

ケニア側要請

Terms of Reference

REPUBLIC OF KENYA
NATIONAL IRRIGATION BOARD

MWEA IRRIGATION SETTLEMENT
REHABILITATION
TERMS OF REFERENCE

OCTOBER, 1985.

LIST OF CONTENTS

	<u>Page No.</u>	
1.0.	Background	1
2.0	Description and scope of the works	3
2.1	Field Operations	3
2.1.1	Machinery	3
2.1.2	Insecticides, chemicals and spraying equipment	3
2.2.	Canals and Drains including flood protection drain	4
2.2.1	Two kilometres of lining	4
2.2.2	Re-forming of canals and drains	4
2.3	Scheme Roads	4
2.3.1	Murraming & Grading	4
2.3.2	Machinery for maintenance of scheme roads	4
2.4	Canal and Drain Structures including measuring devices	4
2.4.1	Re-building	4
2.4.2	Equipment	4
2.5.	Public Health	5
2.5.1	Molluscicides	5
2.5.2	Equipment	5
2.6	Reception Centres	5
2.6.1	Expansion	5
2.6.2	Equipment	5
2.7	Communications	5
2.7.1	Internal Communication System	5
2.7.2	Vehicles and motor cycles	5

List of Contents:Cont.

		<u>Page No.</u>
2.8	Research Centre	5
2.8.1	Stores	5
2.9	Workshop	5
2.9.1	Expansion and paving of floor	5
2.9.2	Machines and Tools	5
2.10	Engineering Office	6
2.10.1	Expansion	6
2.10.2	Survey equipment	6
2.10.3	Drawing tables and instruments	6
2.11	Manager's Office	6
2.11.1	Repairs and expansion	6
2.11.2	Re-surfacing of office compound	6
2.11.3	4.wheel Drive Saloon Car for Manager	6
2.11.4	Office Equipment	6
2.11.5	Expansion of Club House	6
2.12	Communication between Head Office and Mwea	6
2.12.1	Vehicles stationed at Head Office	6
2.12.2	Telephone facilities at Head Office	6
2.13	Domestic water supply	6
3.0.	Cost Estimates	6

1.0 BACKGROUND:

Mwea Irrigation Settlement, situated near Embu in the Central Province of Kenya, covers a gross area of 12,150 ha. and a net irrigated area of 5830 ha.

Irrigation water is from two sources, rivers Thiba and Nyamindi, Thiba supplying the bigger area while Nyamindi supplies the smaller area as shown below:-

THIBA HEADWORKS

Mwea Section	1300 ha.
Thiba Section	1200 ha.
Wamumu Section	1130 ha.
Karaba Section	1100 ha.
	<hr/>
Total	4730 ha.

THIBA RUBBLE WEIR

Unit T20	100 ha.
----------	---------

NYAMINDI HEADWORKS

Tebere Section	1000 ha.
(less T20)	
	<hr/>
Total	5830 ha.

Water from these sources is supplied to the project area throughout by gravity after abstraction by means of diversion weirs. Drainage is also by gravity which means that there is no pumping in the whole system.

The scheme is a settlement - type project where farmers live in specific villages conveniently located within the project area. The National Irrigation Board does land preparation and provides inputs, extension services and water at a nominal fee to the farmers.

Although Mwea is widely regarded as being among the more successful irrigated rice projects in the world, its performance has, over the last few years, begun to deteriorate. One of the contributory factors to this is lack of adequate maintenance and rehabilitation, referring to all aspects of project operation and maintenance. This situation is likely to deteriorate further unless corrective measures are taken.

The Government of Kenya, through the National Irrigation Board, therefore wishes to carry out major rehabilitation of the scheme to prolong its life and so improve rice production.

2.0 DESCRIPTION AND SCOPE OF THE WORKS:

It is expected that rehabilitation of the scheme will involve all aspects of its operation and maintenance. If necessary, new works will be effected to enable efficient subsequent operation and maintenance practices.

The study should recommend the best way to achieving the above including possibilities of the work being carried out by contract. Based on the size of the project and operations therein, the study should indicate in detail all the works, operations, machinery and equipment necessary to provide effective rehabilitation of the scheme. Below is a list of some of the operations and equipment which should serve as a guide as to the requirements from the study:-

2.1 Field Operations:

Field operations comprise mainly land preparation, cultivation and harvesting of paddy including application of agricultural inputs and chemicals. For these, the following will be required:-

- 2.1.1. - 1 No. D5 Caterpillar Bull dozer for re-levelling of some fields.
- 2 No. Mobile Fuel Tankers
- 1 No. Mobile Workshop and Lubrication Unit.
- 40 No. Tractors with rotavators and spares
- 2.1.2 Insecticides, chemicals and spraying equipment.

2.2 Canals and Drains including Flood Protection Drain

- 2.2.1 Two kilometres of appropriate form of lining of Thiba and Tebere main canals
- 2.2.2 Complete re-forming (re-shaping) of canals and drains.
- 2.2.3 Machinery for maintenance of canals and drains
- 1 No. Dragline
 - 3 No. Excavators
 - 3 No. Backhoes
 - 1 No. Scraper

2.3 Scheme Roads

- 2.3.1 Complete murraming and grading of all scheme roads
- 2.3.2. Machinery for maintenance of scheme roads
- 2 No. Motor Graders
 - 2 No. Water-Bowsers
 - 4 No. Ti-per Lorries
 - 1 No. Motor Roller
 - 3 No. Lorries

2.4 Canal, Road and Drain Structures including Measuring Devices

- 2.4.1 Most of the structures to be re-built completely
- 2.4.2 Equipment to carry out the above including 5 No. Concrete Mixers.

2.5 Public Health

- 2.5.1 Molluscicides for all water courses and fields
- 2.5.2 Equipment for application of the molluscicides

2.6 Reception Centres

- 2.6.1 Expansion and Repair of all reception centres
- 2.6.2 Equipment i.e. 10 no. additional weighing equipment
(scales)
 - 2 No. Rice Driers
 - 10 No. Winnowers

2.7 Communications

- 2.7.1 Internal communication system
- 2.7.2 7 No. 4-wheel Drive Pick-ups and
20 No. Motor Cycles

2.8 Research Centre

- 2.8.1 Additional store building for seed and equipment

2.9 Workshop

- 2.9.1 Expansion and paving of floor
- 2.9.2 Machines and tools i.e.
 - 1 No. Lathe Machine
 - 1 No. Drilling Machine
 - 1 No. Wheel Balancing Machine
 - Spares and Other Workshop Tools.

2.10 Engineering Office

- 2.10.1 Expansion of existing office
- 2.10.2 Survey equipment
- 2.10.3 Drawing tables and instruments

2.11 Managers' Office

- 2.11.1 Repairs and expansion
- 2.11.2 Re-surfacing of office compound
- 2.11.3 1 No. 4-wheel Drive Saloon Car for Manager
- 2.11.4 Office equipment
- 2.11.5 Expansion of club house

2.12 Communication between Head Office and Mwea

- 2.12.1 Vehicles stationed at Head Office
- 2.12.2 Telephone Facilities at Head Office
- 2.12.3 Domestic Water Supply.

3.0 Cost Estimates

The study shall include a comprehensive breakdown of all cost components associated with rehabilitation of the scheme. The breakdown should be such that the rehabilitation can be carried out in whole or in part, or can be phased as may be necessary. A corresponding financing plan shall also be formulated.

REPUBLIC OF KENYA

NATIONAL IRRIGATION BOARD

MWEA IRRIGATION SETTLEMENT
PROPOSAL FOR MUTITHI EXTENSION

OCTOBER, 1985.

PROPOSAL FOR MUTITHI EXTENSION TO
MWEA IRRIGATION SETTLEMENT

<u>CONTENTS</u>	<u>PAGE NO.</u>
CHAPTER 1 - INTRODUCTION	1
1.1 - General	1
1.2 - Background	1
1.3 - Scope of Study	4
CHAPTER 2 - SUMMARY, CONCLUSIONS AND RECOMMENDATIONS	6
2.1 - Summary	6
2.2 - Conclusions	7
2.3 - Recommendations	7
CHAPTER 3 - PROPOSED DEVELOPMENT	9
3.1 - Present Situation - Mwea Irrigation Settlement	9
3.2 - Project Location	13
3.3 - Population and Land Tenure	13
3.4 - Topography, Climate, Hydrology and Soils	14
3.5 - Water Management	17
3.5.1 - Water Supply	17
3.6 - Project Organisation and Management	17
3.7 - Agro-economics and Marketing	18
3.8 - Settlement, Infrastructure and Social Aspects	22
CHAPTER 4 - EXAMINATION OF ALTERNATIVES	23
4.1 - A Link Canal from a Point on River Nyamindi to Thiba Main Canal	23
4.2 - Diversion by Weir from River Tana to Provide Gravity Supply.	24
4.3 - Pumping from River Tana	25
4.4 - Direct off-take from River Tana	26
4.5 - Supplementing water from Nyamindi with that from River Murubara and streams, Kiwe and Nyaikungu.	26

Contents Cont.....

