5. Hydrology and Design Lecture

Lecture 1-1
Introduction of Hydro-Meteorological Observation

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Objectives

- To understand the purpose of Hydro-Meteorological observation and learn basic information and function of equipment.

Table of Contents

Back Ground

- Atari, Sironko and Namatala were selected as sites for F/S
- Collection of accurate Hydro-Meteorological data is required for further study
  - Hydrological data of water resource : Automatic Water Level Gauge
  - Meteorological data nearby the target areas: Automatic Weather Station
  - Rainfall data within corresponding the watersheds: Automatic Rain Gauge

HYDROLOGICAL OBSERVATION

Installation of Automatic water level gauge

- Namatala and Sironko River
  - MWE have established gauging station in the past
  - Currently, Observer manually record water level 2 times a day
  - JST installed Automatic water level gauge in existing gauging station on February 2015
- Atari River
  - There was no facility for water level recording.
  - JST newly constructed gauging station and installed Automatic water level gauge on February 2015

Introduction of Equipment -Automatic water level gauge-

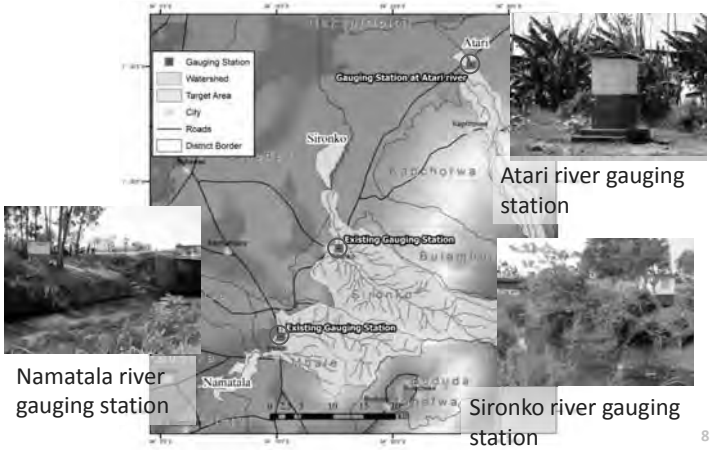
- Brand: STS Sensor Technik Sirnach AG (Switzerland)
- Component of the system
  - DL/N 70 (automatic water pressure gauge) with 10m PUR cable
- Observation interval: every 10minutes

Average water pressure is recorded and water level is calculated from observed pressure.

$$p = \rho g h \quad h = \frac{p}{\rho g}$$

p = Hydrostatic pressure (N/m^2)
ρ = Density of water (kg/m^3)≒Constant
g = Acceleration due to gravity(m/s^2) ＝Constant
h = Water depth (m)

Location Map of Water level Gauge



Atari river gauging station

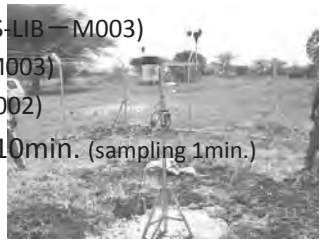
Namatala river gauging station

Sironko river gauging station

METEOROLOGICAL OBSERVATION

Introduction of Equipment - Meteorological station-

- Brand: Onset Computer Corporation (US)
- Component of the system
  - Data Logger (HOBO Micro station H21-002)
  - Temperature and Relative humidity sensor (S-THB-M002)
  - Silicon Pyranometer Sensor (S-LIB－M003)
  - Wind speed Sensor (S-WSA-M003)
  - Rain Gauge Sensor (S-RGB-M002)
- Observation interval: every 10min. (sampling 1min.)

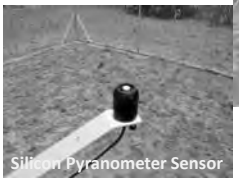


Data Logger and Sensors

Rain Gauge Sensor

Data Logger

Temperature and Relative humidity sensor



Silicon Pyranometer Sensor

Wind speed Sensor

Introduction of Equipment - Rain Gauge Station-

- Brand: Onset Computer Corporation (US)
- Component of the system
  - – Data Logger
  - – Tipping bucket
- Observation interval:
  - – Rainfall: every event (every 0.2mm rainfall)
  - – Temperature: every 1 hour

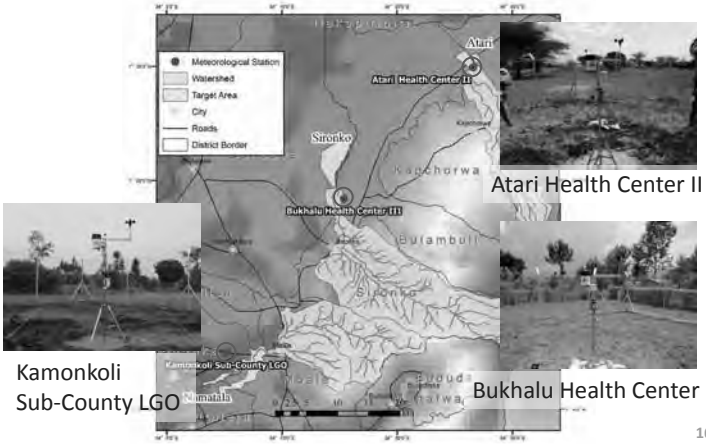
System of Rain Gauge

Selection Criteria for installation of Meteorological equipment

	Meteorological station	Rain gauge
Selection Criteria	・ Located nearby the target areas ・ Appropriate observation environment is ensured ・ No theft, and breakage risk of equipment ・ Easy accessibility	・ Located within or nearby the watershed of target area ・ High altitude ・ Appropriate observation environment is ensured ・ No theft, and breakage risk of equipment ・ Easy accessibility

Governmental land is appropriate for installation of equipment.

Location Map of Met. Station

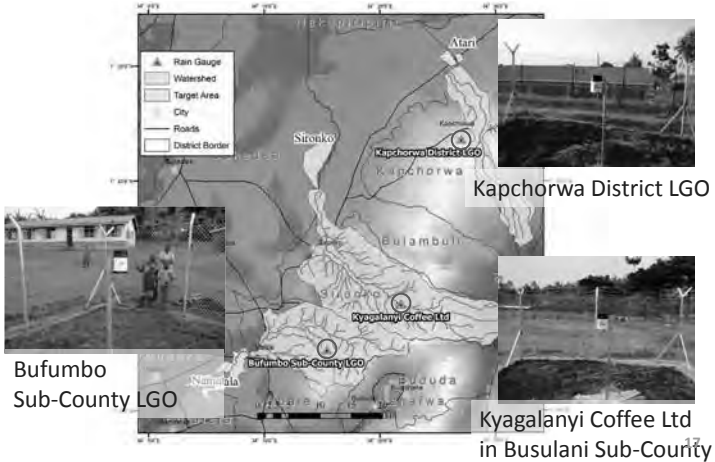


Atari Health Center II

Kamonkoli Sub-County LGO

Bukhalu Health Center III

Location Map of Rain Gauge Station



Kapchorwa District LGO

Bufumbo Sub-County LGO

Kyagalanyi Coffee Ltd in Busulani Sub-County

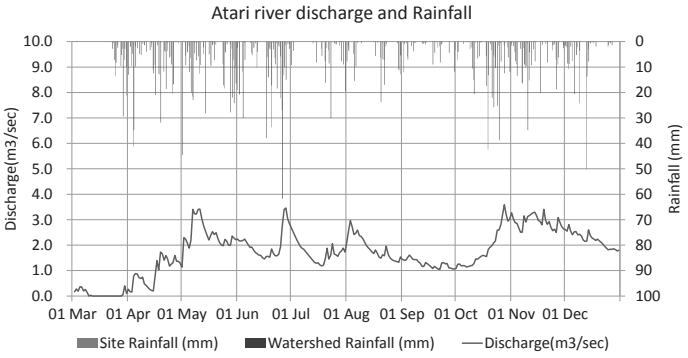
OBSERVED DATA

Present situation of Observation

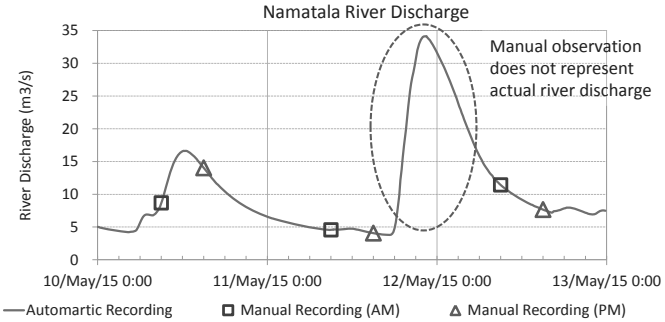
Year	2015										2016		
Month	Mar.	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Water level gauge													
Atari	■	■	■	■	■	■	■	■	■	■	■	■	■
Sironko	■	■	■	■	■	■	■	■	■	■	■	■	■
Namatala	■	■	■	■	■	■	■	■	■	■	■	■	■
Weather station													
Atari	■	■	■	■	■	■	■	■	■	■	■	■	■
Sironko	■	■	■	■	■	■	■	■	■	■	■	■	■
Namatala	■	■	■	■	■	■	■	■	■	■	■	■	■
Rain gauge													
Atari	■	■	■	■	■	■	■	■	■	■	■	■	■
Sironko	■	■	■	■	□	□	■	■	■	■	■	■	■
Namatala	■	■	■	■	■	■	■	■	■	■	■	■	■

HYDROLOGICAL DATA

Observed Data
Namatala River Discharge Data



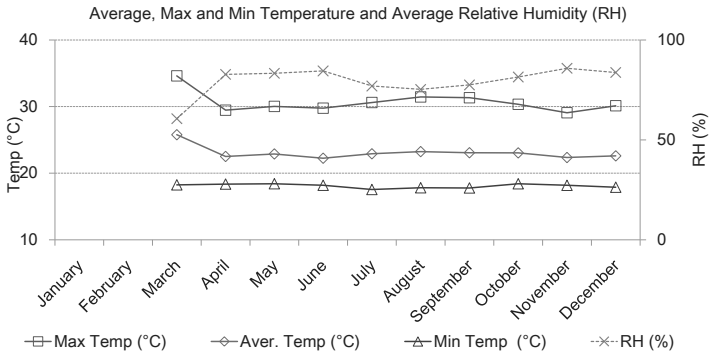
Comparison of Automatic and Daily Manual Observation



Average Discharge	10th May	11th May	12th May
Automatic	9.23 m3/s	**10.00** m3/s	12.84 m3/s
Manual	11.36 m3/s	**4.32** m3/s	9.55 m3/s

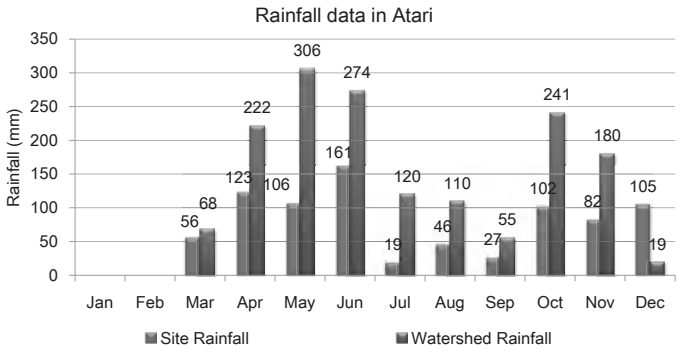
METEOROLOGICAL DATA

Observed Data
Meteorological Data in Kamonkoli S/C



- There is no big difference between Temperature and RH throughout the observation period.

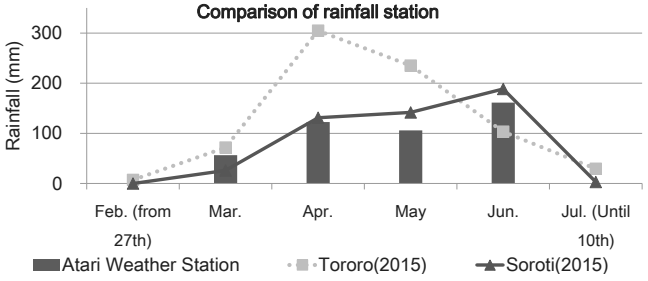
Observed Data
Comparison of Rainfall Data



- Rainfall in Watershed is higher than that one in target area

Comparison of Rainfall

- Weather station was newly installed in Atari Health Center II in February 2015
- Trend of rainfall in Soroti is more similar than that in Tororo



Any questions?

END

Lecture 1-2
Development of H-Q (rating) Curve

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Objectives

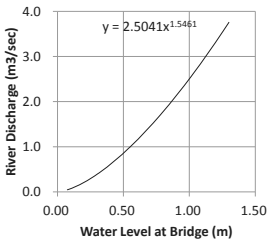
- To learn function of H-Q (rating) curve and understand how to observe necessary data and generate H-Q curve.

Table of Contents

- What is H-Q curve ?
- Function of H-Q curve
- Observation of necessary data
- Generation of H-Q curve
  - Exercise

What is H-Q (Rating) curve

- "**Rating curve** is a graph of discharge versus stage for a given point on a stream, usually at gauging stations, where the stream discharge is measured across the stream channel with a flow meter." *–Wikipedia*

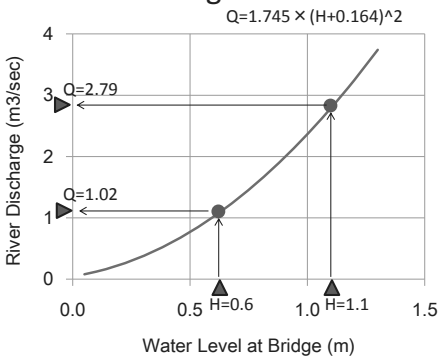


What is H-Q (Rating) curve

- Generally, contentious observation of River discharge is hard compare to observation of river water level.
- H-Q curve have a big influence on amount of water resource

Function of H-Q curve

- To covert water level to discharge
- When H=1.1
  - Q=0.279
- When H=0.6
  - Q=1.02



Observation of necessary data

- Observation of necessary data to generate H-Q curve
  - Water level observation (H)
  - Velocity measurement (V)
  - Measurement of Area of Cross section (A)

Water level observation

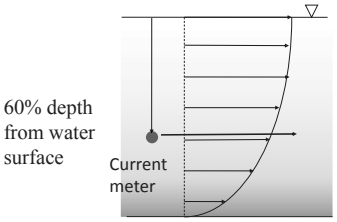
- Manual type
- Float type
- Pressure type
- Non-contact type

Velocity measurement

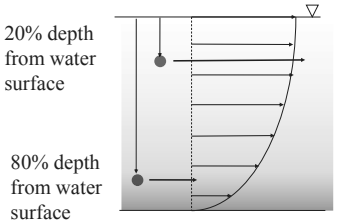
- Acoustic Doppler Current Profiler (ADCP)
- Current meter
  - Rotary type
  - Electromagnetic type

Velocity measurement

- Water level : Less than 1m



- Water level : more than 1m

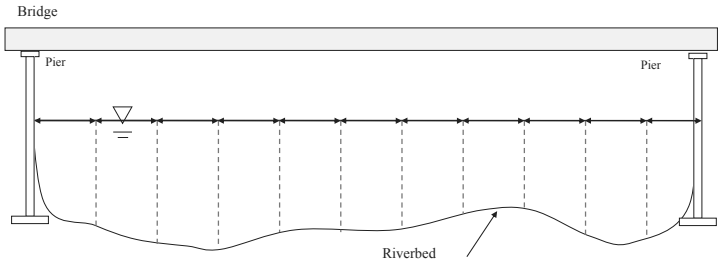


Velocity measurement

Velocity measurement

Measurement of Area of Cross section

- Measurement was conducted every time of velocity measurement
- Pith is adjusted to be less than 1m.



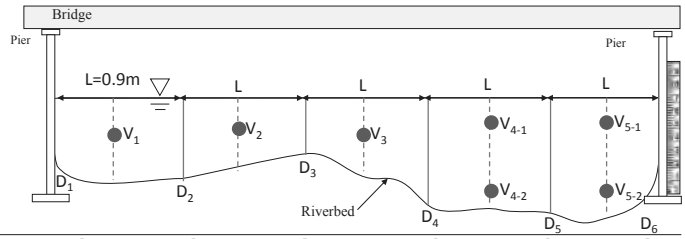
Measurement of Area of Cross section

Tape measure: Measurement of river width

Surveying pole : Measurement of Depth of river at the inside of the river in the dry season.

Exercise:2-1 Circulation of cross section and river discharge

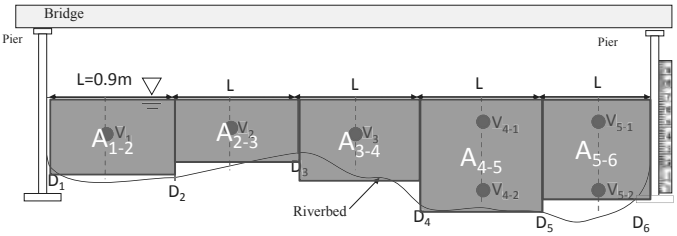
- Water level gauge :1.7m
- D=Depth, L=Width, V=Velocity



Depth (m)	D1 0.6	D2 0.7	D3 0.6	D4 1.2	D5 1.2	D6 1.1
Width (m)	Section 1-2 0.9	Section 2-3 0.9	Section 3-4 0.9	Section 4-5 0.9	Section 5-6 0.9	
Velocity (m/s)	V1 0.4	V2 0.3	V3 0.4	V4-1 0.7 V4-2 0.5	V5-1 0.6 V5-2 0.5	

Exercise:2-1 Tips

- Area of cross section 1-2(A_{1-2}) : (D1+D2)/2 × L
- Discharge of cross section 1-2 :A_{1-2} × V1



H-Q Curve Equation

- H-Q curve is generally represented by equation below.

$$Q = a(h + b)^2$$

  - Q:River discharge (m3/s)
  - H: river water level (m)
  - a,b :constants.
- Constant *a* and *b* is obtained by following manner.
  - Plot the square root of river discharge Q and water level h as scatter diagram.
  - Linear equation of √Q=Ah+B is obtained by the least-squares method, then constants are obtained follows.
    $a=A^2$, $b=B/A$

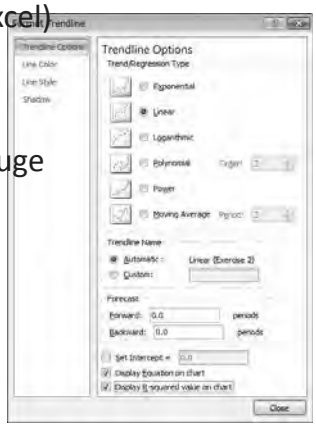
Exercise:2-2 Generation of H-Q curve

No.	Water Level Gauge (m)	Observed Discharge (m^3/s)
1	1.79	2.909
2	1.90	3.368
3	1.93	3.294
4	2.40	6.116
5	2.26	4.751
6	1.48	1.636
7	2.06	3.612
8	1.99	3.527
9	1.95	3.640

Observation period : observed only ordinary flow in rainy season

Exercise:2-2 Tips

- Calculate √Q (=Q^0.5 on Excel)
- Make “scatter chart”
- Plot X axis: Water Level Gauge
  Plot Y axis: √Q
- “Add Trendline”



Exercise:2-3 Generation of H-Q curve

No.	Water Level Gauge (m)	Observed Discharge (m^3/s)	
1	1.79	2.909	
2	1.90	3.368	
3	1.93	3.294	
4	2.40	6.116	
5	2.26	4.751	
6	1.48	1.636	
7	2.06	3.612	
8	1.99	3.527	
9	1.95	3.640	
10	1.25	0.326	Observation in dry season
11	1.25	0.335	
12	1.24	0.297	
13	4.12	16.373	➡ Flood data

Exercise:2-4 Comparison of H-Q curve

- Compare H-Q curve Exe.2 with Exe.3
- Calculate discharge for each water level by using each H-Q curve equation

	Water level (m)						
H-Q Curve Equation	1.2	1.5	2.0	2.5	3.0	4.0	5.0
Exercise 2							
Exercise 3							

Any questions?

END

Lecture 1-3
Analyses of Observed Data

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Objectives

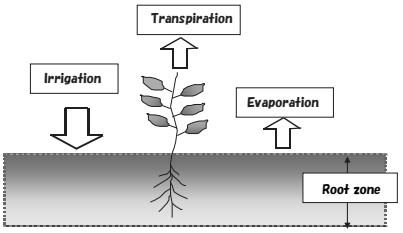
- To understand how to calculate ET_o and to be able to calculate ET_o by using observed Meteorological data thorough CROPWAT.

Table of Contents

- Back ground
- Utilization of observed meteorological data
  – CROPWAT

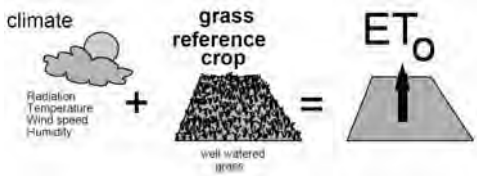
Evapo-Transpiration (ET)

- ET (mm/day) = Evaporation + Transpiration (Required water amount for crop growth)



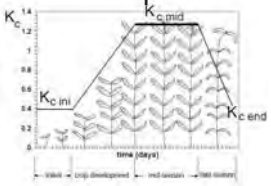
What is ET_o

- Reference crop evapotranspiration (ETo) :
  The evapotranspiration rate from a reference surface, not short of water.
- The reference surface is a hypothetical grass reference crop with specific characteristics.



What is Kc

- Crop Coefficient (Kc):Kc is influenced mostly by crop type and to a minor extent by climate and soil evaporation.
- the Kc for a given crop varies over the crop growing Stages, since ground cover, Crop height and leaf area change as the crop develops.



Various Kc

- **FAO Irrigation and Drainage Paper No. 56**

TABLE 11
Lengths of crop development stages* for various planting periods and climatic regions (days)

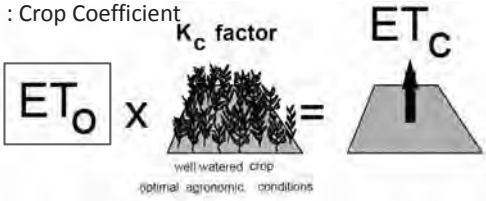
Crop	Init. (L_{ini})	Dev. (L_{dev})	Mid (L_{mid})	Late (L_{late})	Total	Plant Date	Region
a. Small Vegetables							
Broccoli	35	45	40	15	135	Sept	Calif. Desert, USA
Cabbage	40	60	50	15	165	Sept	Calif. Desert, USA
Carrots	20	30	50/30	20	100	Oct/Jan	Arid climate
	30	40					
	30	50					
Cauliflower	35	50					
Celery	25	40					
	25	40					
	30	55					
Crucifers†	20	30					
	25	35					

TABLE 12
Single (time-averaged) crop coefficients, K_c, and mean maximum plant heights for non stressed, well-managed crops in subhumid climates (RH_{min} = 45%, u_2 = 2 m/s) for use with the FAO Penman-Monteith ET_o.

Crop	$K_{c\ ini}$ †	$K_{c\ mid}$	$K_{c\ end}$	Maximum Crop Height (h) (m)
a. Small Vegetables	0.7	1.05	0.95	
Broccoli		1.05	0.95	0.3
Brussel Sprouts		1.05	0.95	0.4
Cabbage		1.05	0.95	0.4
Carrots		1.05	0.95	0.3
Cauliflower		1.05	0.95	0.4
Celery		1.05	1.00	0.6

What is ETc

- The crop evapotranspiration (ETc):
  the evapotranspiration from disease-free, well-fertilized crops, grown in large fields under standard conditions.
- ETc (mm/day) = ETo × Kc
  - ETo : Reference Evapo-Transpiration (mm/day)
  - Kc : Crop Coefficient



FAO Penman-Monteith method

$$ET_o = \frac{0.408\Delta(R_n - G) + \gamma \frac{900}{T+273} u_2 (e_s - e_a)}{\Delta + \gamma(1 + 0.34u_2)}$$

ET_o : reference evapotranspiration [mm day-1],
R_n : net radiation at the crop surface [MJ m-2 day-1],
G : soil heat flux density [MJ m-2 day-1],
T : mean daily air temperature at 2 m height [° C],
u_2 : wind speed at 2 m height [m s-1],
e_s : saturation vapour pressure [kPa],
e_a : actual vapour pressure [kPa],
$e_s - e_a$: saturation vapour pressure deficit [kPa],
Δ : slope vapour pressure curve [kPa ° C-1],
γ: psychrometric constant [kPa ° C-1].

What is CROPWAT

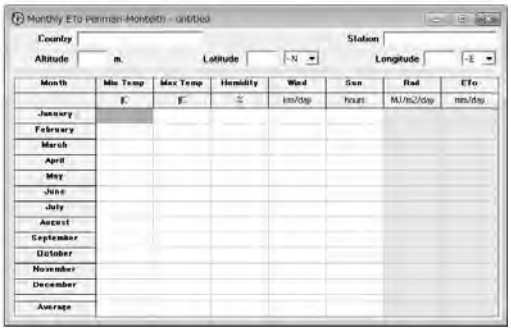
- CROPWAT 8.0 for Windows is a computer programme for the calculation of crop water requirements and irrigation requirements from existing or new climatic and crop data. Furthermore, the program allows the development of irrigation schedules for different management conditions and the calculation of scheme water supply for varying crop patterns.

CROPWAT
version 8.0

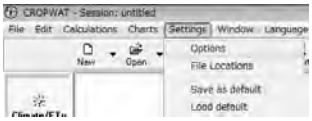
Main CRPWAT window

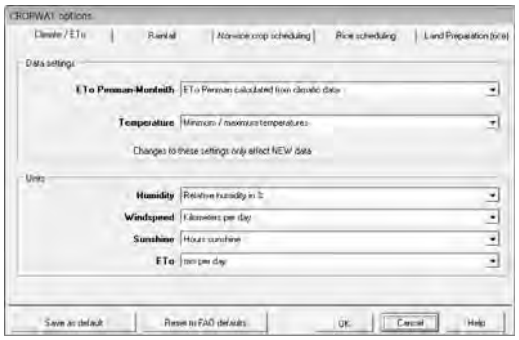
Climate / ETo

- Min and Max Temperature (°C)
  - Average Temperature (°C)



CROPWAT options





Exercise 1 Calculation of ETo in Atari site

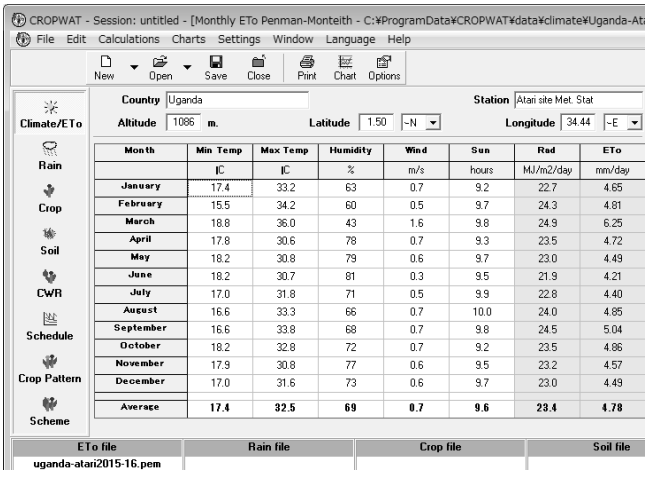
- Country: Uganda
- Station : Atari site Met. Stat.
- Altitude: 1086 m
- Latitude: 1.50° (N)
- Longitude: 34.44° (E)

Exercise 1 Calculation of ETo in Atari site

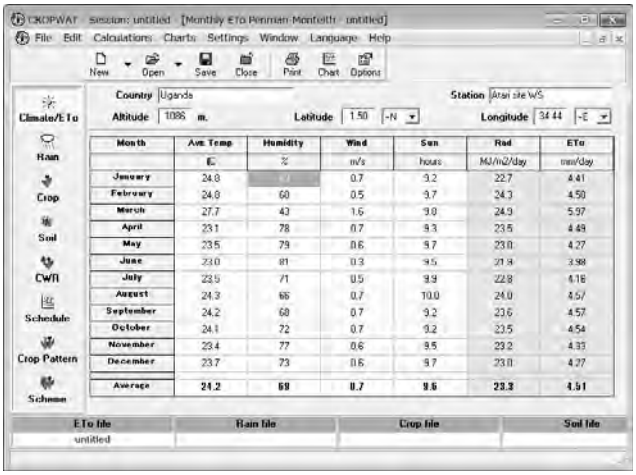
Atari Health Center II Observed Meteorological Data in 2015-16

Month	Hours of Sunlight (Hour)	Solar Irradiation (MJ/m²)	Max Temp (°C)	Aver. Temp (°C)	Min Temp (°C)	RH (%)	Rain fall (mm)	Wind Speed (m/s)	Gust Speed (m/s)
January	9.2	19.0	33.2	24.8	17.4	63	96	0.7	2.2
February	9.7	24.1	34.2	24.8	15.5	60	0	0.5	1.9
March	9.8	23.8	36.0	27.7	18.8	43	56	1.6	4.0
April	9.3	20.8	30.6	23.1	17.8	78	123	0.7	2.1
May	9.7	21.7	30.8	23.5	18.2	79	106	0.6	1.9
June	9.5	20.2	30.7	23.0	18.2	81	161	0.3	1.5
July	9.9	21.6	31.8	23.5	17.0	71	19	0.5	1.8
August	10.0	22.8	33.3	24.3	16.6	66	46.2	0.7	2.1
September	9.8	23.4	33.8	24.2	16.6	68	26.8	0.7	2.1
October	9.2	21.3	32.8	24.1	18.2	72	101.6	0.7	2.2
November	9.5	20.6	30.8	23.4	17.9	77	82.2	0.6	2.1
December	9.7	20.4	31.6	23.7	17.0	73	105.0	0.6	2.0

Answer



Answer



END

Any questions?

Lecture 1-4
Requirement Water & Maintenance Flow

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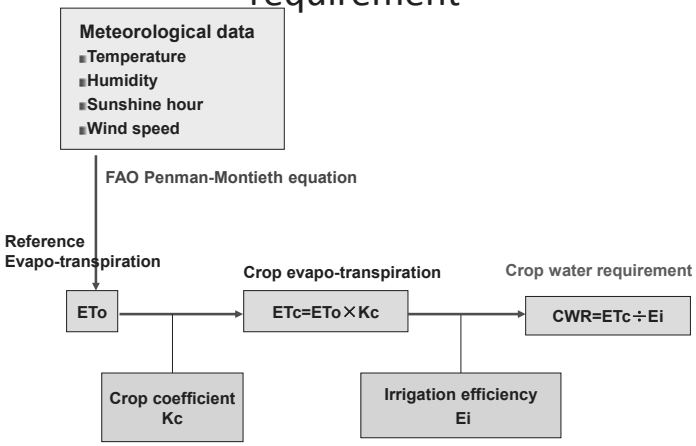
Objectives

- To understand how to calculate crop water requirement by using obtained result of previous lecture.
- To learn the purpose of maintenance flow

Flow of calculation of Crop water requirement



Exercise:4-1 Calculation of Crop evapo-transpiration (Etc)

- ETc (mm/day) = ETo × Kc

ETo : Reference Evapo-Transpiration (mm/day)

Kc : Crop Coefficient

Example

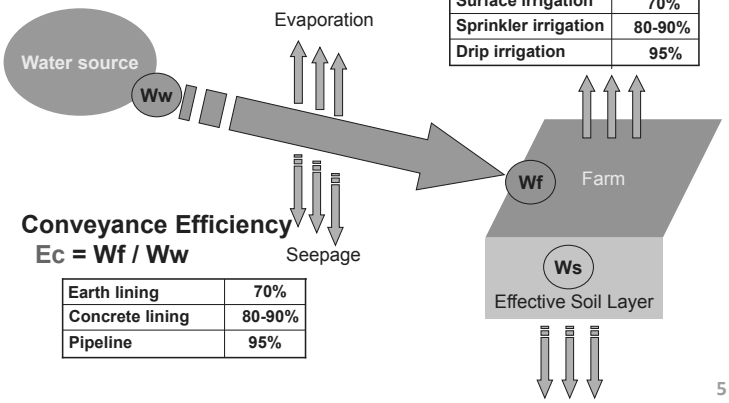
Month	Apr	May	Jun	July	Aug	Sep	Oct
ETo (mm/day)	4.7	4.5	4.2	4.4	4.9	5.0	4.9
Kc (monthly mean)	0.40	0.45	0.90	1.15	1.15	1.15	1.00
ETc (mm/day)	1.9	2	3.8	5.1	5.6	5.8	4.9

Irrigation Efficiency (Ei)

Ei = Ec × Ea

Application Efficiency Ea = Ws / Wf

Surface irrigation	70%
Sprinkler irrigation	80-90%
Drip irrigation	95%



Conveyance Efficiency

Ec = Wf / Ww

Earth lining	70%
Concrete lining	80-90%
Pipeline	95%

Exercise:4-2 Calculation of Crop Water Requirement (CWR)

CWR (mm/day) = ETc ÷Ei

ETc: Crop Evapo-Transpiration (mm/day)

Ei : Irrigation Efficiency

Concrete lining + Surface irrigation=0.85×0.70=0.60(60%)

Example

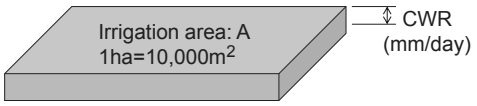
Month	Feb	Mar	Apr	May	Jun	July	Aug
ETc (mm/day)	0.7	1.3	3.5	6.1	7.1	7.2	5.5
Ei	0.6						
CWR (mm/day)	1.2	2.2	6	10.2	11.8	12.0	9.2

Exercise:4-3 Calculation of Irrigation Water Amount (IWA)

IWA=CWR × A × 10 (m³/day)

CWR: Crop Water Requirement (mm/day)

A : Irrigation area(ha)



Example: A=1ha

Month		Apr	May	Jun	July	Aug	Sep	Oct
Number of days		30	31	30	31	31	30	31
CWR (mm/day)		3.2	3.3	6.3	8.5	9.3	9.7	8.2
IWA	m³/day	32	33	63	85	93	97	82
	m³/month	960	1,023	1,890	2,635	2,883	2,910	2,542

River maintenance flow

- Environmental flows :the quality, quantity, and timing of water flows required to maintain the components, functions, processes, and resilience of aquatic ecosystems which provide goods and services to people.
  –*WB web site*

Function of maintenance flow

- Biodiversity conservation (including protection of natural habitats, protected areas, and national parks)
- Food sources such as fish and invertebrates
- Removal of wastes through biogeochemical processes
- Recreational opportunities
- Cultural, aesthetic, and religious benefits.
- Groundwater recharge

Categories of environmental flows methodologies

- Hydraulic rating method
- Habitat simulation method
- Holistic methods
- Hydrologic method
  - Hydrologic statistical analysis
    - 1/10 year probability Drought discharge.

