi Office until August 9th, 1991.

LIST OF ATTENDANTS

| Name | Position |
|------------------------|--|
| LBDA | |
| Mr. S.M. Machooka | Deputy Managing Director (Technical Service) |
| Mr. Magudha | Regional Planner |
| Mr. J.O. Oduk | Irrigation and Drainage Engineer |
| Mr. J.W. Mburu | Structural Engineer |
| JICA Study Team | |
| Mr. H. Yamamoto | Team Leader |
| Mr. M. Kodama | Irrigation and Drainage Engineer |
| Dr. G. Wada | Agronomy |
| Mr. N. Morioka | Agro-economist |
| Mr. A. Honda | Structure Engineer |
| Mr. H. Nozoe | Design Engineer |
| Mr. N. Seno | Environmental Engineer |
| Mr. S. Kikuchi | Assistant to Environmental Engineer |

FEASIBILITY STUDY
ON
KANO PLAIN IRRIGATION PROJECT

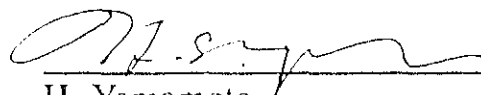
MINUTES OF MEETING
ON
DRAFT FINAL REPORT

DISCUSSED
BETWEEN
THE LAKE BASIN DEVELOPMENT AUTHORITY
AND
JAPAN INTERNATIONAL COOPERATION AGENCY
IN

KISUMU, 21ST NOVEMBER 1991



S. B. Obura
Managing Director
Lake Basin Development Authority



H. Yamamoto
Team Leader
JICA Study Team

MINUTES OF MEETING

1. Place of Meeting : LBDA Board Room
2. Date and Time : 2:30 PM thru 5:00 PM, November 21st, 1991
3. Attendants : As listed in the attachment
4. Agenda of Meeting : Briefing on Draft Final Report and technical discussion

After the opening remarks by the Chairman, Deputy Managing Director of LBDA, Mr. S. M. Machooka, the Team Leader of JICA Study Team, Mr. H. Yamamoto presented the Draft Final Report which was followed by a discussion between LBDA and JICA Study Team on the above report.

LBDA observed that the report covers all the points that had been discussed and minuted during the presentation of the Progress Report No.1, Interim Report and Progress Report No.2. The structure of the report was therefore accepted.

However, the following comments were raised by LBDA;

1. Training;

This being a new kind of project in the region, training of staff, farmers and other relevant operators of the project in water management, irrigation farming methods, extension support services etc. is vital to the successful implementation of the project, and therefore the cost of this should be included in the project fund.

2. Fisheries;

The second paragraph of page 84 and the fifth paragraph of page 86 of the main text should read as indicated in the following comments submitted by the project coordinator of Development of Small Scale Fish Farming Project.

The second paragraph of page 84;

Information about fish production in the Gulf and rivers have been collected from inquiries and questionnaires survey. The survey reports that the introduced Nile perch has increased in the Gulf whereas other indigenous species such as the tilapias, *Labeo victorinus* and *Barbus* spp., have decreased due to predation by Nile perch and fishing pressure. The ecosystem and species composition of the fish in the study area is still undergoing change at present.

the fifth paragraph of page 86;

Water quality deterioration and eutrophication may be increased due to use of fertilizer and agro-chemicals in the project area. Such ecological situation may affect behaviour of fish and fisheries.

JICA study team has undertaken to forward these comments to the environmental expert for consideration and inclusion into the report.

3. Farm labour price;

The current labour price of Ks.25/man-day is below the official price of Ks.38. An explanation of this difference is needed.

The study team stated that at the time of the report the labour price was Ks.25 as confirmed by the field survey. This reflects the situation of agricultural sector in the study area.

4. LBDA raised some issues which include construction of rice mill by LBDA, pricing procedure, environment and other aspects. These issues were examined during the meeting and they will be included in the final report.