Page No.

CHAPTER 5	-	COSTS	27
5.1	-	Cost Estimates	27
5.2	-	Cost Comparison	27
CHAPTER 6	-	SELECTED DEVELOPMENT PLAN	28
6.1	-	Comparison of Alternatives	28
6.2	-	Programme of Works	28
CHAPTER 7	-	CAPITAL EXPENDITURE	29
7.1	-	Link Canal from Nyamindi	29
7.2	-	Diversion from River Tana	29
7.3	-	Pumping from River Tana	30
CHAPTER 8	-	MANPOWER REQUIREMENTS	31
8.1	-	During Construction	31
8.2.	-	During Operation and Maintenance	31
REFERENCES			35

ENCLOSURES

TABLES

Table 1	-	Temperature, Relative Humidities, and Rainfall in the Mwea Irrigation Scheme Area	15
Table 2	-	Mean Monthly Discharge Records for Thiba and Nyamindi Rivers.	16

Contents Cont.....

PAGE NO.

FIGURES:

Fig. 1	- Location of Mwea Irrigation Settlement	2
Fig. 2	- Proposed Extension Area to Mwea Irrigation Settlement.	33
Fig. 3	- Proposed Nyamindi Headworks - general layout.	34
Fig. 4	- Proposed Tana Diversion Works - general layout.	35

CHAPTER 1

1. INTRODUCTION:

1.1 General

The National Irrigation Board (NIB) was established in 1966 and currently manages six irrigation schemes of varying sizes, i.e. Mwea, Perkerra, Hola, Ahero, West Kano and Bunyala. These Schemes grow rice, cotton, maize, groundnuts, fruits, chillies and sugarcane. Rice is grown in four of these schemes i.e. Mwea (5800 ha.), Ahero (800 ha.), West Kano (800 ha.) and Bunyala (210 ha.). Together the four schemes comprise an area of about 7500 ha. producing over 35,000 tonnes of rice per year. This represents more than 90 per cent of the total annual rice production in the country.

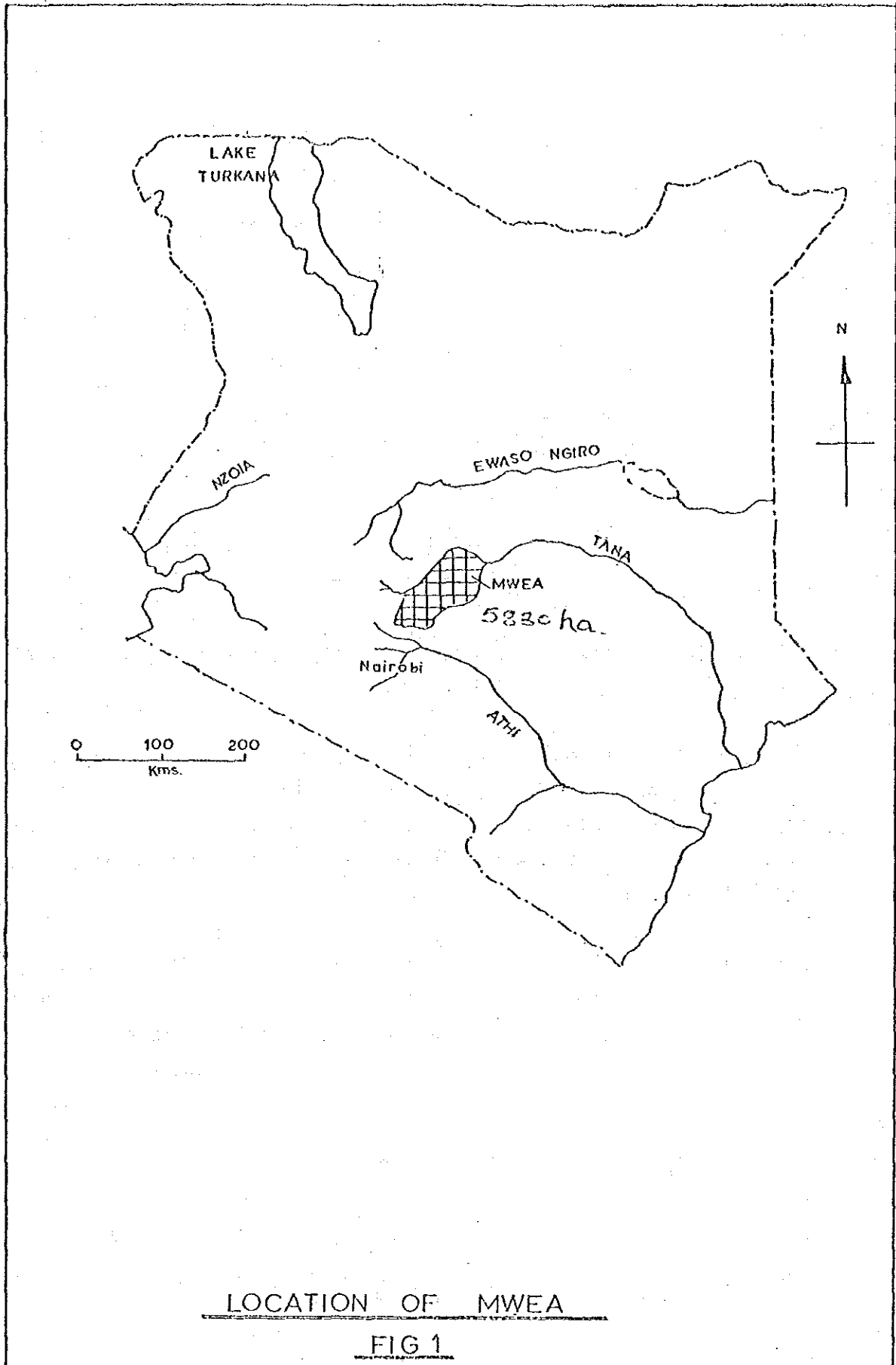
Approximately 80 per cent of the rice produced in NIB schemes comes from Mwea Irrigation Settlement. Mwea alone therefore accounts for over 70 per cent of the total national rice production.

Mwea Irrigation Settlement is located near Embu, 90 km. north-east of Nairobi. The scheme was started in 1954 and now has a gross irrigated area of 6300 ha. and a net area of 5800 ha. It gets water from two tributaries of the Tana River, Thiba and Nyamindi.

In line with the National Food Policy of self sufficiency and alleviation of poverty, the Government of Kenya, through the National Irrigation Board, now wishes to extend the Scheme by developing a further net irrigated area of 1200 ha. near Mutithi.

1.2 Background to Study

In 1973 the National Irrigation Board started to investigate possible extension to Mwea. Two alternatives were proposed. These were:-



LOCATION OF MWEA

FIG 1

- A link canal from a point on Nyamindi River about one mile upstream of the existing headworks to convey water to the existing Thiba main canal.
- A reservoir located near Kandogo, to store available water from the existing Thiba canal for re-use during October-February.

Consultants were, later in the year, asked to study these two proposals and an additional proposal of:-

- A system of link canals located near Mount Kenya Forest Area to convey the required irrigation water between Nyamindi and Thiba Rivers.

The study recommended the link canal between a point on the Nyamindi river, one mile upstream of the existing headworks and the existing Thiba main canal. However, further studies and designs were not carried out due to shortage of resources.

In 1984, NIB carried out a review of these previous studies with particular reference to alternative water abstraction directly from the river Tana as there were indications that water from Nyamindi River would not be sufficient. Here, two Alternatives were considered, viz:-

- Pumping directly from the river Tana at a site approximately 5 km. from the project area.
- Construction of a weir at a site approximately 9 km. from the project area to enable gravity supply.

Further reconnaissance surveys were undertaken in 1984 privately by the Agricultural Development Consultants Association (ADCA) of Tokyo, Japan with the general objectives of:-

- extension and rehabilitation of the Mwea Irrigation Scheme. More specifically, these surveys undertook to consider:-
 - Introduction of double cropping of rice
 - Expansion of Mwea Irrigation Scheme by some 4000 ha. and rehabilitation of existing scheme
 - Undertaking of a Pilot Scheme in Mwea area in order to establish the optimum farming practice for double cropping of rice.

Irrigation water would be obtained by diverting river flow by gravity from the Nyamindi to the Thiba through a 8 km. long channel to be newly excavated.

The resulting report is still under consideration.

1.3 Scope of the Present Study

The present study was initiated in August, 1985.

The project would boost rice production while at the same time utilizing the available land and water resources in the area adjacent to the existing Mwea Scheme.

The aim of the study is to examine all the earlier proposals and recommend the best line of action based on social, economic and engineering considerations for the development of Mutithi as an extension to Mwea Irrigation Scheme.

In addition, the present study should consider:-

- Possible alternative institutional arrangements and mode of management of the Mutithi extension.
- Possible development of the red soil areas
- Rehabilitation of the existing Mwea Irrigation Settlement
- Possible irrigation water abstraction from River Tana by direct gravity off-take
- Construction of a series of canals to augment the water diverted from Nyamindi and Thiba with those of Murubara, Kiwe and Nyaikunga.