Hydrologic statistical analysis

River Maintenance Flow of Sironko river		
Minimum Discharge in the record :	0.038	m3/s/100km2
Minimum Drought discharge in the record :	0.050	m3/s/100km2
Ten(10) year probability Drought discharge:	0.064	m3/s/100km2

"Drought discharge" is the daily natural discharge that is likely to be equaled or exceeded on 355 days in any given year

Lecture 1-5
Introduction to Water Balance Calculation

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Objectives

- To understand flow and factors of water balance calculation for paddy filed.

Considerable factors

Water requirement

- Crop water requirement
  - Land preparation water
  - Percolation
- Domestic water requirement
- Livestock water requirement
- Industrial water requirement
  - Water right
- Environmental water
  - River maintenance flow

Available water resource

- Effective rain fall
- River discharge

Crop water requirement

- ETc (mm/day) = ETo × Kc
- Land preparation water
  - Puddling water is determined 10 mm /day for 15days.
  - Percolation is considered to be 1 mm/day.
  - Management water requirement in the puddling period is assumed same as ETc.
- Crop water requirement =ETc + Land preparation water

Effective Rainfall

- By using complemented daily rainfall data, effective rainfall is calculated in the following manner.
  1. A daily rainfall less than 5mm is neglected.
  2. If a daily rainfall exceeds more than 5mm/day and less than 80mm/day, 80% of the daily rainfall is considered to be effective.
  3. If a daily rainfall exceeds 80 mm/day, the effective rainfall is considered to be 64 mm/day

Exercise 5-1:Calculation of Effective Rainfall

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Rain fall (mm/day)	0	2.3	0.4	12.7	1.3	19.1	0	0	0	34.8	0	0	7.3	30.1	8.4
Effective Rain (mm/day)	0	0	0	10.2	0	15.3	0	0	0	27.8	0	0	5.8	24.1	6.7

Total of Effective Rainfall (mm/half month)=89.9

Water balance on the filed level

Crop water requirement ≦ Effective rainfall
⇒No need to irrigate

Crop water requirement ＞ Effective rainfall
⇒Irrigation is needed
Crop water requirement － Effective rainfall
＝Net Irrigation Required water
Net Irrigation Required water÷ Irrigation efficiency
＝ Gross Irrigation Required water

Domestic and livestock water requirement

- Life Water Requirement (Domestic water)
  = Water consumption rate (L/day) × Population
- Water Requirement for Livestock

=Tropical Livestock Unit (TLU) × Number of Livestock

- Tropical Livestock Unit (TLU)
  One TLU is equivalent to an animal of 250 kg and the following conversion factors are used for animals in sub-Saharan Africa.
- One TLU consumes 50 l/day
  (Source: National Water Resource Assessment Report, MWE, 2013)

Type of livestock	TLU
Indigenous Cattle	0.70
Exotic or cross breeds Cattle	1.00
Goats	0.15
Sheep	0.15
Pig	0.4
Chicken breeds	0.06

Source: National Water Resource Assessment Report (MWE 2013)

Exercise 5-2: Calculation Domestic and livestock water requirement

Area	Water consumption rate (L/day)	Sironko	
		Population	Life water requirement (L/day)
Rural	40	10,000	400,000
Urban	75	0	0
Total			**400,000**

Area	Life water requirement	
Sironko	400 m3/day	4.6 l/s

Project area	District Name (as of July 2007)	Area of District (km2)	Number of livestock						Total TLU	Density of TLU (TLU/km2)	Density of TLU in Project area (TLU/km2)	TLU in Project area (TLU)
			Indigenous Cattle	Exotic or cross breeds Cattle	Goats	Sheep	Pig	Chicken breeds				
Sironko	Bukedea	1,051	85,537	603	54,810	10,010	23,260	215,250	92,421	88	88	2,156
TLU of each livestock (TLU/No.)			0.7	1	0.15	0.15	0.4	0.06				

Source: Number of Livestock - The National Livestock Census Report 2008 (MAAIF 2010)

	Sironko
TLU	2,156
Water requirement for livestock (l/day)	**107,800**

Project Area:2,450ha
=24.5km2

River discharge

- River discharge at proposed intake site is calculated from observed discharge data by ratio of watershed acreage.

Water balance Culiculation

Water requirement	Available water resource
• **Gross Irrigation Required water × <u>Irrigation area</u>** • Domestic water requirement • Livestock water requirement • Industrial water requirement • Environmental water	• River discharge at intake site

Water balance on the scheme

- River discharge at intake site
  - Domestic water requirement
  - Livestock water requirement
  - Industrial water requirement
  - Environmental water

= Available water amount for Irrigation

- Gross Irrigation Required water ✕ **Irrigation area**

= Required water amount for Irrigation

Irrigation area was calculated and adjusted to be balance Available water amount for Irrigation and Required water amount for Irrigation

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Lecture 1

Determination of Basic Factor

Irrigation Parameters

Parameters

- Irrigation method
- Target crop
- Irrigation period
- Reference Evapo-transpiration (ETo)
- Irrigation Interval
- Irrigation efficiency
- Irrigation hour

- Irrigable Area

RIW＜Available water

⇩

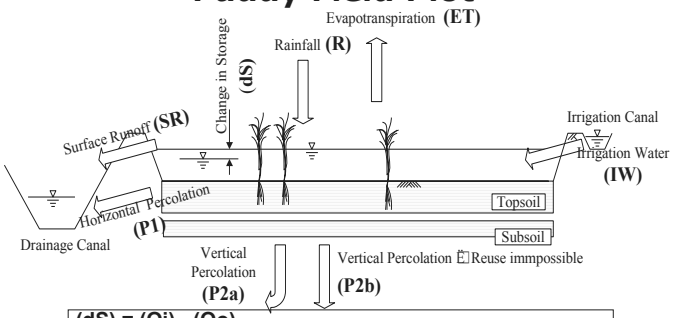
Irrigable Area

RIW＞Available Water

⇩

Water recourse plan

Concept of Water Balance of Paddy Field Plot



(dS) = (Qi) - (Qo)
(Qi) = (IW) + (R)
(Qo) = (ET) + (P) + (SR)
(dS) = (IW) + (R) – (ET) – (P) – (SR)

When the condition of (IW)=0, (R)=0, (SR)=0
(dS) = (ET) + (P1) + (P2)
= Actual Water Requirement

Determination of Basic Factor

- Reference crop evapo-transpiration (ET0)
- Crop coefficient（kc)
- Percolation (mm)
- Puddling water
- Effective rainfall
- Irrigation efficiency (Ep)

Determination of Basic Factor

Basic factors related to the irrigation water requirement had been set referring manual of Crop Water Requirements of Irrigation and Drainage Paper by FAO and other documents.

Item	Adopted Value	Reference
Reference crop evapo-transpiration (ET0)	Tororo (Mean of 1969-1978)	Lake Kyoga Basin Situational analysis final report
Crop coefficient（kc)	Paddy rice: 1.05, 1.10, 0.95	FAO
Percolation (mm)	1.0mm	Typical value in clay
Puddling water	Puddling period: 15day Puddling water: 150mm	Typical value in clay
Effective rainfall	Less than 5mm: 0mm Not less than 5mm and less than 80mm: 80% of the dairy rainfall	Typical method in Japan
Irrigation efficiency (Ep)	60%	National Water Resources Assessment,2013

Crop evapotranspiration （ETc)

- Crop evapotranspiration（ETc)

  ETc = ETo×Kc

  ETo:Reference crop evapotranspiration

  Kc :Crop Coefficient（0.8～1.2）

- ETo is calculated by methodological data.
  - Generally, Penman-Monteith equation is applied.

FAO* Penman-Monteith equation

- Heat balance method
- Radiation and Wind speed

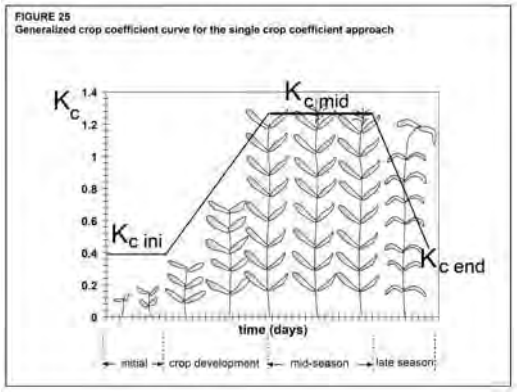
$$ETo\,(mm/day) = \underbrace{\frac{\Delta}{\Delta+\gamma}\cdot\frac{S}{L}}_{\text{Radiation}} + \underbrace{\frac{\gamma}{\Delta+\gamma}\cdot f(u2)\cdot(Esa-Ea)}_{\text{Wind speed}}$$

- Necessary Data for calculation

Daily mean temperature (℃)	Daily mean relative humidity (%)
Sunshine radiation (hour) *dayly or monthly	Daily mean wind speed (m/sec)
Altitude above sea level	latitude of location

*FAO Irrigation and Drainage Paper No.56

Crop coefficient curve



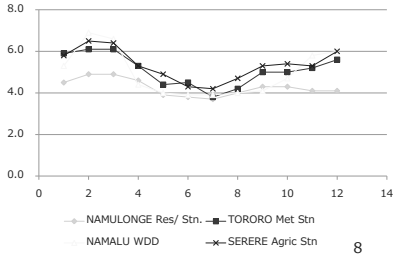
Period (day)		20	30	40	30
Kc	Item	Kcini	Kc dev	Kc mid	Kc end
	Value	1.05		1.20	0.90

ET0

Average daily Evaporation by month in mm/day

TORORO Met Stn Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1969	6.0	5.1	5.9	5.7	4.8	5.4	4.3	5.1	5.6	5.8	5.5	6.1	1,987
1970	6.0	6.1	5.2	6.1	4.5	4.7	4.5	4.1	5.3	4.9	6.3	5.4	1,915
1971	5.6	6.6	7.5	5.4	4.6	4.6	3.8	4.1	5.0	4.9	5.6	5.3	1,913
1972	6.2	5.0	6.2	6.0	4.2	4.4	4.0	4.7	5.8	4.9	4.2	4.8	1,842
1973	5.1	5.7	6.7	5.7	4.8	4.3	3.7	4.0	4.9	5.1	4.2	5.8	1,824
1974	6.7	7.4	6.8	5.5	4.3	4.6	2.9	4.0	xx	5.3	5.1	5.5	
1975	5.9	7.4	5.1	5.0	4.1	4.2	3.3	3.3	4.1	4.4	5.8	5.1	1,747
1977	4.8	5.2	5.1	4.5	3.9	4.1	3.5	4.3	5.9	5.9	5.3	7.2	1,815
1978	7.2	6.3	6.0	4.2	4.6	4.5	4.2	3.9	3.6	4.1	5.0	4.9	1,777
Average	**5.9**	**6.1**	**6.1**	**5.3**	**4.4**	**4.5**	**3.8**	**4.2**	**5.0**	**5.0**	**5.2**	**5.6**	**1,853**

Source; NELSAP/NBI, BRL Ingénierie, (April 2012), "Lake Kyoga Basin Situational analysis Final version"



Puddling water and period

- Puddling Water Requirement summarized from the actual condition is often estimated as the range.

Condition of paddy field	Puddling Water Requirement (mm/day)	Hydraulic conductivity (m/sec)		
		Below 10^{-7}	10^{-7}~10^{-5}	Above 10^{-5}
Well-drained	80~120	80~100	100~120	120
Ill-drained	120~180		120~150	150~180
Over-percolation	150~250			Above 150

- Puddling Period : 15days
  - Puddling Period is the important factor at the time of determining maximum Design Water Requirement
  - The longer this period is set up, the smaller facility capacity can be made.

Crop coefficient (Kc)

- The coefficient is the standard value sorted into the group of evapo-transpiration properties.

Kind of crops	Seeding and Permanent planting	Growth period	Full-ripe stage/ Harvest season
Maize (field corn)	0.30	1.20	0.60, 0.35
Sugar cane	0.40	1.25	0.75
Roots and tubers	0.5	1.10	0.95
Rice	**1.05**	**1.20**	**0.90-0.60**

Effective rainfall

- Effective Rainfall is a part of rainfall in the farmland which is useful for the growth of crops.
- It is the amount of supply expected as the irrigation water on the design irrigation plan.

  - Effective Rainfall (ER : mm/day) = R × 0.8

    where

    5 mm< R (Daily Rainfall) <= 80 mm

Irrigation efficiency (Ep)

- Conveyance efficiency (Ec)
- Field efficiency (Eb)
- Application efficiency (Ea)

- Ep=Ec x Eb x Ea

  Exp.

  Ep = 0.9 x0.8 x 0.8

  = 0.58

  ≒ 0.6

Irrigation Efficiency

Ec; Conveyance efficiency		
Continuous supply with no substantial change in flow		0.9
Rotational supply in projectsof 3,000-7,000ha and rotationareas of 70-300ha,with effective management		0.8
Rotational supply in large schemes(>10,000ha) and small schemes(<1,000ha) with respective problematic communication and less effective management:		
based on predetermined schedule		0.7
based on advance request		0.6
Eb; Field canal efficiency		
Blocks larger than 20ha		
	unlined	0.8
	lined or piped	0.9
Blocks up to 20ha		
	unlined	0.70
	lined or piped	0.80
Ea; Application efficiency		
Surface methods		
	light soils	0.55
	medium soils	0.70
	heavy soils	0.60
graded border		0.60 - 0.75
basin and level border		0.60 - 0.80
contour ditch		0.50 - 0.55
furrow		0.55 - 0.70
corrugation		0.50 - 0.70
Subsurface		up to 0.80
Sprinkler	hot dry climate	0.60
	mederate climate	0.70
	humid and cool	0.80

CASE 2:
After Project with Lining Canal

- Condition
  - Open Canal
  - Concrete Lining by Project
  - Well Managed after training

- How much is Irrigation Efficiency (Ep)?
- How much does increase Irrigable Area comparing without project?

CASE 1: Earth Canal
CASE 2: Lining Canal

PRACTICE 1

Lecture 2

Design Water Requirement and Irrigable Area

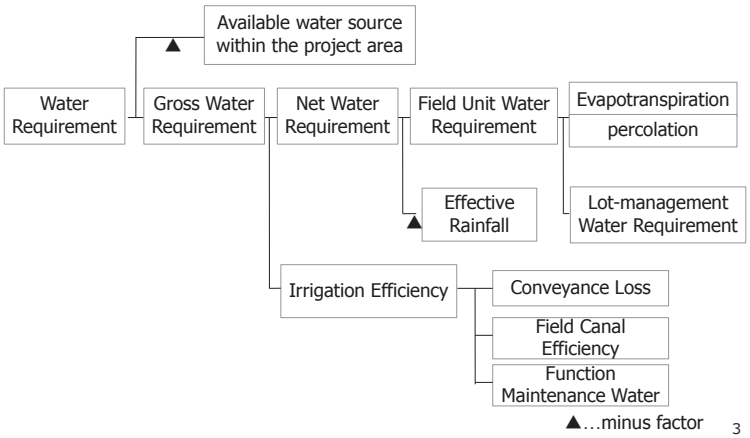
CASE 1:
Before Project with Earth Canal

- Condition
  - Open Canal
  - Earth Canal
  - Mal Management

- How much is Irrigation Efficiency (Ep)?

Contents

Component of Design Water Requirement



Calculation of Water Requirement

(1) Water Requirement for irrigable area (with rainfall)

a. Field Unit Water Requirement (FUWR)
= Evapotranspiration + percolation + Lot-management Water Requirement

b. Net Water Requirement (NWR) = (FUWR **– Effective rainfall**) × Irrigation Area

c. Gross Water Requirement (GWR) = NWR / Irrigation Efficiencies

(2) Water Requirement for determining the capacity/ dimension of facilities (without rainfall)

a. Field Unit Water Requirement (FUWR)
= Evapotranspiration + percolation + Lot-management Water Requirement

b. Net Irrigation Water Requirement (NIWR)
= Maximum Field Unit Water Requirement × Irrigation Area

c. Gross Irrigation Water Requirement (GIWR) = NIWR / Irrigation Efficiency

Field Unit Water Requirement for Paddy Field

- Field Unit Water Requirement
  = Evapotranspiration
  + Percolation
  + Lot-management Water Requirement
- Field Unit Water Requirement is divided into two stage
  - Water Requirement in Ordinary Period (for the paddy-rice growth stage)
  - Water Requirement in Paddling Period (Initial Water)

Water Requirement in Ordinary Period

- Formula

$$Q1 = \frac{d1}{8{,}640} \times \frac{1}{E_P} \times A$$

where
Q1 : Water Requirement in ordinary period (m3/s)
d1 : Evapotranspiration (mm/day)
A : Planning area (ha)
Ep : Irrigation efficiency

Maximum Water Requirement in Ordinary period

PRACTICE 1

Practice 1: Maximum Water Requirement in Ordinary period

Assumption

Panning Area = 1,000 ha
Percolation = 1.0 mm/day
Irrigation efficiency = 60%
Kc =1.0

Average Daily Evaporation by Month in mm at Tororo meteorological station

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Evapotranspiration (mm)	5.9	6.1	6.1	5.3	4.4	4.5	3.8	4.2	5.0	5.0	5.2	5.6

Water requirement during paddling period

- Area equal method

$$q_i = \frac{A}{n}q + \frac{A}{n}d\,(i-1)$$

$$q_{max} = \frac{A}{n}\,(q+(n-1)\,d)$$

$$a_i = \frac{A}{n} \quad (=\text{constant})$$

1	3	5	7	9
2	4	6	8	10

1	3	5	7	9
2	4	6	8	10

- Water equal method

$$q_i = q_{max}\ (=c) = \frac{d \cdot A}{1-\left(\frac{q-d}{q}\right)} \quad (=\text{constant})$$

$$Q = c \cdot n = \frac{d \cdot A \cdot n}{1-\left(\frac{q-d}{q}\right)}$$

$$a_i = \frac{(q-d)^{i-1}}{q^{\,i}} \cdot \frac{d \cdot A}{1-\left(\frac{q-d}{q}\right)}$$

Area Equal Method

$$q_i = \frac{A}{n}q + \frac{A}{n}d\,(i-1)$$

$$q_{max} = \frac{A}{n}\,(q+(n-1)\,d)$$

$$a_i = \frac{A}{n} \quad (=\text{constant})$$

1	3	5	7	9
2	4	6	8	10

where

qi : Water Requirement of i -th day from puddling start day

i : Days from puddling start day

qmax : Maximum Water Requirement of Puddling Period

q : Puddling Water Requirement

n : Puddling Period

d : Unit Water Requirement after puddling

A : Planning area

ai : Puddling area of i-th day from puddling start day

Maximum Water Requirement in Paddling period (Initial water)

PRACTICE 2

Practice 2: Maximum Water Requirement in Paddling period

Assumption

- Panning Area = 1,000ha
- Irrigation efficiency = 60%
- Puddling water: 150mm
- Puddling period: 15day
- d : Unit Water Requirement after puddling: 7.1mm
- Area equal method

$$Q2 = \frac{q+(n-1)d}{n} \times \frac{1}{8{,}640} \times \frac{1}{E} \times A$$

Practice 3: Determination of Irrigable Area

	Sironko	Atari
Season	Oct 15th to 31st	July 1st to 15th
River Discharge (m3/s)	1.08	0.80
Domestic Water (m3/s)	-0.005	-0.005
Livestock Water (m3/s)	-0.001	-0.001
Maintenance Flow (m3/s)	-0.21	-0.17
Available River Discharge (m3/s)		
Effective Rainfall (mm/day)	3.18	0.93
Irrigation Water Requirement (mm/day)	7.0	5.56
Unite Gross Irrigation Required (m3/s/ha)		
Irrigable Area (ha)		

Practice 3: Irrigable Area in Sironko

Assumption

- Ordinal Period
- Critical Period : Oct 15th to 31st

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Evapotranspiration (mm)	5.9	6.1	6.1	5.3	4.4	4.5	3.8	4.2	5.0	5.0	5.2	5.6

- Kc : 1.20
- Percolation : 1.0 mm/day
- Irrigation Efficiency : 60%
- Effective rainfall : 3.18 mm/day

How much the Unite Field Water Requirement ?

How much the Unite Gross Irrigation Requirement ?

- Available River Discharge : 0.864 m3/s

How much the Irrigable Area ?

Appropriate Cropping Calendar

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Evapotranspiration (mm)	5.9	6.1	6.1	5.3	4.4	4.5	3.8	4.2	5.0	5.0	5.2	5.6

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Optimum Development Scale

Irrigable Area in various crapping pattern

CASE	1st Season	Irrigable Area (ha)	2nd Season	Irrigable Area (ha)	Total Irrigation Area (ha)	Cropping Intensity
1	End of March -	120	End of June -	330	450	136%
2	Early April -	570	Early August -	1160	1630	149%
3	End of April -	480	End of August -	510	990	194%
4	Early May-	570	Early Sep. -	410	980	172%
5	End of May	340	End of Sep.-	420	760	181%

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Water Requirement in Paddling period

Assumption

- Panning Area = 1,000ha
- Irrigation efficiency = 60%
- Puddling water: 150mm
- Puddling period: 15day
- d : Unit Water Requirement after puddling: **5.3mm**
- Kc : 1.05
- Area equal method

$$Q2 = \frac{q+(n-1)d}{n} \times \frac{1}{8{,}640} \times \frac{1}{E} \times A$$

Q = (q + (n – 1) d) / 8640 / E x A
= (150 + (15 – 1) x5.57) / 15 / 8640 / 0.6 x 1000
= 2.932 m3/s

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Water requirement in Paddling period

$$Q2 = \frac{q+(n-1)d}{n} \times \frac{1}{8{,}640} \times \frac{1}{E} \times A$$

$$Q2 = (\frac{q}{n} + d1 + d2) \times \frac{1}{8{,}640} \times \frac{1}{E} \times A$$

where

Q2 : Water Requirement in paddling period (m3/s)
q : Puddling Water (mm)
n : period of paddling (day)
d1 : Evapotranspiration (mm/day)
d2 : Percolation
A : Planning area (ha)
E : Irrigation efficiency

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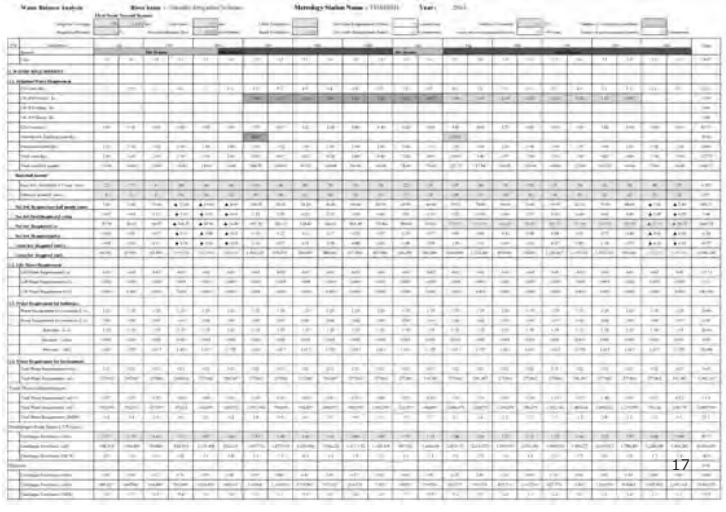
Water Balance Calculation



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ANSWER

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Practice 1: Maximum Water Requirement in Ordinary period

Assumption

Panning Area = 1,000 ha
Percolation = 1.0 mm/day
Irrigation efficiency = 60%
Kc =1.0

Average Daily Evaporation by Month in mm at Tororo meteorological station

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Evapotranspiration (mm)	5.9	6.1	6.1	5.3	4.4	4.5	3.8	4.2	5.0	5.0	5.2	5.6

Q = d1 / 8640 / Ep x A
= (6.1 + 1.0) / 8640 / 0.6 x 1000
= 1.370 m3/s

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Practice 2: Maximum Water Requirement in Paddling period

Assumption

- Panning Area = 1,000ha
- Irrigation efficiency = 60%
- Puddling water: 150mm
- Puddling period: 15day
- d : Unit Water Requirement after puddling: 7.1mm
- Area equal method

$$Q2 = \frac{q + (n-1)d}{n} \times \frac{1}{8{,}640} \times \frac{1}{E} \times A$$

Q = (q + (n – 1) d) / 8640 / E x A
= (150 + (15 – 1) x 7.1) / 15 / 8640 / 0.6 x 1000
= 3.207 m3/s

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Practice 3: Irrigable Area in Sironko

Assumption

- Ordinal Period
- Critical Period : Oct 15th to 31st

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Evapotranspiration (mm)	5.9	6.1	6.1	5.3	4.4	4.5	3.8	4.2	5.0	5.0	5.2	5.6

- Kc : 1.20
- Percolation : 1.0 mm/day
- Irrigation Efficiency : 60%

How much the Unite Field Water Requirement ?

- Effective rainfall : 3.18 mm/day

How much the Unite Gross Irrigation Requirement ?

- Available River Discharge : 0.864 m3/s

How much the Irrigable Area ?

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Determination of Irrigable Area

Critical Point

	Sironko	Atari
Season	Oct 15th to 31st	July 1st to 15th
River Discharge (m3/s)	1.08	0.80
Domestic Water (m3/s)	-0.005	-0.005
Livestock Water (m3/s)	-0.001	-0.001
Maintenance Flow (m3/s)	-0.21	-0.17
Available River Discharge (m3/s)	0.864	0.624
Effective Rainfall (mm/day)	3.18	0.93
Irrigation Water Requirement (mm/day)	7.0	5.56
Unite Gross Irrigation Required (m3/s/ha)	0.00074	0.00089
Irrigable Area (ha)	**1,160**ha	**700**ha

Unite GIR = (7.0 – 3.18) / 8640 / 0.6 =0.00074 m3/s/ha
Irrigable Area = 0.865 / 0.00074 = 1,167 → 1,160 ha

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Lecture 3

Layout and Irrigation Network Schematic

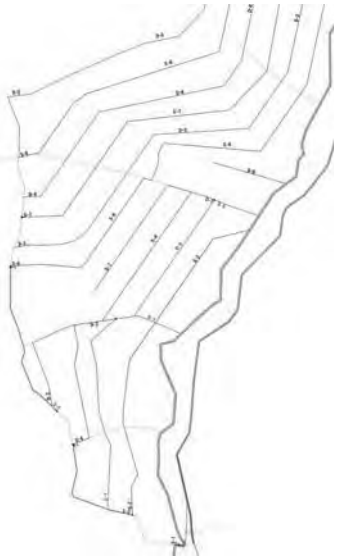
1

Contents

- Layout of Irrigation Canal
  - Example of Sironko
  - Example of Atari
- Irrigation network schematic
  - Practice : Development of irrigation network schematic

2

Sironko site



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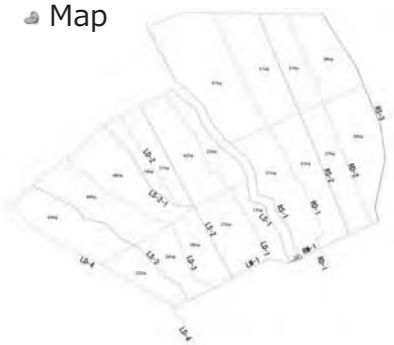
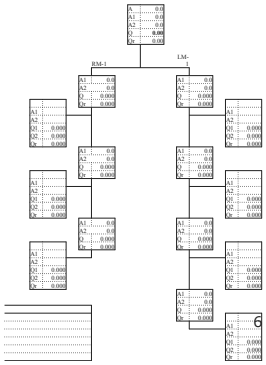
PRACTICE 4: Exp. Atari Irrigation Network Schematic

Condition

- File Name :
  - Practice4_Irrigation Network Schematic.xls
- Map





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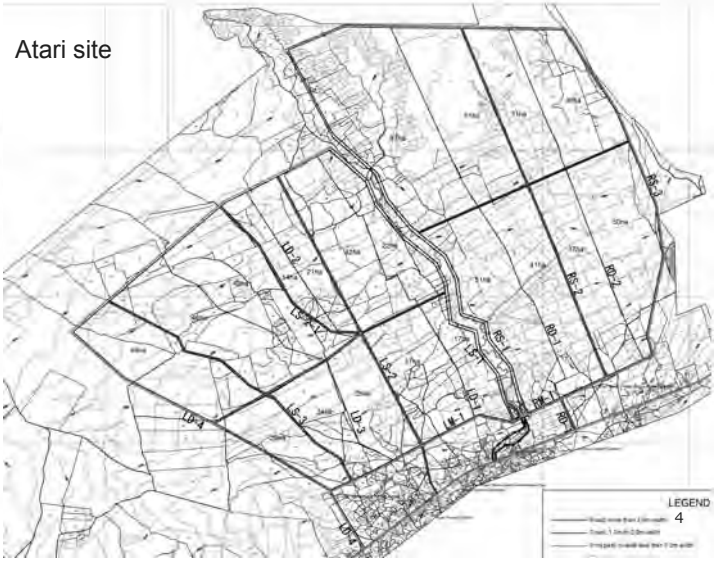
Atari site



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Estimation of Irrigable Area

		Right Hand Side			Left Hand Side				
		RS-1	RS-2	RS-3	LS-1	LS-2	LS-2-1	LS-3	Total
Plot Area									
Total		0	0	0	0	0	0	0	0
Rate of land decrease	94%	0	0	0	0	0	0	0	0
Rate of Paddy Field		90%	90%	90%	90%	90%	60%	60%	
Paddy Acarage	ha	0	0	0	0	0	0	0	0
Upland Field		10%	10%	10%	10%	10%	40%	40%	
Upland Field Acarage	ha	0	0	0	0	0	0	0	0

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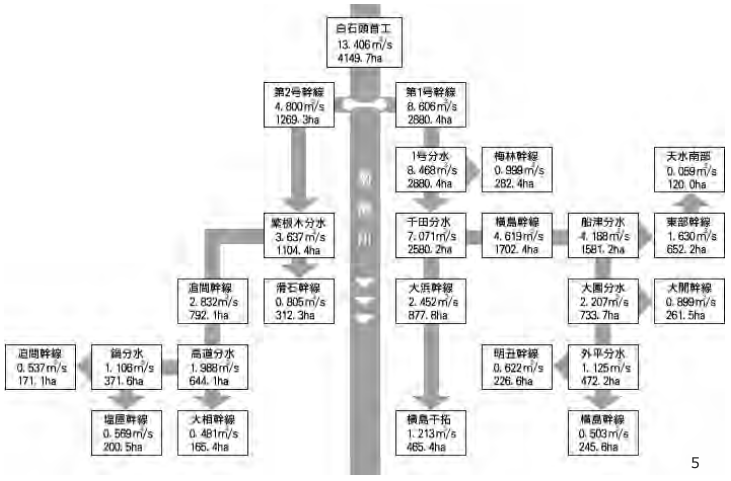
Exp. Irrigation Network Schematic



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PRACTICE 4: Exp. Atari Irrigation Network Schematic

Assumption

Irrigation Area for paddy and upland

		Right Hand Side			Left Hand Side				
		RS-1	RS-2	RS-3	LS-1	LS-2	LS-2-1	LS-3	Total
Total		138	160	89	39	126	62	136	750
Paddy Acarage	ha	117	135	76	33	106	35	77	579
Upland Field Acarage	ha	12	14	8	3	11	14	31	93

Basic Factor for Irrigation

Puddling water	150 mm
Puddling period	15 day
Irrigation Efficiency	0.6
ETc during puddling period	5.57 mm
Percolation	1 mm/day
Effective Rainfall	0 mm/half month
Unite Gross Water Requirement	0.003196 m3/s/ha

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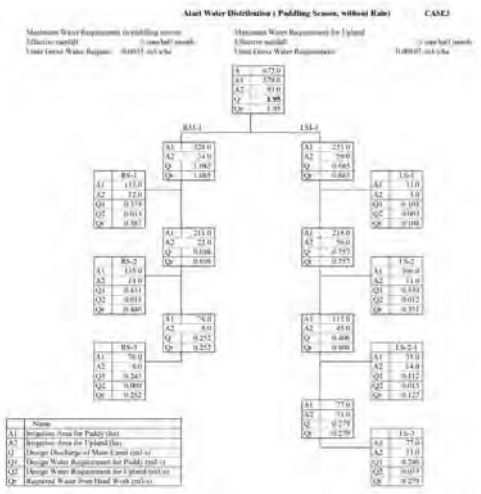
ANSWER

Contents

Irrigation network schematic



Classification of open channel flow

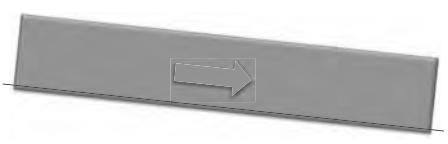
- Steady uniform flow (uniform flow)
  - A flow which remains **constant** independent of **time** and **location**.
- Steady non-uniform flow (as non-uniform flow)
  - A flow which remains constant independent of time, but **changes depending on location**.
- Unsteady non-uniform flow (unsteady flow)
  - A flow which **changes** depending on both **time and location**.