List of Attendants

| Name | Organization | Position |
|---------------------|--------------|---|
| Mr. S. M. Machooka | LBDA | Deputy Managing Director (Technical Services) |
| Mr. R. Athiambo | LBDA | Deputy Managing Director (Finance and Administration) |
| Mr. M. O. K'Oniala | LBDA | Chief Engineer/Team Leader |
| Mr. J. Magudha | LBDA | Regional Planner |
| Mr. J. W. Mburu | LBDA | Structural Engineer |
| Mr. O. Bala | LBDA | Agronomist |
| Dr. J. N. R. Olina | LBDA | Livestock Specialist |
| Mr. M. Omondi Akech | LBDA | Environmentalist |
| Miss B. Munyendo | LBDA | Bio-chemist |
| Mr. B. Aloo | LBDA | Public Relations Manager |
| Mr. M. O. Oyundo | LBDA | Head of Monitoring and Evaluation |
| Mr. F. M. Odok | LBDA | Project Coordinator, WKRRDP |
| Mr. A. P. Achieng | LBDA | Fisheries Specialist |
| Mr. Okulo Arum | LBDA | Senior Planner |
| Miss J. A. Opondo | LBDA | Planning Officer |
| Mr. G. A. Lusui | LBDA | Acting Surveyor |
| Mr. D. Arunga | LBDA | Project Coordinator, RDWSSP |
| Mr. H. S. Oyombe | LBDA | Development Manager |
| Mr. P. A. Kabok | LBDA | Irrigation and Drainage Engineer |
| Mr. H. Yamamoto | JICA Team | Team Leader |
| Mr. M. Kodama | JICA Team | Irrigation and Drainage Engineer |
| Mr. N. Morioka | JICA Team | Agro-economist |
| Mr. H. Hioki | JICA Tokyo | |

付 録

総合開発評価

1. はじめに

ソンドゥーミリウ発電計画、マグワグワ水力発電計画及びカノー平野灌漑開発計画の3開発計画が、ソンドゥー河多目的計画としてソンドゥー河の水資源を利用することになる。開発規模、実施期間及び開発効果が、計画毎に検討されている。本章では3つの開発計画の経済効果について統合的に評価する。

2. 各開発計画の概要

(1) ソンドゥーミリウ発電計画（1991年7月に詳細設計が終了）

ソンドゥーミリウの発電計画は調整地を持つ流れ込み式転流工と発電所の建設を計画している。その内容はソンドゥー河の水をカノーニャカチ平野に導水し、水頭差197m、最大放水量を39.9m³/秒として計画している。施設容量は60MWで、年間平均発電量は330.4GWhである。マグワグワ水力発電計画の実施後には、年間平均発電量は367GWhになるであろう。

(2) マグワグワ水力発電計画（1991年8月にフィージビリティ調査が終了）

ソンドゥーミリウの発電計画上流部にあたる、ソンドゥー河の2つの支流の合流地点の峡谷にダムを建設することを本計画では計画している。ダム高は110m、貯水量は808×10³m³、有効貯水量は701×10³m³である。定格落差170.4m、施設容量は120MW、年間平均発電量は461.6GWhを計画している。これに加え、本計画によりソンドゥーミリウ発電所の発電の安定化と14,930haの灌漑用水の確保を図ることとなる。

(3) カノー平野灌漑開発計画（1992年1月にフィージビリティ調査が終了）

ソンドゥーミリウの発電所の調整地（634×10³m³）を利用することによりカノーニャカチ平野の約14,930haの灌漑が可能となる。カノーニャカチおよびサウスニャンザ幹線水路から供給される灌漑水により水稻等の穀物、豆類、サトウキビ、野菜、果実類、および飼料作物の収量、作付両面が増大し、併せて農家収入、雇用機会が増大することとなる。