CHAPTER 2

2. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

2.1 Summary

Within the terms of reference for the study and based on previous recommendations, the construction of a weir on river Tana at site approximately 9 km from the project area to enable gravity supply is considered most suitable for supplying additional water to the proposed Mutithi development. However, the alternative of a link canal from a point on the Nyamindi River to convey water to the existing Thiba main canal and that of pumping directly from the Tana River should also be considered for further investigations during feasibility study stage.

Two possible forms of institutional and management arrangements have been considered:-

- Existing NIB set up with management as for other schemes
- NIB to act purely as a water undertaker. But, development of the project would have to be facilitated through NIB.

The estimated capital cost for the total project development of 1200 ha. at Mutithi is £6,050,000 for Alternative 1, £9,500,000 for Alternative 2 and £6,050,000 for Alternative 3 at 1985 prices.

Development can be completed within 2½ - 3½ years, the first year being taken up by feasibility study and detailed designs.

2.2 CONCLUSIONS

The proposed project would add greatly to the national rice production. The area which has been selected was originally clearly delineated on the general plan of the Mwea Irrigation Settlement and there is no doubt that the soils, climate and topography of the project area are suitable.

The project is certainly viable but more investigations would be necessary to confirm the cost estimates, depending on which Alternative is finally adopted.

2.3 RECOMMENDATIONS

It is recommended that a feasibility study should be considered on the proposed project as outlined below:-

1. Net project size of 1,200 Ha in the area adjacent to the existing Mwea irrigation scheme and lying between the Makutano - Nyeri and Makutano - Embu roads.
2. Cropping pattern of one rice season per year.
3. Irrigation water supply from one of the following alternatives
 - (a) Diversion from River Tana to supply water by gravity directly to the scheme. The main canal would be about 9km long, crossing the Thika - Sagana Road via a culvert.
 - (b) A link canal from a point on the Nyamindi River about one mile upstream of the existing headworks to convey water to the existing Thiba main canal. It would join the Thiba canal just downstream of the existing headworks.

This would entail a gravity intake, an ogee weir with a scour gate, and intake gates. A pershall flume would be incorporated at the outlet.

The main canal would be approx. 14 km, crossing the Embu road via a culvert. The canal will also cross the Muruba and Thiba Rivers via appropriate structures.

- (c) Pumping directly from the River Tana. The pumpstation would consist of 5 inclined spindle floodlifter turbine pumps and one standby, each capable of delivering 500 litres/sec against a head of 32 - 36 metres. The main canal would be 5 km long and would also cross the Sagana road via a culvert.

The Terms of Reference of the study should include the following aspects:-

- Alternative development strategies
- Topographical survey
- Aerial survey (photography)
- Geotechnical investigations
- Review of soil survey reports
- Review of agronomy records (based on Mwea Irrigation Settlement).
- Hydrology
- Engineering aspects (water supply, irrigation, infrastructure, housing)
- Agro-economics
- Settlement and social aspects
- Marketing
- Land tenure
- Project organization and management
- Economic analysis
- Costs and construction programme.

CHAPTER 33. PROPOSED PROJECT3.1 Present situation - Mwea Irrigation Settlement

Mwea Irrigation Settlement is on the plains to the South of Mount Kenya, with an elevation of 1,159 km. above sea level. It comprises a net irrigated area of 5,800 ha. growing rice at a cropping intensity of some 140 per cent, the main crop being grown during the short rains period. The major farming activities for rice cultivation during this period are:-

Rotavation: March to August

Transplanting: August to end of September

Weeding: September to December

Harvesting: December to February

A second crop, of intensity up to 40 per cent, is now being cultivated after this period.

Rotavation is accomplished by a tractor fleet of 30, each doing an average of 1.5 ha. per day. The operation, which starts in early March and ends by end of August (for main season crop), takes approximately 130 working days.

Each farmer has a holding of 4 acres. They produce seedlings for transplanting on part of the holding comprising an area of about 3 per cent of the holding. Nursery period is approximately 28 days after which transplanting begins.

Farmers are usually divided into four transplanting groups to ensure that not all the rice matures at the same time. This is done to avoid transport and handling problems during harvest, and normally, 70 per cent of the total irrigation area is included in the first two groups

Two main kinds of variety, Sindano and Basmati are grown, both taking upto 120 days from transplanting to harvesting. Weeding is done by the farmers and pest control and water management are provided by NIB Scheme management.

Fertilizer is provided for the farmers on credit. The application rate for the scheme is 100 kg/ha for Nitrogen and 50 kg/ha. for phosphate.

Harvesting starts in December, and takes about 3 months, ending in February. During this operation, the farmers do the cutting, threshing and winnowing while NIB undertakes bagging, transportation to reception centre, drying, re-bagging, weighing and transportation to the mills.

The Mwea Rice Mills is jointly owned by the Mwea Farmers Co-Operative Society (40 per cent) and NIB (60 per cent). It has an installed capacity of 51,000 metric tons per year and at present, it receives approximately 29,000 tons of rice annually.

The following data indicates the farmer's gross returns at Mwea at 1985 prices:-

FARMERS BUDGET

MWEA IRRIGATION SETTLEMENT

1. GROSS RETURNS PER ACRE

(a)	Sindano Rice	30 bags x 75 kg x sh. 2/70	= Kshs. <u>6,075.00</u>
(b)	Basmati Rice	25 bags x 75 kg x sh. 3/25	= Kshs. <u>6,093.75</u>

11 DEDUCTIONS PER ACRE

	<u>Sindano</u>	<u>Basmati</u>
	(Kshs.)	(Kshs.)
(a) Service charge	2223.00	2223.00
(b) Fertilizer (i) Nursery	78.00	78.00
(ii) Field - TSP	199.25	199.25
S/A	156.00	156.00
(c) Seed	60.30	70.60
(d) Field Boards	3.50	3.50
(e) Field Gates	50.00	50.00
(f) Spray (Furadan + Sumithion)	98.20	98.20
(g) Spray Labour	5.00	5.00
(h) Handling Charges at shs. 5/80 per bag	174.00	145.00
(i) KFW Loan	20.00	20.00
Total Deductions per acre	3067.25	3048.55

FARMERS RETURNS FOR DIFFERENT HOLDING SIZES:1) SINDANO

Acreage	1	4
Total deductions (Kshs.)	3,067.25	12,269.00
Gross Returns (Kshs.)	6,075.00	24,300.00
Gross Margin (Kshs.)	3,007.75	12,031.00

2) BASMATI

Acreage	1	4
Total deductions (Kshs.)	3,048.55	12,194.20
Gross Returns (Kshs.)	6,093.75	24,375.00
Gross Margin (Kshs.)	3,045.20	12,180.80

SUMMARY

HOLDING SIZE (acres)	GROSS RETURN - KSHS.	
	SINDANO	BASMATI
1	3,007.75	3,045.20
4	12,031.00	12,180.00
6	18,046.50	18,271.00
8	24,062.00	24,361.00
10	30,090.00	30,452.00

Irrigation water supply is obtained from two sources. The minor one is constructed on the River Nyamindi and provides water by gravity to the Tebere Section of 1300 Ha. net via a main canal of 22 km length.

The major intake is on the River Thiba, providing water to the other four sections of the scheme, i.e. Mwea, Thiba, Wamumu and Karaba. These together comprise some 4,500 Ha. net. The main canal is 38 km long.

3.2 Project Location

The proposed project is an extension of the existing Mwea Irrigation Settlement and will comprise a net irrigated area of 1200 Ha. immediately adjacent to the scheme. It borders the south-western side of the scheme and would either be gravity or pumped irrigated from River Tana. There is also a possibility of gravity irrigation from a combination of Nyamindi and Thiba Rivers. The project could be extended at a later stage to reach a total of 4000 Ha. if water supply is from River Tana.

3.3 Population and Land Tenure

The people residing at Mutithi were settled there by the County Council after independence but some resettlements could be considered to have taken place since then. Population figures can be obtained from the 1969 census and extrapolated. A detailed survey would be carried out during feasibility study.

The size of each holding per farmer will be decided after accurate population figures are known. In the likely event that some individuals have more land than they can cultivate under irrigated rice, a suitable arrangement would have to be reached after consultations with the District Development Committee.

3.4 Topography, climate, hydrology and soils

The proposed project area is on the plains to the South of Mount Kenya, with an elevation of 1,159 m. above sea level. Topography including that of the existing scheme, is very flat, while the surrounding area is undulating appreciably.

Climate in the Mwea area is generally characterized as the lower midland zones with an altitude of between 800 to 1,300 m.

There are two rain seasons in the year; the long rains period from March to May and the short rains period from October to November. The average annual rainfall is 950 mm, out of which some 600 mm concentrates in the long rains period and 220 in the short rains period.

Monthly mean air temperature varies throughout the year, ranging between 20 and 30°C. The average relative humidity varies from 80% at 9.00 am to 50% at 3.00 pm.

The mean radiation varies from 650 gm.cal/cm² per day in January and February to 400 gm. cal/cm² per day. The average monthly wind speed fluctuates from 1.8 to 7.7 km/hr.