Lecture 4

Hydraulic design of open channel

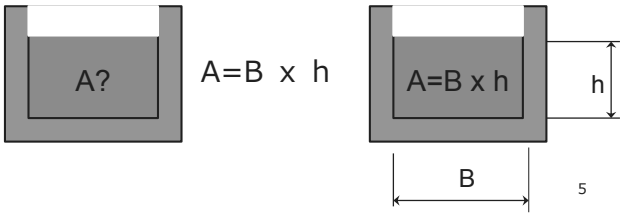
Uniform flow

- It is a state of a constant discharge flow in a canal regardless of the location which has
  - Sufficiently long extension
  - Uniform cross section
  - Uniform slope
  - Constant depth



Flow down discharge

- $Q = A \bullet V$
- *Where;*
  - Q: Discharge (m^3/s)
  - A: Cross-sectional area of flow (m^2)
  - V: Mean velocity (m/s)



Mean velocity formula for open channel system

- The mean velocity of uniform flow in the open channel system is calculated by the Manning's equation.
- Manning Formula
- $V = 1/n \bullet R^{2/3} \bullet I^{1/2}$
  - V: Mean velocity (m/s)
  - n: Coefficient of roughness
  - R: Hydraulic mean depth (m) R
    = Cross-sectional area of flow (A) /
    Wetted perimeter (P)
  - I: Slope of canal bed
  - P: Wetted perimeter (m)

Coefficient of roughness

Table 6.2.1 Values for coefficient of roughness n

① Lining, retaining wall canal, tunnel, culvert, siphon or aqueduct bridge

Material of canal and its condition	Coefficient of roughness		
	Minimum value	Standard value	Maximum value
Concrete (cast-in-place flume, culverts, etc.)	0.012	0.015	0.016
Concrete (shotcrete)	0.016	0.019	0.023
Concrete (prefabricated flume pipe group)	0.012	0.014	0.016
Concrete (reinforced concrete pipe)	0.011	0.013	0.014
Concrete block masonry	0.014	0.016	0.017
Cement (mortar)	0.011	0.013	0.015

② Canals constructed by excavation or dredging

Material of canal and its condition	Coefficient of roughness		
	Minimum value	Standard value	Maximum value
Earth, straight and uniform			
1. No weed (immediately after completion of the canal)	0.016	0.018	0.020
2. No weed (after the canal has been exposed to weather)	0.018	0.022	0.025
3. Gravels (no weed)	0.022	0.025	0.030
4. Few weeds with short grasses	0.022	0.027	0.033
Earth, curved and non-uniform			
1. No vegetation coverage	0.023	0.025	0.030
2. Some weeds	0.025	0.030	0.033
3. Dense growth of weeds or water weeds	0.030	0.035	0.040
4. The bottom is earth, and the side walls are covered by rubble stones.	0.028	0.030	0.035
5. The bottom is covered by stones, and the side walls are covered by weeds.	0.025	0.035	0.040
6. The bottom is covered by cobble stones, and the side walls have no weed.	0.030	0.040	0.050

Allowable velocity

- Minimum allowable velocity

Condition of canal	Minimum allowable velocity
Canal where concerns regarding deposition of floating sediment do exist.	0.45 - 0.90 m/s
Canal where concerns regarding overgrowth of water weed do exist.	0.70 m/s

- Maximum allowable velocity

Type of material	Velocity (m/s)	Classification	Velocity (m/s)
Sandy soil	0.45	Thick concrete (approximately 18 cm)	3.00
Sandy loam	0.60	Thin concrete (approximately 10 cm)	1.50
Loam	0.70	Asphalt	1.00
Clayey loam	0.90	Block cavity wall (buttress pier less than 30 cm)	1.50
Clay	1.00	Block mortar masonry	2.50
Sandy clay	1.20	Reinforced concrete pipe	3.00

Stability of the flow

- It is considered to be largely dependent on the velocity
- The flow of the irrigation canal shall be within the subcritical flow range as a general rule
- It is known that the stable water surface can be expected at least
  - $V \leqq 2/3\ Vc$ (Fr=0.54)

Determination of the cross-section of uniform flow

PRACTICE 5

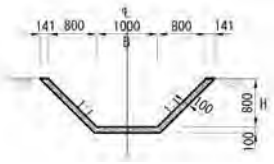
Practice 5

Condition

- Main canal : Trapezoidal shape
- Canal Type : Concrete Lining
- Uniform flow : Manning formula
- Design Discharge : Q=1.96m3/s

Case.1

Canal Slope : 1/700



Case.2

Canal Slope : 1/500

Case.3

Canal Slope : 1/1000

Case.4

Canal type : Earth canal
Canal slope : 1/700

Freeboard

- Non-lining canals and lining canals

  $Fb = 0.05\,d + \beta \bullet hv + hw$

  Where;

  Fb: Freeboard (m)

  d : Water depth (m)

  hv : Velocity head (m)

  β : Conversion factor from velocity head to static head, ranging 0.5 - 1.0

  hw : Freeboard for water surface vibration (m)

- Retaining wall canals

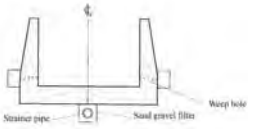
  $Fb = 0.07\,d + \beta \bullet hv + hw$

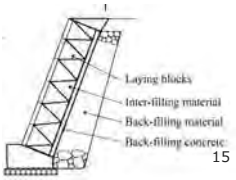
Hydraulically favorable cross-sections

- When a flow area *A is given, a channel cross-section with the shortest length of wetted perimeter p* is capable for the largest quantity of flow.
- Such a cross-section is called the most hydraulically effective cross-section, and it is generally accepted that cross-sections close to the most effective cross-section are usually most cost effective as well.

Type of Open Canal

- **Concrete lining canals**
  - A concrete lining canal is a canal where concrete is used for a pavement material.
  - Thickness of linings: around 10 cm as a standard
  - Bottom width/depth ratio : about 1:1 to 2:1
  - Gradient of slope : range of 1:1 to 1:1.5
- **Flumes**
- **Concrete block masonry canals**
- **Unlined canals (Drainage)**





The most hydraulically effective cross-sections for trapezoid and rectangular cross-sections

$$b = 2H \cdot \tan(\theta/2) \quad \text{.....(8.1.1)}$$

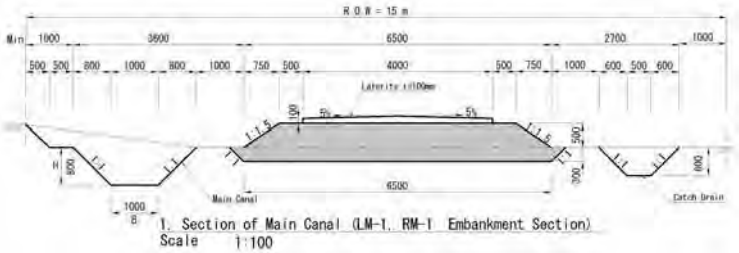
$$H = \sqrt{\frac{A \cdot \sin\theta}{2 - \cos\theta}} \quad \text{.....(8.1.2)}$$

H: Water depth (m)
B: Width of water surface (m)
b: Width of channel bed (m)
θ: Angle between sidewall and horizontal plane (°)
m: Gradient of slope (cot*θ*)
ℓ: Slope length (m)
A: Cross-sectional flow area (m^2)

Table 8.1.1 The most hydraulically effective cross-sections and dimensions

m	0.0	0.3	0.5	0.57	1.0	1.25	1.5	2.0
θ	90°	73°18'	63°26'	53°08'	45°	38°40'	33°41'	26°34'
$\sin\theta$	1.000	0.958	0.894	0.800	0.707	0.625	0.555	0.447
$\cos\theta$	0.000	0.287	0.447	0.600	0.707	0.781	0.832	0.894
ℓ/H	1.000	1.044	1.118	1.250	1.414	1.600	1.803	2.236
B/H	2.000	2.088	2.236	2.500	2.828	3.200	3.606	4.472
b/H	2.000	1.488	1.236	1.000	0.828	0.702	0.606	0.472
$H/\sqrt{A}$	0.707	0.748	0.759	0.756	0.739	0.716	0.689	0.636

Typical Cross Section



1. Section of Main Canal (LM-1, RM-1 Embankment Section)
Scale 1:100

Double Section/ Compound Section

PRACTICE 6

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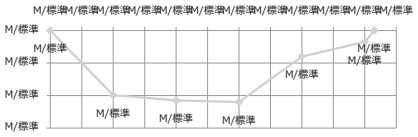
Practice 6-1

Condition

- Protection Dyke : Double section
- Point : Before conjunction of Simu River
- Design Discharge : Q=66m3/s
- River slope : 1/800
- Width of berm : 100m



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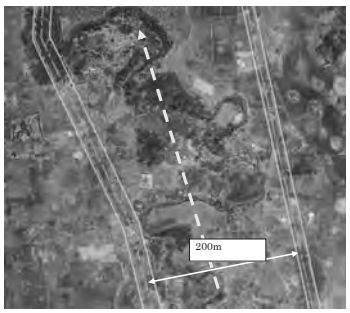
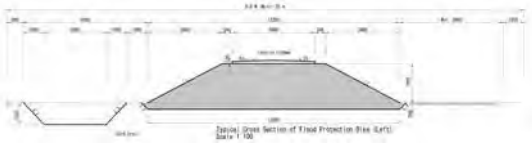
Protection Dyke in Sironko





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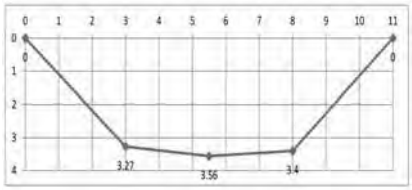
Practice 6-2

Condition

- Protection Dyke : Double section
- Point : After conjunction of Sipi River
- Design Discharge : Q=66m3/s+12m3/s+100m/3s
- River slope : 1/1600
- Width of berm : 100m



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Results of Practice 5

Case			1	2	3	3'	4
Canal type			Con. Lining	Con. Lining	Con. Lining	Con. Lining	Earth
Design Discharge	Q	m3/s	1.960	1.960	1.960	1.960	1.960
Coeficient of roughness	n		0.015	0.015	0.015	0.015	0.030
Slope of canal bed	I		1/500	1/700	1/1,000	1/1,000	1/700
Canal side slope gradient	m		1:1.00	1:1.00	1:1.00	1:1.00	1:1.00
Width of canal bed	b	m	0.700	0.700	0.800	0.700	1.000
depth of uniform flow	h	m	0.800	0.868	0.910	0.946	0.856
Mean velocity	V	m/s	1.632	1.434	1.259	1.259	1.259
Height of canal side wall	H	m	1.026～1.126	1.067～1.167	1.087～1.187	1.124～1.224	1.236～1.336
Froude number (< 0.54 is better)	Fr		0.583	0.493	0.421	0.421	0.261
Determination of Height		m	1.1	1.1	1.1	1.2	1.3

Is Case1 good?

Can we take Case4 (Earth canal) ?

Comparison Case3 and Case3'

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Result of Practice 6

Case			1	2
Canal type			Earth	Earth
Design discharge	Q	m3/s	66	180
Slope of canal bed	I		1/800	1/1,600
Width of river bed	b	m	4.000	5.000
Height of low water revetment	H'	m	2.000	3.000
Berm width	b	m	100.000	100.000
Slope of canal side	m1		1.000	1.000
Slope of bank	m2		2.000	2.000
Depth of uniform flow	h	m	2.399	3.905
Cross-sectional flow area	A	m2	95.283	216.608
Mean velocity	V	m/s	0.6927	0.831
Height of canal side wall	H	m	2.593～2.693	4.186～4.286
Determination of Height		m	**2.6**	**4.2**
Height of embankment		m	0.6	1.2

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6. Training for Design of Irrigation Facility

Time table for Design of Irrigation Facilities Training

Date : 5-6 May 2016

Venue: Fairway Hotel, Kampala, UGANDA

Day 1	Time	Contents	Lecturer
	~9:30	Confirmation of attendance	
	9:30	Opening remark	Mr. Kobayashi
		Outline of the training	Mr. Kobayashi
		Self-introduction	
	9:45	Lecture 1-1	Mr. Takemoto
	10:30	Coffee break	
	11:00	Lecture1-2	Mr. Takemoto
	12:00	Lecture 1-3	Mr. Takemoto
	13:00	Lunch break	
	14:00	Lecture 1-4	Mr. Takemoto
	15:00	Lecture 1-5	Mr. Takemoto
	16:30	Review of today's activity and Discussion	Mr. Takemoto
	17:00	Close	

Day 2	Time	Contents	Lecturer
	9:30	Review of Yesterday	
	9:45	Lecture 2-1	Mr. Takemoto
	10:30	Coffee break	
	11:00	Lecture 2-2	Mr. Takemoto
	13:00	Lunch break	
	14:00	Lecture 2-3	Mr. Takemoto
	15:30	Practice 2-4	Mr. Takemoto
	16:30	Review of training activity and Comment from participants	
	17:00	Closing remark and Issuance of Completion Certificate	Mr. Kobayashi

List of Contents

Design of Irrigation Facilities

Volume I

Notes on Hydraulic Design and Canal and Related structures

NTC International Co., Ltd

List of Contents

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7. Introduction to Method of Project Evaluation for Irrigation Project

Time Table of the Short-Seminar on Project Evaluation

Subject: Introduction to Method of Project Evaluation for Irrigation Project

Date: 11th July (Mon), 2016

Venue: Auditorium room, Fairway Hotel, Kampala

Time	Contents	Lecturer
-10:00	Confirmation of attendance	
10:00	Opening remark:	Eng. Kobayashi
	Outline of the training	
	Key Introduction	
10:15	**Lecture 1: Principle of Economic Evaluation of Project**	Onishi
	➢ "With Project" and "Without Project"	
	➢ Project Cost & Benefit	
	➢ Opportunity Cost, Shadow Price	
	➢ Cash Flow	
	➢ Indicators (IRR, NPV, B/C)	
11:30	Coffee break	
12:00	**Lecture 2:**	Onishi
	Part 1: Project Cost	
	Cost component and project life etc.	
	Part 2: Project Benefit	
	Benefit component and development period etc.	
13:00	Lunch break	
14:00	**Practice:** Calculation of NPV and IRR	Onishi
	*use of Laptop PC	
16:00	**Review:** confirmation on the practice	
16:30	Closing remark:	Eng. Negishi
	Today's activity and discussions	
	Provision of Certificate for the participants	

Materials:

- Handout (power-point presentation)
- Exercise Sheet in MS-Excel "*calculation of IRR for Irrigation Project*"

the Short-Seminar on Project Evaluation
Introduction to Method of Project Evaluation for Irrigation Project

Kampala, June 2016

Seminar Programme

Lecture 1: Principle of Economic Evaluation of Project

- "With Project" and "Without Project"
- Project Cost & Benefit
- Opportunity Cost, Shadow Price
- Cash Flow
- Indicators (IRR, NPV, B/C)

Seminar Programme

Lecture 2:

Part 1: Project Cost

- Cost component and project life etc.

Part 2: Project Benefit

- Benefit component and development period etc.

Seminar Programme

Practice: Calculation of IRR, NPV and B/C for sample project using a MS-Excel worksheet.

*use of Laptop PC

Objectives :

- To understand basic process of Project Evaluation (Economic Evaluation) practically rather than theoretically
- To understand approach and method of the evaluation being employed by the PISD
- To actualize the evaluation process through exercise using a MS-Excel worksheet for simplified sample project of irrigation

Principal of Economic Evaluation of Project

Lecture 1:

Project Evaluation: viewing from Cost Benefit Analysis

Systematically compare the streams of costs and benefits in order to determine economic efficiency of a project or project worth

Cost Benefit Analysis

Financial Analysis	**Economic Analysis**
Private stakeholders' interests and profitability (e.g. farmer) → cost and benefit should be valued at Market Price (Financial Price)	*Overall impact of the project and takes the perspectives of the government and society, and wealth created by a project → cost and benefit valued Economic Price reflecting the relative value.*

Commonly used indicators: Net Present Value (NPV), Internal Rate of Return(IRR), Benefit–Cost Ratio(B/C)

Decision Making Process under the Feasibility Study

(source: IFAD, 2015)

Where are we now? Can rice growing (project) can make such impact on the Economy of Uganda and thus for Ugandan Nation …?

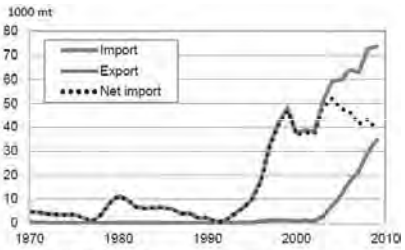


Fig. VI-1 Import, export and net import of rice in Uganda as reported in FAOSTAT, 3-year moving averages

JICA-PRiDe (2013)

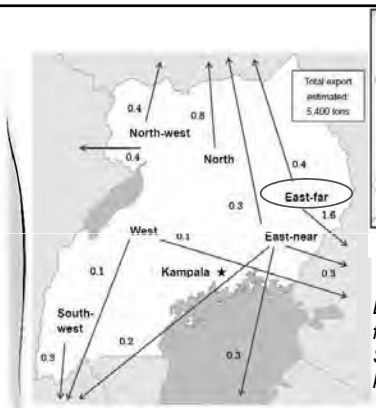


Fig. IV-4 Rice export from Uganda, 2011-12

JICA-PRiDe (2013)

Development Planning for Atari and Sironko…as infulensial key production areas

Whereas we are also importing tens thousands tons of rice…

So now we're asking; What if we develop the area for maximize our rice production to reduce expenditures on rice (milled, processed) and to save foreign currency (e.g. USD) , start thinking about With or Without Project!

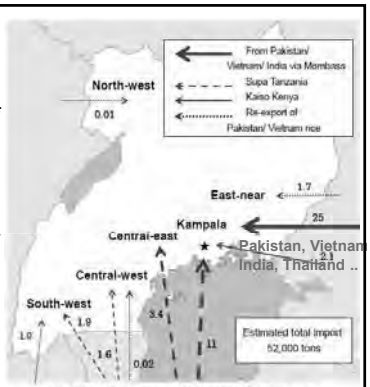


Fig. IV-3 Rice import by country of origin and by variety group, 2011-12

JICA-PRiDe (2013)

With Project – Without Project

- Comparing the impact of "with" and "without" project is a normal technique to determine a project's worth.
- Their difference is the net additional (incremental) benefit arising from the proposed project in the future time-period.
- This is not the difference between "before" and "after" (the "without" case is not static).

Time Discount: Time Value of Money

- When the costs and benefits of a project are spread over time, the problem arises of how to compare **future benefit** with **present benefit**. To be able to do this, the value of future income has to be reduced to its present worth.

Future income =

Present income X $(1 + i)^n$

i : Interest rate n : number of years

Idea of Time Discount, i.e. Time Value of Money

Q. How much will 1,000 UGX be next year ?

A. *100 (1+r)* UGX *r*: interest rate (bank rate, government's treasury bill)

Q. Then how much will 1,000 UGX be after 2 years ?

A. *{100(1+r)}(1+r) = 100(1+r)²* UGX

Q. Then how much will 1,000 UGX be after 3 years ?

A. *{100(1+r)²}(1+r) = 100(1+r)³* UGX

Present, UGX	After *t* years, UGX
a	$a(1+r)^t$ (compounding)
$\frac{1}{(1+r)^t}b$	*b* (discounting)

BANK OF UGANDA

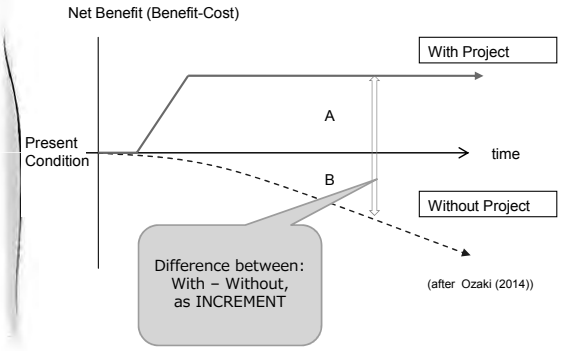
FINANCIAL NEWS REPORT

THE FOLLOWING WERE THE DEVELOPMENTS IN THE FINANCIAL MARKET INTEREST RATES:

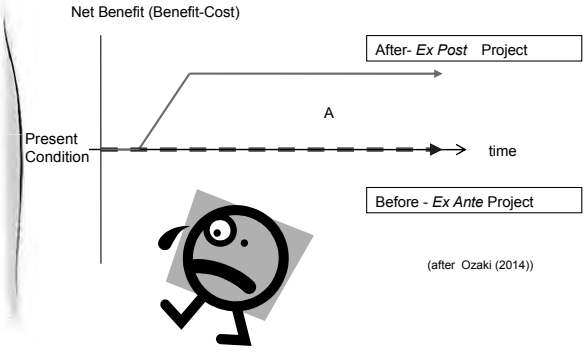
MANAGEMENT

Treasury Bill:
91-days (3 months)
182-day (6 months)
364-day (1 year)

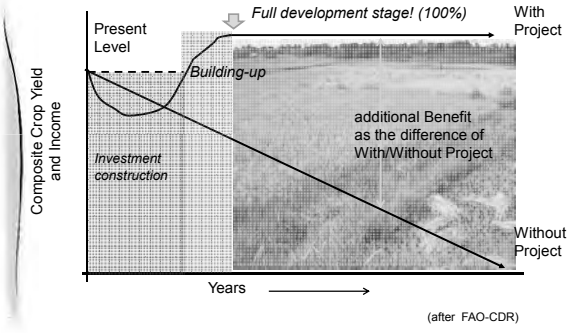
"discount rate"
computed by using;
-Face value (UGX)
-Price paid (UGX)
-Days of maturity
(X days/360)



However….commonly misunderstood as such…



Summary: relationship between "With" and "Without" Project



Project Cost

Initial investment cost:

- Construction cost (directly, indirect)

Recurrent cost year to year:

- O & M cost

Periodic cost at certain stage:

- Replacement/ repair cost

Not for consideration:

- Sunk cost (in case rehabilitation)

detailed explanation will be provided in Lecture2 Part1!

Project Benefit

- Direct benefit
  - Crop production (e.g. high yield of rice)
  - Flood protection
  - Reduction of cost (e.g. farm road)
- Socio-economic impact
  - Creation of employment (on/off farm)
  - Business opportunities
  - Feeling of happiness held by people
- Intangible benefits
  - Improved access to rural infrastructures

**Benefit : detailed explanation will be provided by Eng. Nishiya for Lecture2 Part2 !*

Opportunity Cost

- The best alternative return foregone elsewhe by committing assets to the project. The va of something foregone.
- For example, the direct opportunity cost of person-day of labour is what the person wo otherwise have produced or being paid for t day of work. The value of a resource in its b alternative use.
- For the financial analysis the opportunity cost a purchased input is always its market price. economic analysis the opportunity cost of purchased input is its marginal.

Shadow Price

- A shadow price of a good or service is the economic opportunity cost to society of that good or service.
- The true or economic value of a good (as opposed to the market price, which might be distorted).
- Synonymous with economic or social price.

Cash Flow (stream of cost & benefit)

- In the first step for evaluation work following to collection of necessary data-set, we develop "cash flow" (e.g. use of MS-Excel)
- Reflecting the costs and benefits over time from a stated point of view. Income/benefit is a positive cash flow and expenses/costs are negative flows.

Typical cash flow in MS-Excel worksheet

Fund disbursement
1st: 30%
2nd: 50%
3rd: 20%

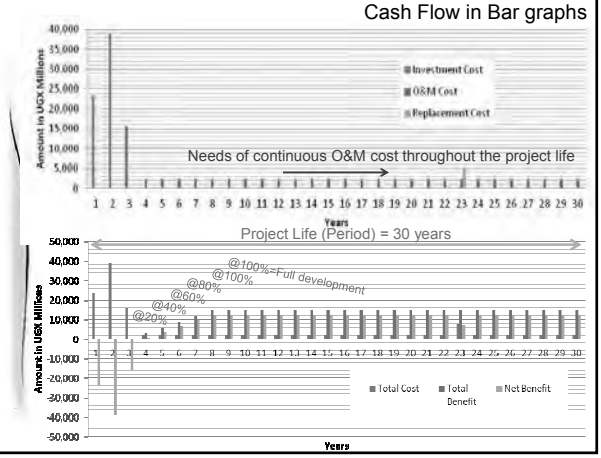
Approx. 3% of the total project cost For each and every year

20years

5-year Build-up
@20%
@40%
@60%
@80%
@100%=full development

Year	Const. Cost	O&M Cost	Replace. Cost	< C > Total Cost	< B > Total Benefit	< B-C > Net Benefit
1	26,348			26,348		-26,348
2	43,914			43,914		-43,914
3	17,566			17,566		-17,566
4		2,363		2,363	3,270	908
5		2,363		2,363	6,540	4,178
6		2,363		2,363	9,811	7,448
7		2,363		2,363	13,081	10,718
8		2,363		2,363	16,351	13,988
9		2,363		2,363	16,351	13,988
10		2,363		2,363	16,351	13,988
11		2,363		2,363	16,351	13,988
12		2,363		2,363	16,351	13,988
13		2,363		2,363	16,351	13,988
14		2,363		2,363	16,351	13,988
15		2,363		2,363	16,351	13,988
16		2,363		2,363	16,351	13,988
17		2,363		2,363	16,351	13,988
18		2,363		2,363	16,351	13,988
19		2,363		2,363	16,351	13,988
20		2,363		2,363	16,351	13,988
21		2,363		2,363	16,351	13,988
22		2,363		2,363	16,351	13,988
23		2,363	3,748	6,110	16,351	10,241
24		2,363		2,363	16,351	13,988
25		2,363		2,363	16,351	13,988
.....		.....		.....	.....	.....
30		2,363		2,363	16,351	13,988

Cash Flow in Bar graphs



Indicators

- Decision criteria for proposing the project upon systematical and objective method.

- Net Present Value: NPV
- Internal Rate of Return: IRR
- Benefit-Cost Ration: B/C Ration

NPV: Net Present Value

- Definition: the sum that results when the expected costs of the investment are deducted from the discounted value of the expected benefits (revenues).
- Whenever NPV > 0, the project is considered worthwhile or profitable. Among mutually exclusive projects, the one with the highest NPV should be chosen.

IRR: Internal Rate of Return *here we refined it as Economic IRR

- The internal rate of return (IRR) indicator is defined as the discount rate (r) that produces a zero NPV.
- This represents the maximum interest rate that a project could face and still not waste resources.

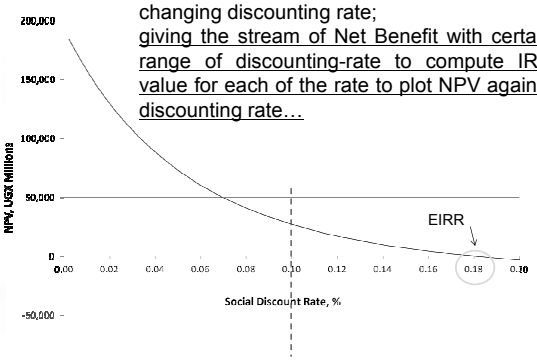
Summary: Relationship between IRR & NPV

- If the (alternative) interest rate (i^{mkt}), also called opportunity costs of capital or social discount rate, is lower than the IRR, the NPV is positive, and vice versa.

$IRR > r = i^{mkt} \rightarrow NPV > 0$

$IRR < r = i^{mkt} \rightarrow NPV < 0$

Trend of NPV (UGX Millions) value with changing discounting rate;
giving the stream of Net Benefit with certain range of discounting-rate to compute IRR value for each of the rate to plot NPV against discounting rate…



Cutoff Line as Social Discount Rate of 10%, employed often by WB, ADB etc.

B/C (benefit-cost) Ratio

- The ratio of the present value of benefits to the present value of costs over the time horizon.
- The B/C ratio provides some advantages when a ranking of alternative investment projects is needed under budget constraints.

If B/C ≥ 1 … the project is accepted.
If B/C < 1 … the project is rejected.

IRR or NPV?

- IRR can always be calculated and will provide information on the magnitude of the return – the IRR is the most commonly used.
- IRR has no meaning in terms of project value or size.
- The project to be chosen from a social point of view would be the one producing the bigger returns to the economy, and the NPV will clearly show this, while the IRR will not.

Sensitivity Analysis

- Consideration for eventualities that cannot be predetermined or are beyond the direct control of those involved in project implementation.
- Major risk areas affect the viability of projects:

Scenario:	Changes in	Numeric used
Unstable prices	Cost, Benefit	Cost +10%, +20% Benefit -10%, -20%
Cost overrun	Cost	
Unstable yields	Benefit	
Delay in Implementation	Cost, Benefit	1 year delayed

Confirmation: Formula/Definition of the Indicators

Key Descriptions	NPV	IRR	B/C
Definition	$\sum \frac{(B_t^{WP}-C_t^{WP})-(B_t^{WOP}-C_t^{WOP})}{(1+r)^t}$	r at which NPV = 0	$\frac{\sum(B_t^{WP}-B_t^{WOP})/(1+r)^t}{\sum(C_t^{WP}-C_t^{WOP})/(1+r)^t}$
Viability Judgment	NPV ≧ 0	IRR ≧ r	B/C ≧ 1
Evaluating net increment value in absolute figure	✓	×	×
Providing the magnitude of return: no vale for project value/size	×	✓	×

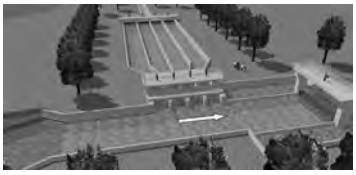
B = benefit; C = cost; WP = with-project; WOP = without-project; t = project year; r = discount rate ; interest rate used as indicator of opportunity cost

Break

Lecture2 (Part-1): Project Cost

Cost Components:

- Construction cost
- Operation & Maintenance cost
- Replacement cost
- Sunk cost



Construction Cost (=Investment)

- Investment refers to the initial costs of construction of the irrigation scheme. The cost items included depend on the type of system.
- If drying-yard and warehouse are constructed for the project, they should also be included in the calculation of the initial costs to field edge (head works and conveyance system) and the infield works.

Breakdown of the Construction Cost

1.	Intake Facility and appurtenant structure
2.	Main irrigation canal construction
3.	Secondary canal construction
4.	Main Farm Ditch
5.	Supplemental Farm Ditch
6.	On-Farm Development
7.	Drainage Canals
8.	Flood Protection Dike
9.	Maintenance Road Length
10.	Warehouse, building works
11.	Temporary cost, X% of (1to 9)
12.	Site expense, X% of (1 to 10)
13.	Overhead and profit, X% of (I to11)

Direct Cost

Indirect Cost

Administration cost , X%

Engineering services , X%

Physical contingency , X%

Project Cost

Operation and Maintenance Cost

- These costs are usually assumed to depend on the cost of the equipment utilized. Thus a percentage of the cost of equipment is taken as repair and maintenance costs per year.
- Real costs can be used if known from other similar schemes.
- In the case of the PISD, the operation and maintenance costs are assumed to be nearly 3% of the investment cost per year.

Sample image of de-silting (twice in a year) from main canals at the Doho Rice Irrigation Scheme in Butaleja District (source: DIFACOS).

Replacement Cost

- These are the costs incurred to replace specific items. In the example of the PISD, the following assumptions about the replacements are made:

  All gates of intake/ check-gate/ turnouts should be replaced every 20 years

Sample image of Intake gates having been installed and used for some 10 years (Ngenge S/C, Kween District).

Sunk Cost:

- The cost incurred in the past that cannot be retrieved as a residual value from an earlier project.
- A sunk cost has no opportunity cost, as the assets represented by the sunk cost have no alternative use.
- A sunk cost is therefore not included in the outflow when projects are analyzed.
- This can be the case if the project is a rehabilitation of a previously operated irrigation scheme.

Economic Cost

- Convert all market prices into economic/shadow prices that better reflect the social opportunity cost of the good.
- Remove transfer payments (taxes and subsidies) and quantify externalities (positive and negative).

Market category	Item	**Method of conversion**	Example
International commodity	Production output	Adjusting price distortion	Rice, maize etc.
ditto	Production input	*ditto*	DAP, Urea
Trading market	Production input	Finance Price x SCF*	Seeds, sucks, Chemicals
ditto	Construction	*ditto*	Material, equipment & associated indirect costs
ditto	O & M cost	*ditto*	*ditto*
Labour market	Production labour (unskilled labour)	Finance Price x Conversion Factor	Farm, construction labour (hired)

*SCF: Standard Conversion Factor

Production Output: Rice

order	Price/cost components	Operation	
(1)	Thai 25% broken, FOB Bangkok (USD)	= P1	Thailand
(2)	Ocean freight (Bangkok - Mombasa)	+	(ocean)
(3)	Insurance	+	(ocean)
(4)	Land transport (Mombasa - Kampala)	+	Kenya
(5)	Custom clearance	+	(boarder)
(6)	CIF at Kampala (@ 3,xxx UGX/USD)	=P2	Kampala
(7)	Conversion to UGX	=	
(8)	Handling charge & margin (X% of CIF)	+	Kampala
(9)	Importer's selling price	=P3	Kampala
(10)	By-product though processing	+	Trader2
(11)	Millgate paddy price	=P4	Market
(12)	Conversion to Paddy (Milling rate X%)	x	Trader1
(13)	Milling cost	-	
(14)	Local transport (farm to mill)	-	
(15)	Economic farm gate price	=P5	Farm

Materials: Construction

How to convert it to Economic Price

Year	Export	Export Tax	Import	Import Tax	Import Subsidy	SCF
2010	1,619	3.41	4,664	1,087	0	0.853
2011	2,159	0.23	5,631	1,148	0	0.872
2012	2,357	0.00	6,044	1,186	0	0.876
2013	2,408	1.23	5,818	1,397	0	0.855
2014	2,274	4.66	5,874	1,529	0	0.842
					Average	**0.860**

Export & Import data: WTO statistic database
Tax information: Uganda Revenue Authority
Conversion currency (UGX to USD): Bank of Uganda

$$SCF = \frac{Imports\ (cif) + Exports\ (fob)}{(Imports + Import\ taxes) + (Exports - Export\ taxes)} = \frac{Total\ trade}{Total\ trade + Net\ trade\ taxes}$$

Simple Trade-Weighted Formula

cif: cost, insurance, **fob**: free on board

Unskilled Labor

Project Life (Period)

- If the project centres on one major asset, for example the irrigation system, the project period will be the estimated life of this asset.
- equipment. If a dam were constructed in connection with the scheme, then the time horizon would be extended to cover the expected lifetime of the dam.
- In the PISD, the project life is set as 30 years including investment period.