3. 総合開発評価

上記の開発計画の調査、設計報告書に従い、各開発計画の事業費と便益は次の通りにまとめられる。

(1) ソンドゥーミリウの発電計画

経済費用 : 9千8百万USドル
維持管理費用 : 98万USドル/年
年間平均発電量 : 330.4GWh
年間便益 : 1千601万USドル

(2) マグワグワ水力発電計画

経済費用 : 2億4千610万USドル
維持管理費用 : 246万USドル/年

年間平均発電量： 461.6GWh
 年間便益： 6千171万USドル

(3) カノー平野灌漑計画

経済費用： 1億2千920万USドル
 維持管理費用： 84万USドル/年
 灌漑面積： 14,930ha
 年間便益： 2千293万USドル

(4) 全開発計画

経済費用： 4億7千320万USドル
 維持管理費用： 428万USドル/年
 年間平均発電量： 792.0GWh
 灌漑面積： 14,930ha
 年間便益： 1億65万USドル

上記の経済費用および便益を基に算出した内部収益率、純便益および純費用（割引率10%）を表-1に示す。その概要は以下の通りである。

| | ソンドゥーミリウ (1) | マグワグワ (2) | カノー平野 (3) | 全計画 (1)+(2)+(3) |
|--------------|-----------------|--------------|--------------|--------------------|
| E I R R (%) | 12.6 | 14.0 | 13.2 | 13.4 |
| 純便益 (百万USドル) | 108.0 | 232.7 | 85.6 | 426.2 |
| 純費用 (百万USドル) | 84.5 | 165.5 | 62.7 | 301.7 |
| B-C (百万USドル) | 23.5 | 67.1 | 22.9 | 113.6 |
| B/C | 1.28 | 1.91 | 1.36 | 1.41 |

感度分析は、以下の条件について行った。

| 条件 | 純現在価値 (百万USドル) | EIRR (%) |
|------------------------|-------------------|-------------|
| (1) 建設費が10%増加した場合 | 94.4 | 12.4 |
| (2) 建設費が20%増加した場合 | 64.2 | 11.6 |
| (3) 事業便益が10%低下した場合 | 81.9 | 12.3 |
| (4) 事業便益が20%低下した場合 | 39.3 | 11.2 |
| (5) 建設費10%増加、事業便益10%低下 | 51.7 | 11.4 |
| (6) 建設費20%増加、事業便益20%低下 | -21.1 | 9.5 |

建設費が20%増加し、事業便益が20%低下した場合でも、内部収益率は依然9.5%を保っている。以上の結果から判断して、これら3つの計画の全内部収益率は13.4%、割引率10%時のB-Cが1億1千4百万USドルで経済的に妥当な事業であると結論できる。また感度分析の結果から、ある程度経済条件が変化した場合でも、この事業が経済的妥当性を保持することを示している。