The water resources of the existing Mwea Irrigation Settlement depend on the natural run-off of the Thiba and Nyamindi rivers, which originate in the Mount Kenya and flows into the Tana River. Further use of these waters could be limited and if considered, may not facilitate future expansion of the proposed project. The River Tana, on the other hand, has abundant water resources and provides an alternative source especially in view of anticipated expansion.

Table 1 TEMPERATURE, RELATION HUMIDITIES, AND RAINFALL
IN THE MWEA IRRIGATION SCHEME AREA

A) Temperature

(Unit: °C)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Mean Max.	28.4	30.3	30.2	28.3	27.1	26.5	25.0	25.8	28.2	29.2	27.3	26.9
Mean	20.9	22.0	23.1	22.6	21.9	20.8	19.9	20.3	21.8	22.9	21.7	20.7
Mean Min.	13.4	13.7	16.1	16.9	16.8	15.2	14.8	14.8	15.5	16.6	16.1	14.5

Note: 14 years records

B) Rainfall (Wamumu Approv. School Naranga)

(Unit: mm)

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
25	29	141	281	179	18	8	1	2	72	152	48	955

Note: 11 years records

C) Relative Humidities

(Unit: %)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
9:00 A.M.	69.4	66.7	66.4	73.3	75.4	73.5	74.6	75.0	69.4	66.5	77.7	72.4	71.7
3:00 P.M.	48.1	39.6	36.2	46.1	54.5	51.0	48.1	45.3	35.8	34.1	54.3	50.3	45.3

Note: 2 years (1979 and 1981) records

Table 2 MEAN MONTHLY DISCHARGE RECORDS AT EXISTING INTAKE

A) NYAMINDI RIVER

SITES

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
1973	*	*	*	*	*	18.42	3.10	6.60	5.19	11.37	*	*
1972	2.93	5.26	2.91	3.41	8.98	12.96	5.38	2.12	5.82	17.92	*	*
1971	2.41	1.05	0.93	5.69	14.86	7.53	7.58	5.91	4.27	4.53	3.42	2.94
1970	3.82	2.76	3.34	11.55	16.53	9.37	4.14	4.19	2.89	5.24	5.46	2.41
1969	8.71	5.16	4.28	1.32	10.67	3.47	2.52	6.65	5.22	3.08	6.48	*
1968	3.19	8.89	7.49	14.60	17.75	15.88	15.59	9.23	5.77	5.78	3.99	98.54
1967	4.37	3.59	3.66	6.46	*	12.42	9.15	8.57	9.85	14.07	*	*
1966	3.11	2.58	5.41	13.24	15.37	12.06	2.21	1.87	3.34	8.04	19.61	6.91
1960	3.17	3.71	3.31	6.85	11.66	9.31	5.12	1.70	1.16	5.01	9.06	4.16
1959	1.98	1.98	2.69	11.26	12.17	7.98	7.16	5.94	6.37	3.03	3.37	2.89

Note: *: Data is not available

B) THIBA RIVER

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
1982	6.14	4.64	4.13	7.92	41.32	26.77	14.77	12.54	9.79	20.69	20.63	23.89
1981	7.73	6.76	8.15	16.95	32.88	18.71	10.67	8.32	8.09	8.35	10.61	8.29
1980	5.38	4.81	6.06	7.05	11.91	9.03	6.96	8.41	7.30	6.06	12.79	9.34
1979	7.70	9.74	8.15	11.35	34.10	37.64	14.01	9.68	7.50	6.76	8.94	7.10
1978	8.49	6.17	7.36	15.82	33.11	10.92	10.49	11.13	6.33	7.19	9.45	9.91
1977	5.63	3.95	3.85	9.33	31.85	16.39	9.59	8.78	6.42	7.23	21.29	12.50
1976	3.59	2.98	2.27	4.62	10.84	9.32	7.23	5.26	4.96	5.05	5.82	6.16
1975	4.01	3.14	3.00	8.16	17.07	12.95	10.51	9.01	7.30	6.97	6.10	5.05
1974	5.40	4.22	3.32	8.01	4.90	7.80	21.80	13.58	11.22	8.21	7.41	5.26
1973	11.89	7.39	5.33	9.40	19.94	18.73	10.88	9.88	8.60	7.98	11.14	7.51
1972	5.11	6.79	4.81	4.65	17.58	19.41	10.22	7.36	8.23	19.25	37.47	19.38
1971	4.35	3.59	4.33	7.56	18.85	16.16	13.07	12.30	9.29	8.02	7.02	5.78
1970	5.74	4.81	5.49	17.77	38.88	18.71	12.40	9.96	10.56	8.77	6.87	5.71
1969	11.94	7.73	6.79	4.87	13.39	8.57	6.28	10.33	9.42	7.19	7.50	5.77
1968	7.41	5.91	8.21	16.58	33.96	32.35	16.75	12.34	9.76	9.71	15.00	21.82

The soils in the project area are similar to those analysed by D'Costa & Markin (1967) for Mwea Scheme. Generally, the area consists of vertosols having such features as impervious heavy clay and rather shallow depth underlain by murram and volcanic tuff. The soils are considered to be suitable for the cultivation.

3.5 Water Management

The peak water demand is estimated at 1.63 l/s/ha. Assuming 65 per cent efficiency, the peak water demand is $2.5 \text{ m}^3/\text{sec}$. for the net irrigated area of 1200 ha. This is the quantity of water to be abstracted at the intake.

3.5.1 Water Supply

It is noted that at present, the natural run-off of River Thiba is exhausted during peak demand. Other possible sources of water supply are therefore Rivers Tana, Nyamindi, Murubara and the smaller streams, Kiwe and Nyaikungu. Water supplies from Murubara, Kiwe and Nyaikungu would be supplementary to those from Nyamindi and could provide an additional of up to 300 l/s., but not at all times of the year. Although up to $2.8 \text{ m}^3/\text{sec}$. can be abstracted from River Nyamindi together with Murubara, Kiwe and Nyaikungu for more than 60 per cent of the time, this quantity is not sufficient to irrigate the total expansion proposed. Resources from River Tanjare, however, abundant and further expansion would not pose any problem from the point of view of irrigation water supply.

Further investigations are however necessary to confirm the viability of a gravity supply from the Tana. Direct pumping would be an alternative.

3.6 Project Organisation and Management

Various alternative forms of project organisation and management should be considered for the proposed project, especially in light of previous experiences from other NIB schemes.

One such proposal is for NIB to undertake to provide irrigation water extension services and agricultural inputs only, to be charged to the farmer.

During construction, NIB, being the implementing agency, would also construct field layouts and all canalization. Part or whole of the capital cost would be recovered from the farmers over, say, 50 years. Tractors and implements for preparation would be available for hire to the farmers. Agreements would have to be drawn up between the farmers and the Government through NIB, stipulating certain regulations to be followed. These regulations should cover cultivation schedules, minimum areas to be cultivated by each farmer and marketing i.e. paddy to be delivered to NIB.

The farmers would establish a co-operative society with a view to taking up some of the services which would initially be provided by NIB.

Further studies would have to be carried out during feasibility studies to finalize the type of institutional set-up to be adopted for the proposed project.

3.7. AGRO-ECONOMICS AND MARKETING:

Development of any irrigation scheme would be meaningless unless it is aimed at, and is able to achieve, increase in yields per unit area and hence higher net income to would be beneficiaries. It is expected that with provision of water and other basic inputs the scheme would be able to raise one rice crop during the main season whose yields are expected to compare favourable with those of Mwea Irrigation Settlement. Possibilities will also be looked into of raising off season crop whose irrigation demand will not be as much as that of rice. Off season crops could be for instance fodder crops, green/yellow grains or sorghum. Double cropping of rice could however be considered if on-going trials at Mwea are successful.

Just like any other area in lower Mwea, subsistence farming is practiced in Mutithi. A casual look at the area reveals that only small portions of land are utilized for crops like pigeon peas, maize, yellow grams and sorghum. Sunflower is currently being experimented in some small areas. Cattle for beef and milk for domestic use are kept by a few residents. Yellow gram and a small quantity of pigeon peas are sold outside the area.

Due to poor husbandry and inadequate rainfall, only approximately 30% of the low lying area is cultivated once in a year. This produces an estimated average of 4 bags per acre (10 bags/ha.) of maize, $\frac{1}{2}$ bag per acre (1.2 bags/ha.) of pigeon peas and $\frac{3}{4}$ bag (1.8 bag/ha) of yellow grams.

The estimated annual gross income per acre is worked out as follows:-

Maize 4 bags x sh. 175 per bag	=	shs. 700.00
Yellow grams .75 bags x 450	=	shs. 337.50
Pigeon peas .5 bag x 450	=	<u>shs. 225.00</u>
TOTAL	=	<u>shs.1262.50</u>

The above being produced from 30% of the area i.e. 900 acres, the total gross income is therefore 900 acres x shs. 1262.50 = sh. $\frac{11362.50}{3000}$ = shs. 379 per acre

over the whole area.