In practicalities

✓The Project Evaluation is a not desk work only for economist but comprehensive field oriented and engineering-related work where in the process all experts of the ministry associate with.

Further Readings

*downloadable from web site

- IFAD (2015) *IFAD's Internal Guidelines: Economic and Financial Analysis of Rural Investment Project*, Vol.1. International Fund for Agricultural Development (IFAD), Rome, Italy. https://www.ifad.org/what/operating_model
- FAO: *Watershed Management Field Manual –Watershed Survey Planning, 9. Economic and Other Assessments*. In FAO Corporate Document Repository (www.fao.org/docrep/006/t0165e/t0165e09.htm).
- Savva, A.P. and K. Frenken (2002) *Financial and Economic Appraisal of Irrigation Project*, Irrigation Manual Module 11. FAO, Rome, Italy. ftp://ftp.fao.org/docrep/fao/010/ai600e/ai600e00.pdf
- Lagman-Martin, A. (2004) *Shadow Exchange Rates for Project Economic Analysis: Toward Improving Practice at the Asian Development Bank*, ERD Technical Note No.11. Asian Development Bank (ADB), Manila, Philippines. http://www.adb.org/publications/shadow-exchange-rates-project-economic-analysis-toward-improving-practice-asian-develop

Appendix F

RD, JTC and JCC Minuets of Meetings

List of RD, JTC and JCC Minutes of Meetings

Note: The entire attendant list has been deleted from the viewpoint of their privacy.

1. Introduction

The R/D was agreed upon by the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF), the Ministry of Water and Environment (MWE), and the Japan International Cooperation Agency (JICA) on 10th February 2014. Ten (10) candidate sites were selected through the preliminary survey made by MAAIF, MWE, and JICA and listed in the Record of Discussion on 10th February 2014 (R/D) of "The Project on Irrigation Scheme Development (PISD) in Central and Eastern Uganda", (hereinafter called "the Study").

The scope of the Study has two phases. In the first phase (Phase 1), JICA Study Team (JST) conducted a study to develop Irrigation Scheme Development Plan (ISDP) for the respective candidate sites, listed in Table 1, from June 2014 to March 2015. ISDP was formulated for each site including cost estimation of the project, benefit, and project evaluation. Based on the analysis of ISDP, three priority sites were selected for further study in Phase 2. During the second phase (Phase 2) of the Study - from May 2015 to December 2016 - JST conducted F/S on two (2) of the three (3) selected sites, namely: Sironko/Acomai and Atari site, and Pre-Feasibility Study (Pre-F/S) on Namatala site. Capacity building on irrigation and natural resource management, targeting counterparts (C/Ps) and district officers was also done during the two phases.

This Appendix-F contains: i) R/D of PISD and its amendments, ii) Minutes of Meetings of Joint Coordination Committee (JCC), iii) M/M of Joint Technical Committee (JTC) as shown below. These meeting were held among C/Ps of PISD, i.e., MAAIF, MWE and member of JCC member of PISD, JICA and JST during the Study.

(1) Record of Discussion

Original : 10th February 2014
Amendment : 12th November 2015

(2)Joint Technical Committee Meetings

Date of the Meeting	Number of JTC	Venue
18th July 2014	First JTC	MWE Office
2nd December 2014	Second JTC	NAADS Library
7th December 2015	Third JTC	City Royal Hotel
20th July 2016	Fourth JTC	City Royal Hotel

(3)Joint Coordination Committee Meetings

Date of the Meeting	Number of JCC	Venue
27th July 2014	First JCC	Cotton House
9th December 2014	Second JCC	City Royal Hotel
24th June 2015	Third JCC	Coffee House
5th October 2015	Fourth JCC	City Royal Hotel
25th April 2016	Fifth JCC	Coffee House
12th October 2016	Sixth JCC	City Royal Hotel

THE REPUBLIC OF UGANDA

MINUTES OF MEETINGS
BETWEEN
THE AUTHORITIES CONCERNED
OF
THE GOVERNMENT OF THE REPUBLIC OF UGANDA
AND
JAPAN INTERNATIONAL COOPERATION AGENCY
ON
THE TECHNICAL COOPERATION
FOR
THE PROJECT ON IRRIGATION SCHEME DEVELOPMENT IN CENTRAL AND EASTERN UGANDA

The Japanese Detailed Planning Study Team (hereinafter referred to as "the Team"), organized by the Japan International Cooperation Agency (hereinafter referred to as "JICA") and headed by Mr. Takeaki Sato, visited the Republic of Uganda from 15 July to 10 August, 2013 for the purpose of formulating a technical cooperation project, "The Project on Irrigation Scheme Development in Central and Eastern Uganda" (hereinafter referred to as "the Project") in response to the request made by the Government of the Republic of Uganda (hereinafter referred to as "GoU") toward the Government of Japan. During its stay in Uganda, the Team exchanged views and opinions with the authorities concerned of GoU through a series of meetings and field studies.

As a result, both sides have reached a mutual understanding on the matters referred to in the document attached hereto.

Kampala, 6th August, 2013

Mr. Takeaki Sato
Leader
Detailed Planning Study Team
Japan International Cooperation Agency

Mr. Vincent R. Rubarema
Permanent Secretary
Ministry of Agriculture, Animal Industry and Fisheries
The Republic of Uganda

Mr. David O. O. Obong
Permanent Secretary
Ministry of Water and Environment
The Republic of Uganda

THE ATTACHED DOCUMENT

Both sides agreed, in principle, on the framework and implementation plan of the Project which is given as follows, and in the attached Draft Record of Discussions (R/D).

After going through the JICA's internal approval, the final draft of R/D with the implementation plan will be prepared. The framework of the Project will be finally determined when R/D is signed by the Chief Representative of JICA Uganda Office, the representative of the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) and the representative of the Ministry of Water and Environment (MWE).

I Outline of the Project

1. Project Title

   The Project on Irrigation Scheme Development in Central and Eastern Uganda

2. Term of the Cooperation

   Two (2) years

3. Project Site

   Ten (10) irrigation potential areas in central and eastern Uganda.

   The list of the candidate sites is shown in Annex 3 of the attached Draft R/D.

4. Output

   - Potential sites for Irrigation Development are identified.
   - Feasibility study for prioritized areas is conducted.
   - Stakeholders' capacity of irrigation development, operation and management is developed.

5. Activities

   [Phase 1 (Potential Site Identification Study (PIS) :10sites)]

   (1) Reviewing existing development plans and projects related to the study.

   (2) Collecting and analyzing the following data and information, through field surveys and interviews with stakeholders especially farmers in the study area.

   - Nature
   - Socio-economic condition
   - Agro-economy
   - Infrastructure
   - Agricultural supporting service
   - Operation and management

- Environmental aspects

(3) Preparing an inventory list of possible irrigation projects

(4) Conducting Initial Environmental Examination (IEE)

(5) Preparing PIS report

(6) Recommending priority project sites for a feasibility study

(7) Making of the topographical maps as needed

[Phase 2 (Feasibility Study (F/S) : 2 or 3 sites)]

(1) Conducting field surveys to collect supplementary data and information on the priority project sites.

(2) Preparing preliminary design for irrigation and drainage facilities

(3) Estimating project costs and benefits

(4) Formulating operation and maintenance plans

(5) Carrying out economic and financial evaluation

(6) Establishing farm planning

(7) Formulating a plan of establishing/strengthening Water Users Association

(8) Conducting Environmental Impact Assessment (EIA)

(9) Preparing Community management plan

(10) Preparing Environmental and Social Management Framework

(11) Preparing Resettlement Action Plan Framework (if necessary)

(12) Drawing implementation schedule of the priority projects

(13) Conducting evaluation of the Project

(14) Preparing recommendations

6. Responsible Organization and Implementing Agency of the Project

Responsible organization:

-MAAIF

Implementing organizations: MAAIF/MWE

Direct counterpart agencies:

- Department of Farm Development, MAAIF
- Department of Water for Production, MWE

The Project organization chart is shown in Annex 1 of the attached Draft R/D.

7. Administration of the Project

(1) Project Director

Permanent Secretary, MAAIF

(2) Co-Project Director

Permanent Secretary, MWE

(3) Deputy Director

Director, Directorate of Crop Resources, MAAIF

(4) Co-Deputy Director

Director, Directorate of Water Development, MWE

(5) Project Manager

Commissioner, Department of Farm Development, MAAIF

(6) Co-Project Manager

Commissioner, Department of Water for Production, MWE

8. Joint Coordinating Committee

For effective implementation of the Project, both Japanese and Ugandan sides agreed to establish a Joint Coordinating Committee (JCC). JCC will meet at least twice a year and whenever necessity arises. The expected responsibilities and the members of JCC are shown in Annex 2 of the attached Draft R/D.

II Other Relevant Issues for Implementation of the Project

(1) Project Implementers

To make the Project successful and to assure national food security and farmer household income, the harmonization of development and conservation of nature is important. To achieve the Project purpose, MAAIF and MWE will collaborate and continue to play an essential role with support from JICA Experts.

(2) Name of the Project

All parties agreed to change the project title from "Feasibility Study for Establishment of Medium to Large Scale Irrigation Schemes" to "The Project on Irrigation Scheme Development in Central and Eastern Uganda" based on the framework of the Project.

(3) Project sites

Preliminary selection of project sites were made through the site reconnaissance jointly conducted by JICA, MAAIF and MWE and the following set of criteria

(a) Existence of rice farming: Present rice cultivation area is put priority for the project sites. The area with extensively covered by papyrus is excluded from the list.

(b) District policy: The sites and/or districts which do not have policy on promotion of rice cultivation in the wetland are excluded.

(c) Ramsar convention area: Sites located in Ramsar Convention registered area are excluded.

As a result, following 4 candidate sites and Olelai swamp are excluded from candidate sites for the Project.

Site	District	Criteria applied for exclusion	Remarks
Kibukuta	Mpigi	(a)	The area is extensively covered by papyrus at present.
Musamya Wetland	Kayunga	(a)&(b)	The candidate area is presently occupied by papyrus. In addition, Kayunga district has policy on conserving permanent wetland including Musamya wetland area.
Kibimba wetland	Gomba	(a)&(b)	The area is permanent wet land covering papyrus. Gomba district also has policy on conserving permanent wetland.
Mamba wetland	Gomba	(a)&(b)	The area is permanent wet land covering papyrus. Gomba district also has policy on conserving permanent wetland.
Olelai swamp	Soroti	(c)	Among Omirio&Olelai Swamp originally proposed, Olelai area is located in the wetland of Ramsar convention registered area. Omirio swamp remains as candidate site.

Finally, 10 candidate sites are selected as project sites.

(4) Capacity building for irrigation and natural resource management

MAAIF, MWE, and JICA agreed on the importance of building both irrigation and natural resource management capacity of the staff of MAAIF, MWE, and Local government. Some equipment needed for the Project can be provided. Considering the framework of the Project, the following items are out of the scope of the Project.

- Field training centre at Doho
- Irrigation courses of Arapai Agricultural Colledge and Busitema University
- Infrastructure and facilities for training

(5) Land Acquisition

In line with the 'JICA Guidelines for Environmental and Social Considerations', MAAIF and MWE will be responsible to prepare "Resettlement Action Plan Framework" if necessary.

(6) Climate Change

The Project is expected to contribute to adaptation to climate change and sustainable utilization of natural resources by means of increased accessibility to irrigation service. Livelihood of the people in the selected potential irrigation sites is now largely depending on rain-fed agriculture without appropriate irrigation infrastructure in place. Increased incidence of prolonged droughts and unreliable rainfall pattern could leave hundreds of million without the ability to produce sufficient foods to meet their household dietary demand; raise food prices leading to food shortage and affecting the rural poor in the areas. The project will target those who produce paddy rice and increase the adaptive capacity to the future threats of climate change by completing and improving irrigation and drainage; and thus allowing multiple cropping in areas that are now limited to an unstable single wet season crop.

Annex Draft Record of Discussions (R/D)

Annex Draft Record of Discussions (R/D)

THE REPUBLIC OF UGANDA

RECORD OF DISCUSSIONS

ON

THE PROJECT ON IRRIGATION SCHEME DEVELOPMENT IN CENTRAL AND EASTERN UGANDA

IN

REPUBLIC OF UGANDA

AGREED UPON AMONG

MINISTRY OF AGRICULTURE, ANIMAL INDUSTRY AND FISHERIES

MINISTRY OF WATER AND ENVIRONMENT

AND

JAPAN INTERNATIONAL COOPERATION AGENCY

Kampala, [date]

Mr. Hirofumi Hoshi
Chief Representative
JICA Uganda office
Japan International Cooperation Agency

Mr. Vincent R. Rubarema
Permanent Secretary
Ministry of Agriculture, Animal Industry and Fisheries
The Republic of Uganda

Mr. David O. O. Obong
Permanent Secretary
Ministry of Water and Environment
The Republic of Uganda

Based on the minutes of meetings on the Detailed Planning Study on the Project on Irrigation Scheme Development in Central and Eastern Uganda (hereinafter referred to as "the Project") signed on 6th August 2013 among Ministry of Agriculture, Animal Industry and Fisheries (hereinafter referred to as "MAAIF"), Ministry of Water and Environment (hereinafter referred to as "MWE") and the Japan International Cooperation Agency (hereinafter referred to as "JICA"), JICA held a series of discussions with MAAIF, MWE and relevant organizations to develop a detailed plan of the Project.

JICA, MAAIF and MWE agreed on the details of the Project and the main points discussed as described in the Appendix 1 and the Appendix 2 respectively.

JICA, MAAIF and MWE also agreed that MAAIF, the counterpart to JICA, will be responsible for the implementation of the Project in cooperation with JICA, coordinate with other relevant organizations and ensure that the self-reliant operation of the Project is sustained during and after the implementation period in order to contribute toward social and economic development of the Republic of Uganda.

The Project will be implemented within the framework of the Agreement on Technical Cooperation signed on December 8, 2005 (hereinafter referred to as "the Agreement") and the Note Verbals exchanged on July 22, 2013 between the Government of Japan (hereinafter referred to as "GoJ") and the Government of the Republic of Uganda (hereinafter referred to as "GoU").

Appendix 1: Project Description
Appendix 2: Main Points Discussed
Appendix 3: Minutes of Meetings on the detailed planning survey

Appendix 1

PROJECT DESCRIPTION

GoU and GoJ confirmed that there is no change in the Project Description agreed on in the minutes of meetings on the Detailed Planning Study on the Project signed on 6th August 2013 (Appendix 3).

I. BACKGROUND

According to the Framework Implementation Plan for Water for Agricultural Production, recently prepared by Ministry of Agriculture, Animal Industry and Fisheries, farming in Uganda is mainly rain-fed and yet rainfall is becoming erratic and unreliable as evidenced by the less than average rainfall experienced in most parts over the past years. An effective intervention to positively impact households should therefore be one that targets enhancing the utilization of the abundant water resources for agricultural production in a sustainable way.

Cognizant of the above situation, the GoU has through its strategic frameworks like the Uganda Vision 2040, NDP (National Development Plan 2010/11 – 2014/15) and the Agriculture sector DSIP (Agricultural Sector Development Strategy and Investment Plan 2010/11-2014/15) prioritized irrigation as a key player for agriculture development. The GoU in collaboration with various Development Partners has undertaken initiatives for the development of irrigation infrastructure in different parts of the country. JICA's support to the irrigation sub sector in Uganda goes back to 2004 when Sustainable Irrigated Agriculture Development (SIAD) study commenced. The study and its subsequent project combined ran for about 6 years during which time small scale irrigation was promoted in some parts of the eastern region and even replicated outside the project areas.

Recognizing this success and, at the same time, a need for scaling it up to benefit more farmers, the GoU, through MAAIF, requested the GoJ for technical cooperation in the form of "a Study on establishment of Medium and Large scale irrigation schemes". Main target beneficiaries are farmers cultivating rice in lowlands with unreliable availability of water. This is expected to contribute to development of the rice sub sector, one of the medium term targets of JICA's assistance to Uganda. Other target beneficiaries include, among others, officers and engineers at both central and district local governments whose capacity for irrigation development and sustainable natural resources management will be built.

II. OUTLINE OF THE PROJECT

1. Title of the Project

The Project on Irrigation Scheme Development in Central and Eastern Uganda

2. Expected Goals which will be attained after the Project Completion

(1) Goal of the Proposed Plan

- To assure national food security and farmer household income through increased sustainable irrigated rice production
- To build capacity for irrigation / natural resource management among the different stakeholder categories

(2) Goal which will be attained by utilizing the Proposed Plan
Beneficial area of irrigation is increased in central and eastern Uganda.

3. Outputs
- Potential sites for Irrigation Development are identified.
- Feasibility study for prioritized areas is conducted.
- Stakeholders' capacity of irrigation development, operation and management is developed.

4. Activities
[Phase 1 (Potential Site Identification Study (PIS) :10sites)]
(1) Reviewing existing development plans and projects related to the study.
(2) Collecting and analyzing the following data and information, through field surveys and interviews with stakeholders especially farmers in the study area.
Nature
Socio-economic condition
Agro-economy
Infrastructure
Agricultural supporting service
Operation and management
Environmental aspects
(3) Preparing an inventory list of possible irrigation projects
(4) Conducting Initial Environmental Examination (IEE)
(5) Preparing PIS report
(6) Recommending priority project sites for a feasibility study
(7) Making of the topographical maps as needed

[Phase 2 (Feasibility Study (F/S) : 2 or 3 sites)]
(1) Conducting field surveys to collect supplementary data and information on the priority project sites.
(2) Preparing preliminary design for irrigation and drainage facilities
(3) Estimating project costs and benefits
(4) Formulating operation and maintenance plans
(5) Carrying out economic and financial evaluation
(6) Establishing farm planning
(7) Formulating a plan of establishing/strengthening Water Users Association
(8) Conducting Environmental Impact Assessment (EIA)
(9) Preparing Community management plan
(10) Preparing Environmental and Social Management Framework
(11) Preparing Resettlement Action Plan Framework (if necessary)
(12) Drawing implementation schedule of the priority projects
(13) Conducting evaluation of the Project
(14) Preparing recommendations

5. Input

(1) Input by JICA

(a) Dispatch of Mission

- Mission leader / Irrigation Development Planning
- Hydrology, meteorology/ Water resource
- Farming / Land use
- Preliminary design and cost estimate
- Agricultural economy and project evaluation
- Farmers association (Water Users Association)/ cooperative
- Environment

(b) Receipt of Ugandan trainee

(c) Equipment for the study (project vehicle and office equipment),

Input other than indicated above will be determined through mutual consultations among JICA, MAAIF and MWE during the implementation of the Project, as necessary.

(2) Input by MAAIF and MWE

MAAIF and MWE will take necessary measures to provide at its own expense:

(a) Services of MAAIF/MWE's counterpart personnel and administrative personnel as referred to in II-6;

(b) Suitable office space with necessary equipment;

(c) Supply or replacement of machinery, equipment, instruments, vehicles, tools, spare parts and any other materials necessary for the implementation of the Project other than the equipment provided by JICA;

(d) Information as well as support in obtaining medical service;

(e) Credentials or identification cards;

(f) Available data (including maps and photographs) and information related to the Project;

(g) Running expenses necessary for the implementation of the Project;

(h) Expenses necessary for transportation within Republic of Uganda of the equipment referred to in II-5 (1)(c) as well as for the installation, operation and maintenance thereof; and

(i) Necessary facilities to members of the JICA missions for the remittance as well as utilization of the funds introduced into Republic of Uganda from Japan in connection with the implementation of the Project

6. Implementation Structure

The Project organization chart is given in the Annex 1. The roles and assignments of relevant organizations are as follows:

(1) MAAIF

(a) Project Director

Permanent Secretary will be responsible for overall administration and implementation of the Project.

(b) Deputy Project Director

Director of Crop Resources will support the administration and implementation of the Project Director.

(c) Project Manager

Commissioner of Farm Development will be responsible for the managerial and technical matters of the Project

(d) Relevant Department / Agency
Department of Crop Production and Marketing
Department of Agricultural Planning and Development
National Agricultural Research Organization (NARO)
National Agricultural Advisory Services (NAADS)

(2) MWE

(a) Co-Project Director
Permanent Secretary will be responsible for support the overall administration and implementation of the Project.

(b) Co-Deputy Project Director
Director of Water Development will support the administration and implementation of the Deputy Project Director.

(c) Co-Project Manager
Commissioner of Water for Production will support the managerial and technical matters of the Project

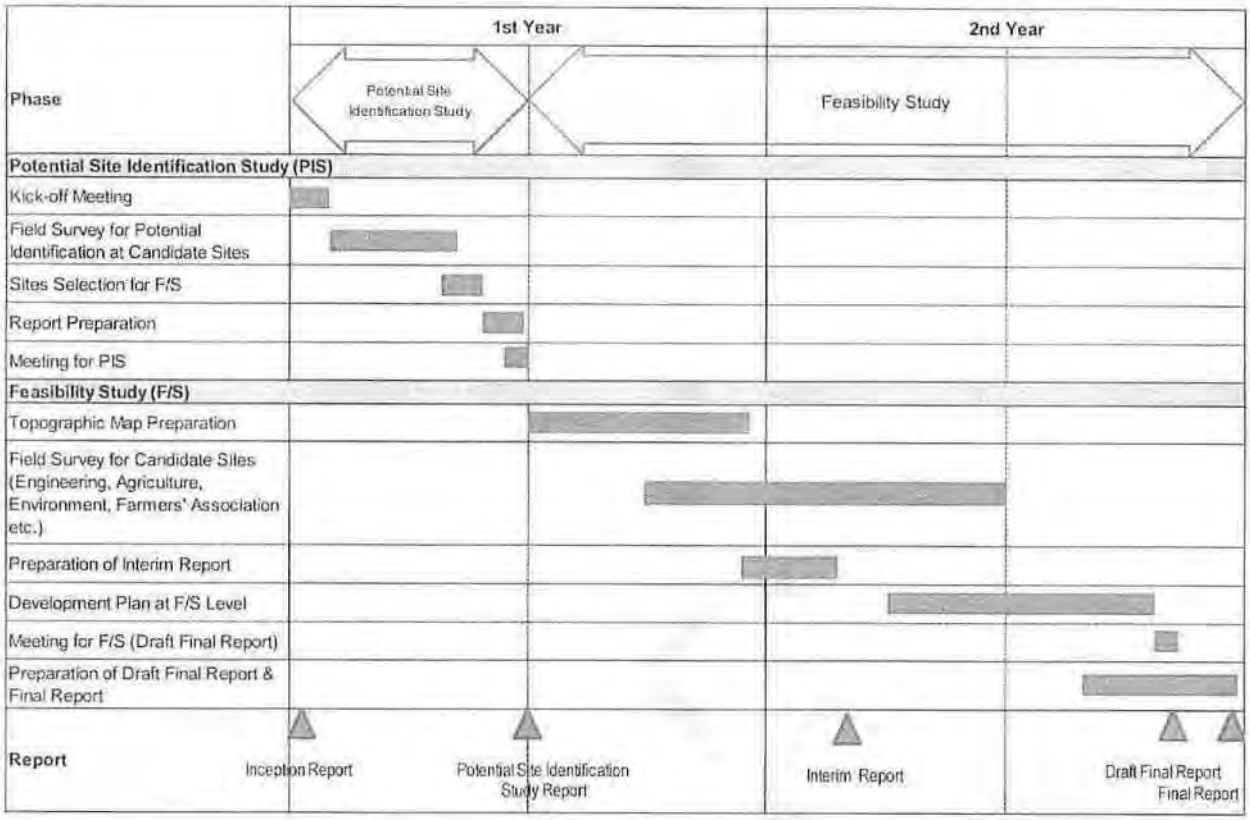
(d) Relevant department / Agency
Department of Water Resources Monitoring and Assessment
Department of Water Quality Management
Department of Water Resources Planning and Regulations
Wetland Management Department
National Environment Management Authority (NEMA)
Department of Meteorology

(3) JICA Mission
The JICA mission will give necessary technical guidance, advice and recommendations to MAAIF and MWE on any matters pertaining to the implementation of the Project.

(4) Joint Coordinating Committee
Joint Coordinating Committee (hereinafter referred to as "JCC") will be established in order to facilitate inter-organizational coordination. JCC will be held whenever necessity arises. Responsibilities and the members of JCC are shown in the Annex 2.

7. Project Sites and Beneficiaries
Project Site: 10 irrigation potential areas in central and eastern Uganda (shown in Annex 3).
Beneficiaries: C/Ps of MAAIF, MWE and local governments of the project sites

8. Duration
2 years
Tentative schedule is as follows;



9. Reports

JICA will prepare and submit the following reports to the MAAIF and MWE in English.

(1) 20 copies of Inception Report at the commencement of the first work period in Republic of Uganda
(2) 20 copies of Potential Site Identification Study Report at the time about 6 months after the commencement of the first work period in Republic of Uganda
(3) 20 copies of Interim Report at the time of 15 months after the commencement of the first work period in Republic of Uganda
(4) 20 copies of Draft Final Report at the end of the last work period in Republic of Uganda.
(5) 30 copies of Final Report within one (1) month after the receipt of the comments on the Draft Final Report

10. Environmental and Social Considerations

JICA, MAAIF and MWE agreed to apply both 'JICA Guidelines for Environmental and Social Considerations' and the Uganda laws on water and environment in order to ensure that appropriate considerations will be made for the environmental and social impacts of the Project.

III. UNDERTAKINGS OF MAAIF, MWE and the Government of the Republic of Uganda

1. MAAIF, MWE and the government of the Republic of Uganda will take necessary measures to:

(1) ensure that the technologies and knowledge acquired by the Republic of Uganda

nationals as a result of Japanese technical cooperation contributes to the economic and social development of Republic of Uganda, and that the knowledge and experience acquired by the personnel of Republic of Uganda from technical training as well as the equipment provided by JICA will be utilized effectively in the implementation of the Project; and

(2) grantdd privileges, exemptions and benefits to members of the JICA missions referred to in II-5 (1) above and their families, which are no less favorable than those granted to experts and members of the missions and their families of third countries or international organizations performing similar missions in Republic of Uganda.

(3) provide security-related information as well as measures to ensure the safety of members of the JICA missions;

(4) permit members of the JICA missions to enter, leave and sojourn in Republic of Uganda for the duration of their assignments therein and exempt them from foreign registration requirements and consular fees.

(5) exempt members of the JICA missions from taxes and any other charges on the equipment, machinery and other material necessary for the implementation of the Project;

(6) exempt members of the JICA missions from income tax and charges of any kind imposed on or in connection with any emoluments or allowances paid to them and/or remitted to them from abroad for their services in connection with the implementation of the Project; and

(7) meet taxes and any other charges on the equipment, machinery and other material, referred to in II-5 above, necessary for the implementation of the Project.

2.MAAIF, MWE and the government of the Republic of Uganda will bear claims, if any arises, against members of the JICA missions resulting from, occurring in the course of, or otherwise connected with, the discharge of their duties in the implementation of the Project, except when such claims arise from gross negligence or willful misconduct on the part of members of the JICA missions.

IV. EVALUATION

JICA will conduct the following evaluations and surveys to mainly verify sustainability and impact of the Project and draw lessons. MAAIF and MWE are required to provide necessary support for them.

(1) Ex-post evaluation three (3) years after the project completion, in principle
(2) Follow-up surveys on necessity basis

V. PROMOTION OF PUBLIC SUPPORT

For the purpose of promoting support for the Project, MAAIF and MWE will take appropriate measures to make the Project widely known to the people of Republic of Uganda.

VI. MUTUAL CONSULTATION

JICA MAAIF and MWE will consult each other whenever any major issues arise in the course of Project implementation.

VII. AMENDMENTS

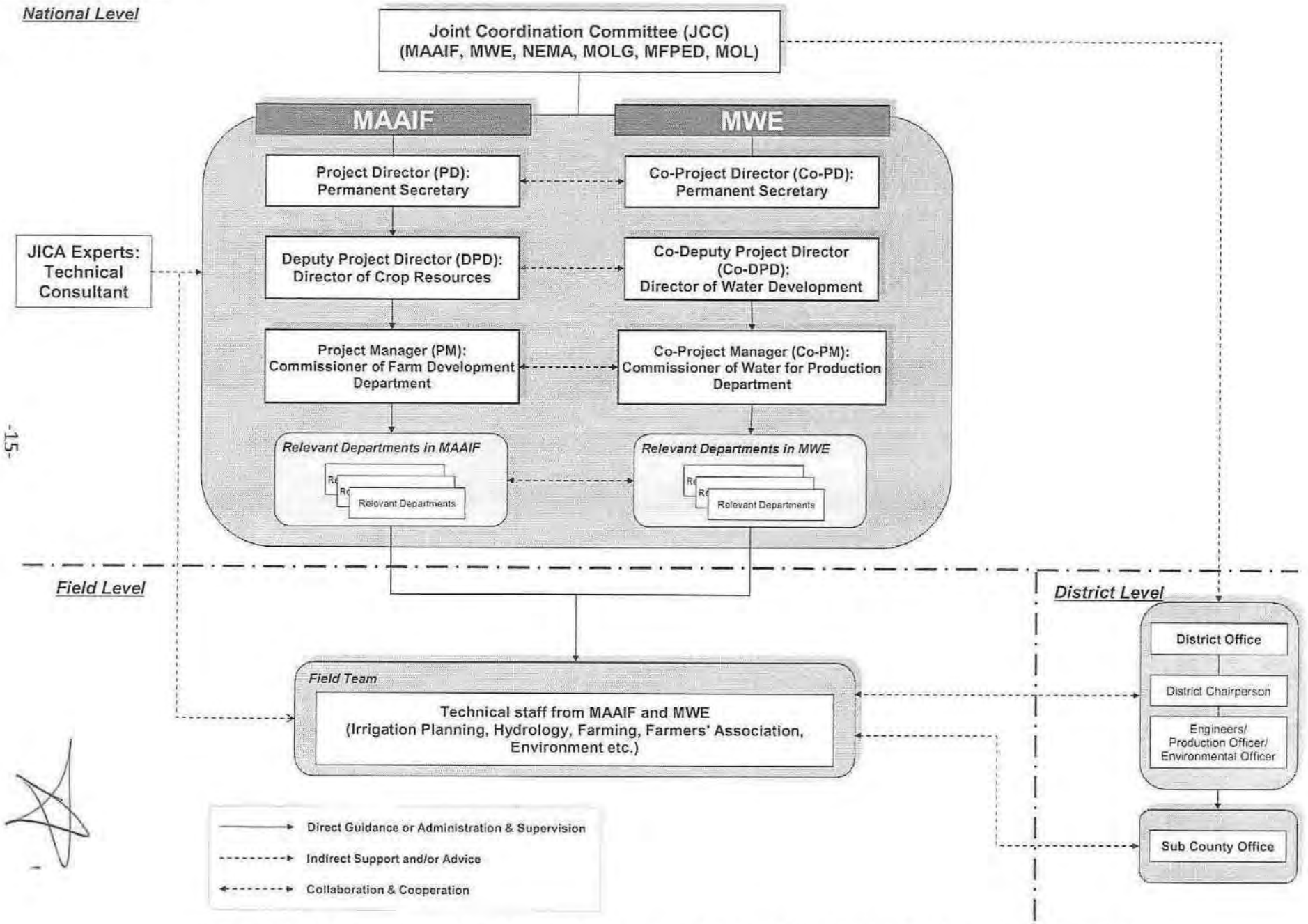
The record of discussions may be amended by the minutes of meetings among JICA, MAAIF and MWE.
The minutes of meetings will be signed by authorized persons of each side who may be different from the signers of the record of discussions.

Annex 1 Project Organization Chart
Annex 2 Responsibilities and the members of Joint Coordinating Committee
Annex 3 List of the Project areas

Appendix 2

MAIN POINTS DISCUSSED

Refer "II Other Relevant Issues for Implementation of the Project" of Appendix 3: Minutes of Meetings on the Detailed Planning Study.