表1 経費及び便益の流れ

| No. Year | | (Integrated with Sonda/Miriu Hydroelectric Power Project, Magwaga Hydroelectric Power Development Project and Kano Plain Irrigation Project) | | | | | | | | | | Unit : million US\$ | | | | | | | | | | |
|-----------|------|--|-------|-------------|-------|------------------|-------|---------|-------|-------------|-------|---------------------|-------|-------|------|------|-------|-------|-------|-------|-------|-------|
| | | Capital Cost (A) | | OM cost (B) | | Total Cost (A+B) | | Benefit | | SONDU MAGWA | | SONDU MAGWA | | KANO | | S-M | | M+K | | S+M+K | | |
| | | SONDU | MAGWA | KANO | SONDU | MAGWA | KANO | SONDU | MAGWA | KANO | Total | SONDU | MAGWA | KANO | B-C | B-C | B-C | B-C | B-C | B-C | B-C | B-C |
| 0 | 1992 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| 1 | 1993 | 14.7 | 3.3 | 1.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 19.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -1.8 | -18.0 | -5.0 | -19.7 | -5.0 | |
| 2 | 1994 | 34.3 | 2.6 | 2.6 | 0.0 | 0.0 | 0.0 | 39.5 | 0.0 | 39.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -34.3 | -36.9 | -5.2 | -39.5 | -5.2 | |
| 3 | 1995 | 39.2 | 11.6 | 5.0 | 0.0 | 0.0 | 55.7 | 0.0 | 0.0 | 55.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -39.2 | -50.8 | -16.5 | -55.7 | -16.5 | |
| 4 | 1996 | 9.8 | 17.4 | 9.0 | 0.0 | 0.0 | 36.2 | 0.0 | 0.0 | 36.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -9.8 | -17.4 | -9.0 | -27.2 | -9.0 | |
| 5 | 1997 | 29.6 | 8.1 | 8.1 | 1.0 | 0.0 | 38.6 | 16.0 | 0.0 | 38.6 | 16.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 15.0 | -29.6 | -8.1 | -14.2 | -37.6 | |
| 6 | 1998 | 26.1 | 5.0 | 5.0 | 1.0 | 0.0 | 32.2 | 16.0 | 0.0 | 32.2 | 16.0 | 0.0 | 1.7 | 17.7 | 15.0 | 0.0 | 15.0 | -26.1 | -3.5 | -11.0 | -14.5 | |
| 7 | 1999 | 51.4 | 7.4 | 7.4 | 1.0 | 0.0 | 59.9 | 16.0 | 0.0 | 59.9 | 16.0 | 0.0 | 2.9 | 18.9 | 15.0 | 0.0 | 15.0 | -51.4 | -4.6 | -36.3 | -40.9 | |
| 8 | 2000 | 54.5 | 12.9 | 12.9 | 1.0 | 0.0 | 68.4 | 16.0 | 0.0 | 68.4 | 16.0 | 0.0 | 3.4 | 19.4 | 15.0 | 0.0 | 15.0 | -54.5 | -9.6 | -39.4 | -49.0 | |