Comparative incomes have been worked out as follows:-

Farm Size in Acres	Without Project Gross sh. per acre	With Project Net sh. per acre	
		Sindano	Basmati
1	379	3,007	3,045
4	1516	12,031	12,180
6	2274	18,046	18,271
8	3032	24,062	24,361
10	3790	30,077	30,452

Incomes without the project can only be expressed as gross income due to the fact that no input records are kept. Land preparation may be by hand digging, oxen or tractor ploughed. Fertilizers are normally not applied and hardly any crop protection is practised.

The above table shows that the estimated annual gross return from 1 acre in Mutithi is shs. 379/= compared with a net return of shs. 3,007/= per acre from the adjacent developed area of Mwea Irrigation Settlement. Thus, as is the case in all populated areas with inadequate rainfall, raising crops or rearing cattle for milk or beef has not been successful in Mutithi area. Income derived from agricultural activities in the area is much less in comparison to the adjacent developed area where irrigation is practiced.

All the rice produced will be delivered to the National Irrigation Board which will in turn market it along similar lines as the existing arrangements for Mwea Irrigation Settlement.

3.8 Settlement, Infrastructure and Social Aspects:

Re-settlement in the project area will be avoided as much as possible. Canalisation and field layouts would be done to maintain the existing homes and villages.

The NIB Administrative centre of the existing Mwea Scheme would be strengthened to cater for the proposed extension. The operating hours of existing Rice Mills would also be increased to take additional paddy and a new reception centre would be constructed for the extension. A network of infield roads would serve every irrigated plot.

As far as health is concerned, the project would provide for measures against Schistosomiasis (bilharzia) and Malaria. Schistosomiasis control would follow current practices within the existing scheme. Routine health checks of the population and chemotherapy of infected people would also be done. Malaria control would be effected as is the current practice at Mwea. It is intended that health services will be provided by the Ministry of Health via their existing dispensaries within the area.

CHAPTER 4:4. EXAMINATION OF ALTERNATIVES:4.1 Alternative - A Link Canal from a Point on River Nyamindi
to Thiba Main Canal

This requires a link canal between a point on the River Nyamindi one mile upstream of the existing headworks and the existing Thiba Main Canal. It will join the Thiba Canal just downstream of the existing headworks.

The gravity intake would consist of a 25m. long, 1m. high ogee weir, with a 1.2m. x 1m. scour gate, and 3 No. 1.2m. x 0.6m. intake gates. A parshall flume would be incorporated for water measurement. The intake will abstract $2.5 \text{ m}^3/\text{sec}$ from Nyamindi.

The main canal will be some 14 km. long with a 3m. bed width between Nyamindi and Murubara and a 1.8m. bed width between Marubara and Thiba Canal.

The first 1 km. will be in fairly deep cut of up to 10 m. but subsequent average depth of cut will be only about 1m.

The canal will cross the Embu Road via a 36m. long culvert. It will also cross the Murubara river via an aqueduct approximately 40m. long, and the Thiba river via a similar structure approximately 25m. long.

The existing Thiba/Canal will need to be improved to /Main enable it to carry the additional flow.

It is assumed that the total cost of this option would be Kshs. 121,000,000 at 1985 prices.

4.2 Alternative 2 - Diversion by Weir from River Tana to Provide Gravity Supply.

This requires a reinforced concrete spillway approximately 50m. long across the Tana. It will have a crest level of approximately +1158m.

The diversion works will also comprise:-

- an intake with flushing facilities and an undersluice.
- a concrete bridge of width 2.5m. resting on 2 piers to enable inspection.

The intake requirement will initially be $2.5 \text{ m}^3/\text{sec}$. but this would be increased to cater for any future development.

The main canal will be about 9 km. long with an average bed width of 2.5 m. It will cross the Thika-Sagana road via a ~~single-cell~~ culvert approximately 25m. long.

It is estimated that the cost of this option would be Kshs. 190,000,000/= at 1985 prices.

4.3 Alternative 3 - Pumping from River Tana.

The pump station would be on the bank of the river and would consist of 5 inclined - spindle floodlift ~~turbine~~ double-stage pumps and one standby, each capable of delivering 500 litres/sec. against a head of 32-36 metres. The water will then flow by gravity to the project area.

The main canal in this case will be 5 km. long, and will also cross the Thika-Sagana Road through a single-cell culvert of approximate length of 25 m.

It is estimated that this option would cost Kshs. 118,000,000/= at 1985 prices.

4.4 Alternative 4 - Direct Off-take From River Tana

Reconnaissance surveys have shown that it is not possible to abstract water by direct off-take from River Tana. The length of supply canal, associated seepage losses and canal structures that would be necessary simply make this alternative not viable. Preliminary costs are therefore not worked out for this proposed.

4.5 Alternative 5 - Supplementing water from Nyamindi with that from River Murubara and streams, Kiwe and Nyaikungu

Water from these three, sources would irrigate an additional 200 ha. only. Capital expenditure over and above that required for Alternative 1 would be minimal, but the extra area is very little. Alternative 5 should therefore only be considered in conjunction with 1.

CHAPTER 5:

5. Costs:

5.1 Cost Estimates:

Cost estimates have only been made for Alternative 1, 2 and

3. These can be summarised as follows:-

Alternative 1	-	Kshs. 120-130,000,000
Alternative 2	-	Kshs. 190,000,000
Alternative 3	-	Kshs. 118,000,000

5.2 Cost Comparison:

Alternative 3 has got the lowest investment cost of Kshs.118,000,000/= followed by Alternative 1 and lastly, Alternative 2. However, initial operation and maintenance costs of the pump station could exceed Kshs. 1 million annually and therefore Alternative 1 is more attractive than Alternative 3, precluding expansion beyond 1200 ha.

CHAPTER 6

6. DEVELOPMENT PLAN

6.1 Comparison of Alternatives:

Alternative 4 is not viable from topographical considerations.

Alternative 5 can only be considered in conjunction with Alternative 1 which, although is the most attractive, limits development to not more than 1,400 ha. Alternative 3 has the lowest investment costs but the subsequent operation and maintenance costs make this option less attractive than Alternative 1 and 2. Alternative 2 should therefore be considered for implementation since it involves no pumping and the extension area can be increased to the possible 4000 ha. The feasibility study should include possibilities of eventually increasing the extension area to 4000 ha. This consideration would be included in the evaluation of economic attractiveness of the three Alternatives.

6.2 Programme of Works:

Development of the 1200 ha. will take $2\frac{1}{2}$ - $3\frac{1}{2}$ years, depending on the final institutional arrangements adopted. If a decision is taken to implement the project, feasibility study and designs would take up to one year, the rest of the period being taken up by construction. The project could be founded through bilateral arrangements between Kenya Government and any willing Donor.

Some Governments, through various institutions, have indicated interest in the project and would be willing to co-finance jointly with the Kenya Government.

Feasibility studies, designs and supervision of construction would be undertaken by consultants with full participation of NIB staff.

CHAPTER 77. CAPITAL EXPENDITURE7.1 Link Canal from Nyamindi

Diversion weir	Kshs. 7,000,000
Canal excavation and rehabilitation of Thiba canal	Kshs.10,000,000
Canal Structures	Kshs. 4,000,000
Irrigation and Drainage works	Kshs.50,000,000
Infrastructure including reception centre and expansion os rice mill	Kshs.24,000,000
Expansion of NIB headquarters at Mwea	Kshs. 5,000,000
Operation and Maintenance equipment	Kshs.10,000,000

SUB-TOTAL Ksh.110,000,000

add 10% contingencies Ksh.121,000,000

7.2 Diverion from River Tana

Diversion weir + Flood protection	Kshs. 62,000,000
Main Canal Excavation	Kshs. 18,400,000
Canal Structures	Kshs. 3,600,000
Irrigation + Drainage works	Kshs. 50,000,000
Infrastructure including Reception Centre + Rice Mill	Kshs. 24,000,000
Expansion of NIB Mwea Headquarters	Kshs. 5,000,000
Operation and Maintenance Equipment	Kshs. 10,000,000

SUB-TOTAL Kshs.173,000,000

Add 10% contingencies Kshs.190,300,000

Say: Kshs.190,000,000

7.3 Pumping from River Tana

Pump station buildings	Kshs. 2,000,000
Pumps and Installation	Kshs. 3,600,000
Operators House	Kshs. 500,000
Canal Excavation	Kshs. 10,000,000
Canal Structures	Kshs. 2,000,000
Irrigation and Drainage Works	Kshs. 50,000,000
Infrastructure including Reception Centre and expansion of Rice Mill	Kshs. 24,000,000
Expansion of NIB Headquarters at Mwea	Kshs. 5,000,000
Operation and Maintenance Equipment	Kshs. 10,000,000
	<hr/>
SUB-TOTAL	Ksh. 107,100,000
	<hr/>
Add 10% contingencies	Ksh. 118,000,000
	<hr/> <hr/>