Implementing Organization for the Project on Irrigation Scheme Development in Central and Eastern Uganda

Annex 2

Responsibilities and the members of Joint Coordinating Committee

1. Functions

The Joint Coordinating Committee will meet at least twice a year and whenever necessity arises. Its functions are as follows:

(1) To review the progress of the Project

(2) To review and exchange opinions on major issues that may arise during the implementation of the Project

(3) To discuss any other issue(s) pertinent to the smooth implementation of the Project

2. Composition

(1) Chairperson

- Project Director

(2) Ugandan side

- Co-Project Director
- Deputy Project Director
- Co-Deputy Project Director
- Project Manager
- Co-Project Manager
- Executive Director (ED) of NEMA
- Director of Water Resources Management
- Director of Environment Affairs
- Director General of NARO (National Agricultural Research Organization)
- ED of NAADS (National Agricultural Advisory Services)
- Representative(s) from MOLG (Ministry of Local Government), MFPED (Ministry of Finance Planning and Economic Development) and MOL (Ministry of Land)

(3) Japanese side

- Members of JICA mission
- Representative(s) from JICA Uganda Office
- JICA Agricultural Planning Advisor to MAAIF
- JICA Irrigation Advisor to MAAIF
- Official(s) of the Embassy of Japan may attend as observer(s).

(4) Other members accepted by the Chairperson, if necessary

List of the Project Areas for the Project on Irrigation Scheme Development in Central and Eastern Uganda

No.	Candidate Sites	River System	District	Estimated Beneficiary Area (ha)	Fragments	Flood	Existing farming	Farmer Organization	Relevant farmers
1	Ngenge & Atari river basin	Ngenge & Atari	Kween & Bulambuli	1,963 ha	Two	Moderate	Rice and Upland Crop	Ngenge Agricultural Farmers' Association (NAIFAM) at Ngenge	2,000
2	Buikwe Wetland	Mubeya	Buikwe	1,666 ha	One	None	Upland Crop + Rice	None	1,000
3	Sironko (Acomai) Wetland	Sironko & Sipi	Bukedea	1,083 ha	2 to 3	Moderate	Rice + Upland Crop	Intellectual Farmers' Group	1,000
4	Namatala Swamp	Namatala	Budaka/ Mbale/Butaleja	3,461 ha	One	Prone	Rice	None	6,000
5	Bulo Wetland	Katonga	Butambala	1,030 ha	3 to 4	None	Upland Crop + Rice(Past)	None	1,000
6	Outside Doho Scheme	Manafwa	Butaleja	2,600 ha	One	Prone	Rice + Upland Crop	None	3,000
7	Upstream Namatala Swamps	Lwere	Mbale	763 ha	3 to 4	Moderate	Rice (SIAD) + Vegetable	SIAD Groups	1,000
8	Upstream Sironko Swamp	Sironko	Sironko	312 ha	4 to 5	Moderate	Rice + Vegetable	Bumasan Farmers' Association	600
9	Sipi Riverside (Muyembe JICA Project)	Sipi	Bulambuli	348 ha	One	Moderate	Rice	Bunamone Farmers' Group	500
10	Omirio Swamp	Awoja Wetland	Soroti	250 ha	2 to 3	Moderate	Rice	Informal Rice Groups	1,000

Note: Data for candidate sites will be updated in the course of the Project.

MINUTES OF MEETINGS BETWEEN JAPAN INTERNATIONAL COOPERATION AGENCY AND THE AUTHORITIES CONCERNED OF THE GOVERNMENT OF THE REPUBLIC OF UGANDA FOR AMENDMENT OF THE RECORD OF DISCUSSIONS ON THE PROJECT ON IRRIGATION SCHEME DEVELOPMENT IN CENTRAL AND EASTERN UGANDA

The Japan International Cooperation Agency (hereinafter referred to as "JICA") and the authorities concerned of the government of the Republic of Uganda (hereinafter referred to as "GoU") hereby agree that the Record of Discussions on the Project on Irrigation Scheme Development in Central and Eastern Uganda (hereinafter referred to as "the Project") signed on 10th February, 2014 will be amended as follows;

1. Duration

Before	Amended Version
Two (2) years	Thirty-one (31) months from June 2014 to December 2016
Reason: Since the dispatch of mission was started from June 2014, both parties recognized that the duration of the Project was two (2) years from June 2014 to May 2016. Based on the request from GoU on the extension of the Project dated 2nd November, 2015, both parties agreed to extend the duration of the Project for seven (7) months from June to December, 2016 in order to achieve the Project Purpose successfully.	

This amendment will become effective once after both parties sign this Minutes of Meeting.

Annex : Record of Discussions (signed on 10th February, 2014)

Kampala, 11th November, 2015

Mr. Kyosuke Kawazumi
Chief Representative
JICA Uganda Office

Mr. Sunday James Mutabazi
For: Permanent Secretary
Ministry of Agriculture, Animal Industry and Fisheries
The Republic of Uganda

Eng. Richard Cong
For: Permanent Secretary
Ministry of Water and Environment
The Republic of Uganda

MINUTES OF DISCUSSION
ON
THE FIRST JOINT TECHNICAL COMMITTEE (JTC)
FOR

THE PROJECT ON IRRIGATION SCHEME DEVELOPMENT IN CENTRAL AND EASTERN UGANDA (PISD)

Kampala, 18th July 2014

The first JTC Meeting has been held at the MWE to identify and decide the scope of the potential irrigable area in the 10 candidate sites. The minutes of discussion in the 1st JTC Meeting is shown in the following pages.

Generally the JTC has agreed on the delineation criteria and the outcome of the delineation of the project area prepared by the Study Team. Therefore, the Study Team shall continue its activities on the delineated area agreed upon by the JTC.

Mr. Ronald Kato Kayizzi
PAE I&D
For Mr. Sunday Mutabazi
Project Manager
Commissioner
Department of Agricultural Production
MAAIF, Uganda

Eng. Richard Cong
Co-Project Manager
Commissioner
Directorate of Water for Production
MWE, Uganda

Dr. Callist Tindimugaya
Commissioner
Department of
Water Resource Plan and Regulation
MWE, Uganda

Mr. Collins Oloya
Commissioner
Department of Wetland Management
MWE, Uganda

Mr. Toshimasa Kobayashi
JICA Study Team Leader
The Project on Irrigation Scheme Development
in Central & Eastern Uganda (PISD)

The preliminary selection of project sites were made through the site reconnaissance jointly conducted by JICA, MAAIF and MWE as reported in the Minutes of Meeting and the R/D dated February 10, 2014 under the following set of selection criteria.

i) Existence of rice farming: The existence of rice cultivation area has given priority. Area with extensively covered by papyrus is excluded from the list
ii) District Policy: The sites and/or districts which do not have policy on promotion of rice cultivation in the wetland are excluded
iii) Ramsar Convention area: Sites located in Ramsar Convention registered area are excluded.

Applying the above criteria, 10 candidate sites were selected as project sites. However, the exact boundaries of these 10 sites in consideration of the site condition were not clearly delineated in the R/D. To clearly identify and delineate the potential irrigable area, the survey team from MAAIF, MWE and JICA study team have made field visit to the 10 candidate sites between July 1 and July 13, 2014. The result of the field survey is presented and discussed among the JTC member on July 18, 2014.

As a result, all sides have reached a mutual understanding on the matters referred to in 1) Delineation Criteria for the Potential Irrigable Area, and 2) Potential Irrigable Area described hereto.

1) Delineation Criteria for the Potential Irrigable Area

i. Generally, the existing cultivated area found in the wetland area will be included as target sites
ii. Upland slopes that are found around the existing cultivated wetland area will be included as target site together with stated in above (i) area.
iii. Undeveloped or untouched wetland area will be totally excluded from the target site;
iv. If the area is sufficiently cultivated within the limited water resources, and if there is no more expansion area to be developed, such area will be excluded from the target site.
v. Sugar cane area will not be converted to paddy field and will be excluded from the target site.

2) Potential Irrigable Area

The Potential Irrigable Area shown in the table below shall be modified in accordance with further water balance analysis.

Potential Irrigable Area

No.	Name of Site	District	Estimated Beneficiary Area by R/D (ha)	Potential Irrigable Area (ha)	Difference (ha)
1	Bulo Wetland	Butambala	1,030	92	-938
2	Buikwe Wetland	Buikwe	1,666	486	-1,180
3	Omirio Swamp	Soroti	250	250	0
4	Ngenge & Atari River Basin	Kween & Blambli	1,963	1,963	0
5	Sipi Riverside	Bulambli	348	348	0
6	Sironko (Acomai) Wetland	Bukedea	1,083	1,083	0
7	Upstream Sironko Swamp	Sironko	312	312	0
8	Upstream Namatala Swamp	Mbale	763	763	0
9	Namatala Swamp	Budaka/Mbale /Butaleja	3,461	3,461	0
10	Outside Doho Scheme	Butaleja	2,600	1,581	-1,019

According to the result of further investigation on water balance analysis which will be made on each potential site, some of the potential irrigation area will be modified from the irrigation area shown in the table above.

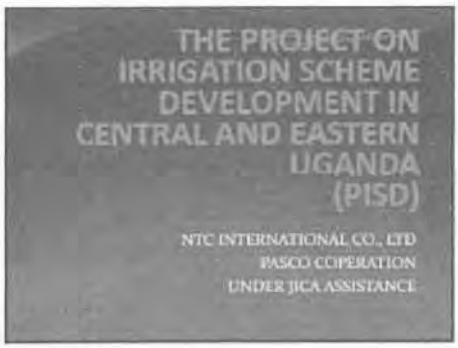
Attachment 1 Distributed Material at the 1st JTC Meeting

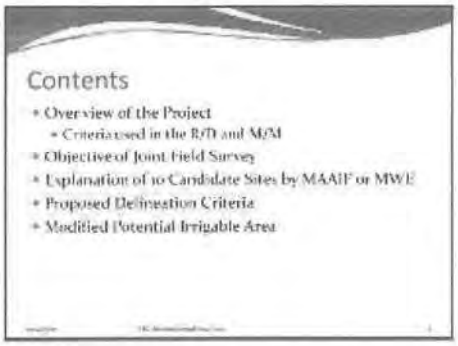
Attachment 2 Participants of the 1st JTC Meeting

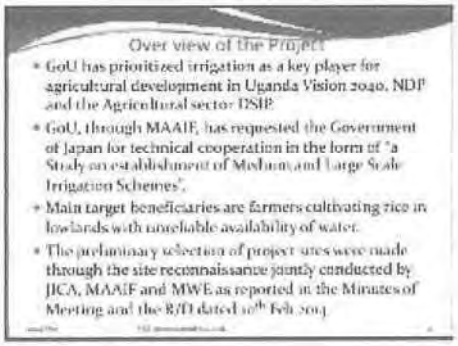
Attachment 1 : Distributed Material at the 1st JTC Meeting

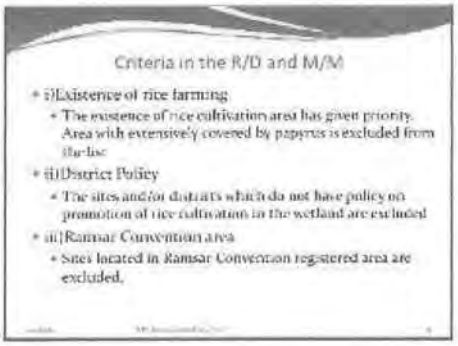
The Project on Irrigation Scheme Development in Central and Eastern Uganda

18/07/2014









NTC International Co., Ltd.

1

Objective of Joint Field Survey

- ICR. Potential Irrigable Area were assumed using the existing topographic map
  - To delineate Potential Irrigable Area on Candidate Sites by field survey
  - To confirm the actual conditions of the candidate sites by all stakeholders (JICA Study Team, MAAIF, MWE, etc)

Explanation of 10 Candidate sites

- MWE
- MAAIF

Proposed Delineation Criteria

Target of the Project in R/D

- The main target beneficiaries
  - Farmers cultivating rice in wetland area with unreliable and uneven distribution of water
- The target irrigation area
  - The existing cultivated area in the wetland and upland slope found around cultivated wetland
  - Untouched and natural wetland area where no cultivation activities exist must be excluded (not necessary)

Proposed Delineation Criteria

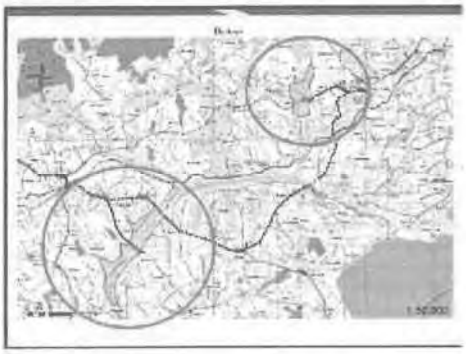
- (1) The existing cultivated area found in the wetland area will be included as potential irrigable area.
- (2) Upland slopes that are found around the existing cultivated wetland area will be included as potential area together with stated in above (1) sites.
- (3) Undeveloped or untouched wetland area will be totally excluded from the target area.
- (4) If the area is sufficiently cultivated within the limited water resources, and if there is no more expansion area to be developed, such area will be excluded from the potential area
- (5) Sugar cane area will not be converted to paddy field and will be excluded from the potential area

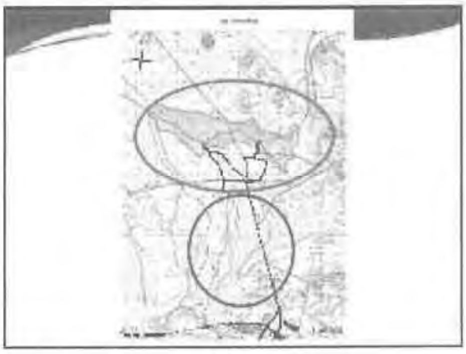
Modified Potential Irrigable Area

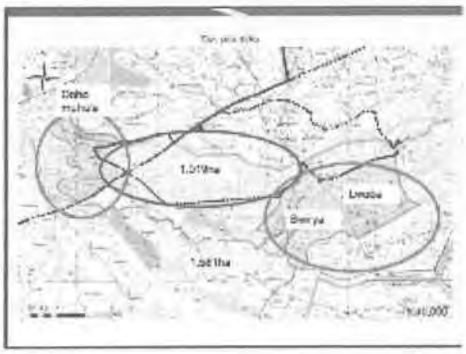
- (1) Bulo
- (2) Bulkwe
- (8) Upstream Namatala
- (10) Outside Dabo

The Project on Irrigation Scheme
Development in Central and Eastern Uganda

18/07/2014







No.	Name of Area	District	[illegible]	[illegible]	[illegible]
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	290	236	0
4	[illegible]	[illegible]	[illegible]	[illegible]	0
5	[illegible]	[illegible]	[illegible]	[illegible]	0
6	[illegible]	[illegible]	[illegible]	[illegible]	0
7	[illegible]	[illegible]	[illegible]	[illegible]	0
8	[illegible]	[illegible]	[illegible]	[illegible]	0
9	[illegible]	[illegible]	[illegible]	[illegible]	0
10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Minutes of Meeting

The second Joint Technical Committee (JTC) meeting

The Project on Irrigation Scheme Development in Central and Eastern Uganda

JICA is conducting a project on investigation of irrigation scheme development in Central and Eastern Uganda. The joint preliminary survey conducted by JICA, MAAIF and MWE have identified 10 candidate sites to be investigated for the formulation of Irrigation Scheme Development Project on these sites.

The JICA Study Team together with counterpart from MAAIF and MWE has conducted a study on the candidate sites during the period between July and November 2014. According to the minute of meeting and R/D signed between JICA and MAAIF this study is expected to select two to three sites for feasibility study, therefore the team has designed selection criteria to identify 2-3 sites for feasibility study. The result of the field survey is presented and discussed among the JTC member on 2nd December 2014.

As a result, all sides have reached a mutual understanding on the matters referred to in the document attached hereto.

Kampala, 2nd December 2014

Commissioner Sunday Mutabazi
Department of Agricultural Production
Project Manager
MAAIF
Uganda

Commissioner Eng. Richard Cong
Department of Water for Production
Co-Project Manager
MWE
Uganda

Commissioner Dr. Callist Tindimugaya
Department of Water Resource Plan and Regulation
MWE
Uganda

Commissioner Collins Oloya
Department of Wetland Management
MWE
Uganda

Mr. Mr. Kobayashi Toshimasa
Project Leader
The Project on Irrigation Scheme
Development in Central & Eastern Uganda

Place of meeting: NAADS Library, Legacy Towers, Block A, Kyandondo road Kampala

Date of meeting: December 2 2014

Participants: Refer to the Attendant list attached herewith

Topics of Discussion

1. **Presentation of the Development Plan by JICA Study Team**

   The result of the Irrigation Scheme Development Plan (ISDP) was presented by MAAIF/MWE/JICA Study Team. In the development plan the candidate area were generally categorized into two types such as small scale irrigation and medium to large scale irrigation scheme. The JICA Study Team define small scale irrigation scheme as those which have less than 200 ha of potential irrigable land and medium to large scale irrigation are considered as those with more than 200 ha. This demarcation between small and large scale is generally agreed by the Joint Technical Committee (JTC).

2. **Selection Criteria**

   The selection criteria proposed by the JICA Study Team is presented and discussed among the JTC members. The main selection criteria used to identify 2 to 3 project sites for feasibility study are:

   i) Project Evaluation: Net Present Value (NPV), Economic Internal Rate of Return (EIRR) and Benefit Cost (B/C) ratio;
   ii) Project Cost : Unit cost of construction per hectare;
   iii) Project Benefit: Total benefit (Financial Net Return);
   iv) Water Resources: Catchment size and reliability of irrigation water;
   v) Irrigation Potentiality for Rice: annual cropping acreage;
   vi) Agricultural Production Potentiality.

   According to the selection criteria, the sites have the following cumulative results.

Final Point	Rank	Site Name	Type	Irrigation Area		
118	1st	Sironko Large	2	2,450	ha	Selected (Very high potentiality)
117	2nd	Atari Large	2	1,000	ha	Selected (High potentiality)
98	3rd	Doho Lwoba/Bwilaya (upper)	1	1,178	ha	Private Land Owner (WB)
94	4th	Namatala (without Dam)	1	1,600	ha	Selected (High potentiality for future)
91	5th	Sipi	2	400	ha	Too near to the Sironko Site
86	6th	Up Namatala	3	55	ha	Best among the small scale
80	7th	Up Sironko	3	26	ha	Small scale
72	8th	Ngenge	1	880	ha	Flood problem

3. Selection of 2 to 3 sites for feasibility study

According to the result of the selection criteria Sironko (Acomai) and Atari are selected as priority sites for further feasibility investigation. Considering the third site, JICA Study Team proposed to include one from small scale site such as Up-Namatala (the best among small scale) on the understanding that it can be used as a site for the capacity building of the counterparts.

As a third site Doho, Namatala and Sipi is considered more feasible compared to Up-Namatala but have some set-backs. Sipi will create a problem of congestion of project in one area (it is close to Atari and Sironko). Doho scheme has already been selected for funding under the World Bank Cluster Project. Namatala is not considered due to the high cost of construction and due to the environmental considerations and safety safe guards for dam construction which takes time and may not fit in the time frame of JICA. In addition, Namatala has high potentiality for land conflict (inter-district land boundary issues).

The counterparts from MAAIF and MWE noted that the small scale sites can be handled by Government of Uganda (GOU) under the technical support of the JICA Study Team. For the past 10 years, JICA support has targeted small scale irrigation which has enabled MAAIF to develop sufficient capacity for small-scale irrigation development.

Finally the JTC agreed that the three sites selected for feasibility study are:

1st Sironko

2nd Atari

3rd Up-Namatala

JTC recommends the following:

- Potential land conflicts in the proposed sites especially Namatala should be resolved in due course of the project by developing clear strategies for sustainable land management;
- Comprehensive capacity building of the Ministries calling for urgent recruitment of personnel;
- A strategy for sustainable management of all schemes.

4. General Discussion and Way Forward

Generally the JTC has agreed on the selection criteria and the result of the selection of the sites. Therefore, the JTC recommends to the Joint Coordination Committee (JCC) for final discussion and selection of the three priority sites for the Feasibility Study.

Minutes of Meeting

The third JTC meeting

For the Second Phase of

The Project on Irrigation Scheme Development in Central and Eastern Uganda

JICA has been assisting the study for the project on irrigation scheme development in Central and Eastern Uganda since June 2014. The study has been conducted by the JICA study team in collaboration with MAAIF and MWE. During the first phase of this project the joint investigation team has identified three priority sites among the 10 candidate sites for further survey. Accordingly the Joint Coordination Committee has agreed and approved on the investigation of feasibility survey on the selected two priority sites and prefeasibility level survey on the remaining one site.

Now, JICA has launched the second phase of this project starting from June 2015 and since then JICA Study Team has been conducting the feasibility study. Therefore the JICA Study Team has prepared the progress of the project and is presented and discussed among the JTC members on 7th December 2015.

As a result, all sides have reached a mutual understanding on the matters referred to in the document attached hereto.

Kampala, 7th December 2015

Commissionaire Sunday Mutabazi
Department of Infrastructures and Water for Agricultural Production
Project Manager
MAAIF
Uganda

Commissionaire Eng. Cong
Department of Water for Production
Co-Project Manager
MWE
Uganda

Commissionaire Collins Oloya
Department of Wetland Management
MWE
Uganda

Mr. Kobayashi Toshimasa
Project Leader
The Project on Irrigation Scheme Development in Central & Eastern Uganda

Place of meeting:	City Royal Hotel
Date of meeting:	December 7th 2015 starting from 9:00AM to 12:00AM
Participants	Refer to Attachment for Attendant List

Topic of Discussion

1. Progress of the Project

The progress of the feasibility study of the project was presented by JICA Study Team (JST) and PISD Task Force. The presentation has focused on the following points which were agreed among the Joint Technical Committee of PISD project. These are:

a. ***Water Balance Calculation***: River discharge of Sironko River was determined from the new H-Q curve developed using the result of automatic water level gauge installed by JST. However, the new rating curve shall be harmonized with Directorate of Water Resource Management. Whereas, the river discharge of Atari River was estimated from regression of Sipi River specific discharge. In addition, the water balance analysis is made using a five year return period with reference year taken at 2004.

b. ***Irrigation Layout Plan***: The layout of irrigation scheme related to the alignment of canals was prepared taking into consideration not only the technical feasibility and topography of the project area but also the request of the communities, location of settlements, existing roads and foot paths.

c. ***Scale of the Project***: Considering the water balance of the river, the size of the irrigation scheme is set as 1,700ha and 700ha for Sironko (Acomai) and Atari sites, respectively. However, the JTS shall also consider other option like including different crops in addition to paddy and installing night storage system in the project.

d. ***Layout of the Protection Dyke***: Flood protection dykes shall be provided along the river which shall create a buffer zone which will preserve the biodiversity of the wetlands and river. Considering the scale and the meandering nature of the river a buffer zone of about 200m and 30 to 80m area is set for Sironko and Atari River, respectively, where the protection dyke is planned to be installed. In addition, the protection dyke on the right side of Sironko River shall also be considered in the design stage.

e. ***Return Period***: JST had set the return period for flood protection dyke as ten years considering the balance of the construction cost, flood damage expenditures and the type of the river according to the standard used in Japan.

2. Work Schedule related to the Project

JST has presented the expected work schedule of the project until the commencement of implementation of the project. In case the project is to be implemented by Japanese Grant Aid program, the necessary tasks that must be accomplished by GoU before the commencement of construction of the project is presented as follow.

a. ***Procedure related to EIA/RAP***:

i. *Preparation of RAP*: The Resettlement Action Plan prepared at F/S level by JST is expected to give the rough estimation of compensation cost due to lack of actual landownership that might be affected by the facilities. Therefore, GoU should prepare the final RAP and compensation plan with determination of method and budget allocation before the end of 2017. This activity also include:

Activity	Schedule
RAP Disclosure	in the beginning of 2018
Grievances management	Mid 2018 up to mid 2019
Resettlement and Compensation Payment	To be completed before mid 2019
RAP Monitoring	To be completed before mid 2019
RAP Completion audit	To be completed before mid 2019

These activities shall be completed before the commencement of the construction of the project which is set tentatively at the middle of 2019.

ii. *Certificate of EIA/RAP*: The project implementing agency, MAAIF and MWE shall process for the certificate of approval of EIA/RAP and get the certificate before July of 2017. For the purpose of processing this certificate the implementing agency shall allocate budget as payment for the certificate which according to NEMA guideline amount to 0.1% of the construction cost. This cost shall be included during the preparation of the budget for 2017 Fiscal Year.

b. ***Land Acquisition for Facilities***: The implementing agency (GoU) shall prepare the clear methodology and plan of acquiring land for irrigation facilities. In addition, counterparts agree to form a land acquisition team consists of expert among the Ministry of Land, Ministry of Agriculture and Ministry of Water to create a clear methodology and plan of acquiring land for facilities.

c. ***Landowner Confirmation***: For the smooth implementation of RAP the preparation of cadastral map of the project area is found to be a necessary activity. It is also agreed that the survey for confirmation of land owner shall be carried out during F/S so that smooth implementation of detail design is possible. JICA (JST) agrees to prepare the cadastral map which identifies the boundary of land and landownership. The survey for the preparation of cadastral map shall be conducted according to the following schedule and involving the stakeholders listed in the tables below:

Place of meeting:	City Royal Hotel
Date of meeting:	December 7th 2015 starting from 9:00AM to 12:00AM
Participants	Refer to Attachment for Attendant List

Topic of Discussion

1. Progress of the Project

   The progress of the feasibility study of the project was presented by JICA Study Team (JST) and PISD Task Force. The presentation has focused on the following points which were agreed among the Joint Technical Committee of PISD project. These are:

   a. ***Water Balance Calculation***: River discharge of Sironko River was determined from the new H-Q curve developed using the result of automatic water level gauge installed by JST. However, the new rating curve shall be harmonized with Directorate of Water Resource Management. Whereas, the river discharge of Atari River was estimated from regression of Sipi River specific discharge. In addition, the water balance analysis is made using a five year return period with reference year taken at 2004.

   b. ***Irrigation Layout Plan***: The layout of irrigation scheme related to the alignment of canals was prepared taking into consideration not only the technical feasibility and topography of the project area but also the request of the communities, location of settlements, existing roads and foot paths.

   c. ***Scale of the Project***: Considering the water balance of the river, the size of the irrigation scheme is set as 1,700ha and 700ha for Sironko (Acomai) and Atari sites, respectively. However, the JTS shall also consider other option like including different crops in addition to paddy and installing night storage system in the project.

   d. ***Layout of the Protection Dyke***: Flood protection dykes shall be provided along the river which shall create a buffer zone which will preserve the biodiversity of the wetlands and river. Considering the scale and the meandering nature of the river a buffer zone of about 200m and 30 to 80m area is set for Sironko and Atari River, respectively, where the protection dyke is planned to be installed. In addition, the protection dyke on the right side of Sironko River shall also be considered in the design stage.

   e. ***Return Period***: JST had set the return period for flood protection dyke as ten years considering the balance of the construction cost, flood damage expenditures and the type of the river according to the standard used in Japan.

2. Work Schedule related to the Project

   JST has presented the expected work schedule of the project until the commencement of implementation of the project. In case the project is to be implemented by Japanese Grant Aid program, the necessary tasks that must be accomplished by GoU before the commencement of construction of the project is presented as follow.

Minutes of Meeting

The fourth JTC meeting

For the Second Phase of

The Project on Irrigation Scheme Development in Central and Eastern Uganda

JICA has been assisting the study for the project on irrigation scheme development (PISD) in Central and Eastern Uganda since June 2014. The study has been conducted by the JICA study team in collaboration with MAAIF and MWE. During the first phase of this project the joint investigation team identified three priority sites among the 10 candidate sites for further studies. Accordingly the Joint Coordination Committee (JCC) agreed and approved on the investigation of feasibility study on the selected two priority sites (Atari in Kween/Bulambuli Districts and Sironko/Acomai in Bukedea/Bulambuli Districts) and prefeasibility level survey on the remaining one site (Namatala wetland system in the Districts of Mbale, Budaka and Butaleja).

JICA launched the second phase of this project starting from June 2015 and since then JICA Study Team has been conducting the feasibility study. The JICA Study Team has prepared the feasibility study of the project and is presented and discussed among the JTC members on 20th July 2016.

As a result, all sides have reached a mutual understanding on the matters referred to in the document attached hereto.

Kampala, 20th July 2016

Commissioner Sunday Mutabazi
Department of Infrastructures and Water for Agricultural Production
Project Manager
MAAIF
Uganda

Assistant Commissioner Eng. John Twinomujuni
Department of Water for Production
Co-Project Manager
MWE
Uganda

Assistant Commissioner Albert Orijabo
Directorate of Water Resources Management
MWE
Uganda

Mr. Kobayashi Toshimasa
Project Leader
The Project on Irrigation Scheme Development in Central & Eastern Uganda

Place of meeting:	City Royal Hotel
Date of meeting:	July 20th 2016 starting from 9:00AM to 13:00PM
Participants	Refer to Attachment for Attendant List

Topic of Discussion

The Phase-2 Works of the project in 2016 has been presented by JICA Study Team (JST). The presentation has focused on the following points which are agreed upon among the Joint Technical Committee of PISD project. These are:

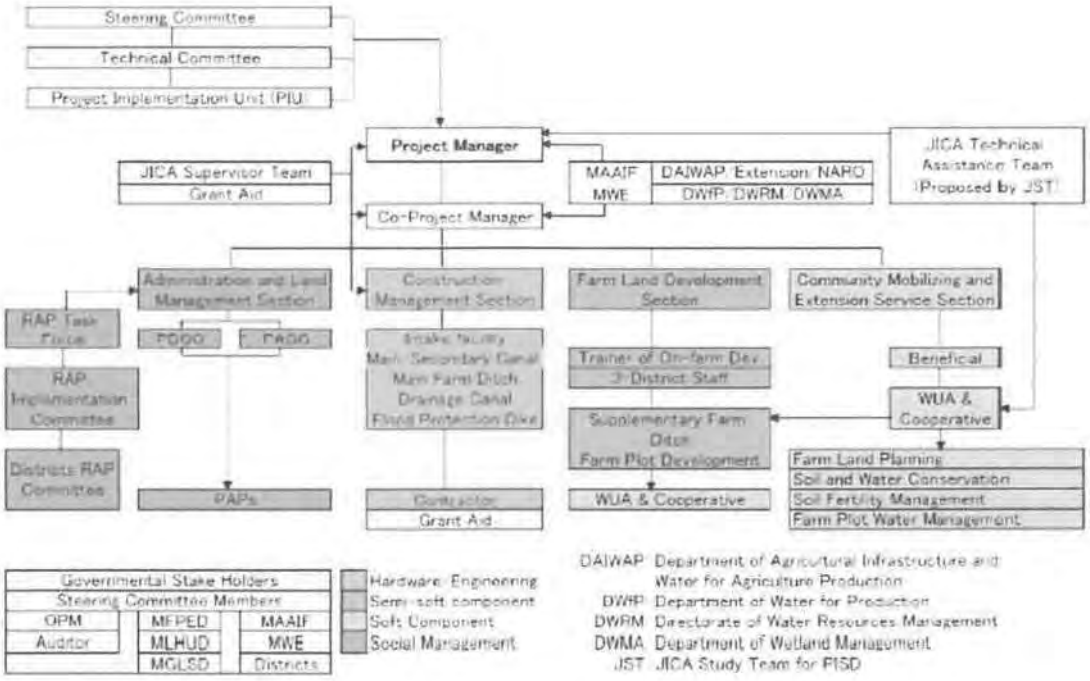
1. JST explained the results of the F/S sites of Sironko and Atari and Pre-F/S of Namatala Site.
2. Proposed Site for requesting Japanese Grant Aid:

   The selection criteria proposed by the JST has presented and discussed among the JTC members. The JST recommends the priority site for the first implementation as Atari site. JTC members understand the advantages of the Atari site but implores JST to confirm final site having taken into consideration the comments made on the selection criteria . However the final selection will be made during the next JCC Meeting. JTC notes that detailed designs shall be done for the selected site upon requesting for Japanese Grant Aid.
3. Implementation Agencies and Executing Agency are required for the next step for implementing one of the F/S sites. The implementing Agencies shall be MAAIF and MWE. The Executing Agency shall be MAAIF. JTC proposes that components to handled by the different Implementing Agencies be made clear to aid the budgeting process.:
4. Basic idea of the Proposed Implementation and Management Organization and Operation & Maintenance Structures for the Project

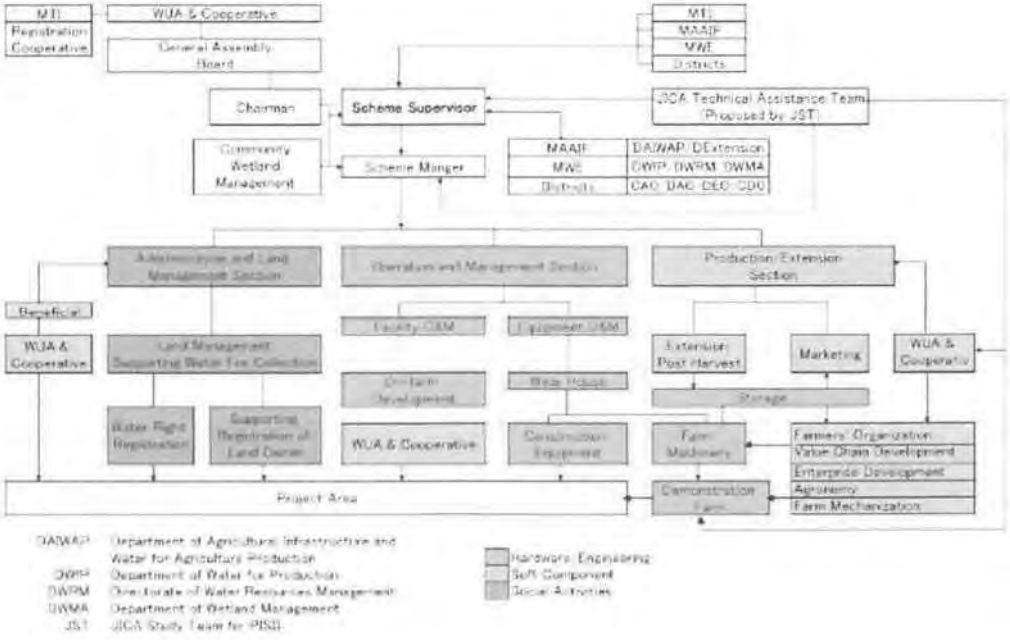
   JST has presented the proposed implementation and management and Operation & Maintenance Structures for sustainability of the project. JTC notes that the detailed institutional arrangements will be refined taking into account the comments raised and the practices under the existing projects.