| 9 | 2001 | 60.8 | 16.9 | 16.9 | 1.0 | 0.0 | 78.8 | 16.0 | 0.0 | 78.8 | 16.0 | 0.0 | 3.6 | 19.7 | 15.0 | 0.0 | 15.0 | -60.8 | -13.4 | -45.7 | -59.1 | |
| 10 | 2002 | 14.5 | 26.6 | 26.6 | 1.0 | 0.0 | 42.2 | 16.0 | 0.0 | 42.2 | 16.0 | 0.0 | 3.9 | 19.9 | 15.0 | 0.0 | 15.0 | -14.5 | -22.9 | 0.5 | -22.3 | |
| 11 | 2003 | 22.4 | 22.4 | 22.4 | 1.0 | 3.3 | 27.2 | 16.0 | 0.0 | 27.2 | 16.0 | 0.0 | 11.4 | 89.1 | 15.0 | 0.0 | 15.0 | 58.4 | -11.6 | 73.5 | 61.9 | |
| 12 | 2004 | 8.5 | 13.6 | 13.6 | 1.0 | 3.3 | 13.6 | 16.0 | 0.0 | 13.6 | 16.0 | 0.0 | 15.5 | 93.3 | 15.0 | 0.0 | 15.0 | 58.4 | 6.2 | 73.5 | 79.7 | |
| 13 | 2005 | 5.1 | 5.1 | 5.1 | 1.0 | 3.3 | 5.1 | 16.0 | 0.0 | 5.1 | 16.0 | 0.0 | 17.7 | 97.4 | 15.0 | 0.0 | 15.0 | 58.4 | 18.9 | 73.5 | 92.3 | |
| 14 | 2006 | 5.1 | 5.1 | 5.1 | 1.0 | 3.3 | 5.1 | 16.0 | 0.0 | 5.1 | 16.0 | 0.0 | 21.2 | 98.9 | 15.0 | 0.0 | 15.0 | 58.4 | 20.4 | 73.5 | 93.8 | |
| 15 | 2007 | 5.1 | 5.1 | 5.1 | 1.0 | 3.3 | 5.1 | 16.0 | 0.0 | 5.1 | 16.0 | 0.0 | 22.4 | 100.1 | 15.0 | 0.0 | 15.0 | 58.4 | 21.5 | 73.5 | 95.0 | |
| 16 | 2008 | 5.1 | 5.1 | 5.1 | 1.0 | 3.3 | 5.1 | 16.0 | 0.0 | 5.1 | 16.0 | 0.0 | 22.8 | 100.5 | 15.0 | 0.0 | 15.0 | 58.4 | 21.8 | 73.5 | 95.3 | |
| 17 | 2009 | 5.1 | 5.1 | 5.1 | 1.0 | 3.3 | 5.1 | 16.0 | 0.0 | 5.1 | 16.0 | 0.0 | 22.9 | 100.7 | 15.0 | 0.0 | 15.0 | 58.4 | 22.1 | 73.5 | 95.6 | |
| 18 | 2010 | 5.1 | 5.1 | 5.1 | 1.0 | 3.3 | 5.1 | 16.0 | 0.0 | 5.1 | 16.0 | 0.0 | 22.9 | 100.7 | 15.0 | 0.0 | 15.0 | 58.4 | 22.1 | 73.5 | 95.6 | |
| 19 | 2011 | 5.1 | 5.1 | 5.1 | 1.0 | 3.3 | 5.1 | 16.0 | 0.0 | 5.1 | 16.0 | 0.0 | 22.9 | 100.7 | 15.0 | 0.0 | 15.0 | 58.4 | 22.1 | 73.5 | 95.6 | |
| 20 | 2012 | 5.1 | 5.1 | 5.1 | 1.0 | 3.3 | 5.1 | 16.0 | 0.0 | 5.1 | 16.0 | 0.0 | 22.9 | 100.7 | 15.0 | 0.0 | 15.0 | 58.4 | 22.1 | 73.5 | 95.6 | |
| 21 | 2013 | 5.1 | 5.1 | 5.1 | 1.0 | 3.3 | 5.1 | 16.0 | 0.0 | 5.1 | 16.0 | 0.0 | 22.9 | 100.7 | 15.0 | 0.0 | 15.0 | 58.4 | 22.1 | 73.5 | 95.6 | |
| 22 | 2014 | 5.1 | 5.1 | 5.1 | 1.0 | 3.3 | 5.1 | 16.0 | 0.0 | 5.1 | 16.0 | 0.0 | 22.9 | 100.7 | 15.0 | 0.0 | 15.0 | 58.4 | 22.1 | 73.5 | 95.6 | |
| 23 | 2015 | 5.1 | 5.1 | 5.1 | 1.0 | 3.3 | 5.1 | 16.0 | 0.0 | 5.1 | 16.0 | 0.0 | 22.9 | 100.7 | 15.0 | 0.0 | 15.0 | 58.4 | 22.1 | 73.5 | 95.6 | |