.... / 31

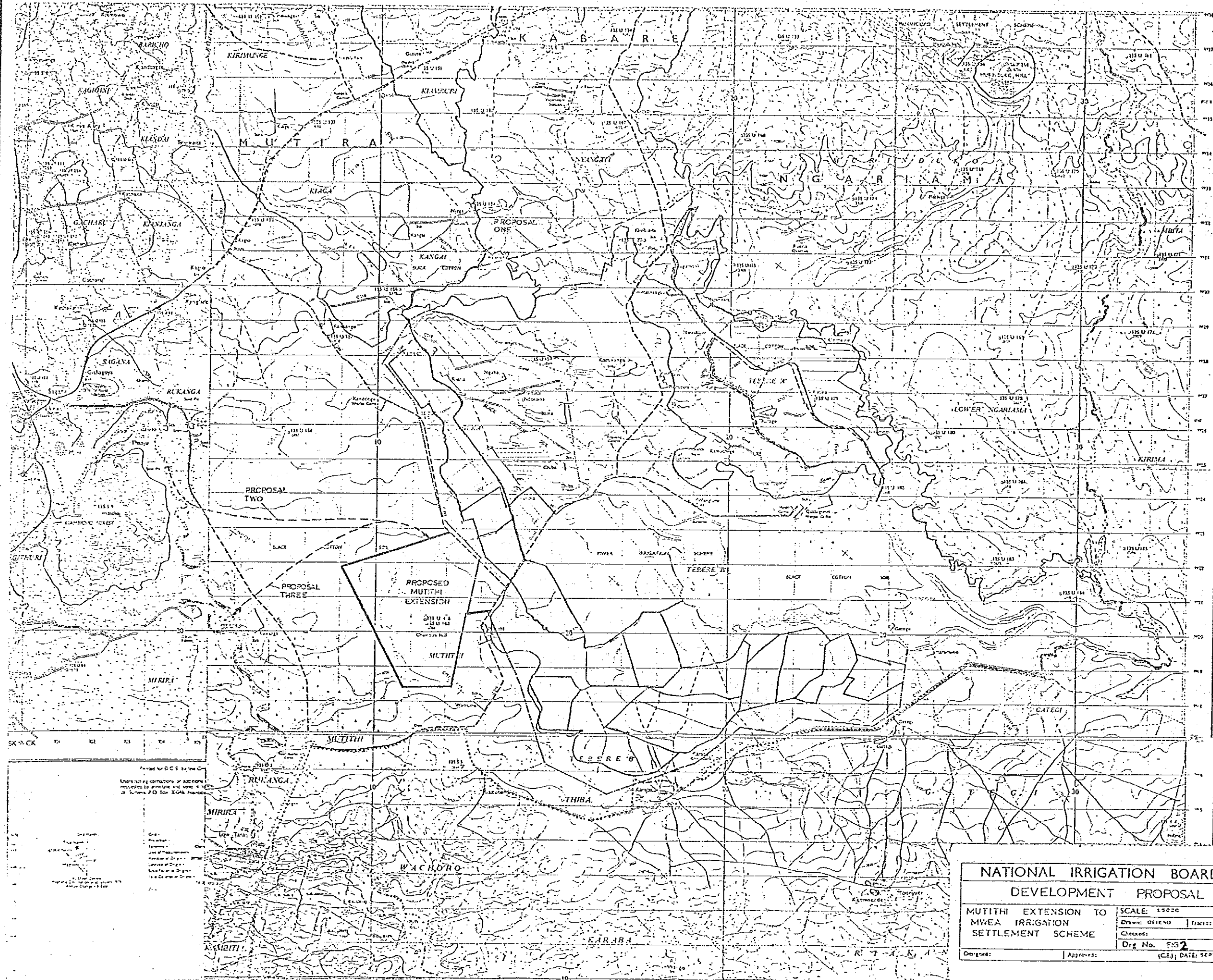
CHAPTER 88. MANPOWER REQUIREMENTS:8.1 During Construction

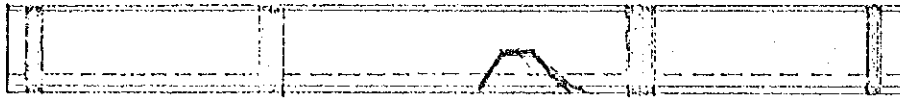
Resident Engineer	1 Nr.
Assistant Resident Engineers	3 Nr.
Design Engineers	2 Nr.
Clerk of Works/Site Agent	1 Nr.
Inspectors (Foreman)	6 Nr.
Surveyors	2 Nr.
Draughtsmen	2 Nr.
Workshop Foreman	1 Nr.
Mechanics/Electricians	8 Nr.
Artisans	30 Nr.
Plant Operators	10 Nr.
Drivers	20 Nr.
Unskilled Labour	

8.2 During Operation and Maintenance

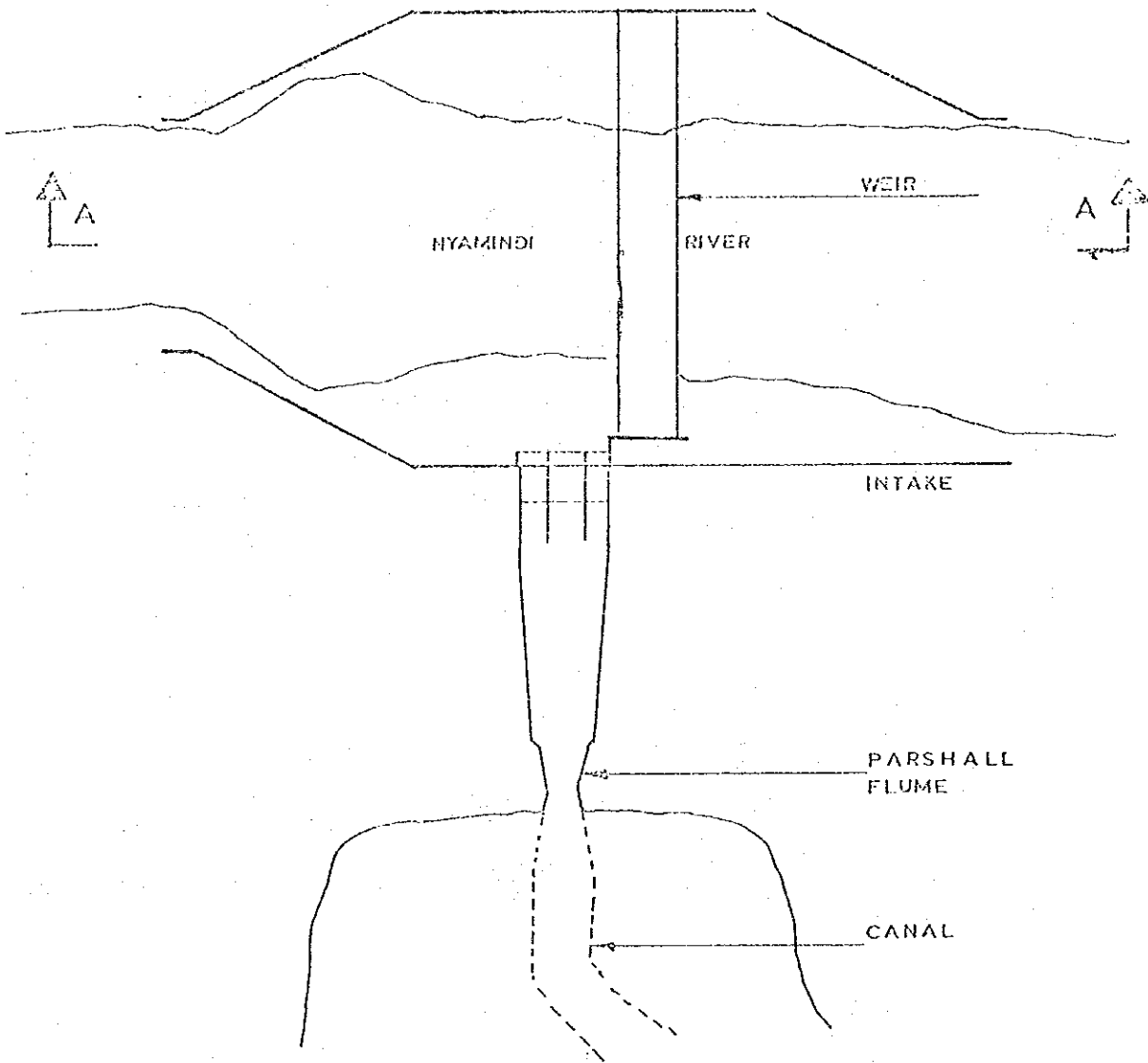
1. Co-ordinating Committee (DDC, NIB, Farmers)
2. Irrigation Officer 1 No. (Agricultural Extension)
3. Workshop Foreman 1 No.
4. Works Officer 1 No.

5.	Accountant (Senior)	1 No.
6.	Accounts Clerks, Secretaries, Typists etc.	6 No.
7.	Water Distribution Supervisor	1 No.
8.	Tractor Drivers	14 No.
9.	Mechanics	8 No.
10.	Store keepers	2 No.
11.	Drivers	6 No.
12.	Plant Operators	4 No.
13.	Field Assistants	6 No.
15.	Unskilled Labour (Messengers, Watchman)	30 No.