   JTC agrees to the basic idea of the structures as follows:

   (1) Proposed Implementation Structure



(2)Structure for O&M



5. Confirmation of Submission of Reports

JTC confirms the dates for submission of Draft Final Report and Final Report as follows:

Draft Final Report: Middle of August 2016

Final Report: Middle of November 2016

6. General Discussion and Way Forward

JTC has made recommendations for refining the selection criteria of the priority site for further implementation to be taken into consideration by JST. Therefore, the JTC recommends to the Joint Coordination Committee (JCC) for final discussion and selection of the priority site for requesting Japanese Grant Aid.

JTC recommends an exit meeting for Namatala site.

The JTC members generally agree on the discussion made above and will take the necessary action for the successful implementation of the responsibility bestowed upon the Government of Uganda.

Minutes of Meeting

The first JCC meeting

The Project on Irrigation Scheme Development in Central and Eastern Uganda

The Government of Uganda, through MAAIF, has requested the Government of Japan for technical cooperation in the form of study on establishment of medium and large scale irrigation scheme in Central and Eastern Uganda targeting farmers cultivating mainly rice in lowland area with unreliable agricultural water source.

Based on this request JICA has agreed to conduct a Study for "The Project on Irrigation Scheme Development in Central and Eastern Uganda". Consequently, JICA has sent a JICA Study Mission (the Study Team) to Uganda on June 22 2014. In accordance with the Records of Discussion signed on February 10 2014 between JICA and the Uganda, JCC meeting was held on June 27 2014. The Study Team has presented the Inception Report of the project during the meeting. The JCC members exchanged views and opinion on the implementation method, work schedule and proposed arrangement of JCC members.

As a result, all sides have reached a mutual understanding on the matters referred to in the document attached hereto.

Kampala, 27th June 2014

Dr. Hirofumi Hoshi
Chief Representative
JICA Uganda Office
Japan International Cooperation Agency

Mr. Alex Kakooza
For: Permanent Secretary
Ministry of Agriculture, Animal Industry and Fisheries
The Republic of Uganda

Mr. Richard Cong
For: Permanent Secretary
Ministry of Water and Environment
The Republic of Uganda

Place of meeting: Cotton House, Kampala

Date of meeting: June 27 2014 starting from 9:00AM to 11:45AM

Attendee Refer to ANNEX-2, Attendant List

Agenda

1. Short name of the Project

   It is agreed that the proposed short name for "The Project on Irrigation Scheme Development in Central and Eastern Uganda" to be called as **PISD**

2. Implementation Method

   The Study Team has presented the Inception Report of the Project (attached in ANNEX-1) and it is agreed that the Study Team shall proceed with its activities on the implementation of the Study.

3. Work Schedule

   As indicated in the Inception Report the Project shall be conducted in two phases. During the first phase the Study Team will conduct survey on the candidate 10 sites and identify 2 to 3 potential sites for further study. In the second phase the Study Team will conduct Feasibility Study on the identified priority sites

4. Proposed arrangement of JCC

   For better implementation of the project the JCC proposed to rearrange the stakeholders of JCC emphasizing the need for the direct involvement of key departments whose contribution for the preparation of feasible irrigation development project in the target area is important. The JCC agrees that the original JCC structure will remain as it is, however the key departments such as Department of Wetland Management and Department of Water Resource Planning and Regulation shall be involved in subsequent JCC meetings.

5. Joint Technical Committee (JTC)

   It is agreed that a Joint Technical Committee that involves commissioners from relevant departments, the study team and counterparts shall be formed and held a meeting before the JCC meeting and thereafter as need arises. The purpose of this meeting shall be to review the progress of the study and discus technical issues on the Project so that the JCC meeting will be conducted smoothly in the approval of the subject matters.

ANNEX-1: Attendant List

ANNEX-2: Inception Report

ANNEX-1: Inception Report

Inception Report shall be attached here and has been distributed during the JCC Meeting. Please refer to the distributed Inception Report.

Minutes of Meeting

The second Joint Coordination Committee (JCC) meeting

The Project on Irrigation Scheme Development in Central and Eastern Uganda

JICA is conducting a project on investigation of irrigation scheme development in Central and Eastern Uganda. The joint preliminary survey conducted by JICA, MAAIF and MWE identified 10 candidate sites to be investigated for the formulation of Irrigation Scheme Development Project on these sites.

The JICA Study Team together with counterparts from MAAIF and MWE has conducted a study on the candidate sites during the period between July and November 2014. According to the Minute of Meeting (MM) and Record of Discussion (R/D) signed between JICA and MAAIF this study is expected to select two to three sites for feasibility study. Therefore the team has designed a selection criteria to identify 2-3 sites for feasibility study. The result of the field survey is presented and discussed among the JCC members on 9th December 2014.

As a result, all sides have reached a mutual understanding on the matters referred to in the document attached hereto.

Kampala, 9th December 2014

for

Mr. KAWAZUMI Kyosuke
Chief Representative
JICA Uganda Office
Japan International Cooperation Agency

Mr. MUTABAZI Sunday
For: Permanent Secretary
Ministry of Agriculture, Animal Industry and Fisheries
The Republic of Uganda

Eng. KABIRIZI Aaron
For: Permanent Secretary
Ministry of Water and Environment
The Republic of Uganda

Place of meeting: City Royal Hotel, Kampala

Date of meeting: December 9 2014

Participants: Refer to the Attendant list attached herewith

Topics of Discussion

1. **Presentation of the Development Plan by JICA Study Team**

   The result of the Irrigation Scheme Development Plan (ISDP) was presented by MAAIF/MWE/JICA Study Team. In the development plan the candidate area were generally categorized into two types such as small scale irrigation and medium to large scale irrigation scheme. The JICA Study Team define small scale irrigation scheme as those which have less than 200 ha of potential irrigable land and medium to large scale irrigation are considered as those with more than 200 ha. This demarcation between small and large scale is generally agreed by the Joint Technical Committee (JTC) and JCC.

2. **Selection Criteria**

   The selection criteria proposed by the JICA Study Team is presented and discussed among the JCC members. The main selection criteria used to identify 2 to 3 project sites for feasibility study was done in two steps.

   1st Step: Quantifiable Factors such as :

   i) Project Evaluation: Net Present Value (NPV), Economic Internal Rate of Return (EIRR) and Benefit Cost (B/C) ratio;
   ii) Project Cost : Unit cost of construction per hectare;
   iii) Project Benefit: Total benefit (Financial Net Return);
   iv) Water Resources: Catchment size and reliability of irrigation water;
   v) Irrigation Potentiality for Rice: annual cropping acreage;
   vi) Agricultural Production Potentiality: Increment of production and Ratio of production increase;
   vii) Accessibility: Distance to the main market.

   2nd Step: Non-Quantifiable Factors such as Environmental conditions, Sustainability/Maintenance, Social problems like land conflict and land ownership, etc. According to the comment at the JTC Meeting, Land Conflict can be observed almost at every site and solved by the Uganda Government through sensitization.

   According to the selection criteria, the sites have the following cumulative results.

Rank	Points	Site Name	Type	Irrigation Area	Remark
1st	**118**	**Sironko Large**	**2**	**2,450 ha**	**High potentiality**
2nd	**117**	**Atari Large**	**2**	**1,000 ha**	**High potentiality**
3rd	98	Doho Lwoba/Bwilaya (upper)	1	1,178 ha	**WB has listed**
4th	94	Namatala (without Dam)	1	1,600 ha	Stage development is needed to resolve issues
5th	91	Sipi	2	400 ha	Need to resolve some issues Near to Sironko
6th	86	Up Namatala	3	55 ha	**Best among the small scale**
7th	80	Up Sironko	3	26 ha	Small Scale

3. Selection of 3 sites for feasibility study (Phase-2)

According to the result of the selection criteria Sironko (Acomai) and Atari are selected as 1st and 2nd priority sites for further feasibility investigation in the second phase. Doho Lwoba/Bwirya has already been listed for consideration under the Agriculture Cluster Development Project (ACDB) World Bank Project. Automatically, Namatala Wetland with target irrigation area of 1600 hectares, becomes the 3rd site for consideration, even though Namatala development is not yet matured to implement to solve the problem of land conflict (inter-district land boundary issues) and land degraded by rice farmers. There is need to solve the social problems in Namatala before full scale implementation.

The Namatala Site will be mainly studied for the soft component of irrigation and WUA management technology and long term comprehensive development scenario for the Namatala Site. In the proposed soft component of Management Technology for Namatala area farmers will be sensitized to establish Water User Association (WUA) which will be supported along with the establishment of Irrigation Policy by the Government. Some ideas to establish a registration system of the WUA in the wetland have already been proposed. The soft component will then be followed by preparation of mainly Hydrometeorological fundamental data for detailed design.

4. General Discussion

The JCC agrees to the 1st site (Sironko) and 2nd site (Atari) for feasibility study based the scientific procedure presented by the JICA Study Team and the agricultural potential of these sites.

The JCC agrees that Doho Lwoba/Bwirya be left out since it has already been listed for consideration under the Agriculture Cluster Development Project (ACDB) World Bank Project.

The JCC agrees that it was right for the JICA Study Team to drop land conflict as a killer constraint for site selection as noted by the JTC which automatically makes Namatala Wetland the 3rd site for consideration. However, JCC recommends that a clear strategy be formulated to solve potential land conflicts for all the sites.

The JCC agrees to Namatala Wetland with all aspects including Dam case for further investigation and notes that the JICA Study Team should include activities of the long term comprehensive stage development scenario for the Namatala Site in Phase 2 as presented.

5. Final Conclusion of Selection of 3 priority sites for Phase-2

Finally, the JCC agrees that the three sites selected are:

1st Sironko (Feasibility Study);

2nd Atari (Feasibility Study);

3rd Namatala Wetland (Management Technology and Stage Development Scenario with all aspects including Dam case /Pre-feasibility);

6. Way Forward

As indicated in the Inception Report the Project shall be conducted in two phases. During the first phase the Study Team will conduct survey on the candidate 10 sites and identify 2 to 3 potential sites for further study. In the second phase the JICA Study Team will carry out :

- Photographing aerial photo for Topographical Mapping;
- Feasibility Study on the identified priority sites (Sironko and Atari);
- Management Technology and Stage Development Scenario with all aspects including Dam case /Pre-feasibility for Namatala;
- Installation of Hydro-meteorological stations in the irrigation and catchment areas of the identified priority sites (Sironko, Atari and Namatala);
- Capacity building programme.

The work schedules are as shown below.

Phase 1

Work Items \ Period	Fiscal Year 2014				
	Phase 1				
	Nov	Dec	Jan	Feb	Mar
1-10. Selection of Priority Sites	■				
1-11. Implementation of Irrigation Technology Training, etc (The First Term).	- - -	- - -	- - -	■	
1-12. Explanation and Agreement of Draft Interim Report	□	■ △			
1-13. Preparation of Interim Report		□	□	□	△
1-14. Photographing Aerial Photo				■	

Phase 2

Work Items \ Period	Fiscal Year 2015												Fiscal Year 2016		
	Phase 2														
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
[The Second Term: Feasibility Study]															
2-1. Topographic Mapping		■	■												
2-2. Explanation of Work Plan in the Second Term			■ △												
2-3. Collection of Additional Information on Priority Sites and Implementation of Feasibility Study			□	□	□	□	□	□	□						
2-4. Implementation of Irrigation Technology Training, etc (The Second Term).			- □ -	- - -	- - -	- - -	- - -	- ■ -	- - -	- - -	- ■ -	- - -			
2-5. Preparation of Draft Final Report										■	■	■ △			
2-6. Preparation of Final Report													□	□	△

△—△ Explanation of Report, et ---------- Other Works

Minutes of Meeting

The third JCC meeting

For the Second Phase of

The Project on Irrigation Scheme Development in Central and Eastern Uganda

JICA has been assisting the study for the project on irrigation scheme development in Central and Eastern Uganda since June 2014. The study has been conducted by the JICA study team in collaboration with MAAIF and MWE. During the first phase of this project the joint investigation team has identified three priority sites among the 10 candidate sites for further survey. Accordingly the Joint Coordination Committee has agreed and approved on the investigation of feasibility survey on the selected two priority sites and prefeasibility level survey on the remaining one site.

Now, JICA is launching the second phase of this project starting from June 2015. Therefore the JICA Study Team has prepared the work plan for the second phase of the investigation of the project and is presented and discussed among the JCC members on 24th June 2015.

As a result, all sides have reached a mutual understanding on the matters referred to in the document attached hereto.

Kampala, 24th June 2015

Mr. KAWAZUMI Kyosuke
Chief Representative
JICA Uganda Office
Japan International Cooperation Agency

Mr. MUTABAZI Sunday
For: Permanent Secretary
Ministry of Agriculture, Animal Industry and Fisheries
The Republic of Uganda

Eng. CONG Richard
For: Permanent Secretary
Ministry of Water and Environment
The Republic of Uganda

Place of meeting: Uganda Coffee Development Authority

Date of meeting: June 24 2015 starting from 9:00AM to 12:00AM

Participants Refer to Attachment, Attendant List

Topic of Discussion

1. Confirmation of the Scope of the Study

   As it was agreed in the second JCC meeting held on December 9 2014 the scopes of the second phase of the project are ①conducting feasibility study on Sironko (Acomai) site and Atari Scheme and ②preparation of long term irrigation development plan for Namatala Scheme.

2. Presentation of the work Plan

   The JICA study team has presented the work plan of the second phase of the project and it is agreed that the Study Team shall proceed with its activities as explained in the Work Plan. The detail of the Work Plan is presented as attachment to this document.

3. Revision of Activity and Schedule

   Due to the change in the environmental categorization of the project, (from Category B to category A), under the JICA Guideline), it is agreed that the content of the activities in this phase and the time schedule of the project to be changed altered from the one agreed upon during the signing of R/D as follow:

   3.1 Additional activities in this phase

   In addition to the activities of Phase 2 of the project which was stipulated in the R/D of this project, the following additional activities shall be conducted, such as:

   1) Work for JICA's Advisory Committee for Environmental and Social Consideration
   2) Conducting Abbreviated Resettlement Action Plan (RAP)

   3.2 Revised Schedule

   Due to the change in the activities of this phase the implementation schedule is revised as follow.

Item	Original Schedule	Revised Schedule
1st JICA's Advisory Committee	Not planned	End of June, 2015
Commencement of Phase2	Mid of May, 2015	Mid of June, 2015
Submitting of DFR	Beginning of April, 2016	Mid of June, 2016
2nd JICA's Advisory Committee	Not planned	End of June, 2016
Submitting of FR	End of June, 2016	Beginning of September, 2016
Termination of project	End of July, 2016	End of September, 2016

4. Environmental Issue of the Project

   As stipulated in the environmental guideline of Uganda this project lies in Category 4 (Equivalent to Category A under JICA guideline) which is believed to have diverse significant impact on the environment. Therefore, an EIA is required as part of the feasibility study for Atari and Sironko sites and SEA shall be conducted for Namatala Site. In addition, Abbreviated Resettlement Action Plan (RAP) and Community Wetland Development Plan shall be prepared as part of feasibility study. The project must not deviate significantly from the World Bank's Safeguard policy related to involuntary resettlement.

5. Shared Responsibility among Stakeholder

   - Community Sensitization: For smooth implementation of the activities in this phase the counterpart (MAAIF and MWE), in collaboration the local government, agree to take the lead responsibility of sensitization of the community, especially in Sironko (Acomai) wetland Scheme.
   - Workshop: The counterpart (MAAIF and MWE) agree to organize and prepare a workshop that will be held at Mbale (for general workshop) and each project sites (for workshop at each target project)
   - Approval of TOR: The project brief was submitted to NEMA and they have agreed to give conditional approval of the TOR of EIA and RAP.
   - Resettlement plan: The counterpart (MAAIF and MWE) agree to implement resettlement plan.

6. Counterpart fund

   The counterparts agree to allocate fund for the activities of counterparts related to the capacity development, preparation of workshop and participating the feasibility study of the project.

7. Stakeholder participation

   All stakeholders should be involved during the feasibility study.

ANNEX-1: Attendant List
ANNEX-2: Work plan for the 2nd phase of the project
~~ANNEX-3: Attendant List~~

Minutes of Meeting

The Forth JCC meeting

(Extraordinary)

For the Project on Irrigation Scheme Development in Central and Eastern Uganda

(Phase Two)

JICA has been assisting the study for the project on irrigation scheme development in Central and Eastern Uganda since June 2014. Accordingly, the second phase of the project was commenced on June 2015. The JICA study team in collaboration with MAAIF and MWE has prepared the work plan for the second phase of the investigation of the project and presented and discussed among the JCC members on the third JCC meeting of the project which was held on 24th June 2015. The work plan was approved by JCC and consequently the JICA study team has been in the field engaging in the investigation of the project area for preparation of the feasibility of the project.

However, during the course of the field investigation and engaging with the communities the study team has been facing with numerous obstacles and hindrance of the field activities resulting from misunderstanding and lack of enough sensitization from C/P side to the communities.

Therefore, the JICA study team in collaboration with a Task Force Team consists of technical staffs from MAAIF and MWE have designed a methodology of tackling the issue for smooth implementation of the project. Accordingly, the teams have prepared and presented the approach used to the issue; the progress of the work including the work plan, challenges faced and way forward during the extraordinary JCC meeting which was called by members on 5th October 2015.

The presentation was discussed among the JCC members on the same day; and as a result, for successful implementation of the project, all sides have reached a mutual understanding on the matters referred to in the document attached hereto

Kampala, 5th October 2015

Mr. MURAKAMI Shunichi
For: Mr. KAWAZUMI Kyosuke
Chief Representative
JICA Uganda Office
Japan International Cooperation Agency

Mr. MUTABAZI Sunday
For: Permanent Secretary
Ministry of Agriculture, Animal Industry and Fisheries
The Republic of Uganda

Eng. ONG Richard
For: Permanent Secretary
Ministry of Water and Environment
The Republic of Uganda

Place of meeting:	City Royal Hotel
Date of meeting:	5th October 2015 starting from 9:00AM to 12:00AM
Participants	Refer to Attachment, Attendant List

Topic of Discussion and Approved points

1) Ratify the PISD Task Force Team

PISD Task Force Team is comprises of the technical staff of MAAIF, MWE and MLHUD. All Ministries assigned the technical staffs who shall work in the project area for the purpose of smooth implementation of the project by mobilizing, establishing and supporting PDCC, PACC and guide and coordinate between PDCC, PACC and JICA Study Team.

2) Clear sustainability plan to sustain PDCC, PACC and PISD Task Force Team

For sustainable of the team and smooth implementation of their activities, MAAIF/MWE/MLHUD allocates the necessary budget to support PDCC, PACC and PISD Task Force Team from October to end of the Study.

3) Methodology for Land Acquisition for infrastructure

As a pre-condition for the implementation of the project, the Government of Uganda should prepare a clear methodology (strategy) for land acquisition for infrastructure starting from F/S level.

4) Landowner confirmation survey will be conducted as an additional task during F/S.

For the purpose of smooth designing and implementation of the project JCC members agreed on the necessity of confirmation of landowner in the project area during as additional task of Phase II of the project.
The methodology and budget allocation for this additional task shall be discussed and approved by the end of December considering the condition on the ground.

5) Approve PACC & PDCC to act as a planning unit for the preparation of CRM plan

According to the guideline prepared by MWE (WMD), for the preparation of CRM plan (Wetland management and Catchment management Plans), a planning unit consists of stakeholders should be formulated at community level, however, in this project since the conditions on the ground are sensitive and frangible, and to avoid confusion by the community it is recommended to use these committee as a planning unit for CRM plan. Hence, JCC has approved utilizing the established committee such as PDCC and PACC as a planning team for CRMP.

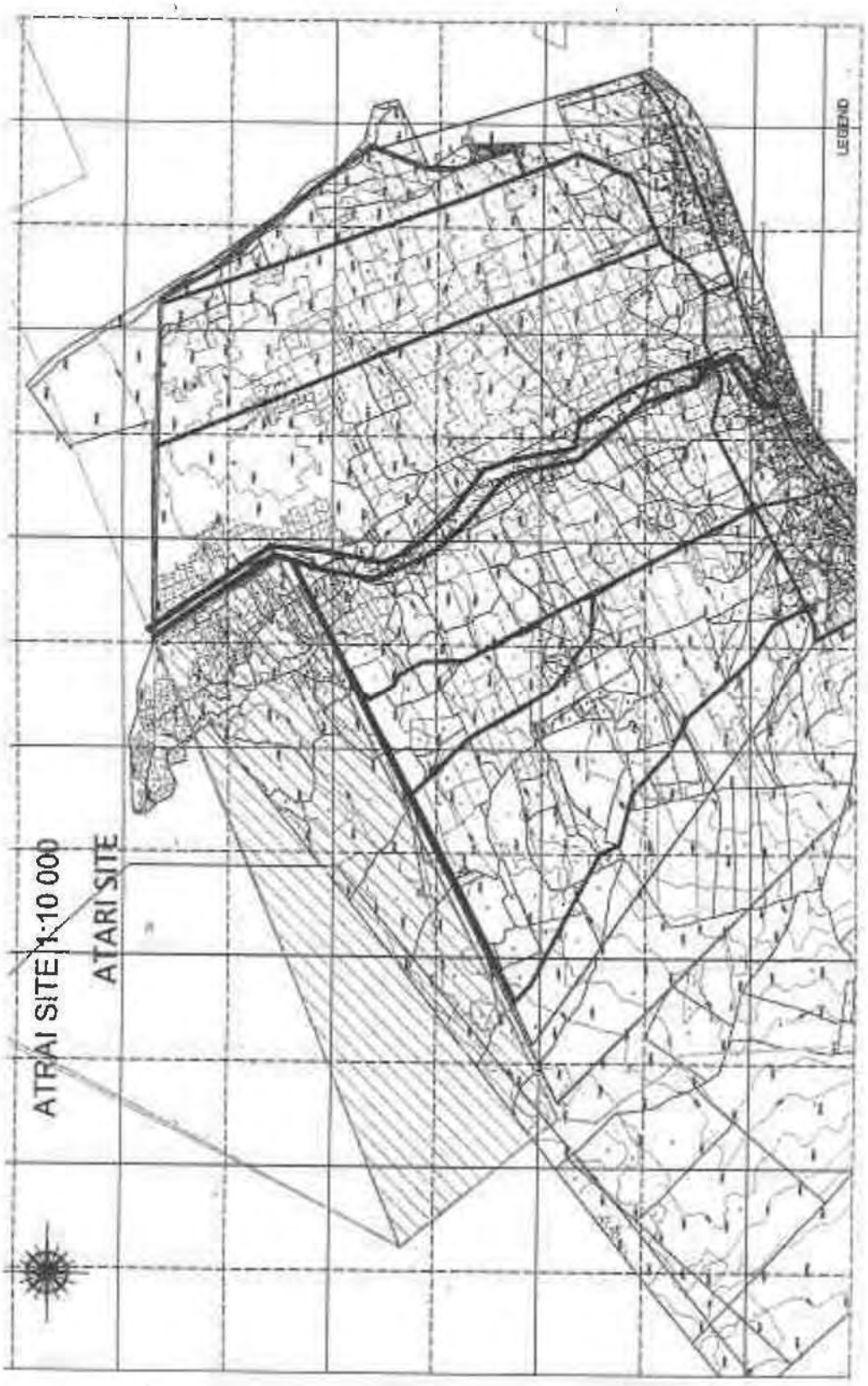
6) Atari disputed land removed from the project development/ study area

To avoid complication of the study that might arise from disputed land, JCC members agreed to set the study area in Atari site excluding the disputed land area as shown in ANNEX-2.

7) The acquisition of necessary Permits for the development of the Project

JCC members agreed that the project shall obtain the necessary permits for the development of the project

ANNEX-2: Map showing the project area in Atari excluding disputed land



Minutes of Meeting

The Fifth JCC Meeting

For the second phase of the Project on Irrigation Scheme Development in Central and Eastern Uganda

JICA has been assisting the study for the Project on irrigation Scheme development in Central and Eastern Uganda since June, 2014. The study has been conducted by the JICA study team in collaboration with MAAIF & MWE. During the first phase of the project, the joint investigation team identified three priority sites amongst the 10 candidates for further study. The work plan for the second phase of the study has been approved by JCC during the third JCC meeting, (24th June 2015), consequently the second phases of the study was launched on June 2015.

However, strong resistance from the communities triggered by lack of enough sensitization and the political atmosphere (election season) the study have faced several setbacks. As a result, during the extraordinary meeting (4th JCC meeting held on 5th October 2015), JCC has agreed to include additional tasks to the study and ratify the formation of task force and project coordination committee at district and community level to help smoothen the implementation of the study.

Accordingly, JICA has agreed to facilitate the additional tasks and extend the project termination period from September 2016 to December 2016. Therefore the JICA Study Team has prepared the modified work plan for the second phase of the investigation of the project and is presented and discussed among the JCC members on 25th April 2016.

As a result, all sides have reached a mutual understanding on the matters referred to in the document attached hereto.

Kampala, 25th April 2016

Mr. Yasumichi ARAKI
For: Chief Representative
JICA Uganda Office
Japan International Cooperation Agency

Mr. Vincent R. Rubarema
Permanent Secretary
Ministry of Agriculture, Animal Industry and Fisheries
The Republic of Uganda

Mr. Henry Kizito
For: Permanent Secretary
Ministry of Water and Environment
The Republic of Uganda

Place of meeting: Coffee House

Date of meeting: 25th/04/2016

Participants: Refer to attached attendance list (Annex 1)

Topics of Discussion

1. Presentation of the work Plan

   The JICA study team has presented the modified work plan of the second phase of the project and it is agreed that the Study Team shall proceed with its activities as explained in the Work Plan. The detail of the Work Plan is presented as attachment to this document.

2. Revision of Activity and Schedule

   Due to the delay in the progress of the study caused by strong resistance from the communities triggered by lack of enough sensitization and the political atmosphere of the country (election season) it is agreed that the content of the activities in this phase and the time schedule of the project is modified and approved as follow:

   2.1 Additional activities in this phase

   In addition to the activities of Phase 2 of the project which was stipulated in the MM of third JCC meeting (24th June 2015), the following additional activities shall be conducted, such as:

   1) Support the establishment of Task force team, PDCC, and PACC
   2) Support strengthening cooperation between C/P organizations, PDCCs & PACCs
   3) Support activities for promoting PACC's Understanding of the Irrigation and drainage project
   4) Land Survey issues in Atari Site
   5) Support for strengthening cooperation between C/P and DLC (District Land Committee)
   6) Support the Land owner confirmation investigation
   7) Formulation of guideline for irrigation development project implementation in the wetlands in Uganda
   8) Advice for formulation of the ''Irrigation Policy''

   2.2 Revised Schedule

   Due to the change in the activities during this phase of the project, the implementation schedule is revised and approved as follow.

Activities	Original Schedule	Revised Schedule
Submitting of DFR	Mid of June, 2016	Mid August, 2016
Submitting of FR	Beginning of September, 2016	Mid November, 2016
Termination of project	End of September, 2016	End of December, 2016

3. Project Implementation Plan

3.1 Tentative Timeline towards the Project Implementation

JST has presented the expected work schedule until the commencement of implementation of the project which was agreed during 3rd JTC meeting held in December 2015. JCC has approved the tentative timeline towards the project implementation as follow:

In case the project is to be implemented by Japanese Grant Aid program, the necessary tasks that must be accomplished by GoU before the commencement of construction of the project is presented as follow.

a. *Certificate of EIA/RAP*: The project implementing agency, MAAIF and MWE shall process for the certificate of approval of EIA/RAP and get the certificate before July of 2017. For the purpose of processing this certificate the implementing agency shall allocate budget as payment for the certificate which according to NEMA guideline amount to 0.1% of the construction cost. This cost shall be included during the preparation of the budget for 2016/17 Fiscal Year.

b. *Preparation of RAP*: The Resettlement Action Plan prepared at F/S level by JST is expected to give the rough estimation of compensation cost due to lack of actual landownership that might be affected by the facilities. Therefore, GoU should prepare the final RAP and compensation plan with determination of method of compensation and budget allocation before the end of 2017 or E/N (Exchange of Note).

c. *Implementation of RAP*: The GoU should complete the implementation of the Resettlement Action Plan of the project before the commencement of the construction of the project which is set tentatively at the middle 2019. This activity include:

Activity	Schedule
RAP Disclosure	In the beginning of 2018
Grievances management	Mid 2018 up to mid 2019
Resettlement and Compensation Payment	To be completed before mid 2019
RAP Monitoring	To be completed before mid 2019
RAP Completion audit	To be completed before mid 2019

3.2 Proposed Implementation Plan for ESIA by Ugandan Government

The JST presented the proposed implementation plan that shall be conducted by the counterpart side (Ugandan Government). Hence, JCC agreed and approved the formulation of RAP Task Force Team, the composition of RAP Task Force Team and the terms of reference (ToR) of RAP Task Force Team.

a; Composition of RAP Task Force

Permanent members
- ✓ MAAIF,
- ✓ MWE,
- ✓ MLHUD,
- ✓ MJCA, and
- ✓ MFPED

Non-permanent members
- ✓ MGLSD,
- ✓ UNRA
- ✓ Local Governments, and
- ✓ Uganda Land Commission

b; Contents of TOR of RAP Task Force
- ✓ Eligibility
- ✓ Cut-off Date
- ✓ Entitlement Matrix
- ✓ Grievance Management Mechanism
- ✓ RAP Institutional Framework
- ✓ RAP Implement Schedule
- ✓ Cost Estimation
- ✓ RAP implementation unit
- ✓ Monitoring & Evaluation system
- ✓ Any other matter relating to the project

4. Transfer of Equipments

JST presented the transfer of the equipment and facilities that were procured and installed specifically for this study to the relevant Ministries and Departments. Accordingly, JCC approves the transfers of the equipments and facilities as follows:

Equipment	Unit	Specification	MAAIF	MWE
Copier	1	Canon: Image Runner 2520	DFD	
Desktop PC	1	Dell: OPTIPLEX 9020	DFD	
AutoCAD	1	Autodesk: Version 2015 LT	DFD	
Rain gauge with Data Logger	3	Onset Computer Corp.: HOBO RG3-M, BASE-U-1		DWRM
Meteorological Station	3	Onset Computer Corp.: HOBO Micro station H21-002		DWRM
Current meter	1	MT precision Co. Ltd: MTS-1		DWRM
Water level gauge with data logger	1	STS AG: DL/N70		DWRM
	2	STS AG: DL.OCS/N		DWRM
Quadcopter drone	2	DJI: Phantom2 vision+	DFD	DWfP

Note DFD: Department of Farm Development
DWfP: Department of Water for Production
DWRM: Directorate of Water Resource Management

Attachments
Annex 1: Attendant list
Annex 2: Work plan for the 2nd phase of the project

MAAIF
MWE

MINISTRY OF AGRICULTURE, ANIMAL INDUSTRY AND FISHERIES (MAAIF)
MINISTRY OF WATER AND ENVIRONMENT (MWE)
UGANDA

THE PROJECT ON IRRIGATION SCHEME DEVELOPMENT IN CENTRAL AND EASTERN UGANDA (PISD)

REVISED PHASE 2 WORK PLAN

NOVEMBER 2015

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
NTC INTERNATIONAL CO., LTD.
PASCO CORPORATION

Table of Contents

Chapter 1 Introduction

1.1 Background of the Project

Very recently, the Ministry of Agriculture, Animal Industry and Fisheries of Uganda (MAAIF) has prepared a Framework Implementation Plan for Water for Agricultural Production. In this plan it is reported that, farming in Uganda is mainly rain-fed and yet rainfall is becoming erratic and unreliable as evidenced by the less than average rainfall experienced in most parts of the country over the past years. An effective intervention to positively impact the household community in the country should therefore be one that targets enhancing the utilization of the abundant water resources for agricultural production in a sustainable way.

Cognizant of the above situation, the Government of Uganda (GoU) has through its strategic frameworks such as the Uganda Vision 2040; the NDP (National Development Plan 2010/11 – 2014/15) and the Agricultural sector DSIP (Agricultural Sector Development Strategy and Investment Plan 2010/11 – 2014/15) prioritized irrigation as a key player for agricultural development. The GoU in collaboration with various development Partners has undertaken initiatives for the development of irrigation infrastructure in different part of the country. JICA as one of the development partner has been engaging in the support of this sector. JICA's support to the irrigation sub sector in Uganda goes back to 2004 when Sustainable Irrigated Agriculture Development (SIAD) study commenced. The study and its subsequent project combined ran for about six (6) years during which time small-scale irrigation was promoted in some part of the eastern region and even replicated outside the project areas.

Recognizing this success and, at the same time, a need for scaling it up to benefit more farmers, the GoU, through MAAIF, has requested the Government of Japan (GoJ) for technical cooperation in the form of "a Study on establishment of Medium and Large Scale Irrigation Schemes". Main target beneficiaries are farmers cultivating rice in lowlands with unreliable availability of water. This is expected to contribute to the development of the rice sub sector, which is one of the medium term target of JICA's assistance to Uganda. Other target beneficiaries include, among others, officers and engineers at both central and district local governments whose capacity for irrigation development and sustainable natural resource management will be built.