| 24 | 2016 | 5.1 | 5.1 | 5.1 | 1.0 | 3.3 | 5.1 | 16.0 | 0.0 | 5.1 | 16.0 | 0.0 | 22.9 | 100.7 | 15.0 | 0.0 | 15.0 | 58.4 | 22.1 | 73.5 | 95.6 | |
| 25 | 2017 | 5.1 | 5.1 | 5.1 | 1.0 | 3.3 | 5.1 | 16.0 | 0.0 | 5.1 | 16.0 | 0.0 | 22.9 | 100.7 | 15.0 | 0.0 | 15.0 | 58.4 | 22.1 | 73.5 | 95.6 | |
| 26 | 2018 | 5.1 | 5.1 | 5.1 | 1.0 | 3.3 | 5.1 | 16.0 | 0.0 | 5.1 | 16.0 | 0.0 | 22.9 | 100.7 | 15.0 | 0.0 | 15.0 | 58.4 | 22.0 | 73.5 | 95.5 | |
| 27 | 2019 | 5.1 | 5.1 | 5.1 | 1.0 | 3.3 | 5.1 | 16.0 | 0.0 | 5.1 | 16.0 | 0.0 | 22.9 | 100.7 | 15.0 | 0.0 | 15.0 | 58.4 | 22.1 | 73.5 | 95.6 | |
| 28 | 2020 | 5.1 | 5.1 | 5.1 | 1.0 | 3.3 | 5.1 | 16.0 | 0.0 | 5.1 | 16.0 | 0.0 | 22.9 | 100.7 | 15.0 | 0.0 | 15.0 | 58.4 | 22.1 | 73.5 | 95.6 | |
| 29 | 2021 | 5.1 | 5.1 | 5.1 | 1.0 | 3.3 | 5.1 | 16.0 | 0.0 | 5.1 | 16.0 | 0.0 | 22.9 | 100.7 | 15.0 | 0.0 | 15.0 | 58.4 | 22.1 | 73.5 | 95.6 | |
| 30 | 2022 | 5.1 | 5.1 | 5.1 | 1.0 | 3.3 | 5.1 | 16.0 | 0.0 | 5.1 | 16.0 | 0.0 | 22.9 | 100.7 | 15.0 | 0.0 | 15.0 | 58.4 | 22.1 | 73.5 | 95.6 | |
| 31 | 2023 | 5.1 | 5.1 | 5.1 | 1.0 | 3.3 | 5.1 | 16.0 | 0.0 | 5.1 | 16.0 | 0.0 | 22.9 | 100.7 | 15.0 | 0.0 | 15.0 | 58.4 | 22.1 | 73.5 | 95.6 | |
| 32 | 2024 | 5.1 | 5.1 | 5.1 | 1.0 | 3.3 | 5.1 | 16.0 | 0.0 | 5.1 | 16.0 | 0.0 | 22.9 | 100.7 | 15.0 | 0.0 | 15.0 | 58.4 | 22.1 | 73.5 | 95.6 | |
| 33 | 2025 | 5.1 | 5.1 | 5.1 | 1.0 | 3.3 | 5.1 | 16.0 | 0.0 | 5.1 | 16.0 | 0.0 | 22.9 | 100.7 | 15.0 | 0.0 | 15.0 | 58.4 | 22.1 | 73.5 | 95.6 | |
| 34 | 2026 | 5.1 | 5.1 | 5.1 | 1.0 | 3.3 | 5.1 | 16.0 | 0.0 | 5.1 | 16.0 | 0.0 | 22.9 | 100.7 | 15.0 | 0.0 | 15.0 | 58.4 | 22.1 | 73.5 | 95.6 | |
| 35 | 2027 | 5.1 | 5.1 | 5.1 | 1.0 | 3.3 | 5.1 | 16.0 | 0.0 | 5.1 | 16.0 | 0.0 | 22.9 | 100.7 | 15.0 | 0.0 | 15.0 | 58.4 | 22.1 | 73.5 | 95.6 | |
| 36 | 2028 | 5.1 | 5.1 | 5.1 | 1.0 | 3.3 | 5.1 | 16.0 | 0.0 | 5.1 | 16.0 | 0.0 | 22.9 | 100.7 | 15.0 | 0.0 | 15.0 | 58.4 | 22.1 | 73.5 | 95.6 | |
| 37 | 2029 | 5.1 | 5.1 | 5.1 | 1.0 | 3.3 | 5.1 | 16.0 | 0.0 | 5.1 | 16.0 | 0.0 | 22.9 | 100.7 | 15.0 | 0.0 | 15.0 | 58.4 | 22.1 | 73.5 | 95.6 | |