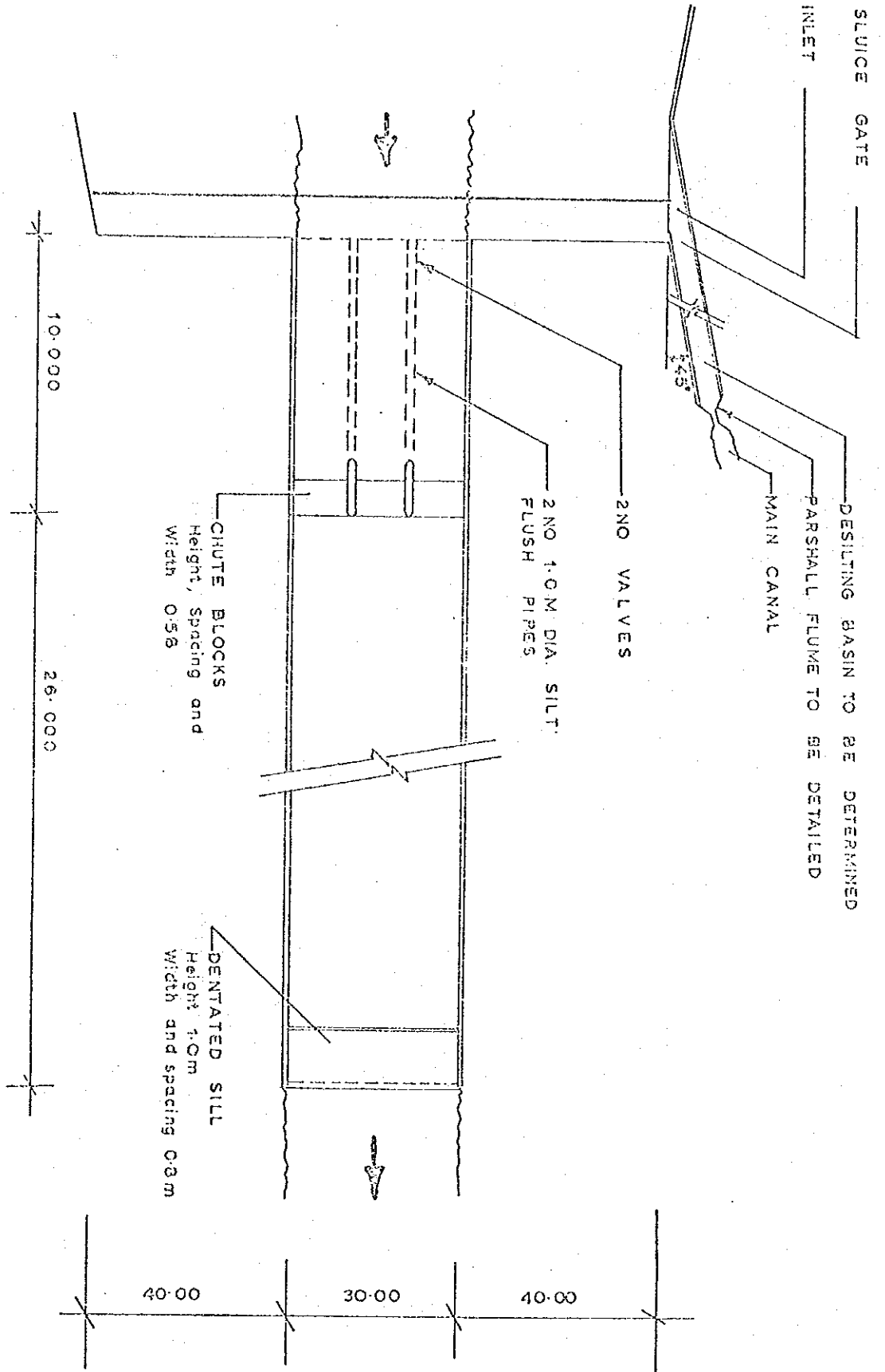


A-A



PLAN

FIG. 4



SPILLWAY LAYOUT PLAN

Longitudinal Scale 1:500
Lateral Scale 1:1000

REFERENCES:

1. Outline Study of Alternatives for the Irrigation of approximately 3000 acres at Mutithi: Howard Humphreys & Partners, 1973.
2. Soils of the proposed Wamumu Extension: M.O.A. - National Agricultural Laboratories, 1975.
3. Project Alternative for Implementation of Mutithi at Mwea: M.O.W.D., 1981.
4. Reconnaissance Survey Report on Extension and Rehabilitation of the Mwea Irrigation Project: Agricultural Development Association (ADCA), 1984.
5. Alternative for Mutithi Extension: NIB, 1984.

ENCLOSURES:Tables:

- Table 1 - Temperature, Relative Humidities, and Rainfall in the Mwea Irrigation Scheme Area.
- Table 2 - Mean Monthly Discharge Records for Thiba and Nyamindi Rivers.

Figures:

- Fig. 1 - Location of Mwea Irrigation Settlement
- Fig. 2 - Proposed Extension Area to Mwea Irrigation Settlement.
- Fig. 3 - Proposed Nyamindi Headworks - general layout.
- Fig. 4 - Proposed Tana Diversion Works - general layout.

REPUBLIC OF KENYA

NATIONAL IRRIGATION BOARD

MWEA IRRIGATION SETTLEMENT

DEVELOPMENT OF RED SOILS

TERMS OF REFERENCE

OCTOBER, 1985

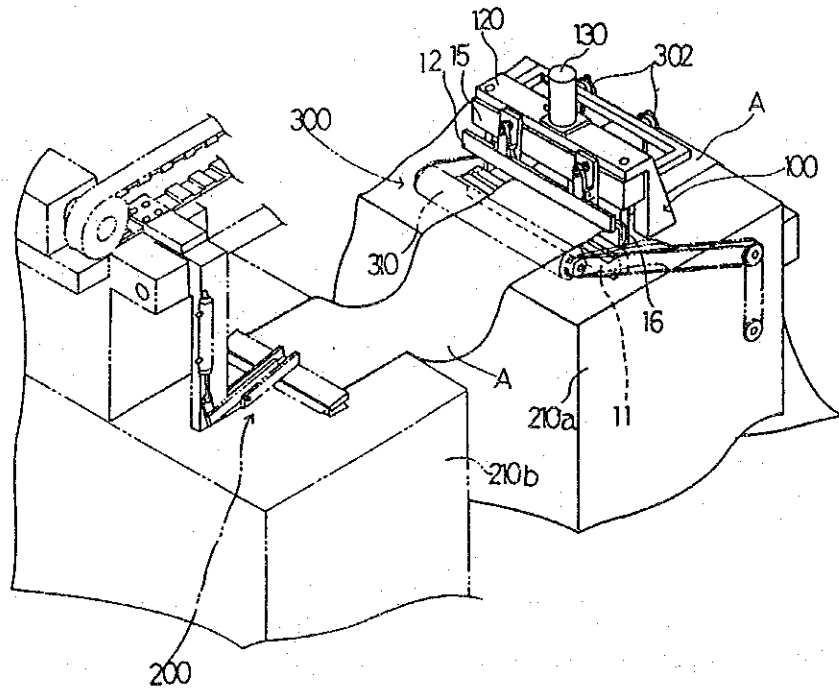
LIST OF CONTENTS

- 1.0 Background
- 2.0 Description of proposed areas
- 3.0 Description and scope of the study
 - 3.1 Exact delineation of study areas
 - 3.2 Surveys and experiments
 - 3.3 Recommended development
- 4.0 Reporting
- 5.0 Cost estimates

Figures

Fig 1

第4図



1.0 BACKGROUND

The development of Mwea Irrigation Settlement was started in 1954 with the main objective of producing rice under basin irrigation. The choice of the Mwea area was based on the availability of a flat stretch of land consisting mainly of black cotton soil (vertisols). However, during development, it was noticed that some areas, notably in the Tebere Section, consisted of red soils on slightly higher grounds.

Due to high infiltration rates and high slopes, it was not possible to cultivate irrigated rice on these areas under conventional basin irrigated practices. The Government of Kenya, through the National Irrigation Board, now wishes to develop these areas in the best way possible, to boost food production for the ever growing population of the country.

2.0 DESCRIPTION OF PROPOSED AREAS

The bulk of the red soil areas occur in the Tebere Section of Mwea Irrigation Settlement. They occupy patches in-between irrigated blocks and together comprise approximately 400-500 ha. Some few areas (up to 150 ha) also occur in the Mwea Section of the settlement, see Fig. 1.

3.0 DESCRIPTION AND SCOPE OF THE STUDY

3.1 EXACT DELINEATION OF STUDY AREAS

The first phase of the study shall consist of demarcation of the exact areas comprising the red soils of Mwea Irrigation Settlement. This will include soil sampling to confirm the areas, and subsequent areal surveys to establish the exact acreage of the red soil areas.