1.2 Objectives of the Project

The major objective of the project can be summarized into the following two points:

- To assure national food security and farmer household income through increased sustainable irrigated rice production
- To build capacity for irrigation / natural resource management among different stakeholder categories

1.3 Scope of the Project

1.3.1 Phasing and Activities

The scope of the Project is categorized into two phases. In the first phase of the Project, the Study Team will conduct potential site identification study on all the candidate sites. Irrigation Scheme Development Plan (ISDP) will be formulated for each site which includes estimating brief project cost, IRR and project evaluation. During the second phase of the study the team will conduct feasibility study on selected 2 to 3 sites. In addition, capacity building for both irrigation and natural resource management staffs in the country will be considered. The details of the activities are presented below:

Phase 1 (Irrigation Scheme Development Plan in Central & Eastern Uganda (ISDP): 10 sites)
Duration: from June 2014 to March 2015

1) Reviewing the existing development plans and projects related to the study
2) Collecting and analyzing data and information through field surveys and interviews with stakeholders especially farmers in the target area. The data is related to: Natural condition, Socio-economic condition, agro-economy, infrastructure, agricultural supporting service, operation and management of the system and environmental aspects
3) Preparing an inventory list of possible irrigation projects
4) Conducting Initial Environmental Examination (IEE)
5) Preparing ISDP report
6) Recommending priority project sites for feasibility study
7) Preparation of the topographical maps as the need arises
8) Conducting training stakeholders on irrigation/natural resource management through lecture courses and practices in actual fields

Phase 2 (Feasibility Study (F/S): 2 or 3 sites)
Duration: from May 2015 to September 2016

1) Conducting field surveys to collect supplementary data and information on the priority project sites
2) Preparing preliminary design for irrigation and drainage facilities
3) Estimating project cost and benefits
4) Formulating operation and maintenance plans
5) Carrying out economic and financial evaluation
6) Establishing of farm planning
7) Formulating a plan of establishing/strengthening Water Users Association
8) Conducting Wetland Management Plan

1.3.2 Candidate Sites for Phase 1

Preliminary selection of project sites were made through the site reconnaissance jointly conducted by JICA, MAAIF and MWE as reported in the Minutes of Meeting and the R/D, under the following set of criteria.

i)Existence of rice farming: The existence of rice cultivation area has given priority. Area with extensively covered by papyrus is excluded from the list

ii) District Policy: The sites and/or districts which do not have policy on promotion of rice cultivation in the wetland are excluded

iii)Ramsar Convention area: Sites located in Ramsar Convention registered area are excluded.

Accordingly applying the above criteria some candidate sites and swamps were excluded from the project and finally ten (10) candidate sites were selected as project sites. These candidate sites cover ten (10) irrigation potential sites located in the Central and Eastern Uganda. The lists of these target area is presented in the table below.

Table 1.1 List of the Project Areas in Central and Eastern Uganda

No.	Candidate Sites	River System	District	Region
1	Bulo Wetland	Katonga	Butambala	Central
2	Buikwe Wetland	Mubeya	Buikwe	Central
3	Omirio Swamp	Awoja Wetland	Soroti	Eastern
4	Ngenge & Atari river basin	Ngenge, Atari	Kween, Bulambuli	Eastern
5	Sipi Riverside	Sipi	Bulambuli	Eastern
6	Sironko (Acomai) Wetland	Sironko, Sipi	Bukedea	Eastern
7	Upstream Sironko Swamp	Sironko	Sironko	Eastern
8	Upstream Namatala Swamps	Lwere	Mbale	Eastern
9	Namatala Swamp	Namatala	Budaka, Mbale, Butaleja	Eastern
10	Outside Doho Scheme	Manafwa	Butaleja	Eastern

1.4 Scope of Work for Phase 2

According to the results of study during Phase 1 and agreement made on the 2nd JCC on 9th December 2014, feasibility study will be carried out on the selected high priority sites, namely: Sironko (Acomai) wetland and Atari River Basin, and the feasibility study report will be prepared.

As for the Namatala site, the following two items will be studied on the view point of comprehensive long term development scenario

- ✓ As a soft component, establishment of WUA and training and education of farmers for management, operation and maintenance activities for irrigation scheme in the wetland area.
- ✓ As for the comprehensive long term development plan, alternative plan for stage development

will be studied and established and the most recommendable plan will be proposed.

The Outputs of Phase 2 shall be:

- Feasibility Study: Sironko (Acomai) and Atari site
- Formulation of Long Term Irrigation Development Plan: Namatala wetland site

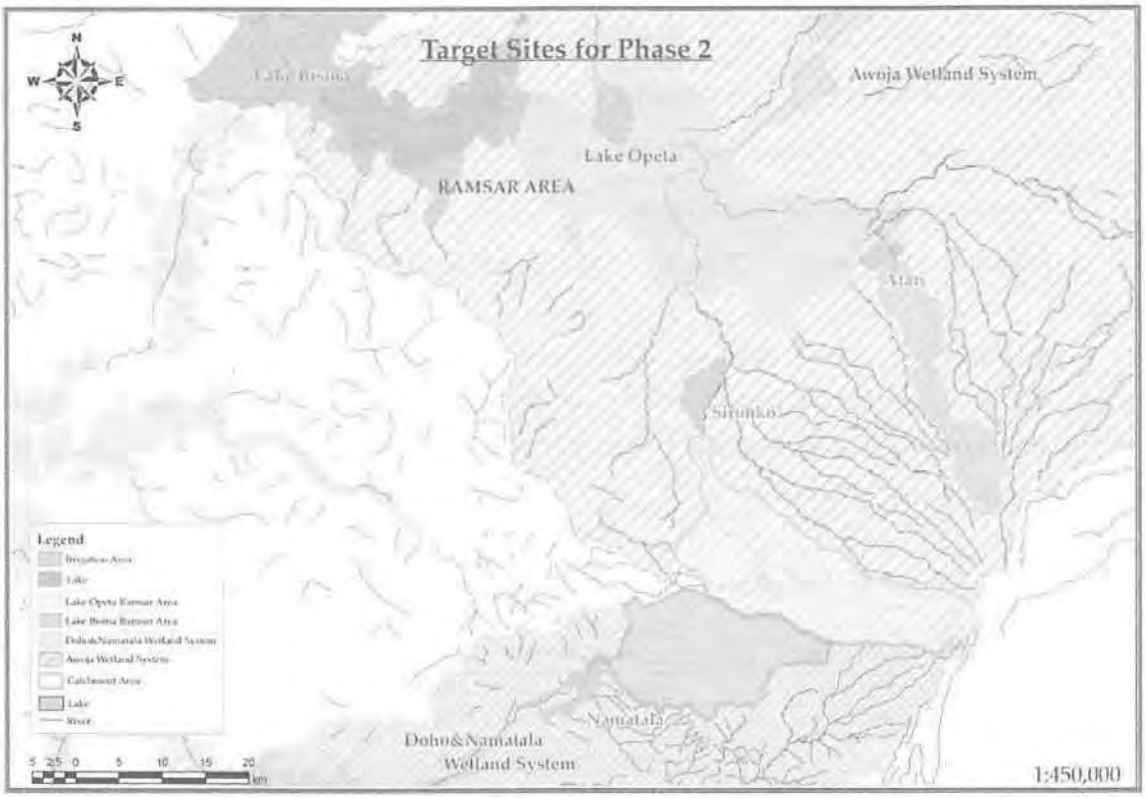


Figure 1.1 Location Map of Target Site for Phase 2

1.5 Reason of Revision of Phase 2 Work Plan

Phase 2 of the F/S started from June 2015 and several sensitization meetings and workshops was organized by C/Ps and JST in F/S sites of Sironko (Acomai) and Atari, but it was very hard to build consensus among communities in project area since the villagers had suspicious due to misunderstanding, misinterpretation, misperception due to land issue, political season and other reasons and this factor forced most activities to be suspended for two months.

Due to a strict dead line of 30th September 2015 when JST was to pull out of the F/S in case community consensus building was failed, with strong commitment and struggle for two months, C/Ps and JST discussed how to resume the study and prepared immediate action plan for one month.

PISD Task Force Team (PTAF) formulation of strategy and action plan for resumption and subsequent acceptance of project in the two affected communities and that is the reason why JST propose the revision to extend the time schedule in this Phase 2 work plan.

Chapter 2 Plan of Operation

2.1 Basic Concept of the Project Implementation

No Change from "Phase 2 Work Plan".

Chapter 3 Implementation Methodology of the Project

3.1 Flow of the Project

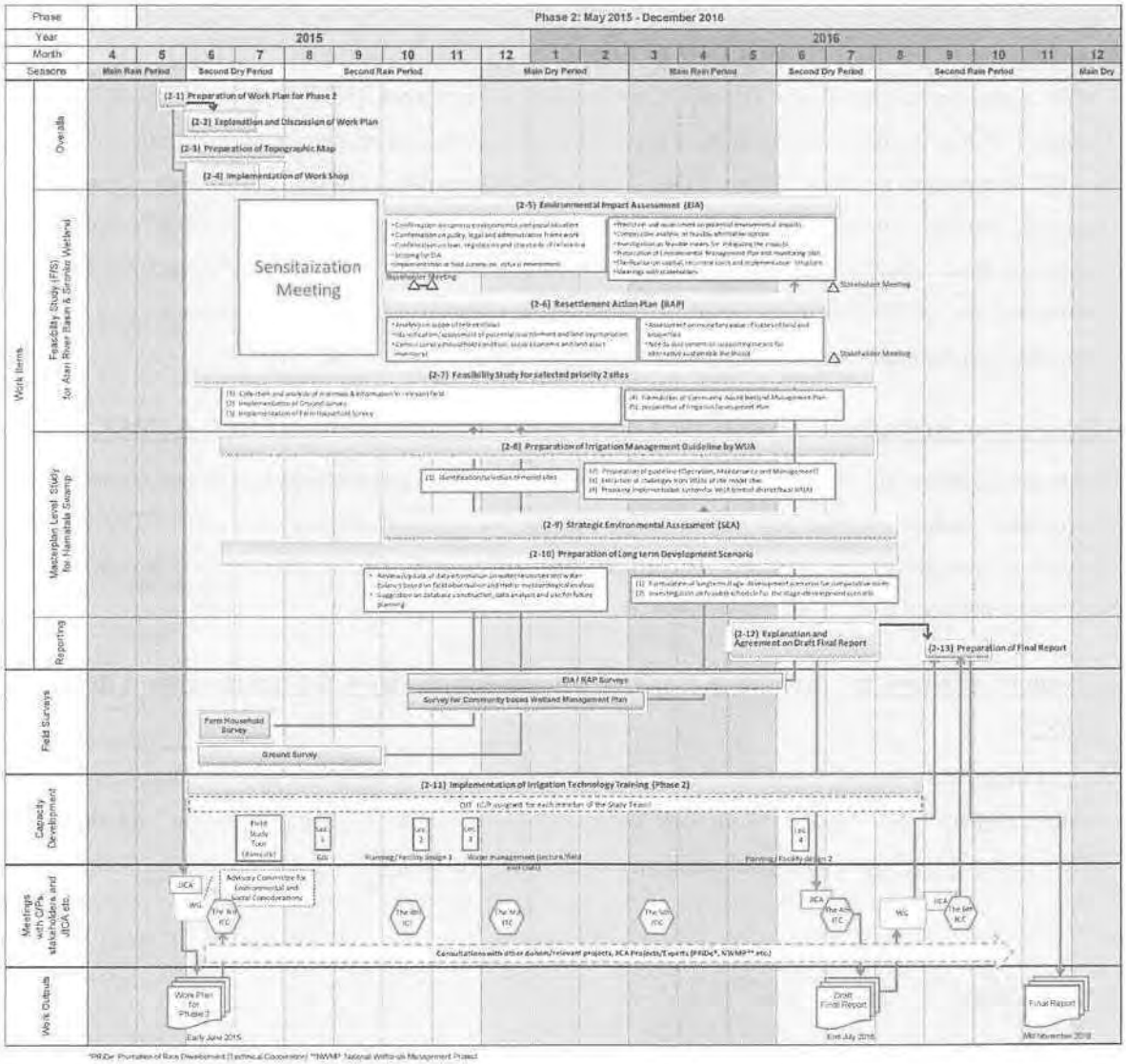


Figure 3.1 Revised Flow of the Project Implementation (Phase 2)

3.2 Processes of Implementation of the Project

The following works are added.

Indirect support to promote community's understanding about PISD

a) Implementation of Work Shop

No Change from "Phase 2 Work Plan".

b) Support the establishment of Task force team, PDCC, and PACC

To promote community's understanding and cooperation for the Project, JST supports to formulate PISD Task Force Team which consists of C/P agencies (MAAIF and MWE). The task force team as a main actor formulates PISD District Coordination Committees (PDCC) for each three related Districts. PDCC is the mechanism in which C/P organization and related local government officials and JST cooperate together. The PDCC, District responsible officials act mainly to make a consensus among communities about the Study together with Sub-County officials, and JST strengthens their capacity. In addition, as a lower organization of PDCC, PISD Area Coordination Committees the (PACC) will be established in each relevant Parishes as a contact point to the communities at the time of the field survey.

c) Support for Strengthening cooperation between C/P organizations and PDCC & PACC

For the promotion of the Project, cooperation between the central government C/P organizations, local governments such as District and Sub-County, and the local community is essential. However, the cooperation is weak in current state. Therefore, JST adjusts and guides to promote and strengthen the cooperation between C/P, PDCC, and PACC.

d) Support activities for promoting PACC's understanding about the irrigation and drainage project

For promoting community's understanding of which do not have experiences of middle-large scale irrigation project, JST together with C/P promotes the awareness of the irrigation and drainage projects to the PACC through consultation meetings and workshops.

[F/S for 2 sites]

Land issues survey in Atari site

Of the F/S target two sites, JST performs the following tasks in the Atari site where disputes on land registration have occurred, to achieve the promotion of community's cooperation and understanding for the PISD field survey.

- Confirmation of the facts relating to the land registration
- Extraction of lessons learned and challenges related to the land registration in Customary

Tenure, and making recommendations for forming the implementation mechanism of irrigation and drainage plan.

Support for strengthening cooperation between C/P and DLC (District Land Committee)

PISD needs to cooperate with DLC which is the existing local administrative organization whose role is to grab the land issues within District. However, because the cooperation lacks at the current situation, JST performs following activities.

- Current state investigation about DLC
- Forming action plan of problem solving regarding land for C/P, related Ministries, Districts and DLC.
- Support for implementation the action plan
- Extraction of lessons learned and challenges through the above-mentioned activities and making recommendations for implementation mechanism forming of irrigation and drainage plan

Support for the land owner confirmation investigation

Investigation for grabbing the outline of land boundary and land owner, which is needed for estimation of compensation cost that accompany to the implementation of irrigation development project will be conducted utilizing PDCC and PACC. Cooperating together with C/P, JST will perform the consultation meeting with local communities prior to the field survey, workshops, training and giving instruction to the local consultant, supervision of the site investigation, and scrutiny of reports.

This investigation can be sub-contracted to the local resources such as local consultants or NGOs.

【Phase 2 Work】

Formulation of a guideline for irrigation development project implementation in the wetlands in Uganda

Problems of irrigation development projects in wetlands in Uganda that found through the activities in the second phase, such as regulation of land use in wetlands, various challenges associated with land ownership, insufficient cooperation between the central government and local government agencies, will be compiled, and lessons learned and challenges are extracted. Then, policies on these problems and counter measures conforming to the compliance will be compiled as a guideline for the irrigation and drainage project implementation in Uganda in future.

Advice for formulation of the "Irrigation Policy"

Currently MAAIF is formulating the "Irrigation Policy" in order to promote irrigation and drainage projects in Uganda. Following tasks will be performed so that the lessons learned and issues

obtained through PISD are reflected in the policy.

- Technical advice for MAAIF regarding forming of the "Irrigation Policy".
- Discussion and advice on cooperation with the related department of MWE
- Organizing the existing information, making comments and recommendations on the " Irrigation Policy".

3.3 Work Plan and the Study Reports

3.3.1 Revised Work Plan

The implementation of the work will cover the period from June 2014 to December 2016 (31 months). The work plan for second phase is indicated in the work implementation plan below (see Fig.3.4 on the next page).

3.3.2 Submission of the Study Reports

The following reports will be prepared and submitted as the product of the Project.

Table 3.1 List of Study Reports

Report	Submission Date	Number of Copies			Remark
		Japanese	English	Others	
1) Inception Report	Beginning of June 2014	5	15		Submitted
2) Interim Report	Beginning of March 2015	5	15		Submitted
3) Work Plan	Beginning of June 2015	5	15		
4) Progress Report	Middle of Jan. 2016	3	-		
5) Draft Final Report	End of July 2016	5	20		
6) Final Report	Middle of Nov. 2016	5	30	5 CD-R	

Work Items and Schedule proposed based on th results from the Phase 1

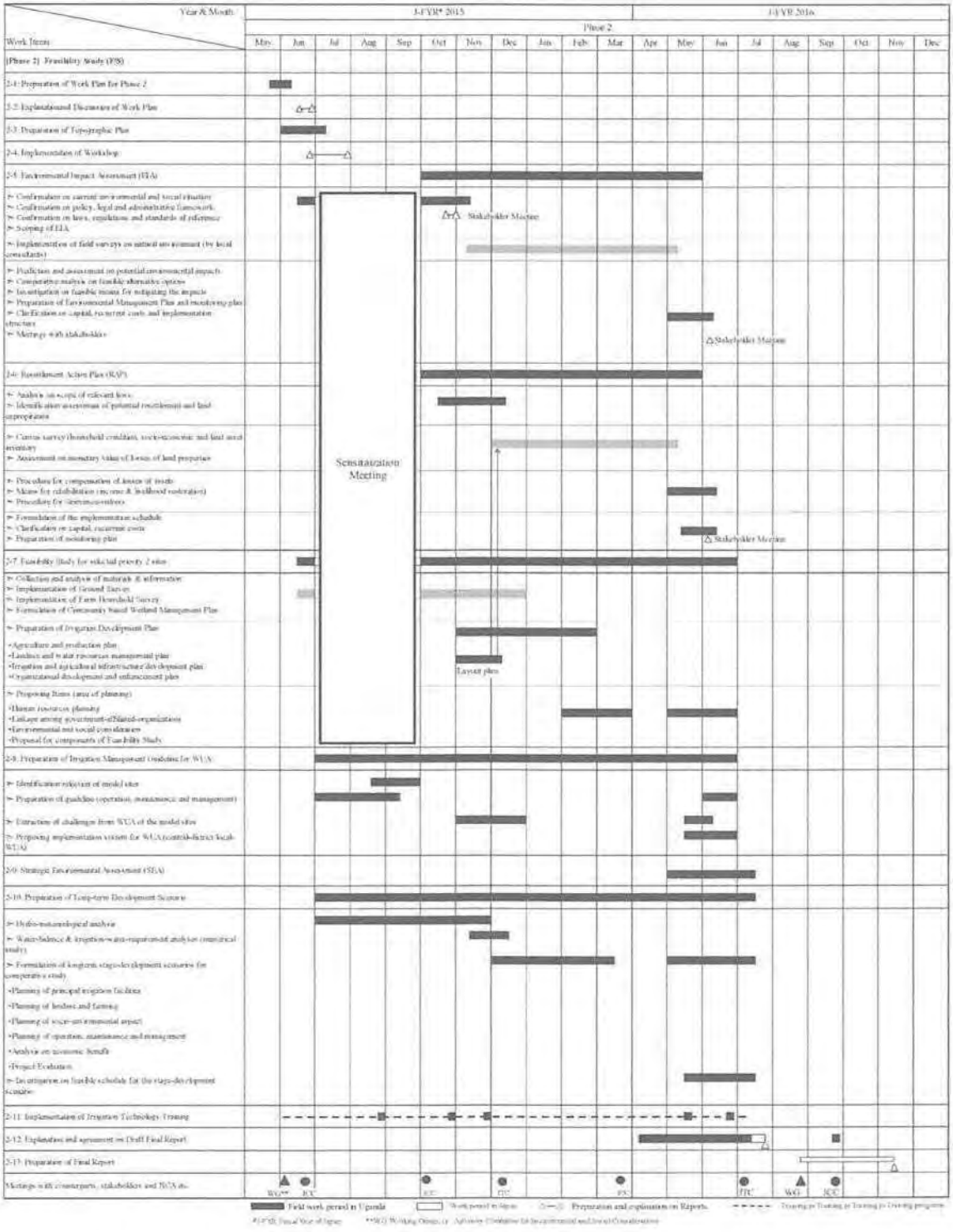


Figure 3.2 Revised Work Item and Schedule for Phase 2

3.4 Revised Staffing Schedule and Assignment Schedule

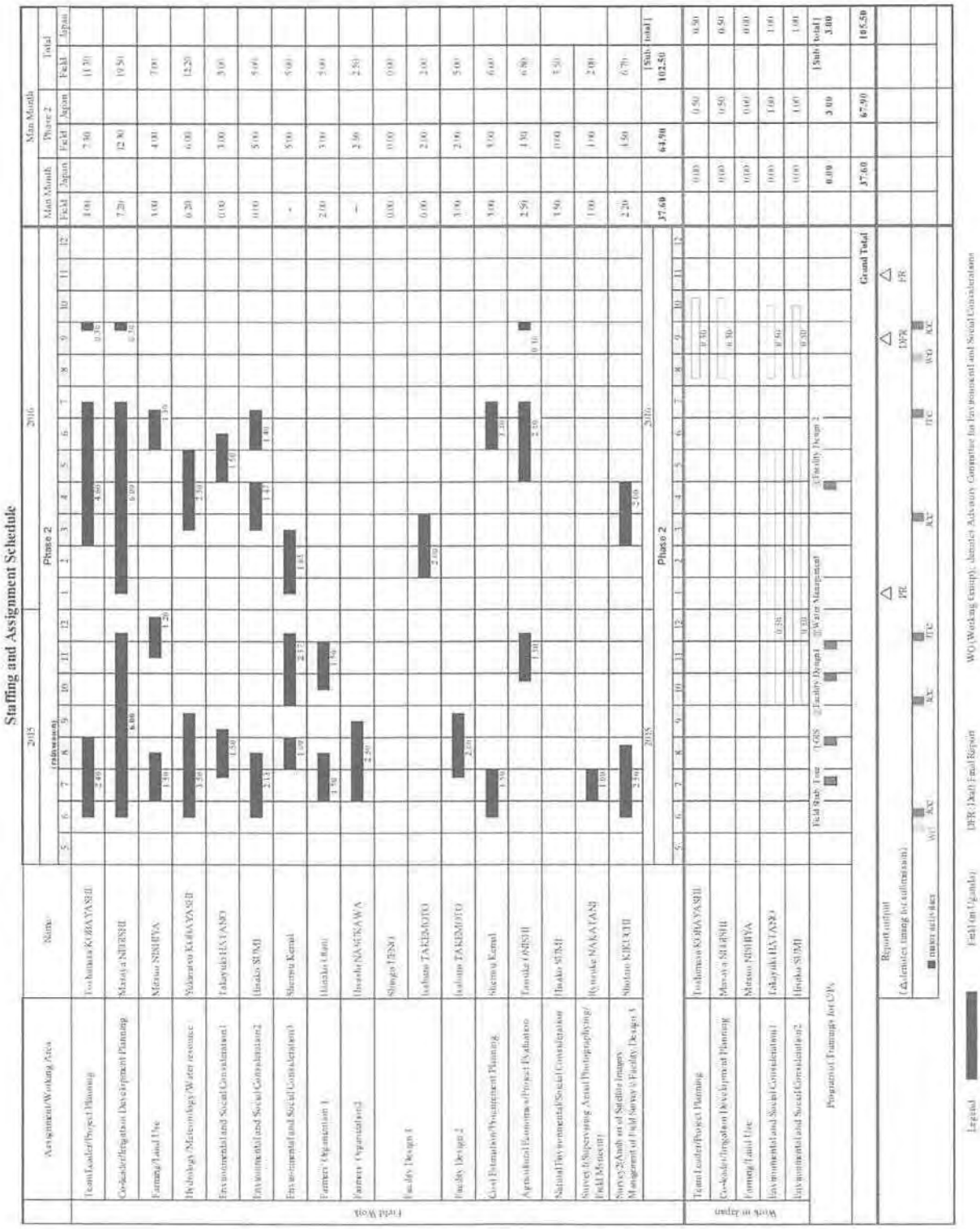


Figure 3.3 Revised Staffing and Assignment Schedule for the Project

3.5 Others

No Change from "Phase 2 Work Plan".

Chapter 4 Project Implementation System

4.1 Implementation Structure of the Project

4.1.1 Framework of implementation

No Change from "Phase 2 Work Plan".

4.1.2 Implementation Structure

No Change from "Phase 2 Work Plan".

4.1.3 Framework of Coordination

PISD Task Force Team (PTAF) had been formulated by C/Ps (MAAIF and MWE) to work together with JICA Study Team (JST) for the purpose of resuming the study in the project area. PTAF together with JST had formulated PISD District Coordination Committee (PDCC) within the related three Districts that is Bukedea, Bulambuli and Kween District, in F/S sites and trained District Officers through the explanation of the project outline and discussion. After mutual understanding among PTAF, JST and PDCC, PTAF and JST organized Workshop to educate community members through the information materials such as project brief, project map, project benefits, FAQ, and so on. Then PTAF together with JSC and PDCC had established PISD Area Coordination Committee (PACC) by self selection of representative among communities which composes from the landowners/ beneficiaries in PISD project area in each Parish. Through the accurate and profounder understanding of project/study, PTAF and JST had received the agreement to resume the study on the site from PACC under the witness of local political leaders and elders.

Fig 4.1 shows the framework of coordination among PTAF, JST, PDCC and PACC. PDCC and PACC had been approved by JCC members (4th JCC on 5th October 2015) to be supported by C/Ps and JTC for further activities and coordination among community in study area for the smooth implementation of F/S. Further F/S activities by C/Ps and JST shall be conducted through the coordination and facilitation by PDCC and PACC under coordination and mobilization by C/Ps and JST.

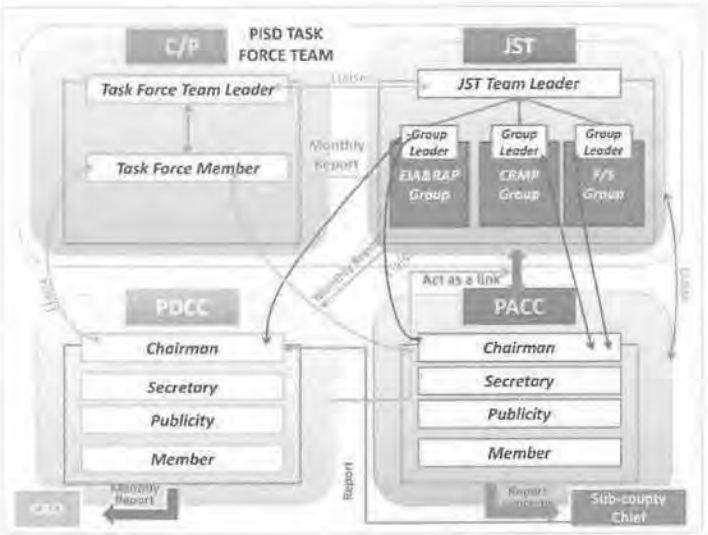


Figure 4.1 Framework of Coordination

Minutes of Meeting

The sixth JCC meeting

For the Second Phase of

The Project on Irrigation Scheme Development in Central and Eastern Uganda

JICA has been assisting the study for the project on irrigation scheme development (PISD) in Central and Eastern Uganda since June 2014. The study has been conducted by the JICA study team in collaboration with MAAIF and MWE. During the first phase of this project the joint investigation team identified three priority sites among the 10 candidate sites for further studies. Accordingly, the Joint Coordination Committee (JCC) agreed and approved feasibility study for the selected two priority sites (Atari in Kween/Bulambuli Districts and Sironko/Acomai in Bukedea/Bulambuli Districts) and pre-feasibility level survey on the remaining one site (Namatala wetland system in the Districts of Mbale, Budaka and Butaleja).

JICA launched the second phase of this project starting from June 2015 and since then JICA Study Team has been conducting the feasibility study. The JICA Study Team has prepared the feasibility study of the project and is presented and discussed among the JCC members on 12th October 2016.

As a result, all sides have reached a mutual understanding on the matters referred to in the document attached hereto.

Kampala, 12th October 2016

Mr. KAWAZUMI Kyosuke
Chief Representative
JICA Uganda Office
Japan International Cooperation Agency

Mr. MUTABAZI Sunday
For: Permanent Secretary
Ministry of Agriculture, Animal Industry and Fisheries
The Republic of Uganda

Eng. KIZITO Henry
For: Permanent Secretary
Ministry of Water and Environment
The Republic of Uganda

Place of meeting: City Royal Resort Hotel, Kampala

Date of meeting: October 12th 2016 starting from 9:00AM to 15:30PM

Participants: Refer to Attachment for Attendant List

Topic of Discussion

The Phase-2 Works of the Project in 2016 has been presented by JICA Study Team (JST). The presentation has focused on the following points which were agreed upon during the 4th Joint Technical Committee (JTC) of PISD project that took place on 20th July 2016 at City Royal Resort Hotel. These are:

1. JST explained the results of the F/S for Sironko/Acomai and Atari Sites and recommendations and the results of the Pre-F/S for Namatala Site and recommendations.

2. Proposed Site for requesting Japanese Grant Aid:

   The selection criteria used by the JST has been presented and discussed among the JCC members. The JST recommends the priority site for implementation as Atari site as per Project Evaluation Results shown in Annex 1: JCC members understand the advantages of the Atari site and resolves it as the priority site for requesting Japanese Grant Aid.

   JCC notes irrigation development is one of the key ingredients for economic transformation and the Government of Uganda is to take necessary steps including capacity development in the irrigation sub-sector.

   JCC notes that PISD and subsequent Atari Project should be a model for irrigation scheme development in the country and experiences of the project will be utilized by GOU for other similar projects

3. Implementation Agencies and Executing Agency are required for the next step for implementing Atari site. The implementation Agencies shall be MAAIF and MWE. The Executing Agency shall be MAAIF.

4. Basic idea of the Proposed Implementation and Management Organization structure and Operation & Maintenance Structure for the Project.

   JST has presented the proposed implementation structure and Operation & Maintenance Structures for sustainability of the project.

   JCC agrees to the basic idea of the structures shown in Annex 2:

   JCC agrees with JTC that the structures for implementation and O&M are adopted subject to further refinement through discussion among Government stakeholders.

5. Scope of construction demarcation

   JST has presented the proposed scope of construction demarcation for project implementation.

JCC agrees to the basic idea of the scope of construction as follows:

(1) Major facilities for irrigation and drainage from intake, main, secondary and tertiary (main farm ditch) canals, drainage canal and flood protection dike should be constructed under the project.

(2) From the division box (turnout) of main farm ditch, supplemental farm ditch, on farm drainage and farm plot with bunds and land leveling should be constructed by farmers supported by the Central Government and the District Local Government (DLG).

6. EIA and RAP Implementation

JCC notes that Resettlement Action Plan (RAP) implementation should be managed and implemented for the PAP (Project Affected Persons) by Ugandan Government before starting of project construction.

JCC approves performing Environmental Monitoring Plan (EMoP) in the FR (Final Report) which is necessary for the Exchange of Note (E/N) signing of Grant Aid.

The EMoP will in addition to the key parameters take special consideration of the recommendations by JICA Advisory Committee of Environmental and Social Consideration that include:

- ✓ Water quality
- ✓ Gender consideration
- ✓ Information sharing among GOU and District (s) of the project area and related Districts which surround and co-manage Ramsar convention wetlands (Lake Bisina and Lake Opeta) for the conservation of the wetlands.
- ✓ Safety of children

The signed agreement for project implementation between the project beneficiaries and Government should be obtained by Ugandan Government by the completion of Draft Outline Design (DOD).

The estimated necessary budget benchmarked by JST and its timeline for RAP implementation of Atari site is shown in ANNEX 1.

7. Way Forward

(1) Confirmation of Submission of Reports

JCC confirmed the dates for submission of Reports as follows:

Comments from GoU on the DFR: End of October 2016

Final Report: End of November 2016

(2) Request letter for the project implementation and Technical assistance should be submitted to Embassy of Japan (EoJ) from GOU before the end of 2016.

The JCC members agree on the discussion made above and will take the necessary action for the successful implementation of the responsibility bestowed upon the Government of Uganda.