| 38 | 2030 | 5.1 | 5.1 | 5.1 | 1.0 | 3.3 | 5.1 | 16.0 | 0.0 | 5.1 | 16.0 | 0.0 | 22.9 | 100.7 | 15.0 | 0.0 | 15.0 | 58.4 | 22.1 | 73.5 | 95.6 | |
| 39 | 2031 | 5.1 | 5.1 | 5.1 | 1.0 | 3.3 | 5.1 | 16.0 | 0.0 | 5.1 | 16.0 | 0.0 | 22.9 | 100.7 | 15.0 | 0.0 | 15.0 | 58.4 | 22.1 | 73.5 | 95.6 | |
| 40 | 2032 | 5.1 | 5.1 | 5.1 | 1.0 | 3.3 | 5.1 | 16.0 | 0.0 | 5.1 | 16.0 | 0.0 | 22.9 | 100.7 | 15.0 | 0.0 | 15.0 | 58.4 | 22.1 | 73.5 | 95.6 | |
| 41 | 2033 | 5.1 | 5.1 | 5.1 | 1.0 | 3.3 | 5.1 | 16.0 | 0.0 | 5.1 | 16.0 | 0.0 | 22.9 | 100.7 | 15.0 | 0.0 | 15.0 | 58.4 | 22.1 | 73.5 | 95.6 | |
| 42 | 2034 | 5.1 | 5.1 | 5.1 | 1.0 | 3.3 | 5.1 | 16.0 | 0.0 | 5.1 | 16.0 | 0.0 | 22.9 | 100.7 | 15.0 | 0.0 | 15.0 | 58.4 | 22.1 | 73.5 | 95.6 | |
| 43 | 2035 | 5.1 | 5.1 | 5.1 | 1.0 | 3.3 | 5.1 | 16.0 | 0.0 | 5.1 | 16.0 | 0.0 | 22.9 | 100.7 | 15.0 | 0.0 | 15.0 | 58.4 | 22.1 | 73.5 | 95.6 | |
| 44 | 2036 | 5.1 | 5.1 | 5.1 | 1.0 | 3.3 | 5.1 | 16.0 | 0.0 | 5.1 | 16.0 | 0.0 | 22.9 | 100.7 | 15.0 | 0.0 | 15.0 | 58.4 | 22.1 | 73.5 | 95.6 | |
| 45 | 2037 | 5.1 | 5.1 | 5.1 | 1.0 | 3.3 | 5.1 | 16.0 | 0.0 | 5.1 | 16.0 | 0.0 | 22.9 | 100.7 | 15.0 | 0.0 | 15.0 | 58.4 | 22.1 | 73.5 | 95.6 | |
| 46 | 2038 | 5.1 | 5.1 | 5.1 | 1.0 | 3.3 | 5.1 | 16.0 | 0.0 | 5.1 | 16.0 | 0.0 | 22.9 | 100.7 | 15.0 | 0.0 | 15.0 | 58.4 | 22.0 | 73.5 | 95.5 | |
| 47 | 2039 | 6.3 | 6.3 | 6.3 | 1.0 | 3.3 | 11.4 | 16.0 | 0.0 | 11.4 | 16.0 | 0.0 | 22.9 | 100.7 | 15.0 | 0.0 | 15.0 | 52.1 | 22.1 | 67.2 | 89.3 | |
| 48 | 2040 | 4.0 | 4.0 | 4.0 | 1.0 | 3.3 | 9.1 | 16.0 | 0.0 | 9.1 | 16.0 | 0.0 | 22.9 | 100.7 | 15.0 | 0.0 | 15.0 | 54.5 | 22.1 | 69.5 | 91.6 | |
| 49 | 2041 | 21.9 | 21.9 | 21.9 | 1.0 | 3.3 | 27.0 | 16.0 | 0.0 | 27.0 | 16.0 | 0.0 | 22.9 | 100.7 | 15.0 | 0.0 | 15.0 | 36.5 | 22.1 | 51.6 | 73.7 | |
| 50 | 2042 | 5.8 | 5.8 | 5.8 | 1.0 | 3.3 | 10.9 | 16.0 | 0.0 | 10.9 | 16.0 | 0.0 | 22.9 | 100.7 | 15.0 | 0.0 | 15.0 | 52.7 | 22.1 | 67.7 | 89.8 | |
| NPV (10%) | | 77.9 | 153.1 | 59.2 | 6.6 | 12.4 | 301.7 | 108.0 | 332.7 | 85.6 | 426.2 | 23.5 | 67.1 | 22.9 | 22.9 | 22.9 | 22.9 | 22.9 | 22.9 | 22.9 | 22.9 | 90.0 |
| | | | | | | | | | | | | | | | | | | | | | | 113.6 |

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