3.2 SURVEYS AND EXPERIMENTS

The study shall include topographic surveys after which detailed topographic maps, in appropriate scales, shall be produced.

The map scales should enable accurate field layouts and designs to be carried out. All necessary soil maps in suitable scales, shall also be produced.

Appropriate experimental methodology shall be employed to enable accurate determination of infiltration parameters and hence the basic infiltration rates. Furrow and/or Border strip advance and recession rates shall also be determined so that the viability of surface irrigation can be confirmed. Tests for all soil parameters shall also be carried out. If surface irrigation is confirmed, the lengths, sizes and slopes of furrows and/or border strips shall be indicated. If, based on the foregoing, it is decided that surface irrigation is not feasible, then suitable sprinkler irrigation systems should be recommended.

The above tests and surveys should be carried out with sufficient frequency to provide representative results to cover all red soils areas.

3.3 RECOMMENDED DEVELOPMENT

Based on results of surveys and experiments carried out as in 3.2 above, the study shall recommend the most fitting forms of development. If either a sprinkler system and/or surface irrigation is recommended, the study shall give the detailed field and/or sprinkler layouts.

If necessary, a pilot farm should be formulated to confirm the findings of the study e.g. recommended crops, cropping pattern etc. The following aspects shall also be included in the study:-

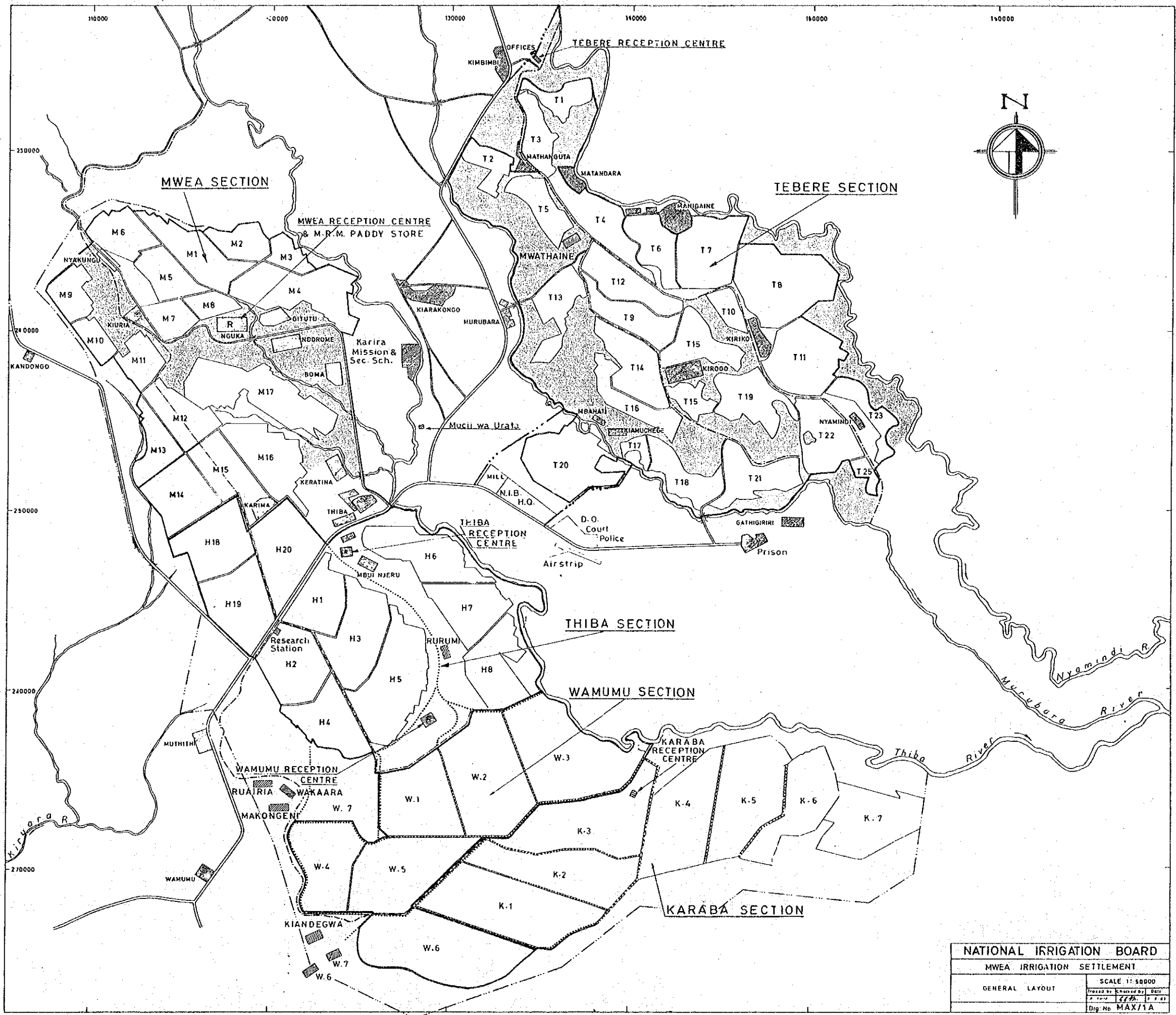
- (i) Marketing for recommended crops
- (ii) Training for the extension workers, if necessary
- (iii) Mode of management including institutional arrangements and how these will fit into existing Mwea Management set up.
- (iv) Possibility of dairy farming
- (v) Investigation of existing land tenure within whole or part of the red soil areas.

4.0 REPORTING

At the end of the study, a report shall be submitted which will cover all pertinent aspects of the proposed development. The report shall be sufficient to enable detailed designs and programmes to be carried out. It is expected that the report shall be ready within six months of commencement of the study.

5.0 COST ESTIMATES

The study shall produce cost estimates for development of the whole area. These costs should be comprehensively broken down to enable phased, part or whole development of the red soils. Proposals for a financing plan for the above should also be advanced.



NATIONAL IRRIGATION BOARD	
MWEA IRRIGATION SETTLEMENT	
GENERAL LAYOUT	SCALE 1:50000
	Drawn by: Checked by: Date:
	1975/76 19 7 47
	Fig. No. MAX/1A

収 集 資 料 リ ス ト

現地収集資料リスト

NO.	資料の名称	形態	収集先名称	寄贈 購入別
1	Results of Short Rains 1984 Research Program, Technical Report No.29, Ahero Irrigation Research Station		NIB	寄贈
2	NIB Annual Report and Accounts 1982-83	"	NIB	"
3	NIB Mwea Irrigation Settlement, Annual Report 1983/84	"	NIB	"
4	Kenya Agricultural Research Institute, Veterinary Research Development, Annual Report	"	Government Press	購入
5	The seed and Plant Varieties Act	"	"	"
6	The Agriculture Act	"	"	"
7	Agriculture Census of Large Farms 1979 & 1980	"	"	"
8	Mwea Irrigation Settlement, Rehabilitation, Terms of Reference, 1985/10	ゼロックス	NIB	寄贈
9	Mwea Irrigation settlement, Proposal for Mutithr Extension, 1985/10	"	"	"
10	Mwea Irrigation Settlement, Development of Red Soils, 1985/10	"	"	"
11	The Water Act, 1972 revised	製本		購入
12	The Lakes and Rivers Act, 1983	"	"	"
13	The Irrigation Act, 1967	"	"	"
14	Proposed Criteria for Land Suitability Classification for Irrigation	"	Kenya Soil Survey	"

NO.	資料の名称	形態	収集先名称	寄贈 購入別
15	Outline Study of Proposals for the Irrigation of Approximately 3000 acres at Mutithi, 1975	コピー	NIB	寄贈
16	Project Proposal for Implementation of Mutithi Extension Scheme, 1981	コピー	NIB	"
17	Mean Monthly Discharge, Nyamindi, 1959-1973	コピー	NIB	"
18	Irrigation and Drainage, Research Project Report, 1982. Ministry of Agriculture	コピー	NIB	"
19	Soils of the Kingdarum Area, 1972-73 1975	製本	Kenya Soil Survey	購入
20	Detailed Soil Survey of Kibirigwi Irrigation Scheme, Kirinyaga district, 1979	"	" "	"
21	Summary Report, National Food Policy Seminar 1981, Kenya Institute for Administration	コピー	Min. of Agriculture	"
22	Statistical Abstract 1984, Central Bureau of Statistics	製本	Min. of Finance and Planning	購入
23	Exploratory Soil Map and Agro-climatic Zone Map of Kenya, 1980 (Scale: 1/1,000,000)	製本	Kenya Soil Survey	"
24	Soils of the Proposed Wamumu Extension, Mwea Irrigation Settlement Scheme, 1975	製本	" "	"

NO.	資料の名称	形態	収集先名称	寄贈 購入別
25	An Assessment of the Irrigation Suitability of the Soil of the IDRP Farm, Mwea Kirinyaga District, 1984	コピー	Kenya Soil Survey	寄贈
26	△エア計画地区 1/50,000		Survey of Kenya	購入
27	" 1/50,000 航空写真		Survey of Kenya	"

JICA