ANNEX 3: Budget for RAP implementation for ATARI

	Purpose	Amount (US$)	Total Amount (US$)	Fiscal year	Activity duration
	RAP Consultant (finalize the RAP framework)	86,000	86,000	2016/2017	March - August 2017
	EIA certificate (0.1 % of construction cost)	11,760	182,760	2017/2018	July 2017
	RAP implementation Consultant (compensation payment and evacuation)	171,000			April 2018 - April 2019
	Compensation for land and assets, Livelihood assistance	599,000	851,000	2018/2019	August 2018 – April 2019
	External Monitoring & evaluation Consultant/NGO	107,000			August 2018 –April 2022
	Contingency	145,000			August 2018 – April 2022
	Total		1,119,760		

Appendix G

List of Collected Data and Materials

List of Collecting Data and Documents (PISD, Uganda）

No.	Name	Date	Procurement	Format	Size	Page	Remak
1 Agriculture							
11 Agriculture Policy							
111	THE SUCCESSFUL IMPLEMENTATION OF THE AGRICULTURAL SECTOR DEVELOPMENT STRATEGY AND INVESTMENT PLAN(DSIP)	2010	REPUBLIC OF UGANDA	pdf	A4	9	
112	Agriculture Sector Development Strategy and Investment Plan : 2010/11-2014-15	2010	MAAIF	pdf	A4	149	
113	Agriculture Sector Sector Performance Summarized Report THE SECOND JOINT AGRICULTURE SECTOR ANNUAL REVIEW (JASAR) 2012-1ST-2ND N	2012	MAAIF	pdf	A4	24	
114	JOINT AGRICULTURAL ANNUAL SECTOR REVIEW	2012	MAAIF	pdf	A4	2	
115	Irrigation Policy revised July 17 2012	2012	MAAIF	word	A4	23	
116	Draft National Irrigation Policy	2015	MAAIF	pdf	A4	36	
117	Agriculture Sector Strategic Plan	2016	MAAIF	word	A4	197	
118	Final Revised WfAP FIP 03.06.2015	2015	MAAIF	pdf	A4	57	
12 Rice							
121	UGANDA NATIONAL RICE DEVELOPMENT STRATEGY (UNRDS) 2nd Draft	2009	MAAIF	pdf	A4	36	
122	UGANDA NATIONAL RICE DEVELOPMENT STRATEGY 2008-2018(NRDS)	2012	MAAIF	pdf	A4	87	
123	コメ振興プロジェクト詳細計画策定調査報告書	2011	JICA	pdf	A4	79	
124	ネリカ米振興計画プロジェクト中間レビュー調査報告書	2010	JICA	pdf	A4	82	
125	ネリカ米振興計画プロジェクト終了時評価調査報告書	2011	JICA	pdf	A4	77	
13 Statistics							
131	Statistical Abstract 2010 (Agriculture)	2010	MAAIF	pdf	A4	62	
132	Statistical Abstract 2011 (Agriculture)	2011	MAAIF	pdf	A4	64	
14 Forest							
141	FARM INCOME ENHANCEMENT AND FOREST CONSERVATION PROJECT APPRAISAL REPORT	2015	REPUBLIC OF UGANDA	pdf	A4	63	
15 PPP							
151	Water for Agricultural Production (WfAP) Thematic Area Framework Implementation Plan/Report	2012	MAAIF	word	A4	189	
152	Summary on PPP			word	A4	4	
16 Livestock							
161	National Livestock Census Report 2008	2008	MAAIF	pdf	A4	273	
17 Cooperative							
171	DIFACOS ByeLaws 2015 DRIS	2015	DIFACOS	pdf	A4	5	
172	Pamphlet_DIFACOS_the latest Ver		DIFACOS	pdf	A4	4	
18 Fisheries							
181	Guidelines on the Use of Ugachick feed to Rear [Tilapia & Catfish] in Eastern Ponds (USAID,2011)	2011	USAID	pdf	A4	4	
2 Irrigation							
21 National Irrigation							
211	National Irrigation Master Plan for Uganda (2010-2035) Final Report	2011	MAAIF	pdf	A4	218	
212	National Irrigation Policy 1st draft	2012	MAAIF	word	A4	43	
213	National WR Assessment Report - Uganda 2013	2013	MWE	pdf	A4	272	
22 Irrigation in Africa in figures: AQUASTAT Survey-2005		2005	FAO, Land and Water Development Division	pdf	A4	89	
23 Collective Action in Canal Irrigation Systems Management: The Case of Doho Rice Scheme in Uganda		2003	Department of Agricultural Economics and Agribusiness, Makerere University	pdf	A4	21	
24 Case study Uganda National Water Development Report Uganda		2006	UNESCO	pdf	A4	220	

List of Collecting Data and Documents (PISD, Uganda)

No.	Name	Date	Procurement	Format	Size	Page	Remak
25 THE STUDY ON POVERTY ERADICATION THROUGH SUSTAINABLE IRRIGATION PROJECT							
251	東部ウガンダ持続型灌漑開発計画調査事前調査(S/W協議)報告書	2003	JICA	2 pdf	A4	98(in total)	
252	Final report (Japanese)	2007	NK, Taiyo consultant	2 pdf	A4	130(in total)	
253	THE STUDY ON POVERTY ERADICATION THROUGH SUSTAINABLE IRRIGATION PROJECT IN EASTERN UGANDA: FINAL REPORT (Vol.1 MAIN REPORT)	2007	NIPPON KOEI, TAIYO CONSULTANTS	3 pdf	A4	249 (in total)	
254	THE STUDY ON POVERTY ERADICATION THROUGH SUSTAINABLE IRRIGATION PROJECT IN EASTERN UGANDA: FINAL REPORT (Vol.2 PILOT PROJECT REPORT)	2007	NIPPON KOEI, TAIYO CONSULTANTS	5 pdf	A4	361(in total)	
26 Sustainable Irrigated Agriculture Development Project in Eastern Uganda							
261	東部ウガンダ持続型灌漑農業開発計画プロジェクト中間レビュー調査報告書	2010	JICA	3 pdf	A4	74(in total)	
262	東部ウガンダ持続型灌漑農業開発計画終了時評価調査報告書	2011	JICA	pdf	A4	55	
27 Result of Uganda Irrigation scheme study		2010		word	A4	22	
28 Africa local irrigation							
281	現地調査報告書	2010	NTC International	pdf	A4	50	
282	案件形成調査(インセプションレポート)	2010	NTC International	pdf	A4	46	
283	案件形成調査(Doho and Namatala Maps)			2 JEPG	A4		
284	業務実施計画書全体	2010	NTC International	pdf	A4	47	
285	アフリカ灌漑 II編 Uganda J						
29 Feasibility Study for Irrigation Scheme Development in Central and Eastern Uganda		2014	Nelson&Associates Environment Consultants	word	A4	12	
290 KWEEN District							
2901	FEASIBILITY STUDY FOR IRRIGATION SCHEME(S) DEVELOPMENT IN KWEEN DISTRICT		Senior Irrigation Agronomist (Local)	word	A4	3	
2902	Studies for Irrigation Potential in Kween district Prefeasibility Report		BEC Engineers	word	A4	146	
2903	KWEEN STUDY PRESENTATION-AGRON & CWR			power point		35	
2904	KWEEN IRRIGATION SCHEME Map 1		BEC Engineers	pdf	A3	1	
2905	KWEEN IRRIGATION SCHEME Map 2		BEC Engineers	pdf	A3	1	
2906	PRE-FEASIBILITY STUDY FOR IRRIGTION DEVELOPMENT IN KWEEN DISTRICT – AGRONOMY SECTION			word	A4	38	
2900 Statistics (Uganda Existing and Potential Irrigation List)							
29001	Dams 300000 or more			Excel	A4		
29002	Existing Irrigation			Excel	A4		
29003	Flower Farms			Excel	A4		
29004	Potential Irrigation_Hydromet 1982			Excel	A4		
29005	UGANDA WATER SUPPLY Atlas 2010	2011	Republic of Uganda	pdf	B4	12	
29000Internatinal argency							
290001	国際機関によるIrrigation scheme in Uganda			word	A4	1	
290002	Islamic Development Bank Final Pearl_Tilda_PAD 01.10.2012	2012	Islamic Development Bank	pdf	A4	64	
3 Wetland							
31 Guidelines for Smallholder Paddy Rice Cultivation in Seasonal Wetlands Wetland Booklet Number 3		2005	MWE, USAID, PRIME WEST	pdf	A5	17	
32 National Policy for the Conservation and Management of Wetland Resources		1995	Ministry of Natural Resources	pdf	A4	16	
33 (from p.13～)FRAMEWORK MANAGEMENT PLAN FOR AWOJA WETLAND SYSTEM Executive Summary				pdf	A4	100	
35 Community Wetland Management Planning Guide		2005	MWE	pdf	A4	64	

List of Collecting Data and Documents (PISD, Uganda)

No.	Name	Date	Procurement	Format	Size	Page	Remak
36 Lake Wetland System Ramsar							
361	Lake Bisina Wetland System Ramsar Information Sheet (RIS)	2005	Nature Uganda	word	A4	13	
362	LAKE BISINA WETLAND SYSTEM PROPOSED RAMSAR SITE			JPEG	A4	1	
363	Lake Opeta Wetland System Ramsar Information Sheet	2005	Nature Uganda	word	A4	12	
364	LAKE OPETA WETLAND SYSTEM PROPOSED RAMSAR SITE			JPEG	A4	1	
37 Final Wetlands Subsector Paper for PEAP Revision		2008	Belgian Technical Cooperation	word	A4	65	
38 Wetland management project							
381	湿地管理プロジェクト詳細計画策定調査報告書	2012	JICA	pdf	A4	155	
382	湿地管理プロジェクト業務進捗報告書2015 年	2015	JICA	pdf	A4	62	
383	NATIONAL WETLANDS MANAGEMENT PROJECT IN REPUBLIC OF UGANDA PROGRESS REPORT IV	2015	JICA	pdf	A4	59	
4 EIA							
41 The National Environment (Environmental Impact Assessment) Regulations) Statutory Instrument 153-1		1998	Republic of Uganda	pdf	A4	28	
42 ENVIRONMENTAL IMPACT ASSESSMENT GUIDELINES FOR WATER RESOURCES RELATED PROJECTS		2011	MWE	pdf	A4	136	
43 ENVIRONMENTAL IMPACT ASSESSMENT GUIDELINES FOR ROAD PROJECTS		2008	MINISTRY OF WORKS AND TRANSPORT	pdf	A4	164	
5 Meteorological and Hydrological Data							
51 Uganda Rainfall 2006-2009							
511	2006 WEATHER DATA ALL STATION Uganda	2006	NAARI	Excel	A4		
512	2007 WEATHER DATA ALL STATION Uganda	2007	NAARI	Excel	A4		
513	2008 WEATHER DATA ALL STATION Uganda	2008	NAARI	Excel	A4		
514	2009 WEATHER DATA ALL STATION Uganda	2009	NAARI	Excel	A4		
515	2010 WEATHER DATA ALL STATIONS	2010	NAARI	Excel	A4		
516	2011 WEATHER DATA ALL STATIONS	2011	NAARI	Excel	A4		
517	2006-2011 WEATHER DATA ALL STATION Uganda	2011	NAARI	Excel	A4		
52 Uganda River Discharge data							
521	Manafwa Discharge Graph (2003～2010)	2010		Excel	A4		
522	Manafwa_Flow(2003-2010)	2012		Excel	A4		
523	Namatala_Flow(2003-2012)	2012		Excel	A4		
524	Sipi_Flow(2003-2012)	2012		Excel	A4		
525	Sironko_Flow(2003-2009)	2009		Excel	A4		
526	Location of Hydromeorologic Stations	2003	MAAIF,JICA	word	A4	5	
527	Manafwa and other rivers Q revised2			Excel	A4		
528	Sipi, Sironko, Manafwa, Namatala(kubo)			Excel	A4		
529	Sipi-Sironko データ補正			Excel	A4		
55 National Water Policy		1999	MWE	pdf	A4	40	
56 The Water Act (CHAPTER 152)		1997	Republic of Uganda	pdf	A4	52	
57 AGROMET DATA NAMULONGE 2011-2012				Excel			
58 Rainfall and temperature in Gulu, Lira				3 Excel			
59 Hydro-Climatic Study Report on the Water Resources of Uganda		2010	UNRA	pdf	A4	151	
5100 Natinal water resources assessment		2013	MWE	pdf	A4	268	
5110 The Water Resources Regulations 1998		1998		pdf	A4	26	

List of Collecting Data and Documents (PISD, Uganda)

No.	Name	Date	Procurement	Format	Size	Page	Remak
6 Others							
61 National Development Plan							
611	National Development Plan (2010/11-2014-15)	2010	National Planning Authority	pdf	A4	441	
612	SECOND NATIONAL DEVELOPMENT PLAN (NDPII)	2015	National Planning Authority	pdf	A4	344	
62 Uganda Result-Based Country Strategy paper 2011-2015		2010	AfDB, ADF	pdf	A4	45	
64 Statistics							
641	Statistical Abstract 2011	2011	Uganda Bureau of Statistics	pdf	A4	287	
642	Statistical Abstract 2012	2012	Uganda Bureau of Statistics	pdf	A4	288	
643	Statistical Abstract 2013	2013	Uganda Bureau of Statistics	pdf	A4	264	
66 Agriculture Sector Development strategy and Investment Plan: 2010/11-2014/15		2010	MAAIF	pdf	A4	149	
67 Doho_Preliminary_Finding_Report		2010	MAAIF				
68 Projections of demographic trends in Uganda 2007-2017		2007	Uganda Bureau of Statistics	pdf	A4	39	
69 CONSTITUTION OF THE REPUBLIC OF UGANDA, 1995. Arrangement of the Constitution		1995	Republic of Uganda	pdf	A4	192	
610 Environment							
6101	LIST OF CERTIFIED AND REGISTERED ENVIRONMENTAL PRACTITIONERS IN UGANDA, 2013	2004	NEMA	pdf	A4	25	
6102	INCREASING INCOMES THROUGH EXPORTS:A Plan for Zonal Agricultural Production, Agro-processing and Marketing	2004	Republic of Uganda	pdf	A4	118	
6103	The National Environment Act (Chapter 153)	1995	Republic of Uganda	pdf	A5	93	
6104	THE NATIONAL ENVIRONMENT (AUDIT) REGULATIONS, 2006	2006	Republic of Uganda	pdf	A5	19	
6105	THE NATIONAL ENVIRONMENT (ACCESS TO GENETIC RESOURCES AND BENEFIT SHARING) REGULATIONS, 2005	2005	Republic of Uganda	pdf	A5	31	
6107	ENVIRONMENTAL LEGISLATION OF UGANDA		Republic of Uganda	pdf	A4	651	
6108	Uganda Geochemical Atlas Map (Soils)	1980		JPEG		1	
601	COWI UNMANNED AIRCRAFT SYSTEM ENABLES QUICK AND EFFICIENT AIRBORNE MAPPING	2013	COWI	pdf	A4	2	
602	Part B Surveys and Investigations			pdf	A4	4	
603	REPORT OF SOIL ANALYSIS	2013	Directorate of Government Analytical Laboratory	pdf	A4	1	
604	REPORT OF WATER ANALYSIS	2013	Directorate of Government Analytical Laboratory	pdf	A4	1	
605	UBOS Data 2012						
606	土砂の捕捉に必要な緩衝帯幅の考察	2004		pdf	A4	7	
611 Road							
6111	NATIONAL ROADS AUTHORITY MUYEMBE-NAKAPIRIPIRIT ROAD DESIGN REPORT	2013	UNRA	pdf	A4	61	
6112	Road Design Volume 2	2010	Republic of Uganda	pdf	A4	203	
612 Land Boundary							
6121	District Land Boards			pdf	A4	15	

EACL: Environmental Assessment Consult Limited
(NEMA): NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY
NAARI: Namulonge Agricultural and Animal Research Institute
UNESCO: United Nations Educational, Scientific and Cultural Organization
UNUA: Uganda National Road Authority

List of Abbreviation
MAAIF: Ministry of Agriculture, Animal Industry and Fisheries
MWE: Ministry of Water and Environment
AfDB: African Development Bank
ADF: African Development Fund

which is observed water level manually by MWE and located near the Atari River also confirmed, since past the Sipi River discharge is used to estimate past the Atari River discharge for water balance analysis.

H-Q curve is generally represented by equation below.

$$Q = a(h + b)^2$$

Where Q is River discharge (m3/s), h is river water level (m) and a,b are constants.

Constant *a* and *b* is obtained by following manner. Plot the square root of river discharge *Q* and water level *h* as scatter diagram. Linear equation of $\sqrt{Q} = Ah + B$ is obtained by the least-squares method, then $a = A^2,\ b = B/A$ is obtained

3.2 Methodology of Observation

When the river water level is not more than 1m, the velocity of the river is measured at one point at the depth of 60%. When the river water level is more than 1m, the velocity of the river is measured at two points at the depth of 20% and 80% from water surface. If the obtained result has some difference, re-measurement was conducted.

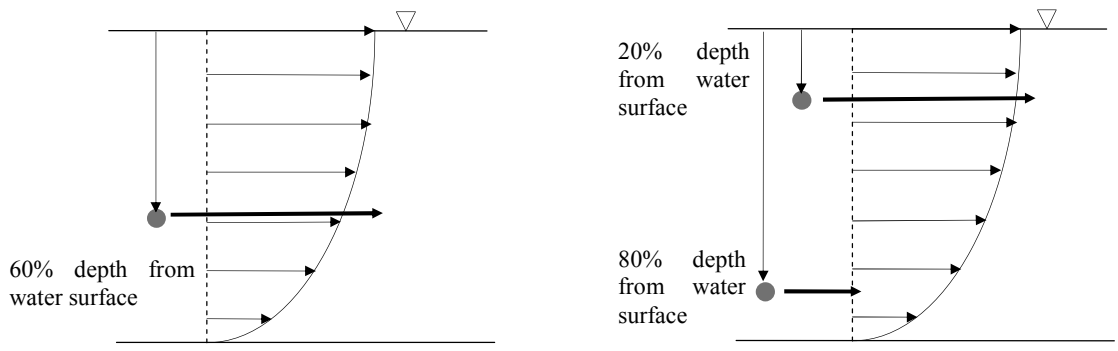


Figure 3.2.1 Depth of river velocity measurement

Digital current meter (MT precision CO. LTD: MTS-1) is used for measurement of river velocity. Velocity is measured by paddling of river when water level is low in dry season. Due to the high water level in rainy season, velocity and depth are measured from the top of the bridge to reduce the risk of incident.

Measurement of cross section of river is conducted at the same tine of every measurement of velocity. Point of measurement of velocity is same as measurement point of depth measurement. Depth of river is measured by using surveying pole measure in the dry season by paddling of the river. Current meter is used to measure depth of river from the top of the bridge.

River cross section is obtained by measuring of width and depth of river. Width of river is measured and interval of measurement of depth and velocity is adjusted depending on the width of river. The pitch should always be less than 1m.

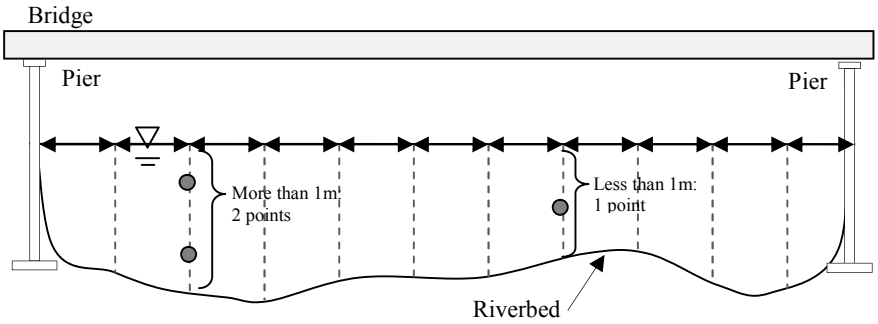


Figure 3.2.2 Interval of depth and velocity measurement of river

Measurement of width of water surface by using tape measure in dry season

Measurement of river depth in dry season

Measurement of river velocity in rainy seson.
To fix current meter at appropriate position, current meter is pulled by ropes from both banks upstream

Measurement of velocity and depth of river in rainy seson.
Due to the high water level it's not possible to measure velocity and depth by paddling of the river. Therefore measruement is conducted from the top of bridge.

Figure 3.2.3 Photo of filed activity

3.3 Results of Measurement of Velocity and Cross-section

3.3.1 Results of Measurement of Velocity and Cross-section of the Atari River

Measurement of velocity and area of cross-section was conducted 14times from March 2015 to end of July 2015.

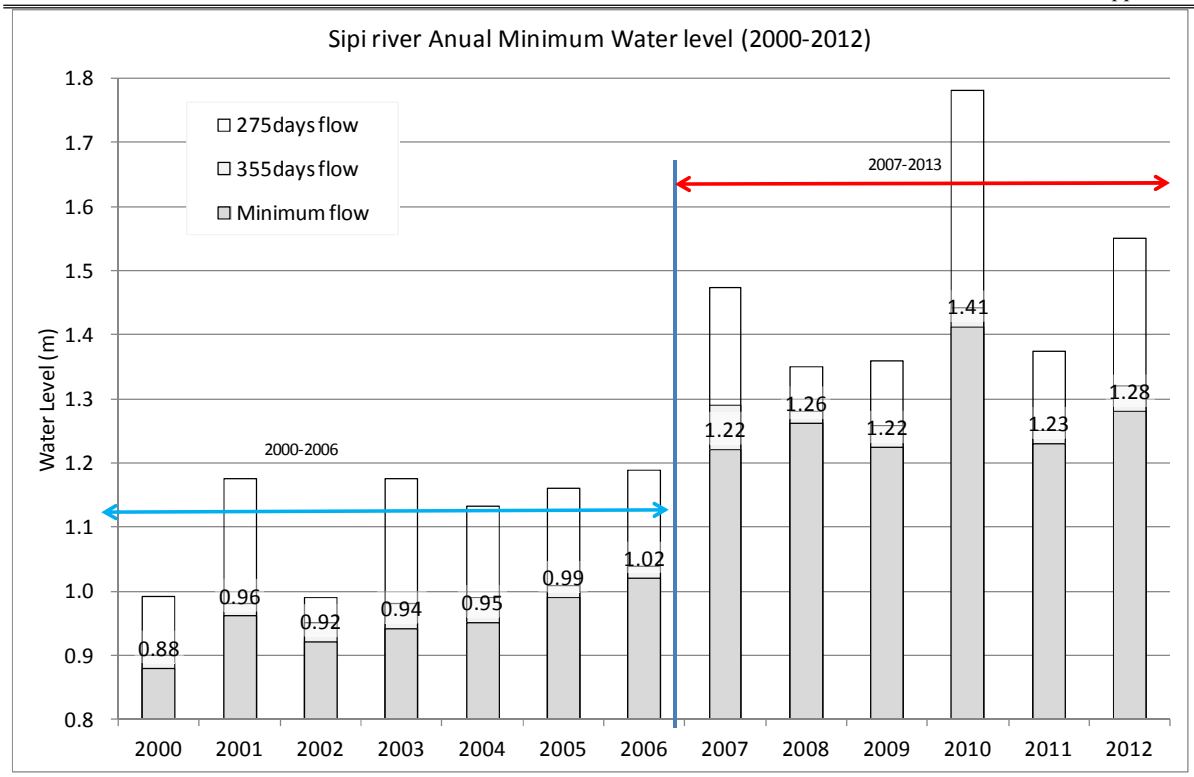


Figure 3.4.1 Time Series Variation of Minimum Water Level in the Sipi River from 2000-2012

3.4.4 The Atari River Discharge

Long-term river discharge data is necessary for water balance analysis but observation for the Atari River was just started from the beginning of 2015. The Sipi River is observed by MWE for long-term and the Sipi River is located near to the Atari River. Then, the Atari River discharge and the Sipi River discharge were compared to verify the possibility to estimate the Atari River discharge from the Sipi River discharge.

The water level in the Atari River which is observed by JST and water level in the Sipi River which is observed by MWE from March 2015 to August 2015 are shown the figure below. The figure shows that changing trend of the Atari River water level is similar to the Sipi River water level. Therefore, it is appropriate to use the Sipi River discharge data to estimate the Atari River discharge.

conservation and sustainable use for present and future generations. No legislation specific to wetlands exists, but a National Wetlands Bill is under preparation.

In Article 7, Specific Policy Strategies are described as followings.

7.1	**Drainage of wetlands**	• There will be no drainage of wetlands unless more important environmental management requirements supersede.
7.2	**Environmentally sound management**	• Only those uses that have proved to be non destructive to wetlands and their surroundings will be allowed and/or encouraged. These include water supply, fisheries, wetland edge gardens, and grazing.
7.3	**Sustainable use of Wetlands**	• Wetlands may be utilized in such a way that they do not lose traditional benefits presently obtained from them. • Any decisions to use wetlands must consider the requirements of all other users in the community.
7.4	**Conversion of Wetlands**	• Government will establish fully "Protected Wetland Areas" of important biological diversity. • Government may also establish wetlands which will be used for partial exploitation as research. • No modification, drainage or other impacts will be entertained for the so protected wetlands.
7.5	**Water Supply and Effluent treatment**	• Any wetland serving as a source of water supply or receiving effluent as part of a designated service to any human settlement shall be fully protected wetland from any encroachment, drainage, or modification.
7.6	**Tenure and Use**	• All wetlands are a public resource to be controlled by the government on behalf of the public. There shall be no leasing of any wetland to any person or organization in Uganda at any given moment and for whatever reason, • However, communal use will be permitted, but only if environmental conservation and sustainable use principles and strategies are adhered to.
7.7	**Recovery of previously drained Wetlands**	• Government may require that some wetlands, which have already been drained, should be allowed to regenerate. For this purpose, Government aims at restoring the soil hydration so as to re-establish the wetland vegetation as far as ecologically possible. Such an operation may range from partial rehabilitation of wetlands along drainage channel in the case of lease holder, to full rehabilitation after the lease has been cancelled or eviction in case of users with no leases.
7.8	**Environmental Impact Assessment (EIA) and monitoring**	• There will be a requirement that all proposed modifications on wetlands be subject to an EIA. • All planned new wetland developments will be subjected to an EIA process to determine the required environmental controls.

(2)The National Environment (Wetlands, River bank, and Lake Shores Management) Regulations (2000)

These regulations are important regarding irrigation development project in wetland. Related articles for the environmental assessment of the project are followings.

5	**Principles**	The principles set out in this Part shall be observed in the management of all wetlands as follows: (a) wetland resources shall be utilized in a sustainable manner compatible with the continued presence of wetlands and their hydrological functions and service; (b) environmental impact assessment as required under the statute is mandatory for all activities in wetlands likely to have an adverse impact on the wetland; (c) special measures are essential for the protection of wetlands of international, national and local importance as ecological systems and habitat for fauna and flora species, and for cultural and aesthetic purposes, as well as for their hydrological functions; and (d) wise use[1] of wetlands shall be interpreted into the national and local approaches to the management of their resources through awareness campaigns and dissemination of information.
11	**Uses of Wetlands**	(1) A person desiring to carry out of the regulated activities listed in the Second Schedule or extract any wetland produce in a wetland shall make an application in Form A set out in the First Schedule to these regulations. (2) Notwithstanding the provisions of sub-regulation (1), the following traditional users of wetland resources shall not be subject to the application of these regulations. (a) Harvesting of papyrus, medicinal plants, trees and reeds; (b) Any cultivation where the cultivated area is not more than 25% of the total area of the wetland; (c) Fishing using traps, spears and baskets or other methods than weirs; (d) Collection of water for domestic use; and (e) Hunting subject to the provisions of the Wildlife Act Cap.200
12	**Wetland resource use permit**	(1) Subject to the provisions of Regulations, a person shall not carry out any activity in a wetland without a permit issued by the Executive Director (of NEMA).
29	**Protection zones for river banks**	(1) The rivers specified in the sixth Schedule to these Regulations shall have a protection zone of one hundred meters from the highest watermark of the river. (2) River not specified in the Sixth Schedule shall have a protected zone of thirty meters from highest watermark of the river. (3) No activity shall permit within protected zones without the written authority of the Executive Director (of NEMA). (4) Each local environment committee shall determine watering points and routes for animals to have access to the water in each river.
30	**Protection zones for lake shores.**	• All shores of lakes specified in the Seventh Schedule to these Regulations shall have a protected zone of two hundred meters measured from the low water mark. • All shores of lakes not specified in the Seventh Schedule shall have a protected zone of one hundred meters from the low water mark.

[1] "wise use" means sustainable utilisation of wetlands in a way compatible with the maintenance of the natural properties of the ecosystem.

		• No activity shall be permitted within protected zones without the written authority of the Executive Director (of NEMA). • Each local environment committee shall determine watering point and routes for animals to have access to the water in each lake.
34	**Environmental impact assessment**	(1) A developer desiring to conduct a project which may have a significant impact on a wetland, river bank or lake shore shall be required to carry out an environmental impact assessment in accordance with sections 19, 20 and 21 of the Act.

In Article 11 (2) (b), cultivation less than 25% of the total area of the wetland is allowed, however, the area of "the total area of the wetland" is not clear. Actually more than 25% of wetland is already cultivated in many wetlands. Nevertheless wetland farmers who are cultivating illegally are not necessarily chased away by authorities. It because, according to DWM, burdens on wetlands should be decreased gradually with wetland user's understanding and cooperation based on the "wise use" concept.

Rivers and lakes stipulated in sixth Schedule and seventh Schedule in Article 29 and 30 each are shown in below **Table 1.2.1** respectively. Rivers within the candidate site of the project are shown marked by *. Length of protection zone for rivers and lakes can be assumed as a temporally measure put in nation widely due to lack of river information for protecting river bank. Actual protection zone is supposed to be decided in stakeholder's meetings to make a community wetland management plan with the consultation from DWM.

Table 1.2.1 Rivers and Lakes Stipulated in Sixth Schedule and Seventh Schedule

Rivers	Lakes
1 R. Nile from Lake Victoria to Lake Albert	1 L.Victoria
2 R. Aswa	2 L. Kyoga
3 R. Katonga	3 L. Albert
4 R. Nkusi	4 L. Edward
5 R Kafu	5 L. George
6 R. Rwizi	6 L. Bisina
7 R. Kagera	7 L. Mburo
8 R. Mpanga	8 L. Bunyonyi
9 R. Manafwa *	9 L. Kijanibarora
10 R. Mpologoma	10 L. Kwania
11 R. Semliki	11 L. Wamala
12 R. Mubuku	12 L. Mutanda
13 R. Mayanja	13 L. Marebe
14 R. Sezibwa	14 L. Opeta.
15 R. Malaba	15 L. Nabugabo
16 R. Sipi *	16 L. Nkugute
17 R. Namatala *	17 L. Katunga
18 R. Sironko *	18 L. Nyabihoko
19 R. Muzizi	19 L. Nakivale
20 R. Nabuyonga	

(3)Institutional Framework on Wetlands

The Wetland Management Department (WMD) in Ministry of Water and Environment is responsible

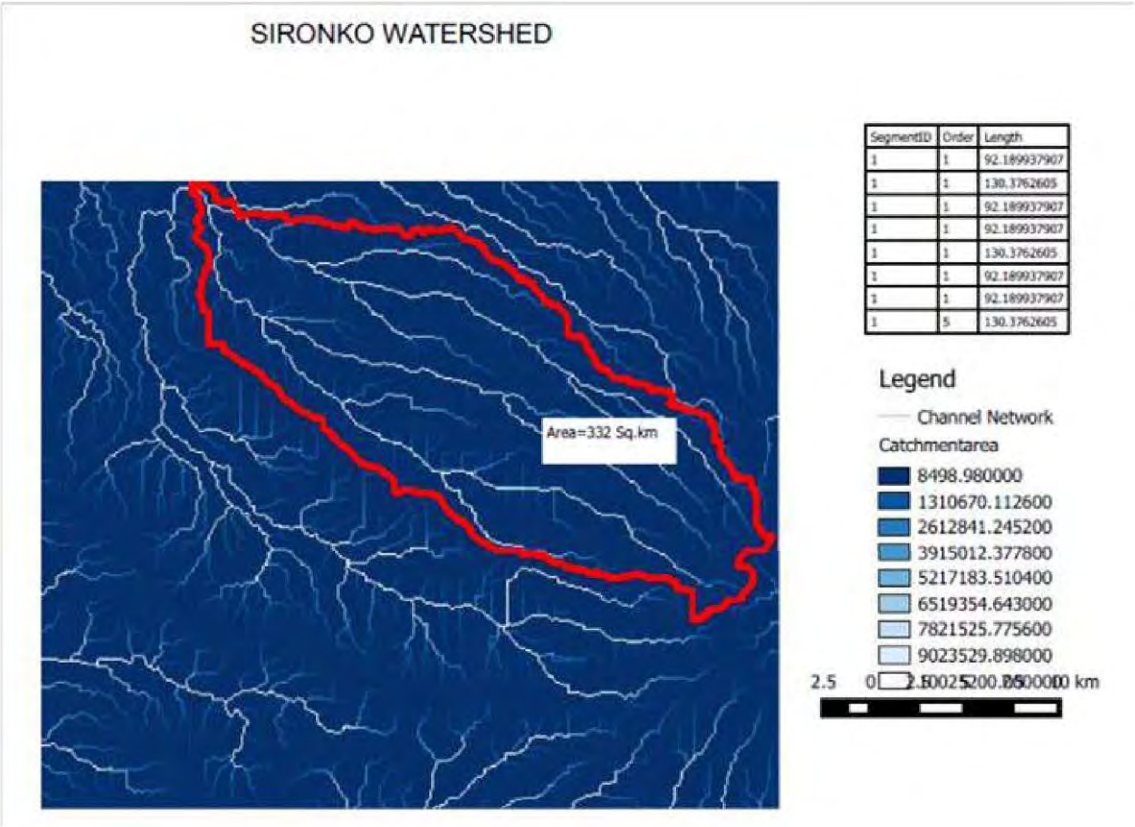


Figure 2.4 Result of Watershed Analysis

(2) Hydrology and Design Lecture

The training term was 2 days, 10th March 2016 and 11th March 2016, and the venue was Fair way hotel in Kampala. The purpose of training was for studying contents and concept of our project, and the participants were three people from MAAIF and five people from MWE. Lecture of hydrology analysis was given on fast day. Contents of the lecture are introduction of hydro-meteorological observation, 1-2 development of H-Q curve, analyses of observed data, and calculation of crop evapotranspiration using CROPWAT made by Food and Agriculture Organization of the United Nations (FAO), requirement aater & maintenance flow, and introduction to water balance calculation. The lecture of second day was mainly about design of irrigation facility, and determination of basic factor, design water requirement and irrigable area, layout and irrigation network schematic, hydraulic design of open channel were given. Discussion after the lectures was active and significant. The training gave a lot of knowledge of hydrology and design, and result of questioner shows the purpose of training was achieved.